FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, POSTMASBURG, NORTHERN CAPE PROVINCE

DEA REFERENCE: 12/12/20/2316

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HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

FINAL EIA REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Appendix List

Acronyms

ARC-ISCW	Agricultural Research Council Institute for Soil, Climate and Water
ARI	Acute Respiratory Infections
BID	Background Information Document
CAGR	Compounded Annual Growth Rate
CAR	Co-ordinated Avifaunal Road-count
COPD	Chronic Obstructive Pulmonary Disease
CSP	Concentrated Solar Power
CWAC	Co-ordinated Waterbird Count
DEA	Department of Environmental Affairs
DNI	Direct Normal Irradiance
DTEEA	Department of Economic Development, Tourism and Environmental Affairs
EC	Electrical Conductivity
ECO	Environmental Control Officer
EDI	Electro-deionization
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Programme
ERM	Environmental Resources Management
GDP	Gross Domestic Product
GHG	Green House Gas
GN	Government Notice
GRU	Groundwater Resource Units
I&APs	Interested & Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa

NGOs	Nongovernmental Organizations
NGDB	National Groundwater Database
QDGS	Quarter Degree Square
RO	Reverse Osmosis
SAHRA	South African Heritage Resources Agency
SANBI	South African Biodiversity Institute
SDF	Spatial Development Framework
ToR	Terms of Reference
WUL	Water Use License

Abbreviations

%	Percent
cm	Centimetres
CO_2	Carbon Dioxide
GWh	Giga Watt Hour
ha	Hectares
kg	Kilograms
km	Kilometres
km^2	Square kilometres
kV	Kilovolt
m	Metres
mamsl	Meters above mean sea level
mbgl	Meters below ground level
MW	Mega Watts
m^2	Square meters
R	South African Rand
$	US Dollar

Definitions and Terminology

Alternative:

A possible course of action, in place of another, that would meet the same purpose and need (of the proposal). Alternatives can refer to any of the following but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.

Cumulative Impacts:

Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combines to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

Direct impacts:

Impacts that are caused directly by the activity and generally occur at the same time and at the same place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

'Do nothing' alternative:

The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do-nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Environment:

The surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part or combination of (i) and (ii) and the interrelationships among and between them; and
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being. This includes the economic, social, cultural, historical and political circumstances, conditions and objects that affect the existence and development of an individual, organism or group.

Environmental Assessment:

The generic term for all forms of environmental assessment for projects, plans, programmes or policies. This includes methods/tools such as environmental impact assessment, strategic environmental assessment, sustainability assessment and risk assessment.

Impact:

The positive or negative effects on human well-being and / or on the environment.

Environmental Management:

Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental Management Programme:

An operational programme that organizes and coordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Indirect impacts:

Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supplies water to a reservoir that supplies water to that activity). These types if impacts include all of the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and Affected Parties (I&APs):

Individuals, communities or groups, other than the proponent or the authorities, whose interests may be positively or negatively affected by the proposal or activity and/or who are concerned with a proposal or activity and its consequences.

Lead Authority:

The environmental authority at the national, provincial or local level entrusted in terms of legislation, with the responsibility for granting approval to a proposal or allocating resources and for directing or coordinating the assessment of a proposal that affects a number of authorities.

Mitigate:

The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.

Scoping:

The process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addresses in an environmental assessment. The main purpose of scoping is to focus the environmental assessment on a manageable number of important questions. Scoping should also ensure that only significant issues and reasonable alternatives are examined.

Significance:

Significance can be differentiated into impact magnitude and impact significance. Impact magnitude is the measurable change (i.e. magnitude, intensity, duration and likelihood). Impact significance is the value placed on the change by different affected parties (i.e. level of significance and acceptability).

It is an anthropocentric concept, which makes use of value judgments and science-based criteria (i.e. biophysical, social and economic).

Stakeholder engagement:

The process of engagement between stakeholders (the proponent, authorities and I&APs) during the planning, assessment, implementation and/or management of proposals or activities.

Humansrus Solar Thermal Energy Power Plant

FINAL EIA REPORT

1 Executive Summary

SolarReserve South Africa (Pty) Ltd. proposes to construct and operate a Solar Thermal Energy Power Plan on the Farm 469 the Hay RD, called the Humansrus Solar Thermal Energy Power Plant in the proximity of Daniëlskuil and Postmasburg in the Northern Cape, South Africa. The Solar Thermal Energy Power Plant will employ the Concentrated Solar Power (CSP) Central Receiver Tower technology, with molten salt as heat transfer fluid and storage medium.

As such, SolarReserve SA has appointed the independent environmental consultants, WorleyParsons RSA, to conduct the integrated waste and Environmental Impact Assessment (Scoping and the EIA phases) for the proposed project. The EMP is included in this report (Appendix R) as a requirement in terms of NEMA.

An Integrated Environmental Impact Assessment (EIA) application, with reference nr 12/12/20/2316 was lodged with the Department of Environmental Affairs (DEA) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), the National Environmental Management: Waste Act (Act 56 of 2006) and the EIA Regulations. The Application was accepted on 21 June 2011.

The project details are contained in Table 1 below.

Table 1: General project information

Requirement	Details
Description of all affected farm Portions	Farm 469, the Hay RD
21-Digit Surveyor General code of affected farm portion	C 03100000000046900000
Copies of deeds of all affected farm portions	Copy of title deed contained in Appendix W
Photos of areas that give a visual perspective of all parts of the site	Site photographs contained in Appendix B and the detailed Visual Impact Assessment contained in Appendix E.
Photographs from sensitive visual receptors	Photographs from sensitive visual receptors contained in Appendix B and the detailed Visual Impact Assessment contained in Appendix E.
Plant design specifications	A circular heliostat field with a mirror reflective surface area of approximately 1 100 000 m^3, that reflects the sunlight to the approximately 200 m high central receiver

Requirement	Details
	tower, where the heat transfer fluid, molten salts, is heated up. A thermal energy collection and storage system with molten salt loop and hot and cold salt storage tanks harnesses the heat utilised in the steam generation system, which drives the steam turbine generator. The power plant will be dry cooled. The final technical scope of work is included in Appendix Q and details the technical aspects of the proposed plant.
Type of technology	CSP, Central Receiver Tower, with molten salt as heat transfer fluid and storage medium as described in Appendix Q.
Structure heights	Tower and receiver approximately 200 m high, heliostats between 12 and 15 m high and overhead distribution and transmission power line pylons approximately 32 m high.
Surface area to be covered	Approximately 600 ha / 6 km^2
Structure orientation	Central tower and power block with a circular heliostat field
Laydown area dimensions	Draft plans of the laydown area design is included in the Final EIAR (Refer to Figure XYZ and Section 2.1.1).
Assembly Plant Dimensions	Approximately 1 ha
Generation capacity	Approximately 107 MW.
Generation capacity of the facility as a whole at delivery points	Approximately 100 MW

The EIA process determined the potential impact of the facility and whether it can be sustainably constructed and operated by negating potential environmental impacts through the identification and implementation of suitable mitigation measures.

The proposed project aims to utilise South Africa's abundant and renewable solar resource to generate power.

The experience, expertise and successes of the project proponent with similar projects worldwide (USA and Spain) will introduce new technology and will effectively reduce Green House Gas emissions, create a sustainable power source for South Africa's stressed Grid Network, generating local employment, facilitating skills development, stimulating the local and national economies (local manufacturing and supplementary sectors) as well as to contribute significantly to the country's Gross Domestic Product (GDP). .

This EIAR follows on the approved Scoping Report and addresses the impacts identified in the Scoping Report. This includes the required amendments and additional information as

requested by the DEA – refer to Appendix Q. Discussions with the DEA defined the detailed scope of work required to undertake the EIA.

SolarReserve SA made a conscious decision based on the recommendations and guidelines by the DEA to undertake 15 independent specialist assessments in order to assess both significant and less significant environmental impacts proposed by the development.

The anticipated impacts were assessed in detail by a range of independent specialists and mitigation measures proposed to reduce any significant impacts. These mitigation measures are included in the EMP contained in Appendix R. The following detailed independent specialist studies were conducted:

- Heritage;
- Visual;
- Biodiversity;
- Avi-fauna;
- Waste;
- Surface hydrology;
- Wetland;
- Socio-economic;
- Air quality;
- Noise;
- Soils and Agriculture Potential;
- Geotechnical Assessment;
- Geohydrology;
- Waste Assessment, and
- Tourism.

In addition to the aforementioned independent specialist assessments, an independent sensitivity mapping analysis was undertaken. This analysis characterised the development site with regards to the significant environmental aspects in order to reflect the sites suitable and unsuitable (no-go) development footprint areas. This action guided the final footprint of the CSP Plant.

The proper procedures were conducted in the performing of the public participation process. All commenting authorities, stakeholders and registered I&AP's were involved throughout the PPP – their inputs, issues and concerns were considered by the EAP and addressed adequately as reflected in the Issues and Response Report contained in Appendix C. To date no formal environmental or social objections have been received with respect to the Humansrus Solar Thermal Energy Power Plant.

The impacts identified and assessed by the specialist impact assessments and the sensitivity analysis conducted, allowed for the development of effective mitigation measures (EMP). The findings of these specialist impact assessments, which through the application of the proposed mitigation measures (EMP) is anticipated to decrease the impacts to such an extent that none of the impacts poses a significant threat to the environment and as such is recommended to be authorised.

2 Introduction

SolarReserve SA (Pty) Ltd. (hereafter referred to as SRSA), intends to construct and operate a Concentrated Solar Power Plant (CSP) utilising the Central Receiver Power Tower technology (with molten salt storage). The Humanrsus Solar Thermal Energy Power Plant is proposed on the Farm 469, the Hay RD, situated in the Northern Cape. The proposed development will be situated in the Tsantsabane Local and Siyanda District Municipalities, respectively. Electricity generated from the power plant will be fed into the national power grid. The authorised Scoping Report ***(DEA Reference: 12/12/20/2316)*** (refer to Appendix B) defines in detail that dual project development status that has been awarded to the proposed site. The dual project development includes a photovoltaic (PV) project and the currently proposed CSP Project. Both projects have distinctively different footprints.

The proposed PV development has already been awarded an Environmental Authorisation (***DEA Reference: 12/12/20/1903***) from the DEA dated 29 August 2011. The CSP Project has been approved by the DEA (Scoping Approval) to be developed on the same site.

The Project Consortium for both the PV and CSP projects includes SRSA, Intikon Energy and Kensani Capital Investments.

The EIA for the CSP development was initiated in 2011, with the application submitted to the DEA on 15 June 2011**,** placing each of the proposed projects in different development phases. WorleyParsons RSA were appointed as independent Environmental Assessment Practitioners (EAP) to conduct the EIA process for the proposed CSP development.

2.1 Project Overview

2.1.1 Brief Project Description

The proposed Humansrus Solar Thermal Energy Power Plant entails the construction and operation of a concentrating solar thermal power plant with associated infrastructure and services for the generation of renewable electricity to the national power grid. The detailed description of the technology and project description is contained in the Scoping Report (Appendix B) and further explained in this report. The project will be capable of producing approximately 480 000 gigawatt-hours (GWh) net of renewable energy annually, with a nominal net generating capacity of approximately 100 megawatts (MW). It is envisaged that the CSP plant will be operated as a mid-merit or base load plant. The power plant will utilise either hybrid or dry cooled technology, dependent on the detail design of the project. Total construction and development costs of the plant are estimated at R6.5 billion.

This Greenfields project entails the transformation of agricultural land to accommodate the proposed plant, associated infrastructure and services. The infrastructure and structures for the proposed project includes but is not limited to *inter alia*:

– A collector field consisting of approximately between 10 300 and 17 500 dual-axis tracking heliostats, each approximately between 64 m^2 - 116 m^2, providing approximately 1 200 000 m^2 of reflective surface area;

- An approximately 200 meter tall slip-form concrete tower and thermal receiver rated at approximately 565 MW thermal (MWt);
- A thermal to electric power block with an approximately 115 MW reheat and multiple extractions high temperature subcritical steam turbine and generator;
- Two molten salt thermal storage tanks;
- An air-cooled condenser and/or a cooling tower for the steam cycle in order to minimise the consumption of water;
- Water reticulation and purification works. This includes water reticulation from the Sedibeng Bulk Water Supply Pipeline for industrial water use, and a water treatment and purification system to provide water for both domestic and process use;
- Sewer reticulation and treatment works;
- An evaporation pond consisting of three compartments with a combined area of approximately 8.0 ha, to completely contain all rejected water from the water treatment system and the steam cycle;
- Roads and storm water infrastructure;
- Two liquid gas or diesel auxiliary burners for start-up;
- Two emergency diesel generators;
- Substation and switchyard of approximately 100 m x 100 m containing transformers and associated structures;
- Approximately 8km overhead power lines connecting to the Eskom grid;
- Construction camp - accommodation and associated facilities for approximately 600 people;
- Administrative and office buildings;
- Visitors centre;
- Equipment and materials lay down area;
- Assembly Plant;
- Concrete batching plant;
- Vehicle workshops and wash bays;
- Fuel storage area;
- Temporary general waste storage facility; and
- Hazardous material storage facility.

Please note that the aforementioned project specifications will only be finalised upon the conclusion of the detailed designs once an EA has been obtained.

The CSP plant (Figure 1) primarily comprises of four subsystems as summarised below:

– **Solar Collector Field** - consists of all systems and infrastructure related to the control and operation of the heliostats;

– **Molten Salt Circuit** - includes the thermal storage tanks for storing low and high temperature liquid salt, a central solar-thermal tower receiver, pipelines and molten salt to steam heat exchangers;

– **The Power Block** – consists of the steam turbine and generator, as well as the air-cooled condenser and associated feedwater system; and

– **Auxiliary facilities and infrastructure -** consists of the switch yard, step-up transformers, power transmission lines, access routes, water supplies and facility start-up generators (gas or diesel-fired – dependent on detailed design).

The proposed site layout is depicted in Figure 4 below and indicates the proposed site including the extent of the tower, heliostat field (including the power block in the centre), evaporation ponds and associated infrastructure.

It is anticipated that the construction of the plant would stretch over an approximated 30 month period and an operational life of approximately 20 – 50 years.

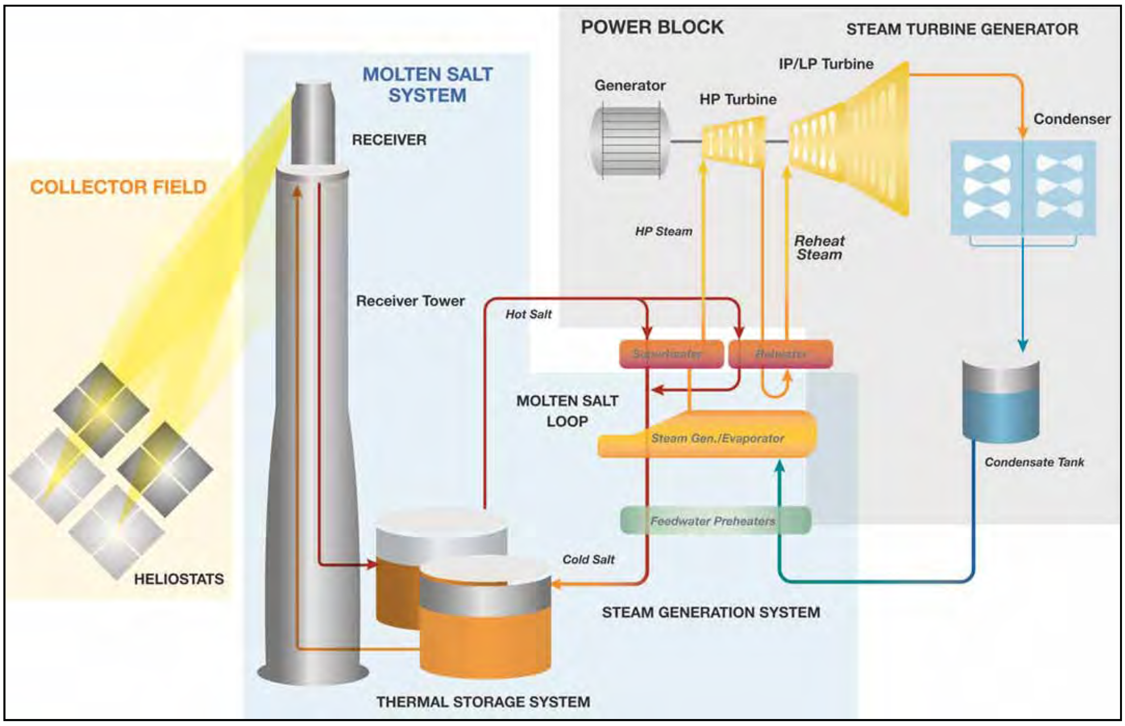

Figure 1: Process flow of a typical Central Receiver Power Plant

Figure 2: An example of a central receiver power plant (Image courtesy NREL).

This project will utilise existing and proven technology that has been implemented successfully around the world. Figure 2 above shows an example of the molten salt central receiver technology. The figure depicts the Solar Two 10 MW demonstration plant that was built in the south-western region of the United States in 1995.

During the construction Phase of the project it would be required that numerous temporary structures and facilities be utilised including the man camp to house the workers, ablution, cooking and dining facilities, material stores, assembly plants, workshops, vehicle wash facilities and a batch plant amongst others. The man camp will house approximately 600 people and the position of the camp is shown in Figure 4. The camp will be either on a single location or split between more than one option on the site. The selection of the option or combination of options to be utilised will be finalised in conjunction with the appointed construction contractor to ensure that the options are practical as well as environmentally sound. The options shown in Figure 4 were selected and positioned in areas of low sensitivity according to the sensitivity analysis conducted and the specialists' impact analyses.

The materials laydown area and the office building locations depicted in Figure 4 is also conceptual at this point in time and although the areas where these facilities are proposed have been assessed no final designs and plans have been drafted. These sites have been positioned in areas of low sensitivity. The position of the laydown area and offices are subject to change if they are not suitable in terms of the practical construction requirements and the positions and layouts thereof will be finalised in collaboration with the appointed construction contractor.

2.1.2 Site Description

The site is located on the Farm Humansrus (Farm 469,the Hay Rd), approximately 5 km southeast of the Groenwater community and 30 km east of Postmasburg, as indicated in Figure 3 below, and falls within the jurisdiction of the Tsantsabane Local Municipality of the Siyanda District. A detailed site plan is contained in Appendix T indicative of the proposed plant and infrastructure footprint. The current land use is agriculture but the land use and baseline environmental description is described in detail in the Scoping Report contained in Appendix B. A function of the baseline reporting in the Scoping Report is to determine the desired state that the environment has to be returned to after the decommissioning and rehabilitation of the project and the site. Within the framework of the Independent Power Producer (IPP) Bid, which only stipulates a lifespan of 20 years for the proposed project it is the intension of the applicant to decommission the plant and rehabilitate the area to resemble as far as possible the state as depicted in the baseline assessments.

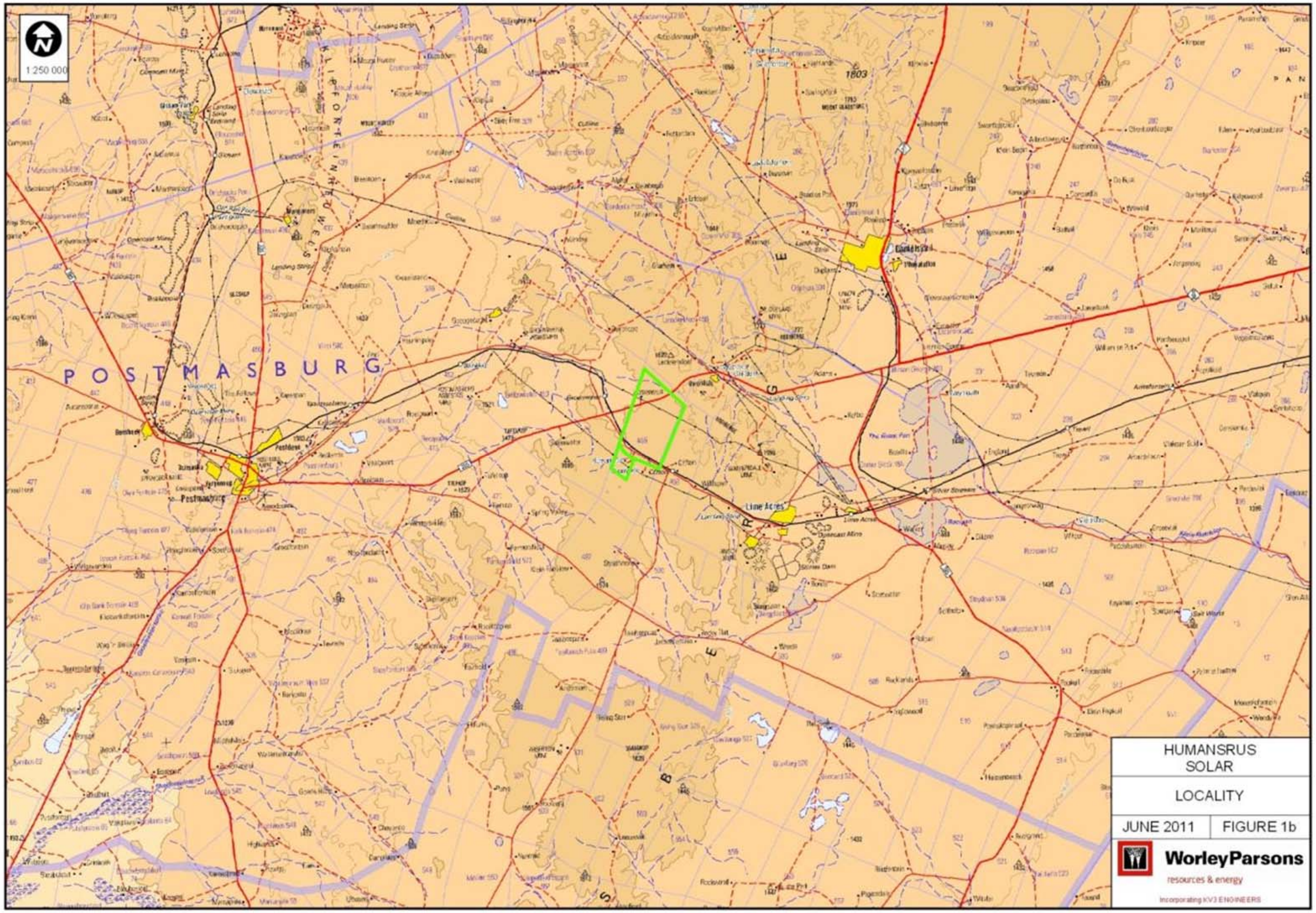

Figure 3: Regional Locality Map

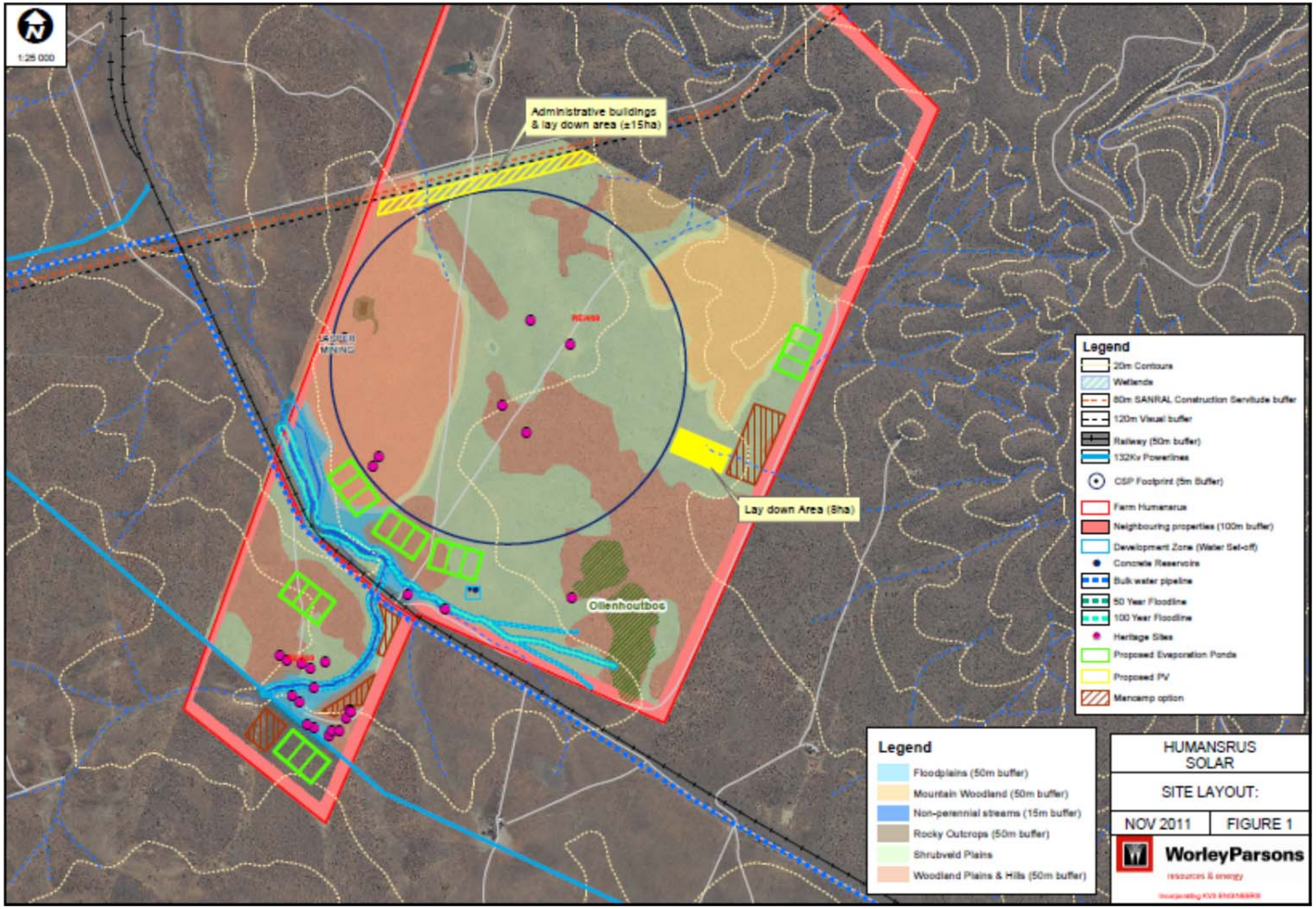

Figure 4: Humansrus CSP Site Layout

2.2 Purpose of this Report

This EIAR follows on the Scope of Work delineated in the detailed Scoping Report, which was approved by DEA on 22 November 2011. The Scoping Report outlined the scope of the project in great detail and set the scene for the detailed assessment that was conducted during the EIAR phase. Existing information and input from specialists, commenting authorities, Interested and Affected Parties (I&APs) was used to identify and evaluate potential environmental impacts (both social and biophysical) associated with the proposed project. No environmental fatal flaws associated with the proposed project were identified through the Environmental Scoping Study. A conscious decision was made based on the recommendations and guidelines by the DEA to undertake 15 independent specialist assessments in order to assess both significant and less significant environmental impacts proposed by the development.

The detailed assessment of the anticipated impacts were undertaken with the purpose of highlighting any areas of concern regarding the proposed project during its construction and operation and proposes necessary mitigation measures of the significant impacts.

In addition to the aforementioned independent specialist assessments, an independent sensitivity mapping analysis was undertaken. This analysis characterised the development site with regards to the significant environmental aspects in order to reflect the sites suitable and unsuitable (no-go) development footprint areas. This action guided the final footprint of the CSP Plant.

This EIA will also be used to motivate and define the previously identified, project alternatives (i.e. site, technology and layout) based on the findings of the environmental specialist reports and the suitability of the site to the type of development.

This EIA Report (EIAR) has been compiled in accordance with the regulatory requirements stipulated in the EIA Regulations (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), and the National Environmental Management: Waste Act (NEM: WA) (Act 59 of 2008) as amended. The EIAR aims to:

- Provide an overall assessment of the social, physical and biophysical environments of the area affected by the proposed establishment of a CSP Plant and associated infrastructure;
- Undertake a detailed assessment of the portion of the Farm 469, the Hay (Humansrus) considered for the CSP Plant development, in terms of environmental criteria and impacts (direct, indirect and cumulative), and recommend a preferred location for the proposed plant (based on environmental sensitivity);
- Identify any cumulative impacts associated with the simultaneous development and operation of the CSP and PV Plant on the Farm Humansrus; and
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and

- Undertake a fully inclusive Public Participation Process to ensure that I&AP issues and concerns are recorded.
- Compiled a detailed Waste Assessment of the proposed project in order to identify the necessary mitigation measures and alternatives.

Fifteen specialist assessments were conducted specifically for the EIAR to identify potential impacts, propose mitigation and inform the sensitivity analysis.

2.3 Assumptions and Limitations

The following assumptions and limitations underpin the approach to this EIA study:

- The information received from the stakeholders, specialist assessments are current and valid at the time of the study;
- A precautionary approach was adopted in instances where baseline information was insufficient or unavailable;
- The Intikon (PV Plant) EIA for the proposed PV Plant on the same property is adjudicated independently from this EIA even though the cumulative impacts of both plants will be addressed in this EIA.
- Mandatory timeframes will apply to the review and adjudication of the reports by the competent authority and other government departments.

2.4 Report Structure

It must be emphasised that the approved Scoping Report, contained in Appendix B, is the basis for the EIAR and for the sake of avoiding a duplication of much of the contents of the Scoping Report in the EIAR, reference must be made to the Scoping Report for details regarding the following:

- Details of the Environmental Assessment Practitioner;
- The background of the Project Proponent;
- The detailed project description;
- Project Alternatives;
- Detailed Legislative Overview;
- The Public Participation Process up until the completion of the Scoping Phase;
- The baseline assessments for the biophysical and social environments; and
- The identified impacts.

The EIAR comprises the following aspects:

- A brief introduction and project description;
- An overview of the EIA process including the legislative overview;
- The Public Participation Process during the EIAR Phase;
- A detailed assessment of the identified impacts including the impact rating;
- Description of the mitigation measures;
- The sensitivity analysis; and
- Recommendations.

2.5 EIAR Process Overview

The EIAR Phase entails the compilation of a mandatory EIAR as required by the relevant legislation and entails four primary activities to be undertaken to ensure the successful completion of the process. These four activities are:

- The conducting of a Public Participation Process;
- A detailed Impact Assessment;
- A sensitivity analysis; and
- The compilation of a Environmental Management Programme.

3 Public Participation Process

3.1 Overview of the Public Participation Process undertaken during the EIAR Phase

The Public Participation process for the project was conducted in accordance with Chapter 6 of the EIA Regulations. The outcomes of the Public Participation Process are contained in the updated Issues and Response Report (IRR) (Appendix C). The primary aims of the Public Participation Process (PPP) during the EIAR Phase were:

- To inform Interested and Affected Parties (I&APs) of the availability of the Draft EIAR for review;
- To identify issues, comments and concerns as raised by I&APs regarding the Draft EIAR;
- To promote transparency and an understanding of the project and its consequences; and
- To serve as a medium for interaction and communication with I&APs;

3.2 Interaction with Key Stakeholders

During the EIAR Phase comments and issues raised by key stakeholders, identified during the preceding Scoping Phase, were addressed in the EIAR, kept informed of the process and were requested to give inputs on the Draft EIAR. These stakeholders included:

- National and Provincial Government Representatives:
  - Department of Environmental Affairs (DEA);
  - Department of Water Affairs (DWA);
  - Department of Agriculture, Forestry and Fisheries (DAFF);
  - South African Heritage Resources Agency (SAHRA); and
  - Relevant Northern Cape Provincial Authorities (e.g. Environment & Conservation, Agriculture).
  - Relevant Local and District Municipalities:
  - Siyanda District Municipality;
  - Tsantsabane Local Municipality; and
  - Kgatelopele Local Municipality.
- Parastatals – Eskom, Civil Aviation Authority;
- Affected and surrounding landowners;

- Environmental Non-Governmental Organizations (e.g. Wildlife Society of South Africa, BirdLifeSA);
- Community based organisations; and
- Other (i.e. Sedibeng Water. Air Traffic and Navigation Systems, Lime Acres Mine)

All I&AP information (including contact details), together with dates and details of consultations and a record of all issues raised is recorded within a comprehensive project database. This database will be updated on an on-going basis throughout the project, and will act as a record of the communication/public consultation process. It will be included in the Issues and Response Report.

3.3 Review of Draft EIA Report

The Draft Environmental Impact Assessment Report was available for public review at the following locations in close proximity to the study area, which were identified as readily accessible to I&APs:

- Tsantsabane Local Municipal offices;
- Postmasburg Public Library – Bo Street, Postmasburg;
- Kgatolopele Local Municipal offices;
- Daniëlskuil Public Library – 222 Barker Street, Daniëlskuil;
- Mobile Public Library in Groenwater;

A 36-calendar day period was allowed for this review process from 1 December 2011 to 23 January 2012. It was confirmed in consultation with the Integrated Permitting System Department from the DEA that it is acceptable if the public comment period for the review of the Draft EIAR was conducted for a minimum of 30 days, however the proponent opted for a 36 day period to the satisfaction of the DEA (correspondence contained in the IRR in Appendix C). Registered stakeholders and I&APs on the project database were notified of the availability of this report via post or e-mail. The report was also distributed to all the commenting authorities for review and comment in electronic or hard copy format. The availability of this draft report was advertised through the following media:

3.3.1 Newspaper Advertising

As per the statutory requirements of the 2010 EIA Regulations, the availability of the Draft EIAR for public review was advertised in the following local newspapers on 1 December 2011:

- Diamondfield Advertiser (English); and
- Kalahari Bulletin (Afrikaans and Setswana).

3.3.2 Site Notices

Site notices were prepared according to the requirement set out in the EIA Regulations. The site notices advertised the availability of the Draft EIAR for public review. Site notices were placed at the northern boundary of the development site at the site entrance from the R385 – refer to Figure 5.

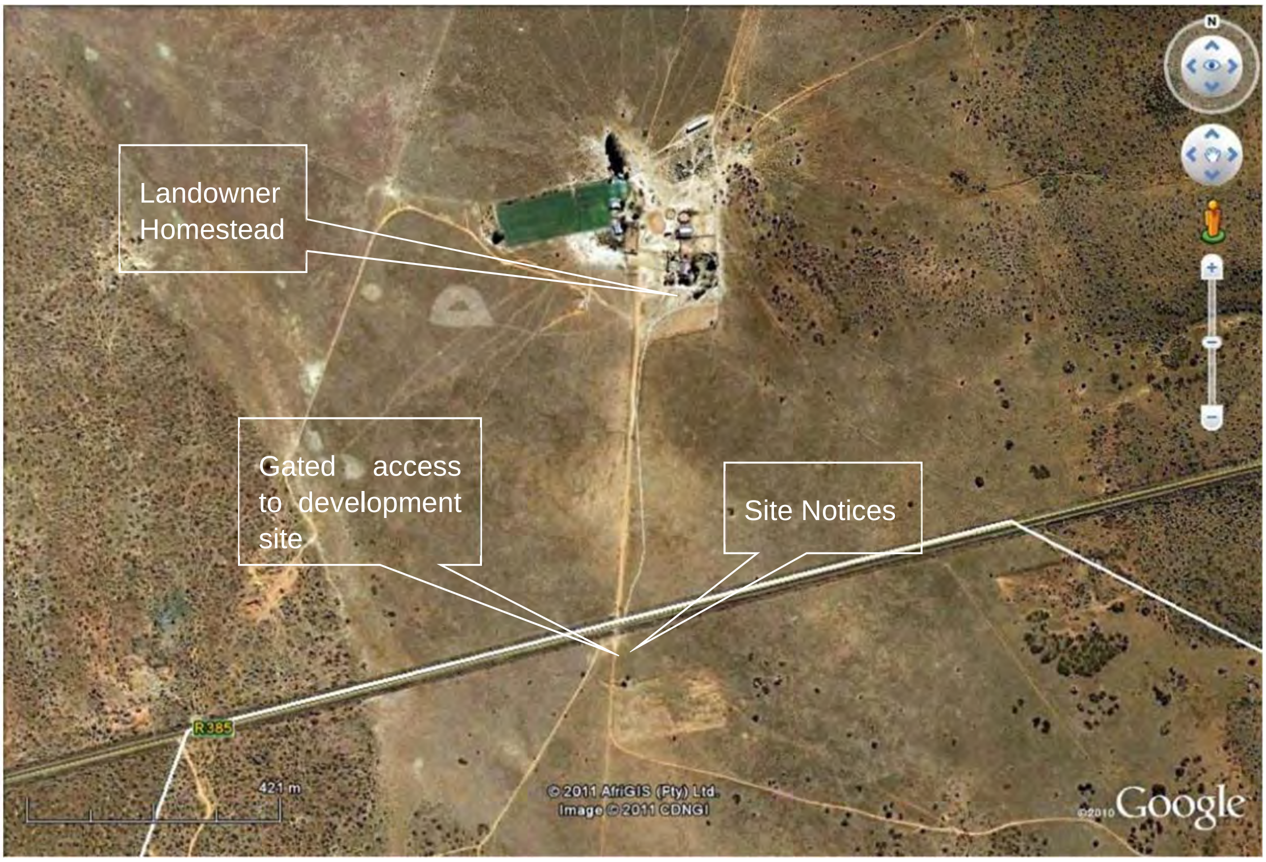

Figure 5: Site notice position

3.3.3 Pamphlets and Poster Notices

The site notice was printed on A5 sized paper pamphlets and distributed via the South African Post Office Services post boxes in Postmasburg (± 1 300 post boxes), Lime Acres (± 400 post boxes) and Daniëlskuil (± 800 post boxes).

Furthermore sets of A4 and A3 site notices were placed on notice boards at the following amenities frequented by I&APs in the Postmasburg, Lime Acres and Daniëlskuil areas:

Daniëlskuil

– Friendly Grocer;

- OK Foods;
- Kgatelopele Local Municipality; and
- Siyanda District Offices of the Department of Social Services and Population Development.

Lime Acres

- Lime Acres Family Store

Owendale village

- Entrance gate to the Owendale village

Postmasburg

- SPAR; and
- Saverite.

3.3.4 Final Environmental Impact Assessment Report

The compilation of the Final EIAR entailed the consideration and inclusion of all relevant comments received from the public during the review of the Draft EIAR. The final document was submitted to DEA as well as Northern Cape Provincial Department of Environment Affairs and Conservation for authority review and decision-making and/or commenting purposes.

3.4 Consultation and Public Involvement

As described in the Scoping Report and the IRR three public meetings with I&APs were held during the public review period of the Draft Scoping Report. The meetings were held at:

- The Postmasburg Town Hall on 25 August 2011 at 17:30; and
- Groenwater Community Hall (approximately 5 km west of the Humansrus site) on 26 and 29 August 2011 at 17:30.

The purpose of the public meetings was to discuss the key findings of the Scoping Phase and provide the representatives with an additional platform to provide input to the EIA Process.

As a result of the great effort that was invested in the hosting of the public meetings during the Scoping Phase and the lack of interest displayed through the poor attendance by the greater part of the affected communities invited to the meetings, the DEA was consulted to request an exemption from the requirements of hosting public meetings during the EIAR Phase. The DEA approved the exemption from this requirement (refer to Appendix S) and subsequently all engagement with stakeholders and I&APs will be via written and or electronic correspondence.

3.5 Social Issues Trail

Issues and concerns raised during the Scoping Phase were included in the IRR appended to the Scoping Report. The issues and concerns that were not addressed and resolved in the Scoping Report was included and addressed in the EIAR. All issues raised during the EIAR Phase Public Participation Process were recorded and resolved. The IRR will be updated and included in the Final EIAR updated with this information.

In summary, no project or environmental related concerns have been raised by registered I&AP's nor have any objections been received in this regard.

Additionally the project has been received very well by all relevant commenting authorities and no objections or opposition has been received.

4 Assessment of Impacts Identified During EIA Phase

4.1 Introduction

During the EIA Phase, the preliminary identification and consideration of issues and concerns that may impact (positively and/or negatively) the biophysical and socio-economic environments was conducted. The issues that were identified as potentially significant during the EIA Phase formed the basis on which the more detailed specialist studies were conducted during the EIAR Phase. In addition the less significant environmental impacts were also assessed providing a holistic assessment of the site.

A screening process was conducted based on the inputs from the specialist baseline investigations to determine the most significant impacts that required further specialist assessment. Each of these potential issues identified in the Scoping Phase was assessed by the respective specialists and will be addressed in this section.

4.2 Impact Rating Methodology

The standard impact rating methodology that was provided to the different independent specialist during this EIA for the calculation of the impact significance for each identified impact is described below.

4.2.1 Significance Rating Methodology

All specialists were requested to provide their feedback, recommendations, impact ratings and possible mitigation measures in a uniform format.

To ensure the various specialist studies present an accurate depiction of the proposed environmental status, six standard rating scales are defined, applied in order to assess and quantify the identified impacts.

The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on five criteria, namely:

- The relationship between impacts/issues and impact status (Box 1);
- The relationship between impacts/issues and spatial scale (Box 2);
- The relationship between impacts/issues and temporal scale (Box 3);
- The relationship between impacts/issues and probability (Box 4);
- The relationship between impacts/issues and severity (Box 5);

These three criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of impacts

Rating	Description	Quantitative

		Rating
Positive	A benefit to the receiving environment.	+
Neutral	No cost or benefit to the receiving environment.	N
Negative	A cost to the receiving environment.	-

Box 2: Spatial scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Box 3: Temporal scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years.	1
Medium	Medium term; Reversible over time; 5 – 15 years.	2
High	Long term; Approximate lifespan of the project: 16 - 30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Box 4: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Box 5: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction.	2
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value.	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example, the permanent change to topography resulting from a quarry.	4

Box 6: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	No Impact	Zero impact.	0
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	- 1 – 5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required.	- 6 – 11
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible	- 12 - 16

		mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	

4.3 Description of Identified Impacts

The identified impacts on environmental and social receptors arising from the proposed development include direct and indirect impacts. Impacts are also linked to the different stages of the project which are identified as construction, operation and decommissioning. During the Scoping Phase of the project discussions were held with DEA on the specialist studies that would need to be conducted during the EIAR Phase. The potentially significant impacts that were highlighted during Scoping are as follow:

- Loss to archaeological and cultural heritage;
- Visual and landscape impacts;
- Impact on natural vegetation and ecology;
- Avifaunal;
- Waste impacts;
- Surface hydrology;
- Wetland impacts; and
- Socio-economic impacts.

The impacts listed above were earmarked for further specialist assessment in order to assess their impacts more accurately and determine possible mitigation measures to be included in the Environmental Management Programme (EMP).

In addition to the potentially significant impacts, specialist assessments were also conducted for a number of the potentially less significant impacts. This was done in order to discount any possibility of a potentially significant impact occurring as a result of the proposed project and it being left unaccounted and unmitigated causing potentially serious harm to the environment. These specialist assessments included the following:

- Air quality;
- Geotechnical;
- Soils and Agriculture Potential;
- Noise;
- Geohydrology; and

– Tourism.

Through the implementation of standard environmental management measures the impacts on traffic, loss of agricultural land, and health and safety will also be addressed sufficiently in the impact assessment and controlled by the EMP.

4.3.1 Specialist Assessments for Potentially Significant Impacts

The following section describes the findings and recommendations of the potentially significant issues as described above. The specialist assessments are only discussed in broad terms in this section highlighting the most pertinent findings and recommendations but the specialist reports are all contained in Appendices D to O, U and V.

4.3.2 Heritage and Archaeological Impact Assessment

4.3.2.1 Construction Phase

4.3.2.1.1 Impact Description and Assessment

In terms of the findings from the Scoping Phase Heritage Impact Assessment, it was determined that no further Palaeontological Assessment is required for the EIAR phase.

With regards to impacts on heritage and archaeological resources during the construction phase it is expected that the predominant impact would arise as a result of the total destruction of the heritage resources that were identified and assessed. The earthworks and construction of the proposed plant and associated infrastructure will impact significantly on the identified heritage resources.

It is important to note that although the impact will be severe that the significance of the heritage resource is a determining factor in the overall impact significance calculation. The assessment entailed the determination of the heritage significance of each resource and the calculation of the significance of the impact pre- and post- the implementation of the proposed mitigation measures. Table 2 below is a summary of the heritage impact ratings, extracted from the Heritage Impact Assessment Report contained in Appendix D.

Table 2: Summary of the Heritage Impact Rating Table

			No Mitigation						With Mitigation						
Issue	Specific Impact	Heritage Significance.	Status	Extent	Duration	Probability	Intensity	Impact Significance.	Heritage Significance.	Status	Extent	Duration	Probability	Intensity	Impact Significance.
Heritage	Destruction of site with low heritage significance	GP.C	-	1	4	3	1	-9	GP.C	-	1	4	3	1	-9
	Destruction of site with medium heritage significance	GP.B	-	1	4	4	3	-12	GP.B	-	1	4	3	1	-9
	Destruction of possible graves	3B	-	1	4	4	3	-12	3B	-	1	4	3	1	-9
	Impact on cemetery outside PV area	3B	-	1	4	2	4	-11	3B	-	1	4	2	2	-10
	Destruction of cemetery inside PV impact area	3B	-	1	4	4	4	-13	3B	-	1	4	2	1	-8
	Destruction of historical sites	GP.C	-	1	4	3	4	-12	GP.C	-	1	4	4	2	-10
	Possible infant burials	3B	-	1	4	2	4	-11	3B	-	1	4	1	2	-8

The Heritage Scoping Report, that forms part of the Heritage Impact Assessment (HIA), has shown that the area between Postmasburg and Daniëlskuil generally referred to as the Ghaap plato has a rich history of occupation from the Stone Age with hunter gatherers to the Thlaping and Thlaro during the Iron Age period. The 1800's saw the rise of the Griqua people in the area and their loss of sovereignty after 1880 to Cape rule.

The field work that feeds into the HIA has utilised the findings of the Scoping report to guide this work. The field work identified a total of 25 heritage sites. All of the sites were assessed and of the 25 sites 14 sites will require further mitigation.

4.3.2.1.2 Mitigation Measures

Archaeological Sites:

PGS06 as indicated on the site map (Refer to the Heritage Impact Assessment Report Appendix D) –The sites needs to be documented through a surface collection and test excavation to determine the extent of the site. This will include mapping of the lithic distribution as well as analysis of the lithic assemblage.

Cemeteries:

AC02 - PGS09 and PGS13

It is recommended that the development layout be adjusted to accommodate the cemeteries and that the cemeteries be fenced with a 10 meter buffer.

It is further recommended that in the event that the cemeteries cannot be incorporated in to the development the graves be relocated after a full grave relocation process that includes comprehensive social consultation. The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
- Site notices indicating the intent of the relocation
- Newspaper Notice indicating the intent of the relocation
- A permit from the local authority;
- A permit from the Provincial Department of health;
- A permit from the South African Heritage Resources Agency if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- An exhumation process that will safeguard the legal implications towards the developer;
- The whole process must be done by a reputable company that are well versed in relocations;
- The process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Possible infant burials at **ACO013**, **PGS11-13** needs to be monitored during construction. However best practice would be to do test excavations to ascertain the presence of possible infant burials at each of these sites.

Further to these recommendations the general Heritage Management Guideline in Sections 6 of the Heritage Impact Assessment needs to be incorporated in to the EMP for the project.

4.3.2.1.3 Residual Impact

The overall impact of the development on heritage resources is seen as acceptably low and impacts can be mitigated to acceptable levels. The residual impacts after the implementation of the proposed mitigation measures are calculated as **medium negative**.

4.3.2.2 Operational Phase

Due to the impact of the construction activities of the plant on the heritage or archaeological resources and the resultant implementation of the proposed mitigation measures it is anticipated that the only potential impact during the operational phase of the proposed project would be on sites identified as **AC02 - PGS09 and PGS13**, should these graves not be relocated as a mitigation measure during the construction phase.

These sites fall outside the footprint of the proposed CSP plant and associated infrastructure but run the risk of being impacted on during operations. For this purpose it carries the same impact significance rating as during the construction phase and the very same mitigation measures i.e. that the cemeteries be fenced with a 10 meter buffer, are proposed for the operational phase as well.

4.3.2.3 Decommissioning Phase

The only potential heritage resources that are anticipated to prevail during the decommissioning phase of the proposed project is the graves associated with the sites **AC02 - PGS09 and PGS13**. In the instance where these sites were preserved instead of being relocated it is recommended that the proposed mitigation of fencing the cemeteries off with a 10 meter buffer during the decommissioning activities be implemented or maintained as implemented during the preceding construction and operational phases.

4.3.3 Visual and Aesthetic Landscape Impact Assessment

Visual resource impacts would result from the construction, operation, and maintenance of the proposed CSP project. Specifically, impacts would result from project components being seen from sensitive viewpoints and from effects to the scenic values of the landscape. Impacts to views would be the highest when viewers are identified as being sensitive to change in the landscape, and when their views are focused on and dominated by the change.

Visual impacts would occur when changes in the landscape are noticeable to viewers observing the landscape from their homes or from tourism / conservation areas, travel routes, and important cultural features and historic sites, especially when the project occurs in foreground a

middle ground views. The visual impacts that could result from the project would most likely be direct, adverse, and long-term and must be addressed in the assessment phase of the project.

4.3.3.1 Viewing areas

The project site lies in a shallow valley between two ridgelines that mostly contain the visuals of the heliostats (orange viewshed footprint in Figure 11 of the Visual Impact Assessment (VIA) Report contained in Appendix E) as seen in below, to a band of approximately 5km to the east and west of the project site. Along the length of the valley north and south of the site, exposure is greater and would affect foreground and background views i.e. up to 10 km from the site.

The central receiving tower, which is 200m tall, would be visible from a far greater distance as indicated in the viewshed in Figure 11 of the VIA. However, beyond 8km it would tend to recede into the background of views and at 16km it would be deemed as 'infrequently' viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention.

Public views (sensitive viewing areas) to the project site would be experienced by people living, working and passing through the study area. The closest of these viewing areas and the most exposed to the impact of the project, are the R385, which passes immediately to the north of the site and the Groenwater / Lime Acres farm road which passes immediately to the west of the site.

There are a few farmsteads and residential properties (along Groenwater road immediately north west of the site) that occur near the site and the project would appear in the foreground of these views resulting in a potential high visual impact. The farmsteads (two) occur to the immediate north and south of the site. There are 3 farmsteads with potential middleground views of project activities. These are located immediately west (approximately 5km from the site) of the site and to the north east (5km) and south east (3km). Visual exposure at these greater distances is reduced but nevertheless could have an impact on these sensitive views.

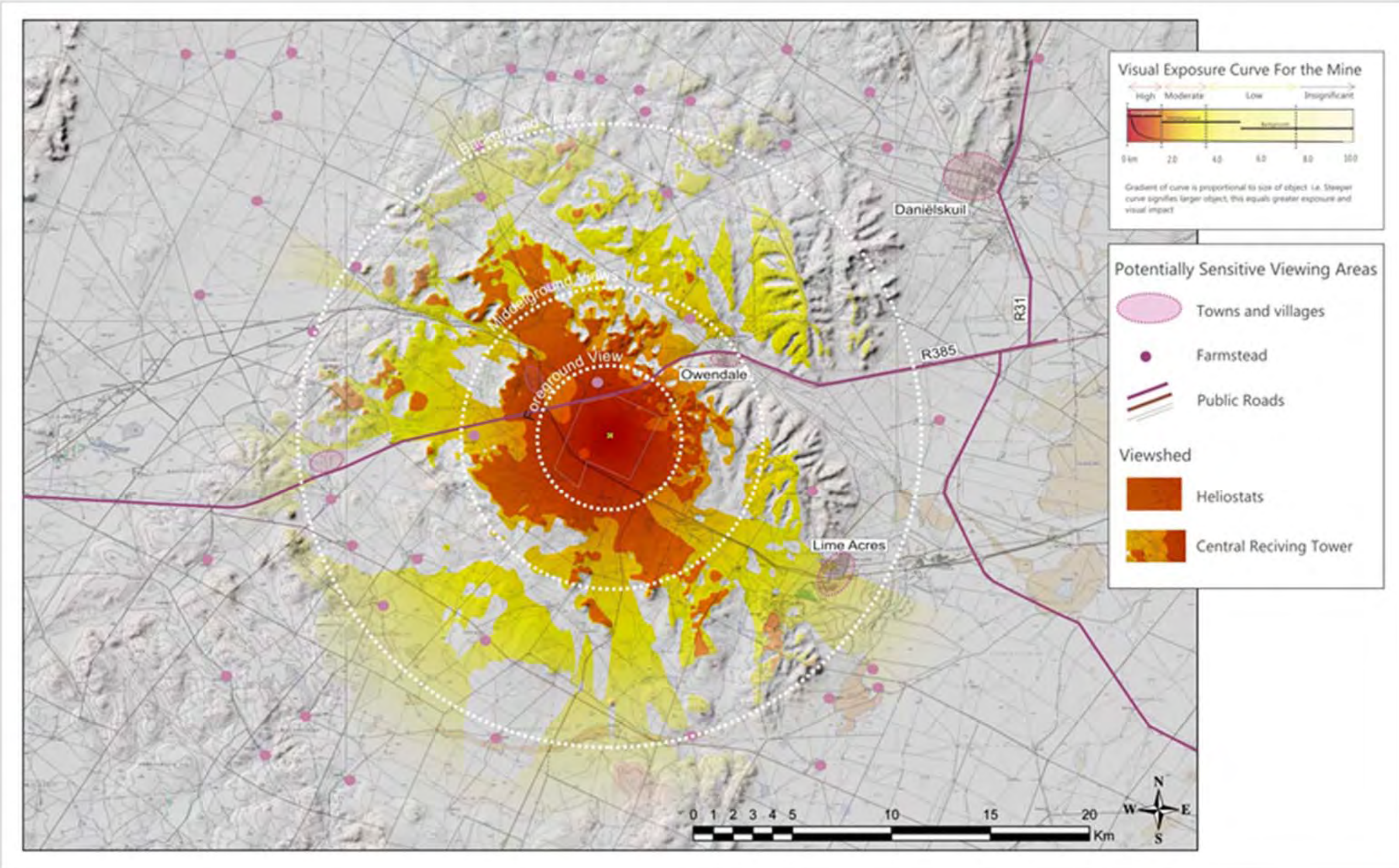

Figure 6: Viewshed and Sensitive viewing Areas

4.3.3.2 Construction and Operational Phase

The assessment of the visual impacts were conducted with only the construction and operational phases in mind as the site would be restored and rehabilitated to a natural state during the decommissioning phase and other than the perceived negative visual impacts associated with the construction activities during the decommissioning and rehabilitation phase the impact would indeed be positive and an improvement to the negative visual impact of the proposed plant and structures.

4.3.3.2.1 Impact Assessment

The impact of the proposed project on the primary sensitive viewing areas have been summarised in Table 3 and Table 4 below. The predominant sensitive viewing areas that have been assessed are grouped together as the views from R356 and Humansrus Farm and also the views from Groenwater, Sunnyside farmstead and the dirt road west of the site

Table 3: Significance of Visual Impact – R356 and Humansrus Farm

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation
– Construction Phase					
– - The proposed CSP project s located in a landscape of moderate value partially tolerant of change; – - The construction activities are visible from less than half the zone of potential influence, – - Views from the R356, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. – - Construction activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the short term and have a high negative effect on the visual quality of the area –	Medium (2)	Severe (3)	Low (1)	Probable (2)	Moderate Negative (9)
– Operational Phase					

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation
– - The proposed CSP project is located in a landscape of moderate value partially tolerant of change; – - The operation activities are visible from less than half the zone of potential influence, – -. Views from the R356, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. – - Operation activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the long term and have a high negative effect on the visual quality of the area.	High (3)	Severe (3)	High (3)	Probable (2)	Moderate Negative (11)

The significance rating of the impact on the R356 and Humansrus Farm viewing areas during the construction period is rated as **Moderate Negative** prior to the implementation of the proposed mitigation measures. The significance of the impact during the operational phase is also **Moderate Negative** prior to mitigation.

Table 4: Significance of Visual Impact – Views from Groenwater, Sunnyside farmstead and the dirt road west of the site

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation
– Construction Phase					

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation
– - The proposed CSP project s located in a landscape of moderate value partially tolerant of change; – - The construction activities are visible from less than half the zone of potential influence, – - Views from the R356, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. – - Construction activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the short term and have a high negative effect on the visual quality of the area. –	High (3)	Average (2)	Low (1)	Probable (2)	High Negative (8)
– Operational Phase					
– - The proposed CSP project is located in a landscape of moderate value partially tolerant of change; – - The operation activities are visible from less than half the zone of potential influence, – -. Views from the R356, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. – - Operation activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the long term and have a high negative effect on the visual quality of the area.	High (3)	Average (2)	High (3)	Probable (2)	High Negative (10)

The impact of the construction activities on the views from Groenwater, Sunnyside farmstead and the dirt road west of the site is rated as **High Negative** prior to the implementation of the proposed mitigation measures. During the operational phase the impact is also adjudged to be **High Negative** before mitigation.

4.3.3.2.2 Mitigation Measures

The proposed measures for the mitigation of the impact on the viewing areas from the R356 and Humansrus Farm views during the construction and operational phases of the proposed project are summarised as follow:

Site Development

- The minimum amount of existing vegetation and topsoil should be removed. Ensure, wherever possible, all existing vegetation is retained and incorporated into the site rehabilitation.

Good „housekeeping‟ (keeping the site tidy and neat) is essential throughout all phases of the project.**Earthworks**

- Dust suppression techniques should be in place at all times especially during the construction phase.
- Only the footprint and a small „construction buffer zone‟ around the proposed activities should be exposed. In all other areas, the existing vegetation should be retained and access prohibited during the construction phase.
- The final topography should be graded to merge and blend with the existing topography and to yield optimum use and value of the area in the future.
- The heliostat terrace is to be created at the lowest level possible to take advantage of the surrounding topography that can act as an effect visual screen (especially to views from the south and west of the site).

Rehabilitation

- An ecological approach to rehabilitation measures, as opposed a horticultural approach to rehabilitation should be adopted wherever possible. For example communities of indigenous, preferable endemic, plants enhance bio-diversity and blend well with existing vegetation. This ecological approach costs significantly less to maintain than conventional landscaping methods and is more sustainable in the long term. A registered landscape architect (SACLAP) should be consulted for this purpose.

Access Roads

- During construction and operational phases, access roads will require an effective dust suppression management programme, such as regular wetting and / or the use of non-polluting chemicals that will retain moisture in the road surface.

Lighting

- Light pollution should be seriously and carefully considered and kept to a minimum wherever possible as light at night travels great distances. Security and flood lighting should only be used where absolutely necessary and carefully directed i.e. away from nearby residences and communities. Wherever possible, lights should be directed downwards so as to avoid illuminating the sky.
- The negative impact of night lighting, glare and spotlight effects, can be mitigated using the following methods:
- Install light fixtures that provide precisely directed illumination to reduce light “spillage” beyond the immediate surrounds of the CSP site.
- Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on movement at illegal entry to the site.

- Use security lighting at the periphery of the site that is activated by movement and are not permanently kept on.

Visual Intrusion

- The tower should remain as a concrete finish and no advertising should be allowed on it.

Visual Buffer

- It is proposed that a physical visual buffer be constructed along the northern edge of project property boundary between the road reserve and the heliostat field. The buffer would form an effective screen to foreground views of the site and block from view, the heliostat field from this low perspective. Three options are proposed:
- An earth berm approximately 10m high created from excavated site material. The berm should be covered with topsoil removed and stockpiled from the construction footprint (of the berm as well as other proposed facilities) and seeded with indigenous plant materials. Refer to Figures 16 (before scenario) and Figure 17 (with 10m berm). The viewing point is from the R385 at the north eastern corner of the site.
- An earth berm approximately 5m high created from excavated site material. The berm should be covered with topsoil removed and stockpiled from the construction footprint (of the berm as well as other proposed facilities) and seeded with indigenous plant materials. Refer to Figures 16 (before scenario) and Figure 18 (with 5m berm). The viewing point is from the R385 at the north eastern corner of the site.
- Rows of Wild Olive trees (O*lea europea* subsp. *Africana).* It is a small to medium sized indigenous tree with a dense rounded crown, which occurs in the area. The lower branches should be encouraged to grown and not be pruned back, so as to achieve a visual screen as low to the ground as possible. It has a relatively fast growth rate of up to 800mm per year and could reach a height of 5 – 7m in approximately 10 years. This means that the visual buffer would not be effective immediately. Refer to Figures 16 (before scenario) and Figure 19 (with olive tree screen).
- It should be noted that the earth berm options are only viable should excess soil be available from site works. If soil has to be transported from off-site the implementation of the berm would not be economically feasible.

Visitors Centre

- Develop a visitor's centre that explains the new technology and conveys pertinent information about the use of solar energy to produce clean electricity.
-

4.3.3.2.3 Residual Impacts

It is envisaged that the residual impact after the successful implementation of the proposed mitigation measures would result in a **Moderate Negative** impact on the views from the R356 and Humansrus Farm during both the construction and operational phases and **High Negative** during the construction phase and **Moderate Negative** during the operational phase on views from Groenwater, Sunnyside farmstead and the dirt road west of the site.

4.3.4 Assessment of Impacts on Avifauna Species and Habitats

4.3.4.1 Construction Phase

4.3.4.1.1 Impact Description and Assessment

Loss of habitat:

Approximately 800ha will be taken up by the CSP plant in total. The vegetation in this area will should not be fully cleared automatically. Rather, only the areas where infrastructure has to be constructed should be cleared. Obviously construction activities on site will flatten and impact on certain areas of vegetation even if it is not cleared. Similar habitat is abundant in the greater area and it is anticipated that the bird species will move to surrounding areas. The impact significance is rated as **Medium/Moderate Negative** prior to mitigation.

Disturbance:

Construction activities will no doubt disturb the birds in the area, particularly breeding birds – however due to the uniformity of the broader area, these birds can quite easily move off and find similar habitat nearby. The impact significance is rated as **Medium/Moderate Negative** prior to mitigation.

4.3.4.1.2 Mitigation Measures

The mitigation of the loss of habitat and the disturbance caused as a result of the construction activities can be achieved in a very moderate fashion by ensuring that the construction Environmental Management Plan incorporates guidelines as to how best to minimize this impact. Due to the Medium impact significance rating of these impacts prior to mitigation it is not envisaged that the significance of the impact would drop as a result of the mitigation proposed.

4.3.4.1.3 Residual Impacts

The specialist Avifaunal Assessment does not make a pertinent rating of the residual impacts but the conclusion that is derived from the specialist report is that the residual impact for the loss of habitat and the disturbance caused by the construction does not improve a great deal post mitigation and it is hence inferred that the impact would remain at a significance rating of **Medium/Moderate Negative**.

4.3.4.2 Operational Phase

4.3.4.2.1 Impact Description and Assessment

Collision with the heliostats (mirrors):

This is likely to impact on birds, but the extent to which it will occur is unknown at this stage. The impact on bird populations worldwide through them colliding with windows of buildings has been well documented (see www.flap.org). At Solar One, 81% of bird mortalities were through collision with structures, with >75% of these collisions having occurred with the heliostat mirrors

themselves (McCrary et al 1986). The significance rating for this impact is **Medium/Moderate Negative** prior to mitigation.

Collision with the central receiver tower:

Bird collisions with tall infrastructure have also been well documented worldwide. However, this typically occurs with migratory species in flocking behaviour and has usually involved low visibility conditions such as fog. There are unlikely to be sufficient numbers of any particular bird species at the site of the CSP plant to constitute flocking behaviour thereby resulting in this risk. It is however likely that the occasional bird will collide with the tower. The impact significance is rated as **Medium/Moderate Negative** prior to mitigation.

Roosting on the central receiver tower:

The tower will be a prominent structure in the landscape and may be an attractive roost for certain bird species. Although it will be too hot during operation, as it cools down during the evenings it may be a very attractive (particularly during winter) if it retains some warmth (although the temperature it retains remains to be seen). If it is well lit at night, this may attract insects, thereby attracting birds. If birds do roost on the tower, this is likely to simply be a nuisance for plant staff, as bird pollution will build up on any available surfaces. The impact significance is rated as **Medium/Moderate Neutral** and requires no mitigation.

Burning when in vicinity of the central receiver:

It seems unlikely to be a significant impact as birds would presumably be repelled by the heat before they get within burning range. Certain particularly fast flying species may be impacted on, such as the doves, swifts, martins and swallows. Research at Solar One did not detect any fatalities through this mechanism (McCrary et al 1986). The impact significance is rated as **Medium/Moderate Negative** prior to mitigation.

Burning when entering the “standby focal points”:

This impact is likely to occur at the CSP plant. The significance of the impact will depend on a number of factors which are unclear at this stage, for example: exactly how many focal points will exist; what size will they be; how long will they be in operation for each day. At this stage it is safe to say that some birds will in all likelihood be killed in the focal points. The significance of the impact will depend on just how many birds, and what species are killed. Furthermore, it seems unlikely that any mitigation for this impact will be possible. Monitoring at Solar One recorded that 19% of all bird mortalities were through burning in standby or focal points – mostly swifts and swallows (McCrary et al 1986). The significance rating for this impact is **Medium/Moderate Negative** prior to mitigation.

Nesting of Sociable Weavers and other species on the CSP tower:

The extent to which this occurs will need to be monitored closely. This is an impact of the birds on the plant rather than the plant on the birds. It is hoped that the constant moving and cleaning of the heliostats will make them unattractive nesting substrate for the birds. No nests were observed within the site boundaries, however, some nests were observed in the surrounding areas. The significance rating for this impact is **Medium/Moderate Positive** prior to mitigation.

New power line collisions:

Collision of large terrestrial birds with overhead power lines is likely to occur and is anticipated to be the most significant threat posed by associated infrastructure. Species most likely to be affected are korhaans and other large terrestrial species. The significance of this impact depends on the length of new line to be built. In this case it appears that new line will be required from the CSP Plant to a substation connecting with the High Voltage Line running to the South West of the site. The exact routing of this new line was not available at the time of the site visit, and the impact therefore cannot be fully assessed at this stage. The significance rating for this impact is **Medium/Moderate Negative** prior to mitigation.

Electrocution:

Electrocution of birds on pylons will depend entirely upon the exact pylon structure that for the new line – detail of which was not available at the time of this study. Electrocution risk is determined by the phase-phase and phase-earth clearances on a pole structure which differ greatly between different structures. Again, if the structure used is dangerous to birds, the significance of this impact will vary with the length of the line. Nesting of birds on pylons is in fact a positive impact on avifauna, but may impact negatively on the quality of electrical supply by causing electrical faults. In the case of Sociable Weaver nests, the nest material may pose problems to the pylons structural integrity through added weight, and there is an increased fire risk due to the fuel load of these massive nests. The significance rating for this impact is **Medium/Moderate Negative** prior to mitigation.

Nesting of Sociable Weavers and other species on the new power line infrastructure:

Nesting of birds on pylons is in fact a positive impact on avifauna, but may impact negatively on the quality of electrical supply by causing electrical faults. In the case of Sociable Weaver nests, the nest material may pose problems to the pylons structural integrity through added weight, and there is an increased fire risk due to the fuel load of these massive nests. This impact has a significance rating of **Medium/Moderate Neutral** and requires no mitigation with no cost or benefit to the receiving environment.

4.3.4.2.2 Mitigation Measures

The following mitigation measures are proposed for the assessed impacts associated with the operation of the plant and infrastructure:

- Collision of birds with heliostats is likely to be of medium significance.
    - Mitigation: It is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Burning of birds in focal points will be of medium significance.
    - Mitigation: Again, it is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Collision of birds with overhead power lines is likely to be of medium significance.
    - Mitigation: This will be mitigated by marking the relevant sections of line (i.e. those within the Medium-High Sensitivity zones, as depicted in the sensitivity analysis) with appropriate marking devices. These sections of line, and the exact spans, will be finalised as part of the Environmental Management Programme (EMP) phase, once power-line routes are finalised and pylon positions are pegged.
- Electrocution of birds is likely to be of medium significance.
    - Mitigation: Any overhead power lines which are built within the site, and which are 132kV or lower, should use a “bird friendly” monopole structure, fitted with a bird perch, as per Eskom standard guidelines.

4.3.4.2.3 Residual Impact

The impacts anticipated during the operational phase of the proposed project have a predominantly moderate negative impact on the avifauna. The implementation of the proposed mitigation measures will not have any significant effect in reducing the assessed impacts but it will ensure that the impacts remain at a **Medium/Moderate Negative** significance.

4.3.4.3 Decommissioning Phase

The impact of construction activities during the decommissioning phase of the proposed project have not been assessed during the specialist assessment but are likely to have a short term impact on avifauna. The predominant impact during this phase is anticipated to be the disturbance caused by the demolishing, decommissioning and rehabilitation activities similar to the construction phase but only to a lesser degree as a result of the loss of habitat caused during the construction phase. Although not assessed and quantified an overall positive impact is expected as a result of the reinstatement of the natural habitat after the demolishing of the infrastructure and during the rehabilitation of the site. The reinstatement of the natural habitat would cause avifauna and other fauna to gradually return to the area post-rehabilitation.

4.3.5 Impacts on Fauna and Flora (Biodiversity)

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status.

Impacts resulting from the proposed development on ecological attributes of the study area are largely restricted to the physical impacts on biota or the habitat in which they occur. Direct impacts include any impacts on populations of individual species of concern, including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof is immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. In addition, the extent of the effect is frequently large scale, mostly regional. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts.

Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

Eleven impacts were identified that are relevant to the proposed development and are placed in three categories, namely:

- Direct impacts:
    - Direct impacts on threatened flora species;
    - Direct impacts on protected tree species;
    - Direct impacts on threatened fauna species;
    - Loss, or disruption of mammal migration routes on a local scale;
    - Direct impacts on sensitive/ pristine habitat types of the study area;
    - Direct impacts on common fauna species occurring on the study area;
- Indirect Impacts:
    - Faunal interactions with structures, servitudes and personnel;
    - Impacts on surrounding habitat/ species, including ecosystem functioning;
- Cumulative Impacts:
    - Impacts on SA’s conservation obligations & targets (VEGMAP vegetation types);
    - Increase in local and regional fragmentation/ isolation of habitat; and
    - Increase in environmental degradation, pollution (air, soils, surface water).

Other, more subtle impacts on biological components, such as changes in local, regional and global climate, effects of noise pollution on fauna species, increase in acid rain, ground water deterioration, etc., are impacts that cannot be quantified to an acceptable level of certainty and is mostly subjective in nature as either little literature is available on the topic or contradictory information exist. These impacts are therefore omitted from this assessment. Impacts were placed in three categories, namely: direct, indirect and cumulative impacts and each impact were assessed in relation to the six different habitat types that were identified on site. These habitat types are:

- Closed Shrubveld Habitat Type
- Drainage Line Habitat Type
- Floodplains Habitat Type
- Grassland Plains Habitat Type
- Olea Woodland Habitat Type
- Open Shrubveld Habitat Type

The greater majority of these impacts are anticipated to occur predominantly during the construction phase of the proposed project due to the expected alteration of natural habitat or further degradation of habitat as a result of the construction activities. The positive impact of the decommissioning and rehabilitation of the site did not warrant the assessment of the impacts during this phase of the projects. In this light, the impact evaluation of the eleven impacts was not conducted per project phase but rather in the context of the three impact categories namely direct, indirect and cumulative impacts. The EMP will however address the impacts in the context of each project phase.

4.3.5.1 Description and Assessment of Direct Impacts

4.3.5.1.1 Direct Impacts on Threatened Flora Species

This is regarded as a direct impact since it results in the physical damage or destruction of Red Data species or areas that are suitable for these species, representing a significant impact on the biodiversity of a region. Threatened plant species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human activities is one of the greatest reasons for these species having a threatened status.

Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest limitations in terms of mitigating or preventing this particular impact, is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. To allow for an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited to some extent.

The likelihood of Red Data flora species occurring within the study area is regarded relatively low. Available data did not indicate the known presence of Red Data plants in the region. However, habitat types present on the property is in an optimum condition and Red Data plant species might be present. Since this survey was conducted during the winter, no definitive comments could be made about the absence of Red Data plants on the study area.

4.3.5.1.2 Direct Impacts on Protected Tree Species

When the proposed footprint is evaluated, it is clear that a number of protected tree species will be removed during construction. While *Acacia erioloba* and *Boscia albitrunca* occur in low numbers on the property, *Olea europaea* is present as shrubs in most of the woodland and shrubveld habitat types and as relatively dense stands of trees in the Olea Woodland. Impacts within this area in particular will result in direct and significant impacts on this protected tree. It is not regarded as a cause to stop the proposed development, since the species occurs in commonly across most of the region. In addition, most of the habitat where this species occurs is captured within areas where human related impacts are unlikely to happen, thereby ensuring adequate protection for the species.

However, this species is under increasing threat that causes a continuous decline in numbers and it has been placed in a Declining Category; it is a legal requirement to report the presence of this species to relevant authorities in order to monitor their numbers as well as impacts on the status of the species.

The presence of protected tree species on the property has been established and impacts on a number of these trees will occur.

4.3.5.1.3 Direct Impacts on Threatened Fauna Species

The presence of three Red Data fauna species on this property has been confirmed and any surface disturbance therefore represents a direct and significant impact on these species. While some of them are highly mobile and will ultimately be able to avoid impacts that result from the proposed development, some like the Lesser Dwarf Shrew will not be able to avoid

effects of microhabitat destruction, such as the termite mounds, which they occupy. A direct approach can be implemented in order to relocate these animals to adjacent suitable habitat. Similar to Red Data plants, the presence of Red Data animal species is seen as a significant attribute to the biodiversity of an area. Any impact is therefore viewed as significant. Additional aspects that will be affected include migration patterns and suitable habitat for breeding and foraging purposes.

The presence of Red Data fauna species within the study area is confirmed.

4.3.5.1.4 Loss, or Disruption of Migration Routes

The region is characterised by untransformed and large expanses of relatively pristine woodland and grassland habitat types that will likely be occupied by a high diversity of animal species. Evidence of this snapshot investigation has confirmed this and it is therefore possible to assume that the animals that utilises these habitat types migrate across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors or habitat. The loss of an area as large, as this property, will affect the migration pattern of a number of species that are present in the immediate region. While larger animals are able to avoid unsuitable habitat, smaller animals might not be able to cross or avoid these areas.

The size of the proposed development implies that much of the natural habitat that is present on the study area will become unsuitable for a number of species that might utilise this area on a frequent or infrequent nature.

4.3.5.1.5 Direct Impacts on Sensitive/ Pristine Habitat Types

The loss/ change of pristine habitat types or habitat that are regarded sensitive as a result of restricted presence in the larger region (atypical habitat) represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities and faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region.

Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

Parts of the study area are regarded as highly sensitive.

4.3.5.1.6 Direct Impacts on Common Fauna Species

The likelihood of this direct impact occurring is relatively low due to the ability of most animal species to evacuate an area that becomes unsuitable. The presence of a relative diverse faunal species composition on this property has been established. Considering the low levels of habitat transformation and degradation of the surrounding region, most animal species are likely to evacuate towards adjacent areas of natural habitat during the development. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact, some species are not able to relocate, such as ground living and small species. The proposed development will result in severe impacts on these species.

While some fauna species are able to avoid areas of disturbance, some species are simply not able to relocate such vast distances. The proposed development will therefore result in destruction of these animals. It is unlikely that their conservation status will be affected, but any direct and sever impact on animals is considered significant.

4.3.5.1.7 Faunal Interactions with Structures, Servitudes & Personnel

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. While the structures are visible, injuries and death of animals could potentially occur because of accidental contact. An aspect that is of concern is the presence of vehicles on access and infrastructure roads, leading to road kills, particularly amongst nocturnal animals that abound in the study area.

The presence of personnel within the development area during construction and maintenance periods will inevitably result in some, but normally limited, contact with animals. While most of the larger animal species are likely to move away from humans, encounters with snakes and scorpions remain likely. Similarly, the presence of humans within areas of natural habitat could potentially result in killing of animals by means of snaring, poaching, poisoning, trapping, etc.

The nature of the proposed development is expected to result in limited indirect impacts on the fauna species.

4.3.5.2 Description and Assessment of Indirect Impacts

4.3.5.2.1 Impacts on Surrounding Habitat/ Species & Ecosystem Functioning

Surrounding areas and species present in the direct vicinity of the study area could potentially be affected by indirect impacts resulting from construction and operational activities. This indirect impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processed;
- Effects on pollinators; and
- Increased invasion by plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the drainage line, is regarded important. It is well known that the status of a catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines, such as the one on this property, might be insignificant on a regional scale, but the combined status of numerous such small drainage lines will determine the quality of larger rivers further downstream.

The nature of this impact dictates that potential impacts are likely to spread from the development area into bordering areas of high sensitivity.

4.3.5.3 Description and Assessment of Cumulative Impacts

4.3.5.3.1 Impacts on SA's Conservation Obligations & Targets

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types and while any impact that results in irreversible transformation of natural habitat is regarded significant, no significant disruption of ecosystem functioning is assumed in least threatened vegetation types, which still have more than 80% of their original extent untransformed.

Loss of parts of the natural vegetation is expected to result in an insignificant, indirect impact on the conservation status of the regional vegetation types; which is regarded Least Concern.

4.3.5.3.2 Increase in Local & Regional Fragmentation/ Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on

available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by extremely low levels of transformation and habitat fragmentation. Impacts from the proposed development are unlikely to increase regional or local levels of fragmentation and habitat isolation significantly.

4.3.5.3.3 Increase in Environmental Degradation

Cumulative impacts associated with this type of development could lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

The nature of the proposed development dictates that the biological environment is unlikely to be affected since no effluents, spillages or chemical are likely to be produced or transported. However, the general region is characterised by low levels of degradation, this impact therefore becomes more important since it represents the ‘thin end of the wedge’.

4.3.5.4 Impact Rating Prior to Mitigation

In estimating the significance and likelihood of impacts of the proposed development on the biological environment, cognisance is taken of all biophysical, floristic and faunal attributes that characterise the study area as well as the immediate region. It represents a subjective interpretation of the biophysical attributes, estimated sensitivities of habitat types that are present on the study area as well as taking cognisance of the larger region and how the proposed project will affect the biodiversity issues on a larger scale. Impacts are assessed prior to the implementation of all recommended mitigation measures.

Table 5: Issues related to Biodiversity - Closed Shrubveld Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Direct impacts on RD flora	Negative	2	4	1	3	Negligible	10	medium
Direct impacts on Protected Trees	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on RD fauna	Negative	2	4	3	3	Negligible	12	high
Disruption of Migration Routes	Negative	1	4	2	2	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	1	4	3	2	Negligible	10	medium
Direct impacts on common fauna species	Negative	1	4	4	2	Negligible	11	medium
Faunal Interactions w structures	Negative	1	4	2	1	Negligible	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Negligible	12	high
Impacts on conservation targets	Negative	3	4	1	1	Negligible	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	medium
Average Impact Status							10.1	medium

Table 6: Issues related to Biodiversity - Drainage Line Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Direct impacts on RD flora	Negative	2	4	2	3	Negligible	11	medium
Direct impacts on Protected Trees	Negative	2	4	1	2	Negligible	9	medium
Direct impacts on RD fauna	Negative	3	4	2	3	Negligible	12	high
Disruption of Migration Routes	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	4	Negligible	12	high
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	1	1	Negligible	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	3	4	3	3	Negligible	13	high
Impacts on conservation targets	Negative	3	4	2	2	Negligible	11	medium
Increase in fragmentation & isolation	Negative	2	4	1	2	Negligible	9	medium
Increase in environmental degradation	Negative	3	4	2	3	Negligible	12	high
Average Impact Status							10.6	medium

Table 7: Issues related to Biodiversity - Floodplains Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance

Direct impacts on RD flora	Negative	2	4	1	3	Negligible	10	medium
Direct impacts on Protected Trees	Negative	2	4	1	1	Negligible	8	medium
Direct impacts on RD fauna	Negative	3	4	2	3	Negligible	12	high
Disruption of Migration Routes	Negative	2	4	2	3	Negligible	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	4	Negligible	12	high
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	3	4	3	3	Negligible	13	high
Impacts on conservation targets	Negative	2	4	2	2	Negligible	10	medium
Increase in fragmentation & isolation	Negative	2	4	2	2	Negligible	10	medium
Increase in environmental degradation	Negative	2	4	2	3	Negligible	11	medium
Average Impact Status							10.5	medium

Table 8: Issues related to Biodiversity - Grassland Plains Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Direct impacts on RD flora	Negative	2	4	1	3	Marginal	10	medium
Direct impacts on Protected Trees	Negative	1	4	4	1	Marginal	10	medium
Direct impacts on RD fauna	Negative	2	4	4	4	Marginal	14	high
Disruption of Migration Routes	Negative	3	4	3	2	Marginal	12	high
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	2	Marginal	10	medium
Direct impacts on common fauna species	Negative	2	4	4	2	Marginal	12	high
Faunal Interactions w structures	Negative	2	4	3	1	Marginal	10	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Marginal	10	medium
Impacts on conservation targets	Negative	2	4	2	1	Marginal	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Marginal	9	medium
Average Impact Status							10.6	medium

Table 9: Issues related to Biodiversity - Olea Woodland Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Direct impacts on RD flora	Negative	3	4	1	3	Marginal	11	medium
Direct impacts on Protected Trees	Negative	2	4	4	3	Marginal	13	high
Direct impacts on RD fauna	Negative	2	4	4	3	Marginal	13	high

Disruption of Migration Routes	Negative	3	4	2	2	Marginal	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	3	Marginal	12	high
Direct impacts on common fauna species	Negative	2	4	2	3	Marginal	11	medium
Faunal Interactions w structures	Negative	2	4	3	1	Marginal	10	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Marginal	12	high
Impacts on conservation targets	Negative	2	4	1	1	Marginal	8	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Marginal	9	medium
Average Impact Status							11.0	medium

Table 10: Issues related to Biodiversity - Open Shrubveld Habitat Type

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Direct impacts on RD flora	Negative	2	4	1	3	Marginal	10	medium
Direct impacts on Protected Trees	Negative	2	4	4	2	Marginal	12	high
Direct impacts on RD fauna	Negative	2	4	4	4	Marginal	14	high
Disruption of Migration Routes	Negative	2	4	3	2	Marginal	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	2	Marginal	11	medium
Direct impacts on common fauna species	Negative	2	4	4	2	Marginal	12	high
Faunal Interactions w structures	Negative	2	4	2	1	Marginal	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Marginal	10	medium
Impacts on conservation targets	Negative	2	4	2	1	Marginal	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	2	Marginal	10	medium
Average Impact Status							10.8	medium

4.3.5.5 Proposed Mitigation Measures

4.3.5.5.1 General Aspects

Mitigation Measure 1 - Exclude all areas of the Drainage line and Floodplain habitat types from the proposed development. This should be done during the planning phase of the project;

Mitigation Measure 2 - Exclude as much of the Closed shrubveld habitat type from the proposed development as technically feasible. This should be done during the planning phase of the project;

Mitigation Measure 3 - Allow for a suitable buffer in order to provide some protection of sensitive areas against peripheral impacts, wetland related habitat types in particular. Al areas that were ascribed a High Ecological Sensitivity should be buffered against potential impacts. Guidelines of the wetland specialist should be implemented in this regard;

Mitigation Measure 4 - Appoint an Environmental Control Officer (ECO) prior to start of construction. Responsibilities should include, but not be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 5 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Environmental monitoring should be conducted at least twice per year (Summer, Winter);

Mitigation Measure 6 - Limit construction, maintenance and inspection activities to dry periods in order to curb occurrence/ augmentation of erosion in areas of existing erosion, destabilizing of substrate in areas of high slopes, drainage lines, etc;

Mitigation Measure 7 - Ensure responsible storage of hazardous materials, chemicals, fuels, oils, etc. in properly designed facilities in order to prevent accidental spillage, contamination or pollution;

Mitigation Measure 8 - Develop emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas;

Mitigation Measure 9 - Construction sites/camps need a detailed ecological assessment prior to construction;

Mitigation Measure 10 - Limit damage to protected tree species in the Olea woodland as far as possible. Adapt layout plans to avoid any excessive damage to this habitat type;

Mitigation Measure 11 - All individuals/ stands of Protected trees must be clearly and visibly marked prior to the start of construction or maintenance procedures;

Mitigation Measure 12 - Implement strict erosion monitoring and management procedures in all areas where slopes are present.

4.3.5.5.2 Fences & Demarcation

Mitigation Measure 13 - Demarcate construction areas by semi-permanent means in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

Mitigation Measure 14 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

Mitigation Measure 15 - Marking of plants should be done by means of semi-permanent (removable) marker tape;

4.3.5.5.3 Fire

Mitigation Measure 16 - Prevent all open fires;

Mitigation Measure 17 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

4.3.5.5.4 Roads & Access

Mitigation Measure 18 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 19 - Vehicular traffic shall not be allowed in permanently wet areas, no damage shall be caused to wet areas. Where necessary, alternative methods of construction shall be used to avoid damage to wet areas.

Mitigation Measure 20 - Restrict the construction of new access roads to outside sensitive areas. Sensitive areas outside the construction footprint are to be demarcated and no access roads are to be constructed within these areas;

Mitigation Measure 21 - The Contractor shall select a suitable level area free of rock and large bushes as lay down area;

Mitigation Measure 22 - The Contractor shall select an area a suitable distance from any sensitive environmental feature as a construction camp;

4.3.5.5.5 Workers & Personnel

Mitigation Measure 23 - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 24 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

Mitigation Measure 25 - Use of branches of trees and shrubs for fire making purposes is strictly prohibited;

4.3.5.5.6 Vegetation Clearance & Operations

Mitigation Measure 26 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 27 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area;

Mitigation Measure 28 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 29 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 30 - Cut vegetation (grass and shrubs) only if required. No clearing of vegetation or soil by grading machinery shall be undertaken;

Mitigation Measure 31 - The establishment and regrowth of alien vegetation must be controlled after the removal of grass;

Mitigation Measure 32 - All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);

Mitigation Measure 33 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 34 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 35 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 36 - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 37 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 38 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 39 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

Mitigation Measure 40 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act, No. 43 of 1983 and should be addressed on a continuous basis;

4.3.5.5.7 Animals

Mitigation Measure 41 - No animal may be hunted, trapped, snared or killed for any purpose whatsoever;

Mitigation Measure 42 - Conduct a search and rescue operation in all affected areas to remove animals from old termite mounds prior to the commencement of construction activities (vegetation clearing and ground levelling). Reptiles and small mammals that utilises these micro-habitat should be captured and released in suitable nearby areas;

Mitigation Measure 43 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 44 - Dangerous animals should be handled by a competent person;

Mitigation Measure 45 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction; and

Mitigation Measure 46 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

4.3.5.5.8 Protected Trees/ Conservation Important Species

Mitigation Measure 47 - Conduct a suitable assessment of the abundance and structure of protected tree species on the property to assist the client with regards to the submission of relevant applications;

Mitigation Measure 48 - Obtain necessary and required approval per application for damage/ removal/ cutting/ pruning of Protected tree species from Department of Forestry, as per National Forests Act (Act No. 84 of 1998) under Government Notice GN 1012 of 2004 and GN 767 of 2005 as well as NCDENC;

Mitigation Measure 49 - Cutting/ pruning/ damaging of any Protected tree species should not be allowed at any circumstances, unless a permit has been obtained for this purpose; and

Mitigation Measure 50 - Conduct a detailed walkthrough of moderately suitable habitat for Lithops aucampiae subsp. aucampiae var. aucampiae. Implement a removal and relocation programme if required.

4.3.5.6 Residual Impacts

The anticipated residual impacts on the six deferent habitat types after the implementation of the proposed mitigation measures are summarised in the tables below. A singular impact of high significance remained after the implementation of the mitigation measures. This was the direct impacts on Protected Trees within the Olea Woodland Habitat Type.

Table 11: Summary of impacts within respective habitat types

Habitat Type	Impact without mitigation	Impact with mitigation
Closed Shrubveld Habitat Type	10.1 (medium)	6.5 (medium)

Drainage Line Habitat Type	10.6 (medium)	5.0 (low)
Floodplains Habitat Type	10.5 (medium)	5.0 (low)
Grassland Plains Habitat Type	10.6 (medium)	9.3 (medium)
Olea Woodland Habitat Type	11.0 (medium)	9.5 (medium)
Open Shrubveld Habitat Type	10.8 (medium)	9.1 (medium)

4.3.6 Waste Assessment

4.3.6.1 Waste Classification and Impact Description

From the Basis of Design Report for the brine evaporation ponds for the proposed project it is inferred that the waste (brine) to be generated by the proposed activity is classified as a moderate hazard, with a Hazard rating of 3. The brine is an inorganic process wastes or residues and was classified as class 6 (Poisonous (toxic) substances) according to the SABS 0228 code.

The main concern for consideration should be the protection of ground and surface waters. Impacts identified include possible impacts on human health (drinking), aquatic ecosystems, and commercial users (e.g. irrigation).

The elements analyzed and found in brine were compared with the general and special limits for wastewater discharge published in terms of the National Water Act (Act no. 36 of 1998)(NWA). The nitrate/nitrite content does meet the general limit and the fluoride exceeds the limit only by 0.6 mg/l as F, but the main concern is the total salt load. When the maximum loads allowed is compared with the calculated TDS content it is clear that disposal of the Brine as a wastewater will not be allowed.

Using the estimated values the Brine exceeds the maximum level allowed by 3 to 4 times. Such levels will also contribute to “shock loads” where the salinity of the surface water can change significantly. Typically the published limits only allow an increase in dissolved solids content of approximately 300 to 450 mg/l.

Total dissolved solids is not necessarily toxic, but can affect natural aquatic systems negatively with effects on individual species, the overall community present in the system and on microbial and ecological processes. Though an index like the sodium absorption ratio (SAR) is a complex issue, high salt content in surface or groundwater increases the likelihood of negative effects if the water is used for irrigation.

Human health factors in case of drinking are typically aesthetic for example in the case of chloride and sodium above 200 mg/l, where taste and corrosion is the most serious concern.

However sulphate levels of above 400 mg/l can cause diarrhea as well as a bitter taste as do magnesium at levels above 200 mg/l. At 10 mg/l as N the Nitrate/nitrite level of 10 mg/l as N can cause blue baby syndrome (Methaemoglobinaemia) in infants.

Total dissolved solid content levels of more than 3000 mg/l contribute to corrosion and taste problems, but can also have clear short-term health effects as it disturbs the human body’s salt

balance. Similarly potassium can cause serious problems for infants and individuals with renal problems.

Fluoride is also present at the threshold level of 1.5 mg/l as F for dental mottling and softening of enamel in continuous users.

The potential impacts are not rated in the Basis of Design Report (contained in Appendix H) for the brine evaporation ponds in terms of the standard impact significance rating methodology but the impacts are considered as significant and from that premise the design of the evaporation ponds, which are ultimately the mitigation measures of the anticipated impacts, is very sound and will as such attenuate any anticipated impacts to a high level of confidence.

4.3.6.2 Design / Mitigation Measures

The design criteria considered for the concept design and positioning of the evaporation pond for the CSP plant allows for the effective mitigation of the impacts related to the waste generation activities were as follows:

- The Hybrid Cooled zero discharge system will be used for the CSP plant,
- The Hybrid Cooled zero discharge system will produce an average daily flow of effluent (brine) to the evaporation ponds of 164 m^3/day ,
- A design safety factor of 15% was used for the sizing of the evaporation pond,
- The effluent (brine) total dissolved solids (TDS) was taken as 5000 mg/l,
- The specific gravity of the effluent (brine) was taken as 1.28 ton/m^3,
- Annual rainfall for the area was used at 400 mm/annum,
- S-pan evaporation for the area was noted between 2200 mm/annum and 2600 mm/annum, the worst case scenario was used at 2200 mm/annum,
- The evaporation pond must be designed in such a way that maintenance can take place without disrupting the normal processes of the CSP plant,
- The evaporation ponds must fall outside the 1:50 year flood line positions of the non – perennial lines on site,
- The effluent (brine) is classified with a hazardous rating of 3 and therefore the ponds will be lined with a triple liner and double drainage system as required by the Department of Water Affairs (DWA).

4.3.6.2.1 Design Layout

The area of least potential environmental impact for the placement of the evaporation pond is located south west of the heliostat field. Access to the pond will be created by the center line of the heliostat circle that runs in a vertical and horizontal line from the power block. The access road will have a gravel surface. The effluent will be piped or channeled to the evaporation pond as the south – west corner of the site is at a lower position and therefore a gravity feed can be achieved. The evaporation pond was designed in three compartments that would enable maintenance on any of the three compartments without disrupting the normal operations of the

CSP plant. The three compartments will have a small emergency overflow to each of the other compartments. The flow to each of the compartments will be controlled via a splitter box at the top end of the evaporation ponds. A limited amount of silt is to be expected to enter the ponds as no surface water will enter the system. Oil will be separated out of the effluent stream before it reaches the evaporation ponds.

4.3.6.2.2 Evaporation Pond Design

The evaporation pond will be separated into three compartments. Each compartments is sized at 112 m (b) x 200 m (l), giving a total size of 6.7 ha. The three compartments will have an overflow linking each compartment to the other. A 4 m access road will be constructed around each compartment in order to allow access for a small vehicle to move around the compartments. The side slopes of the evaporation pond will be 1 (h) : 2 (l) on the inside slope of the pond and 1 (h) : 3 (l) on the outside slope. The total depth of the evaporation pond is 1.2 m that includes a 300 mm freeboard and a 105 mm allowance for crystalline salt build up. The crystalline salt build for the evaporation pond was calculated at 233 m^3/annum. Over a 30 year life span of the CSP plant this calculates to approximately 105 mm depth in each compartment of the evaporation pond. All three the evaporation pond compartments will be used at the same time, however the pond size was designed that one of the compartments can be shut off for maintenance. This allowance for maintenance was calculated using the highest rainfall month.

4.3.6.2.3 Liner Design

A meeting was held with DWA and the liner requirement recommended by the department is a triple liner system with two drainage layers. The site will be lined with a 2 mm High Density Polyethylene (HDPE) liner as a primary liner and two 1.5 mm HDPE liners that would serve as a secondary and tertiary liner. The three layers of this liner should have a cuspated drainage layer in between that drains toward a leakage detection system. The following figure shows the recommended liner detail.

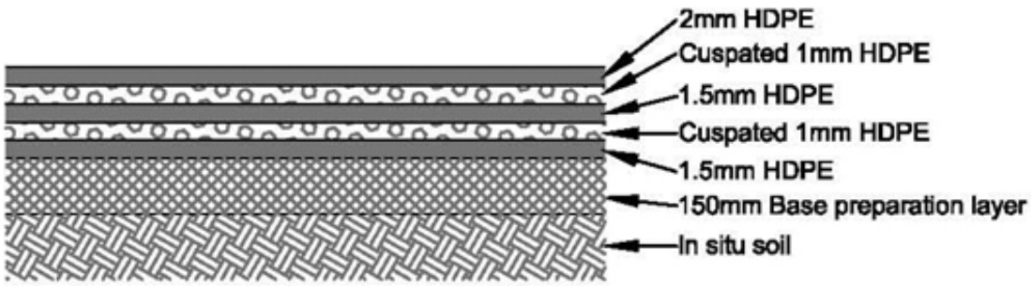

Figure 7: Evaporation Pond Liner Detail

4.3.6.2.4 Evaporation Pond Positioning (Candidate Site Selection)

All care was taken to position the ponds where it could cause the least amount of damage to the environment in the case of a liner failure or unexpected event. From the initial studies it was indicated that the southwest corner of the site was preferable to construct an evaporation pond due to the aquifer vulnerability being the lowest in that area. However six possible pond locations were selected over the entire site in order to ensure that the most suitable could be

selected without disrupting the development of the CSP or PV project options. The first candidate site for the evaporation pond (EPCS1 in Figure 4 of the Basis of Design Report) is the preferred location in terms of a technical perspective as it is the closest to the vertical centre line of the heliostat rings and therefore the closest to the access road. However due to a late change in the layout of the proposed PV plant which encroaches this area it was not considered as an option and the pond indicated as EPCS 2 in Figure 4 of the Basis of Design Report is proposed as the candidate site for the proposed project. A detailed geo-hydrological study was conducted and confirmed the location’s suitability for the establishment of the evaporation pond. From a technical perspective EPCS 2 is close to the vertical centre line of the heliostat rings and close to the access road. The pond to the extreme south of the site as indicated in Figure 4 of the Basis of Design Report is also considered a viable and feasible option but has constraints in terms of its distance from the rest of the CSP infrastructure.

The EPCS 3A pond is not considered feasible as it is located within a more sensitive biodiversity area and a high aquifer vulnerability zone. EPCS 3 encroaches the 100 m buffer zone for verified wetlands and is not considered a feasible option. EPCS 1A is in conflict with the proposed layout of the planned PV project and is not considered as a viable option.

4.3.7 Surface Hydrology Impact Assessment

4.3.7.1 Impact Description and Assessment

For the purposes of this report the anticipated environmental impacts on the hydrology of the site was assessed in detail. The impact assessment was not conducted in terms of the different project phases but rather from a holistic overall project point of view that encompasses all project phases. In terms of the specialist Hydrology Impact Assessment (contained in Appendix I) there are three types of anticipated environmental impacts that were assessed.

4.3.7.1.1 Regional hydrology (related to water supplies to mines, urban areas and domestic and livestock users)

Water for the construction and operation of the proposed project will be sourced from the Vaal-Gamagara Pipeline which could have an impact on the regional hydrology and other users dependant on the Vaal-Gamagara Pipeline seeing that the pipeline has a regional footprint over a large area. Table 12 below outlines the assessment of the impact of the proposed project on the Vaal-Gamagara Water Supply Scheme prior to the implementation of any mitigation measures. It is assessed as having a **Negative-Medium** significance rating.

Table 12: Impact rating table on the the Vaal-Gamagara Water Supply Scheme

Category and Scale	**Rating and Description**	**Description and Justification**	**Quantitative Rating**
Status of Impacts	**Neutral**: No cost to the receiving environment	Water is abstracted from the system (Vaal-Gamagara pipeline) and consumed by the	**N**

		CSP.	
Spatial scale of impacts	**Medium and High:** Local and regional	The impact extends beyond the site boundary. Water demand by the proposed operation requires local and/or regional groundwater abstraction, as well as abstractions from the Vaal-Gamagara pipeline, which supplies water at a regional scale - the pipeline extends for 197 kms, supplies water to urban and mining operations and is of great economic importance. The pipeline requires pumping and storage capabilities. The CSP will compete for water on a commercial and first-come first serve basis (i.e. the CSP will not be able to commandeer water already allocated).	**3**
Temporal scale of impacts	**High to Very High**: Long-term: Water demands will operate for the lifespan of the project (16-30 years and longer).	The requirement for water for cooling and cleaning will last for as long as the CSP can usefully generate electricity. There is potential for the project to last >40 years, so the quantitative assessment could produce an impact lasting more than 30 years and/ or result in a permanent and lasting change that will remain in place.	**4**
Probability of Impact	**Highly probable**: Likelihood of occurrence equal to or greater than 90%	Water is critical to operation of the CSP.	**4**
Severity of Impact	**Average:**	Medium to short term impacts on other Vaal-Gamagara pipeline users and managers.	**2**

		Water is supplied by Sedibeng Water through the Vaal-Gamagara pipeline on a commercial and availability basis.	
Significance of Impacts	**Negative, Medium**	The impact is real, in that water will be supplied from the Vaal-Gamagara pipeline that could be supplied to other users. The impact is not substantial in relation to other impacts such as alternative competing uses of the same water. Social, cultural and economic activities of communities are not affected, Sedibeng Water will not switch supplies at the expense of existing users to new users..	**6**

4.3.7.1.2 Soil infiltration and surface flow conditions on site

Local soil disturbance has the potential to reduce infiltration capacity. The surface of the proposed CSP site is notable for its lack of surface flow features such as channels, implying a high infiltration capacity of the soils. Even very heavy recent rainfalls (January 23, 2011) failed to produce observed surface runoff. The use of heavy machinery for construction of the heliostats will cause soil compaction and result in loss of infiltration capacity. This is likely to generate excess surface water through sheet flow during intense storms. Initial modelling (using SCS procedures) indicates that sheet flow of up to 13 times greater than could be generated from the same design storm in its current condition.

The effects of this increased surface flow would firstly be the significant erosion of soils on site, which would be deposited down slope where-ever water dispersion takes place or drainage flow velocities decrease. The second effect is that the increased surface flow will flow down-slope towards the R385 road. Where this road is located on the NW boundary of the intended CSP site, there is a slight dip in the road but no provision has been made by the road owners to convey water under the road through culverts. It is possible that excess surface flow generated on the CSP site will endanger the structure and integrity of the R385 at this location, either through sediment deposition or through erosion and a breach of the road, or both. This impact (of the CSP on surface flow over the site) is assessed in Table 13 below and are assessed as having a **Negative-Medium** significance rating.

Table 13: Impact rating table on local runoff and the potential for erosion

Category and Scale	Rating and Description	Description and Justification	Quantitative Rating
Status of Impacts	**Negative**: a cost to the receiving environment	Erosion potential over the footprint of the CSP and field of heliostats is increased by hardening with the mirror field and service roads – to each heliostat. Hardening occurs to about 25% of the total ground surface – altering runoff characteristics and increasing opportunities for generating overland flow, which will increase erosivity of moving surface water.	**-**
Spatial scale of impacts	**Medium**: Local impacts, extending beyond the site boundary and a few hundred meters downslope of the CSP.	Extra surface water generated by heavy rainfall flows downslope. Preferential flow lines may occur (channels are created through erosion) and downslope infrastructure (the R385 road) may be affected through generating surface flow and failure of any drainage systems to cope with the size of flows, resulting in damage to the road. The development of channels means loss of productive land.	**2**
Temporal scale of impacts	**Very high**: Permanent changes to infiltration capacity on the CSP site could be expected.	Roads, infrastructure and changes to the physical characteristics of the soil on site will last longer than the presence of an operating CSP. In the event of the dismantling of the CSP, it is unlikely that the infiltration condition of the site could be returned to conditions existing prior to construction.	**4**

Probability of Impact	**Highly probable**: The impact is expected to occur, with a chance of occurrence of 50-90%.	The heliostat surfaces and the service roads linking to every heliostat mean substantial alteration of the characteristics of the soil surface. A road must go to every one of the 17,350 heliostats, as well as the central power tower site and any other related facilities.	**3**
Severity of Impact	**Severe**: Medium to long term impacts but which can be mitigated.	Planning for, and construction of, suitable storm drainage and dissipation infrastructure that protects the site and the road R385.	**2**
Significance of Impacts	**Medium:** Impacts are feasible and possible.	Planning for accommodating and dispersing storm flow off site is required	**-7**

4.3.7.1.3 Possible interference in local hydrological functioning

The construction and operation of the CSP may have an effect and disrupt local hydrological functioning. For example, it may interfere with the natural flow and storage of water in local channels and wetlands (on-site and off-site but nearby), to the detriment of their natural functioning.

These possible impacts are assessed as having a **Negative-Low** significance as evaluated in Table 14 below.

Table 14: Impact rating table on local hydrological functioning

Category and Scale	**Rating and Description**	**Description and Justification**	**Quantitative Rating**
Status of Impacts	**Neutral**: No cost or benefit to the receiving environment	The project is not expected to have an impact on local hydrological functioning concerning surface water flows and storages	**N**
Spatial scale of	**Medium**: Local impacts, extending beyond the site	Any temporary impact on surface water flows would be	

impacts	boundary and a few hundred meters downslope of the CSP.	expected to have an impact on site and to areas adjacent and down-slope to the project site. Construction in waterways and wetlands is not envisaged.	**2**
Temporal scale of impacts	**Low**: Short term; Quickly reversible in 0 – 5 years	Impacts on local hydrological functioning, if any, could be remediated by operators of the CSP	**1**
Probability of Impact	**Improbable**: The possibility of the impact materializing is negligible; Chances of occurrence 10-49%	Construction within areas of noted hydrological activity (channels, wetlands) is not envisaged. Water additions to the environment from the CSP during construction and operation will be negligible, if at all (evaporating pans will dispose of waste water from the CSP).	**2**
Severity of Impact	**Neglible/minor**: The system (environment) and parties (local water users) are marginally affected by the proposed development.	The project is not expected to have an impact on local hydrological functioning concerning surface water flows and storages	**1**
Significance of Impacts	**Negative-Low:** Any impact is of low order and therefore likely to have little real effect. In case of adverse impacts, mitigation is easily achieved. Social, cultural and economic activities continue unchanged.	Any effect (which is unlikely) on local hydrological functioning will have little if any effect of significance on social, cultural and economic activities, or on environmental conditions.	**-7**

4.3.7.2 Proposed Mitigation

Water Use

Mitigation measures for ensuring efficient use of water include alternative designs for reducing consumption of water. These have already been considered in terms of the cooling processes adopted for CSP operation. It is unlikely that there is scope for reducing water use by the CSP for operational reasons any further than has been specified to date in the conceptual design. The remaining effort then is to optimize the cooling operations with the mixes of wet and dry cooling that maximizes cooling with the minimal use of water.

Soil Compaction and Overland Flow

The likelihood that a loss of infiltration capacity on site generates excess surface flow requires that mitigation measures be put in place during construction and operation of the CSP. During construction, vehicular traffic on the construction site should be kept to well-defined roads or delimited zones as far as possible. Proper road drainage procedures need to be put in place and maintained to convey any surface water off the roads and into undisturbed areas. The owner of the R385 road should be approached about the possibility of installing a culvert under the road at the point of minimum elevation along the NW boundary of the CSP site to protect the road. During the operational phase of the CSP, vehicular traffic through the field of heliostats should be kept to a minimum, on well-defined and a minimal number of roads. Abandoned construction roads should be deep-ripped where possible to restore infiltration through the soil profile and a short vegetation cover re-established over the entire site.

Permanent or temporary re-alignments of water courses, wetlands or other water bodies

Permanent or temporary re-alignments of water courses are not envisaged by the current design of the CSP.

Location of sources, intakes and associate infrastructure

The off-take from the Vaal-Gamagara pipeline is likely to take place at its nearest point to the CSP, which is on the boundary of Humansrus 469 on its western side, just downstream of the livestock watering dam (See Figure 2). Installed here, the pipeline will be required to cross the channel below the dam wall. The section on Best Practices for Crossing Water Courses below then applies.

Best Practices for Crossing Water Courses

The ephemeral channel on the south-west side of the property needs to be crossed by the off-take from the Vaal-Gamagara water pipeline. There are two conditions of concern regarding the nature of traverse, namely the flood threat to the pipeline and the possibility of the physical presence of the pipeline causing opportunities for erosion to take place during flash floods. The pipeline should be buried and cross the channel below ground level at a depth of about 3 m or more. Closer to the surface, to a depth of 1.5 m or more, a gabion or wire-basket structure containing rocks of 30 cm diameter or more should be inserted into the trench to prevent turbulence removing material from the disturbed zone during peak flows. Similarly, the upslope

portions of the pipe trench needs protection from washouts and erosion after heavy rainfalls. The CSP operators should inspect the pipeline route after heavy rainfalls and any incipient erosion features must be corrected immediately. As noted earlier, soils in the main channel area are prone to erosion.

4.3.7.3 Residual Impacts

The significance of the assessed impacts prior to mitigation is such that it would not prevent the project to proceed. With the implementation of the proposed mitigation measures the three impact types are mitigated even further below the pre-mitigation significance levels. These significance ratings were not quantified during the specialist impact assessment but are indicated to have a positive effect on possible impacts.

4.3.8 Wetland Impact Assessment

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

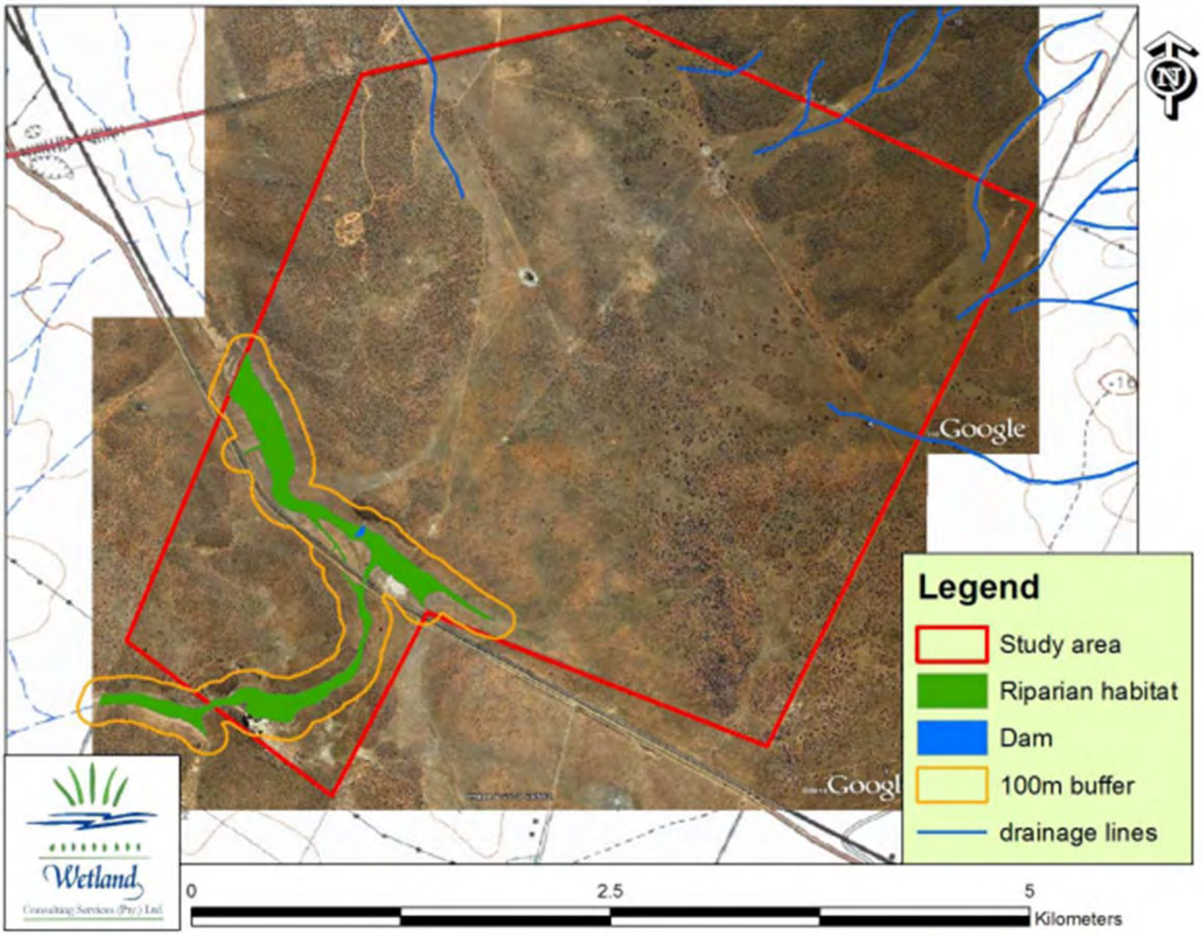

Figure 8: Map of the delineated riparian habitat with a 100m buffer zone as per the GDARD guidelines.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

It is recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development. A map indicating the delineated riparian habitat with a 100m buffer zone is illustrated in Figure 8.

A map showing the proposed infrastructure developments in relation to the site and the delineated riparian habitat is provided in

Figure 9. A 100m buffer zone has also been delineated around the riparian habitat.

From the image it is clear that none of the proposed infrastructure will intrude into the riparian habitat associated with the Groenwater Spruit. Of the three evaporation pond alternatives indicated in the map below, only alternatives 2 and 3 infringe somewhat on the 100m buffer zone but still fall well outside of the riparian habitat.

As no infrastructure will be located within the delineated riparian habitat and associated water course and no construction activities will take place within these areas, no direct impacts to the riparian habitat are expected. Several indirect impacts due to the developments on site are however expected. Expected impacts are related mostly to increased sedimentation due to the earthworks that will be required on site, increased flow within the water course due to the import of large volumes of water, and the deterioration of water quality from leaks and spills of hazardous substances or dirty water.

All of the expected impacts have been grouped into the stage of the project in which they are expected to occur, though some of the impacts are likely to occur across several stages.

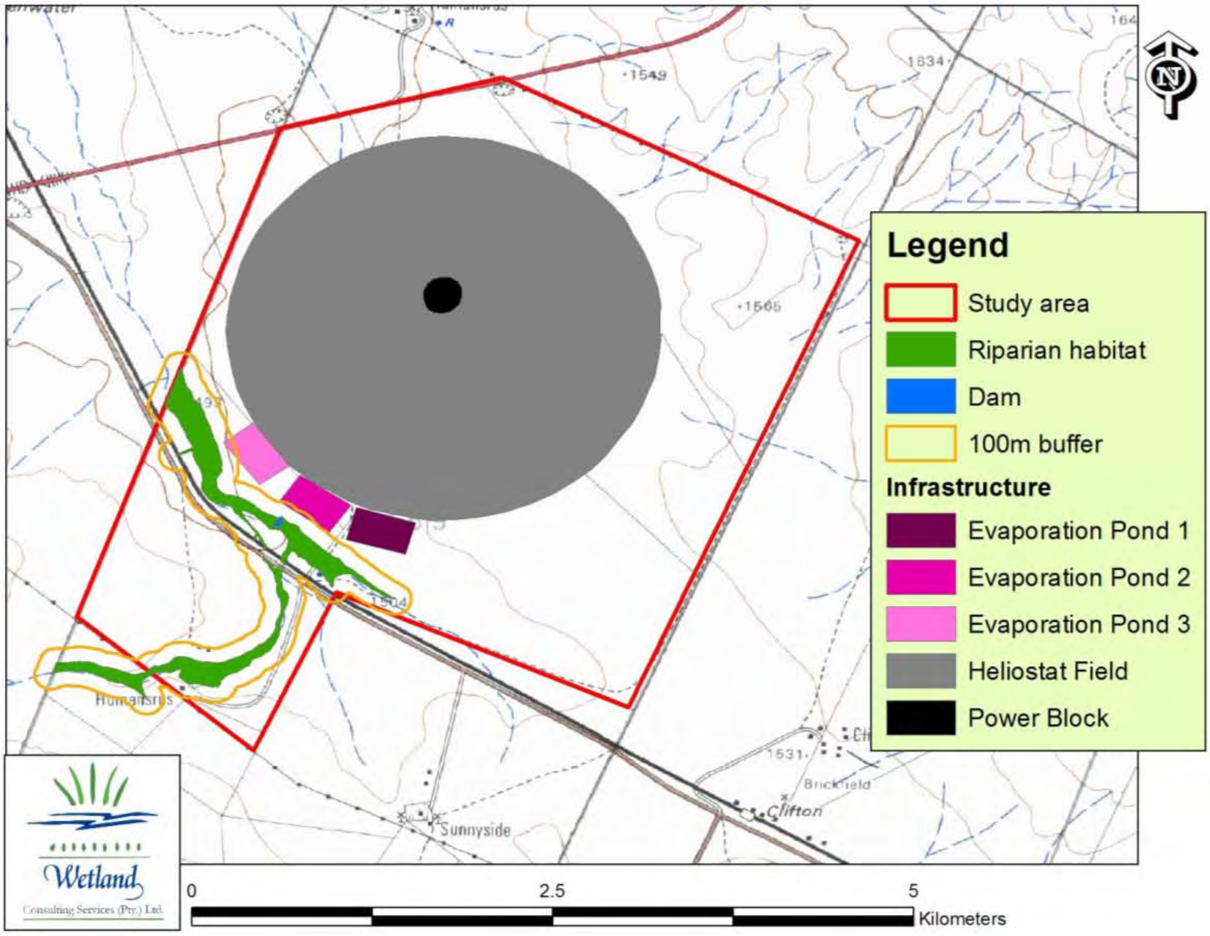

Figure 9: Map showing the proposed infrastructure in relation to the delineated riparian habitat on site

4.3.8.1 Construction Phase

4.3.8.1.1 Increased Sedimentation

During the construction phase it is expected that most of the 600ha footprint of the proposed CSP Plant will be cleared of vegetation and extensive earthworks will take place on site. These activities will expose the disturbed, bare soil to erosion by wind and water. As the construction phase is expected to run over 30 months, this will include at least 2 rainfall seasons. High intensity rainfall events which result in surface runoff could result in significant volumes of sediment being transported off the construction site and into downslope water courses. However, most of the proposed developments (i.e. the entire heliostat field) fall outside the direct catchment of the riparian habitat delineated on site. Though the heliostat field does fall within the Groenwater Spruit catchment, the distance between the heliostat field and the channel of the Groenwater Spruit is such that little sediment is likely to be washed into the Spruit, as most of the sediment would be expected to be trapped and deposited within the grassland downslope of the construction site. Only the proposed evaporation pond falls within the direct catchment of the riparian habitat delineated on site.

This impact is expected to be of **Low significance**.

Table 15: Increased Sedimentation Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	-5

4.3.8.1.2 Water quality deterioration

Numerous hazardous substances will be used and stored on site during the construction phase of the project. These substances will include: diesel, oil, cement, salt mixture for the CSP Plant etc. Spillages or leaks of these substances could enter downslope water courses via surface run-off during high intensity storm events, leading to water quality deterioration within the receiving water courses and making the water less fit for use by downstream water users as well as being deleterious to aquatic biodiversity. Communication with the local farmers indicated the presence of a spring within the Groenwater Spruit further downstream of the site which plays an important role in providing drinking water to livestock as it seldom, if ever, dries up. Water quality deterioration could thus have significant consequences to downstream water users. The distance between the construction site and the Groenwater Spruit will however again ensure that pollutants do not directly enter the water course.

This impact is expected to be of **Medium significance**.

Table 16: Increased Sedimentation Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	Local	2	Medium	3	Probable	2	Average	2	Medium	-9

4.3.8.1.3 Increased Flows within the Watercourse

Significant volumes of water will be imported to the study area during the construction of the CSP Plant – approximately 117 500m^3 during the 30 month construction period. This water will be used mostly for dust suppression, heliostat cleaning and compaction purposes, as well as other uses. Large volumes of the water are thus likely to infiltrate into the sandy soil of the area. This could lead to increased surface run-off during rainfall events as the soil becomes saturated more easily, as well as increased seepage of water through the deeper soil profile, water which might be discharged into the Groenwater Spruit further downstream. Increased flows within the Groenwater Spruit could be considered a positive impact by downstream farmers who might have more water available for livestock watering, though increased flows will also lead to changes in the biodiversity supported by the Groenwater Spruit and should thus be seen as a negative impact. The dry climate of the area and high evaporation rates of the area will limit the

significance of this impact considerably, as much of the imported water used on site will probably be lost to evaporation before it enters the Groenwater Spruit.

This impact is expected to be of **Medium significance**.

Table 17: Increased Flows within the Watercourse Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	Local	2	Low	2	Probable	2	Average	2	Medium	-8

4.3.8.2 Operational Phase

4.3.8.2.1 Water quality deterioration

A number of activities will pose a potential water quality hazard during the operational phase:

- The molten salt circuit
- Diesel storage on site (38 000 litres)
- Water treatment facilities, specifically the discharge of treated or untreated water
- The evaporation pond

The molten salt circuit is a closed system and no discharge of any salt from the system will take place. Both the heated salt and the cool sat tanks will be located within a bunded area that will have a total capacity of 110% the volume of the tank contents, i.e. the bunded area will be of sufficient capacity to contain the entire molten salt used in the plant should the system fail. The molten salt system should thus not pose a significant threat to water quality in the Groenwater Spruit.

It is understood that no water will be discharged from the facilities on site. All dirty water will be routed to the respective wastewater treatment plants, and all treated water will be either re-used or discharged to the evaporation dams.

The evaporation dams will contain dirty water and waste from the water treatment plants and are likely to be highly saline. Leakage or overflow from these dams will flow down the slope and into the Groenwater Spruit, resulting in water quality deterioration, specifically increased salinity, though other pollutants are also likely to occur.

This impact is expected to be of **Medium significance**.

Table 18: Increased Flows within the Watercourse Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	High	3	Medium	2	Probable	2	Severe	3	Medium	-10

4.3.8.2.2 Increased Flow

Significant volumes of water will be used during the operational phase of the project – up to 44.5m^3/hr during peak consumption. Importing such volumes of water into an area characterised by a dry climate such as is found on site could have significant consequences if released into the environment. However, it has been indicated that no water will be discharged from site other than clean storm water captured in the attenuation facility. All water will be treated and re-used as far as possible, with waste water being discharged into the evaporation dam.

This impact is expected to be of **Low significance**.

Table 19: Increased Flows within the Watercourse Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	None	0	Low	2	Improbable	1	Minor	1	Low	-2

4.3.8.2.3 Storm Water Discharge

Clean storm water generated on site will be captured in an attenuation facility and discharged into the environment. The location or size of the attenuation facility is not known, nor the location or design of the discharge point. The discharge of storm water is however likely to occur as a point source discharge and be of higher velocity and concentration that pre-development flows and thus poses a significant erosion risk at the point of discharge.

This impact is expected to be of **Medium** significance.

Table 20: Increased Flows within the Watercourse Impact Rating

Description		**Spatial scale**		**Temporal scale**		**Probability**		**Severity**		**Significance**	
Negative	-	Medium	2	High	3	Highly Probable	3	Average	2	Medium	-10

4.3.8.3 Proposed Mitigation

4.3.8.3.1 Construction Phase: Increased Sedimentation

The following mitigation measures should be implemented:

- Major vegetation clearing activities and earthworks should be undertaken during the dry season as far as practically possible.
- The footprint of vegetation clearing should be limited to the direct footprint of the proposed developments. The construction servitude should be fenced off prior to the commencement of construction activities and all construction activities should be limited to this servitude.
- Access roads and construction roads should include regular low levels humps to slow down stormwater flow and direct stormwater off the road surfaces and into adjacent grassland at regular intervals to minimise erosive energy of stormwater runoff.
- Stormwater infrastructure should include sediment traps.

4.3.8.3.2 Construction Phase: Water Quality Deterioration

The following mitigation measures should be implemented:

- All potentially polluting and hazardous substances used and stored on site should be stored in clearly demarcated areas.
- Storage areas for diesel, oil and other polluting substances must have adequate spillage containment measures to contain any spills within the direct area of the spill. Ideally, all potentially polluting substances should be stored in bunded areas of sufficient capacity to contain the full volume plus 10% of the storage containers.
- All re-fuelling areas and workshops should make use of drip trays to capture fuel and oil spills during re-fuelling or during vehicle maintenance and repairs.
- Storm water should be diverted around the storage areas of polluting substances to prevent contamination of clean storm water.
- Sufficient quantities of spill clean-up materials (e.g. Drizit or Spillsorb) should always be available on site. Once used, absorbent material and contaminated soil should be disposed of at a registered hazardous waste disposal site.
- The following guidelines apply to the use of polluting substances on site, and specifically to the use of cement and concrete:
- Carefully control all on-site operations that involve the use of cement and concrete.
- Limit cement and concrete mixing to single sites where possible.
- Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
- Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

4.3.8.3.3 Construction Phase: Increased Flows within a Watercourse

Water usage on site should be minimised and re-use of water should be maximised. No discharge of dirty water should be allowed.

4.3.8.3.4 Operational Phase: Water Quality Deterioration

The diesel storage tanks on site should be housed in a designated area that will allow for easy containment and clean-up of any spills that could occur on site, ideally in a bunded area. Drip trays should be used at all refuelling sites to capture small spills during refuelling. Emergency spill procedures must be clearly defined and all staff should be familiar with these procedures. Sufficient quantities of absorbent material should be easily available on site for containment of small spills.

Of the three proposed evaporation pond sites (see Figure 9 above), alternative 1 is the preferred alternative from a surface water resources perspective as it is located furthest away from the Groenwater Spruit. The evaporation dam should be lined with a suitable plastic liner (or series of liners) to ensure no seepage or leakage of water out of the dam occurs. The dam should be of sufficient capacity to ensure that no overflow of the dam will occur up to and including the 1:100 year storm event. The dam should be regularly inspected and cleaned to ensure that capacity is not decreased due to sedimentation. All sediments/brine cleaned from the dam should be disposed of in a registered hazardous waste facility.

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

4.3.8.3.5 Operational Phase: Increased Flow

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

4.3.8.3.6 Operational Phase: Storm Water Discharge

To ensure effective functioning of the storm water system, the attenuation facility should be designed to successfully attenuate all regular return rainfall events, up to at least the 1:25 year event. Silt traps should be incorporated into the storm water system upstream of the attenuation facility to prevent sedimentation of the attenuation dam. Silt traps should be regularly cleaned.

Discharge from the attenuation facility should take place via an erosion protected discharge point and should incorporate energy dissipaters to ensure low velocity discharge with low erosive energy. Storm water should not be discharged directly into the Groenwater Spruit.

Clean and dirty storm water should at all times be kept separate. No dirty storm water may be discharged.

4.3.8.4 Residual Impact

The significance rating of the assessed impacts prior to mitigation is of medium to low significance. With the implementation of the proposed mitigation measures the construction and operational phase impacts will be mitigated further to below the pre-mitigation significance levels. These post-mitigation significance ratings were not calculated during the specialist impact assessment but are indicated to have a positive effect on possible impacts and subsequently reduce the impact ratings.

4.3.9 Socio-Economic Impact Assessment

For the purpose of this study the specialist Socio-economic assessment was to determine the potential positive and negative effects of the proposed CSP plant on the local and regional economies. The impacts of the project on the following socio-economic indicators were assessed accordingly for both the construction and operational phases:

- Production/ business sales
- Gross Domestic Product per Region (GDP-R)
- Employment
- Government revenue
- Household income
- Housing provision and basic services.

The construction phase impacts were calculated for a construction period of 30 months and the operational phase impacts for the duration of 30 years.

From the impact assessment it was determined that only one indicator in each of the construction and operational phases of the proposed project had a negative impact prior to the implementation of the mitigation measures. Table 21 below indicates in summary the impact ratings of the proposed project on the socio-economic environment.

Table 21: Summary of economic impacts evaluation

Impact	**Status**	**Spatial scale**	**Temporal scale**	**Probability**	**Severity**	**Total Score**	**Significance**
Construction Phase Impact – 2.5 years							
Temporary increase country's production	Positive	4	1	3	3	11	Medium
Temporary increase in country's	Positive	4	1	3	3	11	Medium

Impact	Status	Spatial scale	Temporal scale	Probability	Severity	Total Score	Significance
GDP-R							
Temporary increase in employment	Positive	3	1	3	2	9	Medium
Increase in household income	Positive	4	1	3	1	9	Medium
Increase in government revenue	Positive	3	1	3	2	9	Medium
Housing provision and basic services pressure	Negative	3	1	4	2	10	Medium
Operational Phase Impact – 30 years							
Temporary increase country's production	Positive	4	3	3	3	13	High
Temporary increase in country's GDP-R	Positive	4	3	3	4	14	High
Temporary increase in employment	Positive	4	3	3	3	13	High
Increase in household income	Positive	4	3	3	3	13	High
Increase in government revenue	Positive	3	3	3	3	12	High
Housing provision and basic services	Negative	3	1	4	2	10	Medium

Impact	Status	Spatial scale	Temporal scale	Probability	Severity	Total Score	Significance
pressure							

The proposed project has negative and positive socio-economic effects with which it is associated. Although negative effects do exist and should be mitigated as far possible, the positive economic impacts of the project far outweigh any negative impacts brought about by the project. All the net economic impacts during construction and operational phases are positive in nature. The potential negative impacts of the project are as follow:

- A third of capital expenditure (R1.9 billion in 2011 prices) will be spent on procurement of imported goods and services, which represents a leakage from the country and which would have a negative effect on the trade balance and lead to an increase in the current account deficit. Although an increase in the current account deficit would not be critical for the country, its continuous growth could significantly weaken the national currency, increase debt servicing costs, and result in lower foreign direct investment, which in turn means lower economic growth.
- Secondly, some cattle farming needs to be discontinued due to the loss of grazing land upon which the plant will be built. The estimated direct loss in revenue is R0.13 million per annum, whilst the total loss to the economy is valued at R 0.21 million per annum in 2011 prices. No loss in direct employment though will be associated with this.
- Thirdly, increase in economic activity in the area would stimulate the demand for housing and basic service provision in the local municipality. This in turn would put pressure on the local government to deliver and on the developer to look for possible alternatives for accommodation of workers during both construction and operation.

4.3.9.1 Mitigation Measures

Despite the relatively short duration of construction of the project, the impact on the economy is substantial during this phase. The assessment shows that during the establishment phase, the project will stimulate production by R11 512 million in 2011 prices, which translated into R4 001 million of GDP and creation of 7 275 temporary employment opportunities. During the operations phase, the proposed project will further stimulate production to the value of R1 519.1 million per annum which will create 849 sustainable jobs and generate R917. 0 million in value added. Furthermore, the increase in government revenue and household income during both phases of the project is of extreme importance and will assist households in improving their quality of life, whilst government can attend to key objectives with the increased revenue. Analysis of the positive effect of the proposed CSP plant relative to the negative impact discussed previously, shows that the loss in revenue and economic impact is insignificant.

4.3.9.1.1 Construction Phase

Despite the overall positive impact of the project the mitigation measures proposed for the negative impact on providing houses and putting pressure on municipal services associated with the construction phase is as follow:

- Considering the temporal status of the impact, it is advisable that a temporary camp is set up to accommodate construction workers. The location of such a camp should be guided by the availability of basis services in the area.

4.3.9.1.2 Operational Phase

Although the impact of providing houses and putting pressure on municipal services is outweighed by the overall positive impact of the project, the following mitigation measure is proposed to reduce this impact.

- Given the situation with housing in the local area, consideration should be given to the provision of housing to the workers. Information regarding the project and the potential requirements with respect to water and electricity will also need to be provided to the local municipality and other authorities to allow for adequate planning and timely provision of services.

4.3.10 Air Quality Impact Assessment

The Air Quality Impact Assessment was conducted, although not identified as one of the aspects that would have a significant impact on the environment, to confirm whether any potential impacts might arise from the construction, operation and decommissioning of the proposed plant. Due to the minor nature of the assessed impacts no quantification of the pre- and post-mitigation impacts were conducted but the proposed mitigation measures will be introduced in the EMP to alleviate the impacts further.

4.3.10.1 Construction Phase Impact Assessment

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access roads, and the plant area. These predicted impacts cannot be quantified, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities. Instead a qualitative description of the impacts will be provided. This will involve the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

Product Transport

- Scraping;
- Debris handling;
- Debris stockpiles; and
- Truck transport and dumping of debris.

Power Plant

- Clearing of area for infrastructure;
- Debris handling;
- Debris stockpiles; and
- Truck transport and dumping of debris.

The following components of the environment may be impacted upon during the construction phase:

- ambient air quality;
- local residents and neighbouring communities;
- employees;
- the aesthetic environment; and
- possibly fauna and flora

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

Sensitive receptors were identified in Section 3.4. of the Air Quality Impact Assessment contained in Appendix L Given the short duration and low level of activity expected during construction, but bearing in mind that no quantitative emission figures exist, no long adverse impacts are anticipated on these receptors. Impact of fugitive dust emissions on employees on site could however be significant during the construction phase, but will vary between phases, with level of activity and meteorological conditions.

4.3.10.2 Operational Phase Impact Assessment

The anticipated impacts identified by the specialist assessment included the impacts created during start-up and those during operations. The start-up is expected to last between 50 and 70 days depending on weather and salt conditions. During this time natural gas and diesel fuel will be used to heat and melt the salt and begin pumping the salt through the system until the plant has reached its operational temperatures and pressures. During this time the emissions from the fuels will result in an increased pollution load within the atmosphere.

Once start-up is complete no fuels are required to ensure the ongoing operations of the CSP plant, therefore all emissions as identified above will no longer be produced and the plant should continue to run on solar power from then on. Should be plant be shut down in its entirety then emissions as described above will resume during startup.

4.3.10.3 Decommissioning Phase Impact Assessment

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (USEPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and tailings impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.3.10.4 Mitigation Measures

The following mitigation measures are proposed to attenuate the expected air quality impacts:

4.3.10.4.1 Construction Phase

Due to the lack of quantitative dust emissions data for the site, it is recommended that the precautionary principle be followed and dust control measures be implemented. Recommendations for the control of fugitive dust emissions are given in Table 22 below. Wet suppression with water is the least expensive of the possible control measures but is temporary in nature.

Table 22: Recommendations for the Control of Fugitive Dust Emissions During the Construction Phase (USEPA, 1996).

Emission Source	**Recommended Control Methods**
Debris handling and debris piles	Wind speed reduction
	Wet suppression[1]
Truck transport[2]	Wet suppression
	Paving
	Chemical stabilisation [3]
Bulldozers	Wet suppression
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression
	Paving
	Chemical stabilisation
General construction	Wind speed reduction
	Wet suppression
	Early paving of permanent roads

[1] Dust control plans should contain precautions against watering programs that confound trackout problems.

[2] Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.

[3] Chemical stabilisation is usually cost-effective for relatively long-term or semi-permanent unpaved roads.

Water may be combined with a surfactant as wetting agent. Surfactants increase the surface tension of water, reducing the quantity of water required. Chemical stabilisation is of longer duration but is not cost effective for small-scale operations. Dust-A-Side (DAS) represents an example of a chemical product, which is commercially available and widely used by mines and quarries. The DAS product binds with the aggregate used to build on-site roads. It should be noted however, that the treatment with chemical stabilisers can have adverse effects on plant and animal life and can contaminate the treated material (USEPA, 1996).

Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. Facilities for the washing of vehicles could be provided at the entry and exit points. A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas or near stockpiles. Traffic over exposed areas should be kept to a minimum (USEPA, 1996).

All stockpiles should be maintained for as short a time as possible and should be enclosed by wind breaking enclosures of similar height to the stockpile. Stockpiles should be situated away from the site boundary, water courses and nearby receptors and should take into account the predominant wind direction. During the transfer of material to piles, drop heights should be minimised to control the dispersion of materials being transferred (USEPA, 1996).

Additional preventative techniques include the reduction of the dust source extent and adjusting work processes to reduce the amount of dust generation (USEPA, 1996).

Operational Phase

It is recommended that vegetation levels below the heliostats is maintained to ensure no exposed surfaces are present for the liberation of dust from within and surrounding the site. Larger trees should also be planted surrounding the site to act as wind breaks and reduce the wind speeds within the plant area.

Decommissioning Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fastgrowing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

Post-Closure Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fastgrowing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

The Air Quality Impact Assessment provides a graphic illustration as to the movement of pollutants through the atmosphere once generated and in the natural environment. Based on the predicted emissions expected from the CSP plant, the plant is not expected to exceed the

National Standards for South Africa, and due to the relatively short duration of the plant start-up no long term air quality concerns are expected.

4.3.11 Noise Impact Assessment

Confirmation was gained from the Noise Impact Assessment of the insignificance of the anticipated noise impacts of the proposed plant. A summary of the findings are contained below.

4.3.11.1 Construction Phase Impacts

The nature of the noise impact from the construction sites is likely to be as follows:

- Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.
- Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme for the various components, work modus operandi and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1380 metres of the construction site. Night-time construction could have a significant impact on noise sensitive sites within a radius of 3000 metres of the construction site.
- Slightly higher ambient noise levels than those normally considered as reasonable are acceptable during the construction period provided that the very noisy construction activities are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site.
- For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise.

There is the potential for minor impact (noise nuisance) at a few sites in the immediate vicinity of the construction site.

4.3.11.2 Operational Phase Impacts

The main noise sources at the CSP Plant will be the steam generating unit, the turbines, the cooling fans, and the pumps. The noise from the cooling fans will be the loudest and will predominate at areas outside the CSP Plant property.

For daytime operations, noise sensitive sites (in a rural setting) within 2150 metres from the Plant could be significantly impacted by the noise from the Plant. Only one NSR is affected, namely the residence on Farm Humansrus to the north of the development site (refer to the 45dBA noise contour in Figure 4).

For night-time operations (standby) noise sensitive sites within 2450 metres of the Plant will be impacted. Only one NSR is affected, namely die residence on Farm Humansrus to the north of the development site.

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point. The sparse vegetation in the area will not assist the attenuation with distance.

With regard to the washing of the heliostats, there will be an intermittent noise generating operation undertaken at night. A truck mounted high pressure washing system will be used. While the trucks are spraying the heliostats, maximum noise levels are not expected to exceed 35dBA at 1000 metres.

For a typical water purification or waste water treatment installation, the ambient noise level could be of the order of 40dBA at 300 metres offset.

The noise profile of a typical Eskom substation (to be built to the south of the CSP Plant) is as given in Table C3 in Appendix C of the Noise Impact Assessment Contained in Appendix M of this report. There are two farmhouses in the vicinity of the Eskom substation site, but noise levels generated should not impact significantly on these residences. It should, however be noted that transformers typically emit a predominant pure tone of 100Hz, which, although not loud in volume, has the potential to induce vibrations in nearby structures, such as the farmhouses.

The total volume of traffic generated by the CSP Plant will be very small in comparison to the total volume of traffic on the adjacent main roads. It is estimated that there could be of the order of 60 vehicle trips (two-way) per day generated by the CSP Plant. These volumes are far too small to cause any significant noise impact.

There are no other sources of noise in the study area with which the CSP will have significant cumulative effects.

4.3.11.2.1 Impact Significance Rating

Table 23: Noise Impact Significance Rating Table

Criteria	Rating	Quantitative Rating
Status of impacts	Negative	-
Spatial scale of impacts	Medium: Local	2
Temporal scale of impacts	High: Lifespan of project	3
Probability of impacts	Highly probable	3
Severity of impacts	Average to severe: Long term	2.5
Significance of impacts	Medium	10.5

4.3.11.3 Mitigation Measures

4.3.11.3.1 Pre-construction Phase

Local residents should be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities should be undertaken at reasonable times of the day. These works should not take place at night or on weekends.

During this phase, consideration must be given to the noise mitigation measures required during the construction phase and which should be included in the tender document specifications and the design.

4.3.11.3.2 Construction Phase

The noise mitigation measures to be considered during the construction phase are as follows:

- Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas.
- Use of low-noise generation construction machinery. Noise control measures on construction machinery must, however, be agreed with the manufacturer.
- Where possible, stationary noisy equipment (for example compressors, pumps, pneumatic breakers,) should be encapsulated in acoustic covers, screens or sheds. Proper sound insulation can reduce noise by up to 20dBA. Portable acoustic shields should be used in the case where noisy equipment is not stationary (for example drills, angle grinders, chipping hammers, poker vibrators).
- Curtailing the uses of reverse-warning signals on site vehicles in certain areas and at certain times. Consideration of alternative safety measures may be necessary when taking such a measure.
- All construction vehicles, plant and equipment are to be kept in good repair, for example, cover sheets should not vibrate or rattle; wheels, rollers and pulleys should not squeak.
- Truck traffic should be routed away from noise sensitive areas, where possible.
- Noisy operations should be combined so that they occur where possible at the same time.
- Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use radiotelephony rather than shouting for communication.
- Blasting operations (if required) are to be strictly controlled with regard to the size of explosive charge in order to minimise noise and air blast, and timings of explosions. The number of blasts per day should be limited, blasting should be undertaken at the same times each day and no blasting should be allowed at night.
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- Construction activities are to be contained to reasonable hours during the day and early evening. Night-time activities near noise sensitive areas should not be allowed. Limited

construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning pending proper consultation and permission from surrounding residents..

- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and owners on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.
- As construction workers operate in a very noisy environment, it must be ensured that their working conditions comply with the requirements of the Occupational Health and Safety Act (Act No 85 of 1993). Where necessary ear protection gear should be worn.

4.3.11.3.3 Operational Phase

The following noise mitigation measures, which will need to be considered where appropriate, are indicators of what needs to be done to reduce or control the noise generated by the operations at the CSP Plant:

- The design of all major plant for the plant is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous day/night rating level (LRdn), namely a noise level of 70dBA (just inside the property projection plane, namely the property boundary of the CSP Plant) as specified for industrial districts in SANS 10103. Refer to Appendix A of the Noise Impact Assessment Report. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the CSP Plant property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103.
- The latest technology incorporating maximum noise mitigation measures for components of the complex should be designed into the system. Ideally, plant and equipment should meet the following specification: the sound power level (LW) should be such that the sound pressure level (SPL – i.e. the noise level) measured at 1 metre from the surface of the given plant/equipment should not exceed 85dBA. When ordering plant and machinery, manufacturers should be requested to provide details of the sound power level. Where possible, those with the lowest sound power level (most quiet) should be selected.
- The design process is to consider, inter alia, the following aspects:
    - The position and orientation of buildings on the site. Ideally the power block should be located as far as possible from any of the Humansrus farm boundaries.
    - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.

    - The insulation of particularly noisy plant and equipment.

- All plant, equipment and vehicles are to be kept in good repair.
- Where possible, very noisy activities should not take place at night (between the hours of 20h00 to 06h00). It must be ensured with the washing of the heliostats at night that noise levels from the high-pressure hose system (compressor) on the trucks are minimised.

It should be noted that any mitigation measures taken at the CSP Plant will limit the impacts in the specific areas designed for, but will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem.

After the implementation of the proposed mitigation measures the Noise Impact Assessment concluded that the noise impact of the proposed CSP plant will not be extensive.

4.3.12 Geohydrological Impact Assessment

4.3.12.1 Impact Identification, Assessment and Mitigation

The following possible groundwater related impacts have been identified for the Humansrus CSP plant:

- Abstraction of groundwater for water supply might negatively impact on the boreholes of other nearby water users; and
- Contamination of the aquifers by spills, leakages and accidental releases of hazardous substances associated with construction and operation of the CSP Plant. These substances include:
    - Fuel and lubricants, paints, solvents and chemicals such as sodium and potassium nitrate. Humansrus CS Plant will operate as a zero discharge site and waste water and liquid effluent will be contained in lined evaporation ponds. There will be no discharge to watercourses.
    - Domestic wastewater, which is water that does not contain a human organic waste component. Sewage is defined as human organic waste, usually within a water suspension. Sources of domestic wastewater and sewage are the toilets, washrooms and offices. Domestic wastewater and sewage will be captured in combined waste streams and directed to a sewage package treatment plant. The sewage package treatment plant will be required to achieve legislated effluent quality discharge standards. Effluent will be pumped to the evaporation ponds. The fully treated solids will be disposed at a suitably licensed waste disposal facility; and
    - Solid waste. The conventional hierarchy of waste reduction and management will be employed and waste materials will be disposed at a suitably licensed waste disposal facility.

Potential pathways that have been identified for contaminants to potentially migrate to the groundwater are:

- Fault zones especially the highly transmissive western and eastern graben faults;
- Zones where the weathered bedrock extents to below the water table; and
- Existing and abandoned boreholes which are not equipped with sanitary seals of bentonite and concrete collars.

Table 24 indicates possible groundwater impacts during the construction, operation and decommissioning phases of the STEP Plant without any mitigation measures taken. Mitigation measures need to be implemented to minimise identified impacts during all phases of the project life-cycle (construction, operation and decommissioning). These measures are also indicated in this table.

Table 25 indicates the severity of the impacts with the proposed mitigation measures applied. It is clear that these measures significantly reduce the risk of groundwater contamination. Therefore it is essential that these measures be implemented as part of the normal plant operation.

Table 24: Possible groundwater impacts without mitigation measures

Phase	Impact description	Status of Impacts: Rating	Status of Impacts: Quan-tative Rating	Spatial Scale of Impacts: Rating	Spatial Scale of Impacts: Quan-tative Rating	Temporal scale of impacts: Rating	Temporal scale of impacts: Quan-tative Rating	Probability of Impacts: Rating	Probability of Impacts: Quan-tative Rating	Severity of Impacts: Rating	Severity of Impacts: Quan-tative Rating	Significance of impacts: Rating	Significance of impacts: Quan-tative Rating
Construction	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while transporting and filling system with salt	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5

Essential mitigation measures:

- Place oil traps under stationary machinery, Only re-fuel machines at fuelling station, Construct structures to trap fuel spills at fuelling station, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only
- Place plastic sheets on surface where salt is uploaded or unloaded to collect spilled salt
- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Ensure vehicles and equipment are in good working order and drivers and operators are trained.
- Ensure that good housekeeping rules are applied.

Phase	Impact description	Status of Impacts: Rating	Status of Impacts: Quan-tative Rating	Spatial Scale of Impacts: Rating	Spatial Scale of Impacts: Quan-tative Rating	Temporal scale of impacts: Rating	Temporal scale of impacts: Quan-tative Rating	Probability of Impacts: Rating	Probability of Impacts: Quan-tative Rating	Severity of Impacts: Rating	Severity of Impacts: Quan-tative Rating	Significance of impacts: Rating	Significance of impacts: Quan-tative Rating
Operational	Groundwater abstraction	Negative	-	Medium	2	Low	1	Probable	2	Minor	1	Low	6
	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while transporting and topping system with salt	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
	Accidental spills/leakage from evaporation ponds	Negative	-	Medium	2	Medium	2	Probable	2	Average	2	Medium	8

Essential mitigation measures:

- Minimise waste water by the appropriate engineering design and re-use for other purposes where possible.
- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Ensure vehicles and equipment are in good working order and drivers and operators are trained.
- Place oil traps under stationary machinery, Only re-fuel machines at fuelling station, Construct structures to trap fuel spills at fuelling station, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only.
- Place plastic sheets on surface where salt is uploaded or unloaded to collect spilled salt.
- Effluent and waste water from the plant must be deposited in evaporation ponds. These ponds must be constructed away from vulnerable areas, fault zones and permeable formations to prevent ponding and ingress of contaminated water. The ponds must be properly lined to prevent vertical infiltration of contaminated water.
- A groundwater monitoring system must be implemented to monitor groundwater quality and water levels.
- Sewerage tanks and/or infiltration pits must be constructed far away from permeable formations and significant aquifer systems.

Phase	Impact description	Status of Impacts: Rating	Status of Impacts: Quan-tative Rating	Spatial Scale of Impacts: Rating	Spatial Scale of Impacts: Quan-tative Rating	Temporal scale of impacts: Rating	Temporal scale of impacts: Quan-tative Rating	Probability of Impacts: Rating	Probability of Impacts: Quan-tative Rating	Severity of Impacts: Rating	Severity of Impacts: Quan-tative Rating	Significance of impacts: Rating	Significance of impacts: Quan-tative Rating
	• Ensure that good housekeeping rules are applied.												
Decommissioning	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while cleaning evaporation ponds	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
	Essential mitigation measures: • A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced. • Ensure vehicles and equipment are in good working order and drivers and operators are trained. • Place oil traps under stationary machinery, Only re-fuel machines at selected re-fuelling points, construct structures to trap fuel spills at re-fuelling points, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only • Place plastic sheets on surface where salt is uploaded to collect spilled salt • Evaporation ponds and the Solar Power Tower must be cleaned out, demolished and the area rehabilitated. This material must be disposed at a suitable, licensed waste disposal site. • Sewerage tanks and/or infiltration pits must be rehabilitated. • Ensure that good housekeeping rules are applied.												

Table 25: Possible groundwater impacts with mitigation measures

Phase		Status of Impacts		Spatial Scale of Impacts		Temporal scale of impacts		Probability of Impacts		Severity of Impacts		Significance of impacts	
	Impact description	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating
Construction	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while transporting and filling system with salt	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
Operational	Groundwater abstraction	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while transporting and topping system with salt	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Spills from evaporation ponds	Negative	-	Low	1	Low	1	Improbable	1	Minor	1	Low	4
Decommissioning	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while cleaning evaporation ponds	Negative	-	None	0	None	0	Improbable	1	None	0	Low	1

It is evident from the findings of the Geohydrological Impact Assessment that the proposed project poses no threat to the geohydrology of the area.

4.3.13 Tourism Impact Assessment

The findings from the Tourism Impact Assessment confirmed the assumption from the Scoping Report that the impacts of the proposed project on tourism would be insignificant post-mitigation.

4.3.13.1 Impact description and assessment

The proposed CSP plant site is located in close proximity to the rural villages of Groenwater and Owendale. The character of the landscape is mainly natural for this locality. The proposed CSP plant therefore could have a major influence on the landscape in terms of the scale, the physical footprint and the aesthetics of the area, considering the spatial extent to the project and the physical size of the infrastructure. The degree to which the proposed development will affect the local area will vary and can be based on both positive and negative aspects. In this light, the four major environmental impacts that are key to how the tourism environment may be affected and that are likely to result from the power plants include visual impacts, noise impacts, land-use change impacts and corporate demand.

4.3.13.1.1 Visual Impact Relative to Tourism

Visual impacts with respect to the tourism environment would be a negative impact to the receiving environment. A low impact is expected during the construction phase. A medium visual impact relative to tourism is expected during the operation phase. However the nearest tourism facilities include is a game farm near Finsch mine in Lime Acres (about 9km away) and Bonza game farm (about 16km away) where commercial hunting takes place. As mentioned above, visual impacts on these facilities will be negligible as ridge lines block views towards the proposed CSP site (Humansrus Visual Impact Report by.

4.3.13.1.2 Noise Impact Relative to Tourism

Noise is a negative impact considered to be a cost to the receiving environment. A low noise impact relative to tourism is expected during the construction phase. This is because there are hardly any sensitive tourism facilities in the immediate vicinity of the proposed development. No Noise impacts relative to tourism are expected during the operation phase. This is because there are no tourism facilities in the immediate vicinity of the proposed development.

4.3.13.1.3 Land use Change Impact Relative to Tourism

Land use change could be a negative impact, but could also be considered to be a positive impact in the sense of being benefit to the receiving tourism environment. The land use impact relative to tourism is considered medium during construction phase. The land use impact relative to tourism is considered medium during the operation phase. However this medium impact would only be achieved if development is marketed as a tourist destination by establishing a visitor information centre associated with the plant.

4.3.13.1.4 Corporate Demand Relative to Tourism

Corporate demand is a positive impact considered to be a benefit to the receiving environment. Corporate demand impact relative to tourism is expected to be medium during the construction phase. This impact relative to tourism is expected to be medium during the operation phase.

4.3.13.2 Mitigation Measures

In order to increase corporate demand, the following measures should be undertaken:

- Tourism bodies should collaborate with the project proponent and create demand through appropriate marketing of the proposed solar power plant as a tourism attraction as well as other tourism assets in the area (responsibility in the case of other tourism assets is for tourism bodies in the study area).
- Tourism bodies in the study area should improve tourism infrastructure by establishing an up to date tourism information office in Postmasburg so as to increase tourism demand.
- Tourism bodies in the study area should identify and develop new tourist attractions.

After mitigation measures, low negative impacts (visual, noise and land use change) will be achieved or persist. As per the positive impact (corporate demand), high positive impacts are likely to be achieved.

4.3.14 Geotechnical Assessment

A Geotechnical Assessment was conducted by Moore Spence Jones (Pty) Ltd. The intention of this report (contained in Appendix U) was to provide preliminary geological and inferred geotechnical information based on a desk study of available information. The primary finding of the geotechnical report was that no fatal flaw was encountered with regarsd to the geotechnical stability but the main constraint would be the shallow bedrock and resistance to excavation.

4.3.15 Soils Assessment

A soils and agricultural potential study was conducted by the Agricultural Research Council to determine the soil types and the agricultural potential of the proposed site. There are three primary soil types on the proposed site which are indicated in Table 26

Table 26: Land types occurring (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Potential (%)
Ae214	Hutton 36	300-1200	31%	Red, sandy loam to sandy clay loam soils on hard rock	High:7.0 Mod: 41.3
	Hutton 33/36	100-300	30%	Red, loamy sand to sandy clay loam soils on hard rock	**Low: 51.7**
Ae215	Hutton 33	450-1200	81%	Red, sandy soils on hard rock and calcrete	High:0.0 **Mod: 92.5**
	Hutton 30	450-1200	8%	Red, very sandy soils on hard rock and calcrete	Low: 7.5
Ib237	Rock	-	61%		High:0.0 Mod: 14.0
	Hutton 30/33	50-300	25%	Red, sandy topsoils on rock	**Low: 86.0**

Much of the central part of the area (land type **Ae215**) comprises moderately deep to deep soils (300-1200+ mm deep) onto rock, while the remainder has more shallow soils (land type **Ae214**) or rock (land type **Ib237**). However, the low rainfall in the area (Table 1) means that the only means of cultivation would be by irrigation and the Google Earth image (Figure 2) of the area shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation.

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 15-20 ha/large stock unit (ARC-ISCW, 2004).

The major impact on the natural resources of the study area would be the loss of arable land due to the construction of the various types of infrastructure. However, this impact would in all probability be of limited significance (due to the low potential soils and the fact that construction of the infrastructure will not involve deep excavations or large-scale topsoil removal) and would be local in extent. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state, with little impact, especially given the low prevailing agricultural potential.

The impact can be summarized as follows:

Table 27: Impact Significance Table

Nature of impact	Loss of agricultural land	Land that is no longer able to be utilized due to construction of infrastructure
Status of impact	Neutral (N)	No cost or benefit to receiving environment
Spatial Scale of impact	Low (1)	Confined to site boundary
Time Scale of impact	High (3)	Lifespan of project
Probability of impact	Probable (2)	Likely to materialise
Severity of impact	Average (2)	Mitigation & rehabilitation will be possible
Significance of impact	Medium (8)	
Mitigation factors	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs.	

It does not appear, from a soils aspect, that there are any especially sensitive areas ("fatal flaws") within the site that should be avoided. Due mainly to the low potential soils and prevailing climatic limitations for agriculture, it is extremely unlikely that any sort of detailed soil investigation will be necessary.

4.4 Sensitivity Analysis

A detailed sensitivity analysis (contained in Appendix P) was conducted not to be used as an impact assessment tool but purely as a visual rendering and ranking system. Areas of diverse sensitivity are identified and ranked according to a pre-determined classification system. This was applied on selected environmental attributes (limited to on-site aspects with biophysical attributes)each using its own judgement criteria.

The purpose of a sensitivity analysis is to integrate the findings of various specialist studies into a single matrix on the basis of standardised impact ratings. These ratings can be quantified, and linked to the geospatial representation (mapping) of each environmental attribute.

The environmental attributes (specialist areas) that were included in the study are:

- Ecology;
- Wetlands;
- Surface Hydrology;
- Soil Sensitivity;
- Visual Quality.

Avifauna was originally included, but it was decided to incorporate this component under 'Wetlands', due to the overlapping nature of the two attributes (wetlands providing a habitat for bird species).

Overlaid with the footprint of the proposed CSP development, the sensitivity map gives a clear indication of areas that are suitable for development and which areas should be avoided. It therefore informs decision making with regard to the evaluation of alternative layouts and the optimal location of infrastructure.

Initially the sensitivity analysis indicated that the proposed layout encroached an area of high sensitivity to the northeast of the site as shown in Figure 10 below. An area of 9.34 ha of the sensitive closed shrubveld habitat type as described in the Biodiversity Impact Assessment was encroached on by the heliostat field but as a result of the identification of this through the sensitivity analysis the heliostat field was moved further to the south and effectively reducing the footprint of the sensitive area that would be impacted to an area of 2.64 ha as indicated in

Figure 11 below.

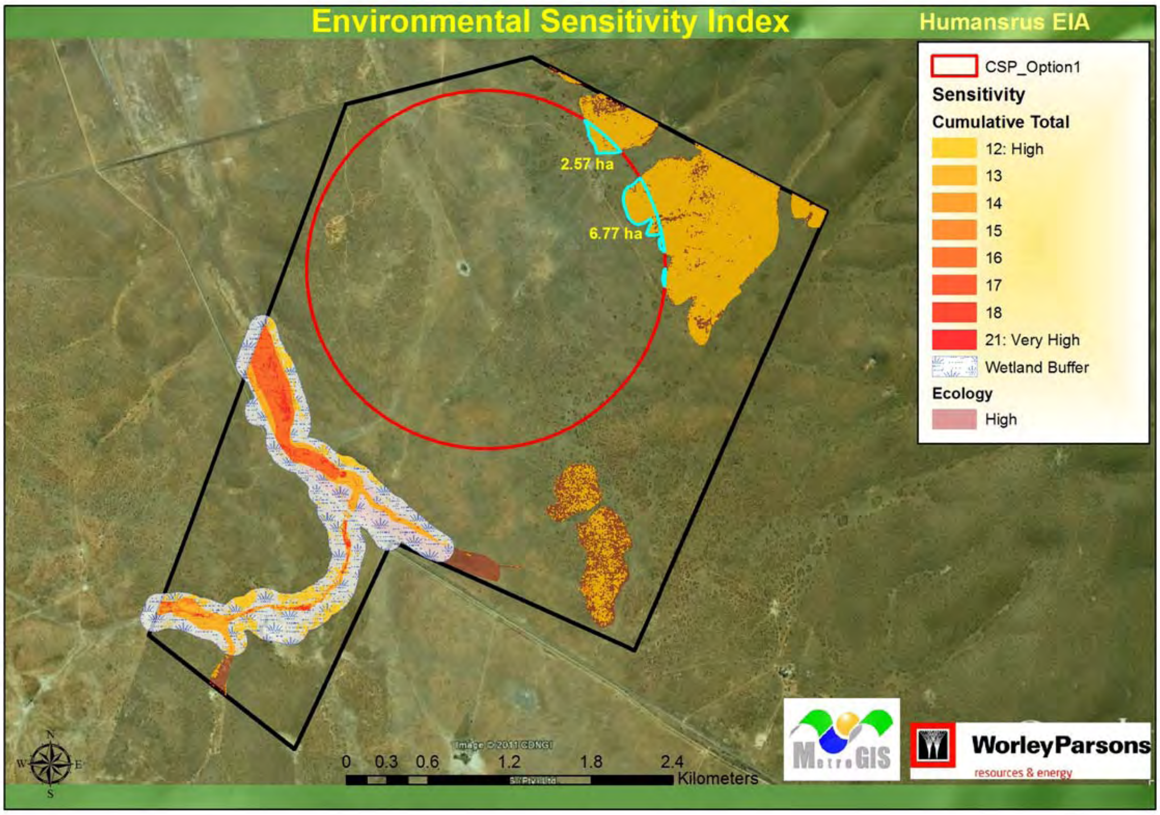

Figure 10: Initial Sensitivity Analysis

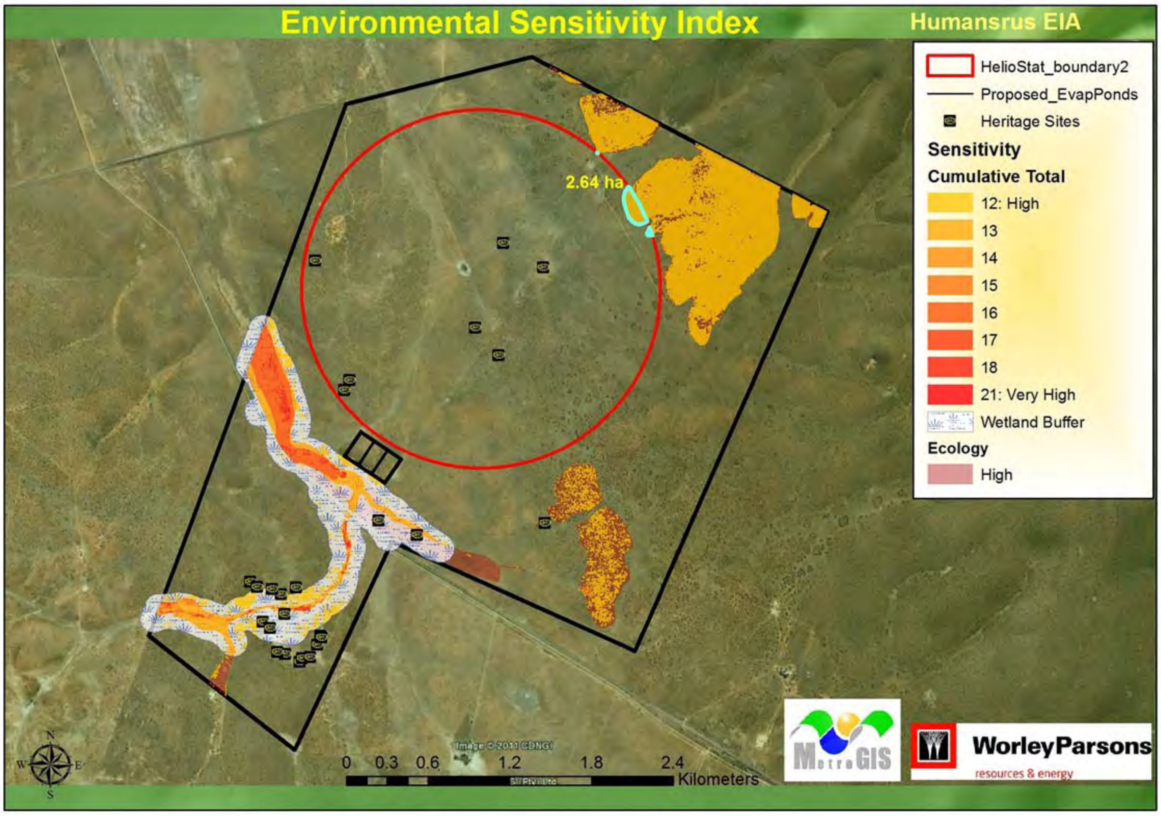

Figure 11: Ultimate Sensitivity Analysis

From the sensitivity analysis and as shown in

Figure 11 the features within the range of high to very high sensitivities are evident. It is evident from the map that very high sensitivity is associated with surface hydrology and Wetland areas. High sensitivity is associated with ecology and visual quality. The CSP footprint is mostly overlaid with very low to moderate sensitivities, except for the hilly terrain in the north-east where high sensitivities occur. The result of this analysis shows that the proposed project would steer clear of the greater part of the highly sensitive features in order to avoid to the maximum any major environmental impacts.

4.5 Cumulative Impacts

As a result of an increase in interest and the number of EIAs for renewable energy developments (solar and other renewable technologies) it is important to follow a precautionary approach in accordance with NEMA to ensure that cumulative impacts are addressed or avoided. The following aspects have been identified as potentially significant cumulative impacts that may result from the proposed development. It was anticipated in the Scoping Report that the two solar energy facilities (Humansrus and Intikon), located on the same property would have a number of cumulative impacts. These anticipated impacts were assessed by the specialists during the EIAR Phase to get a handle on their cumulative effect. The impacts that were assessed included:

4.5.1 Visual Intrusion

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility (visibility) of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions (Institute of Environmental Assessment and The landscape Institute (1996)).

The addition of the Intikon PV project to the Humansrus CSP would ultimately cause an increase in the footprint of the site but in terms of cumulative visual impact it is anticipated that there will be no major increase in impacts as assessed for the CSP. The following impacts, similar to the impacts associated with the CSP were anticipated:

- The proposed CSP project is located in a landscape of moderate value partially tolerant of change;
- The construction and operational activities are visible from less than half the zone of potential influence,
- Views from the R356, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities.
- Construction activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the short term and have a high negative effect on the visual quality of the area.

The mitigation measures proposed are similar to the mitigation proposed for the CSP and will have the same effect and will carry exactly the same significance ratings as the impacts of the CSP. These mitigations include:

- The minimum amount of existing vegetation and topsoil should be removed from construction areas. Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the site design. Eradication of vegetation should be done in 'natural manner', avoiding harsh straight lines.
- Dust suppression techniques should be in place at all times during the construction and operational phases.

- Install light fixtures that provide precisely directed illumination to reduce light “spillage” beyond the immediate surrounds of the of the concentrator plant, refrigeration plant, the incline and vent shafts but which still illuminate the buildings/roads.
- Avoid high pole top flood and security lighting in these areas.
- Build an earth berm along the northern boundary of the site adjacent the R356.
- Good housekeeping and encourage people to visit the Visitors Centre.
- Manage the growth of plant material on the earth berm.

With the implementation of these mitigation measures it is anticipated in all likelihood that the cumulative visual impact of the two projects would not increase above that of the impacts of the CSP in isolation.

4.5.2 Ecological Impacts

From a biodiversity perspective there are cumulative impacts which were assessed by the biodiversity specialist. These impacts are:

4.5.2.1 Impacts on SA’s Conservation Obligations & Targets

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types and while any impact that results in irreversible transformation of natural habitat is regarded significant, no significant disruption of ecosystem functioning is assumed in least threatened vegetation types, which still have more than 80% of their original extent untransformed.

Loss of parts of the natural vegetation is expected to result in an insignificant, indirect impact on the conservation status of the regional vegetation types; which is regarded Least Concern.

4.5.2.2 Increase in Local & Regional Fragmentation/ Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by extremely low levels of transformation and habitat fragmentation. Impacts from the proposed development are unlikely to increase regional or local levels of fragmentation and habitat isolation significantly.

4.5.2.3 Increase in Environmental Degradation

Cumulative impacts associated with this type of development could lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

The nature of the proposed development dictates that the biological environment is unlikely to be affected since no effluents, spillages or chemical are likely to be produced or transported. However, the general region is characterised by low levels of degradation, this impact therefore becomes more important since it represents the 'thin end of the wedge'.

The impact of the development was considered together with additional developments of the same or similar nature and magnitude. The combined impacts for the two proposed developments are considered on the whole to be negligible – i.e. the net effect is the same as the single development.

4.5.3 Geological and Hydrological Impacts

It is highly unlikely there will be cumulative losses or gains that result from the project operations and the project could be considered to be hydrologically neutral from a surface water point of view. There will be neither a net loss nor gain to surface water in the surrounding area of Humansrus 469 and nearby or adjacent properties. There will be a net economic gain to Sedibeng Water through purchase of water supplied from the Vaal-Gamagara pipeline to support CSP operations and generation of electricity. There may be a regional hydrological effect through the supply of water to the CSP from the Vaal-Gamagara pipeline, in that it will increase competition for water from that source.

5 Conclusion and Recommendation

SolarReserve South Africa (Pty) Ltd. proposed the construction and operation of a Solar Thermal Energy Power Plan on the Farm 469 the Hay RD i.e. Humansrus Solar Thermal Energy Power Plant.

An extensive and rigorous EIA process was undertaken for the proposed Humansrus Solar Thermal Energy Power Plant. The EIA was conducted within the context of the broader South African environmental legislative framework and particularly in line with the NEMA EIA Regulations. The project initiation meeting held with DEA in March 2011, August 2011 and the approval of the Final Scoping Report by DEA on 22 November 2011 identified the potential impacts of the proposed project and set the scope for conducting the detailed impact assessment during the EIAR Phase. The process undertaken during the EIAR Phase included the continuation of the extensive Public Participation Process initiated during the Scoping Phase, the independent specialist assessment of anticipated impacts and proposal of mitigation measures, conducting of a sensitivity analysis and the compilation of a detailed EMP.

The Public Participation Process during the EIAR Phase provides stakeholders and I&APs the opportunity to review whether their issues and concerns raised during the Scoping Phase has been sufficiently addressed, mitigated and to highlight additional issues that requires attention.

SolarReserve SA made a conscious decision based on the recommendations and guidelines by the DEA to undertake 15 independent specialist assessments in order to assess both significant and less significant environmental impacts proposed by the development.

The detailed assessment of the anticipated impacts were undertaken with the purpose of highlighting any areas of concern regarding the proposed project during its construction and operation and proposes necessary mitigation measures of the significant impacts.

In addition to the aforementioned independent specialist assessments, an independent sensitivity mapping analysis was undertaken. This analysis characterised the development site with regards to the significant environmental aspects in order to reflect the sites suitable and unsuitable (no-go) development footprint areas. This action guided the final footprint of the CSP Plant.

The proper procedures were conducted in the performing of the public participation process. All commenting authorities, stakeholders and registered I&AP's were involved throughout the PPP – their inputs, issues and concerns were considered by the EAP and addressed adequately as reflected in the Issues and Response Report contained in Appendix C.

To date no formal environmental or social objections have been received with respect to the Humansrus Solar Thermal Energy Power Plant.

EAP Recommendation

The impacts identified and assessed by the independent specialist impact assessments and the sensitivity analysis conducted, allowed for the development of effective mitigation measures (EMP).

The result of the independent specialist impact assessments and the subsequent sensitivity analysis proved that there is no residual impact that will prevail after the implementation of proposed mitigation measures.

It is the recommendation of the EAP that the proposed Humansrus Solar Thermal Energy Power Plant receives an Environmental Authorisation of approval from the competent authority.

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Appendix A

DEA Acceptance of Scoping Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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NEAS Reference: DEA/EIA/0000765/2011
DEA Reference: 12/12/20/2316
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Ms Leanna Rautenbach
WorleyParsons RSA
P.O. Box 36155
MENLO PARK
0102

Fax No: 012-460-1336

PER FACSIMILE / MAIL

Dear Ms Rautenbach

APPLICATION FOR ENVIRONMENTAL AUTHORISATION: HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT ON THE FARM 469 HAY RD, NORTHERN CAPE PROVINCE

The Final Scoping Report (FSR) and Plan of Study for Environmental Impact Assessment dated October 2011 and received by the Department on 20 October 2011 refer.

The Department has evaluated the submitted FSR and the Plan of Study for Environmental Impact Assessment dated October 2011 and is satisfied that the documents comply with the minimum requirements of the Environmental Impact Assessment (EIA) Regulations, 2010. The FSR is hereby accepted by the Department in terms of regulation 30(1)(a) of the EIA Regulations, 2010.

You may proceed with the environmental impact assessment process in accordance with the tasks contemplated in the Plan of Study for Environmental Impact Assessment as required in terms of the EIA Regulations, 2010.

Please ensure that comments from all relevant stakeholders are submitted to the Department with the Final Environmental Impact Report (EIR). This includes, but is not limited to, Northern Cape Provincial Department of Environmental Affairs and Nature Conservation, Department of Agriculture (Provincial and National), Department of Water Affairs, South African Heritage Resource Agency (SAHRA), National Energy Regulator of South Africa (NERSA). Proof of correspondence with the various stakeholders must be included in the Final EIR. Should you be unable to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments.

In addition, the following amendments and additional information are required for the EIR:

a) Details of the future plans for the site and infrastructure after decommissioning in 20-30 years and the possibility of upgrading the proposed infrastructure to more advanced technologies.

b) The total footprint of the proposed development should be indicated. Exact locations of the CSP plant, power lines and associated infrastructure should be mapped at an appropriate scale.

c) Should a Water Use License be required, proof of application for a license needs to be submitted.

d) Possible impacts and effects of the development on the vegetation ecology with regard to lowland-highland interface in the locality should be indicated.

e) The impacts of the proposed facility on avifauna must be assessed in the EIA phase.

f) Possible impacts and effects of the development on the agricultural land in the area.

g) The EIR should include information on the following:
   - Environmental costs *vs.* benefits of the solar farm facility;
   - Financial implications to tourism in the area; and
   - Economic viability of the facility to the surrounding area and how the local community will benefit.

h) Information on services required on the site, e.g. sewage, refuse removal, water and electricity. Who will supply these services and has an agreement and confirmation of capacity been obtained?

i) A construction and operational phase EMP to include mitigation and monitoring measures.

j) Should blasting be required, appropriate mitigation measures should be provided.

The applicant is hereby reminded to comply with the requirements of regulation 67 with regard to the time period allowed for complying with the requirements of the Regulations, and regulations 56 and 57 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the competent authority for decision-making. The reports referred to are listed in regulation 56(3a-3h).

Please ensure that the Final EIR includes at least one A3 regional map of the area and the locality maps included in the final EIR illustrate the different proposed alignments and above ground storage of fuel. The maps must be of acceptable quality and as a minimum, have the following attributes:

- Maps are relatable to one another;
- Cardinal points;
- Co-ordinates;
- Legible legends;
- Indicate alternatives;
- Latest land cover;
- Vegetation types of the study area; and
- A3 size locality map.

Further, it must be reiterated that, should an application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then this Department will not be able to make nor issue a decision in terms of your application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999.

You are requested to submit five (5) copies of the Environmental Impact Report (EIR) to the Department as per regulation 34(1)(b) of the EIA Regulations, 2010. Please submit at least one electronic copy (CD/DVD) of the complete final report with the hard copy documents.

You are hereby reminded that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours sincerely

Fatima Rawjee

Mr Ishaam Abader
Deputy Director-General: Environmental Quality and Protection
Department of Environmental Affairs
Letter signed by: Ms Fatima Rawjee
Designation: Director: Environmental Impact Evaluation (Acting)
Date: 22/11/2011.

CC:	Terence Govender	SolarReserve South Africa (Pty) Ltd	011-784-7549
	Solazi Henge	Tsantsabane Local Municipality	053-313-1602

Appendix B

Scoping Report

ENVIRONMENTAL IMPACT ASSESSMENT
FINAL SCOPING REPORT

PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, POSTMASBURG, NORTHERN CAPE PROVINCE

DEA REFERENCE: 12/12/20/2316

PREPARED FOR:

SOLARRESERVE®

PREPARED BY:

SSI A DHV COMPANY ENGINEERS AND ENVIRONMENTAL CONSULTANTS

WorleyParsons resources & energy

OCTOBER 2011

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

SCOPING REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Appendix List

Acronyms

ARC-ISCW	Agricultural Research Council Institute for Soil, Climate and Water
ARI	Acute Respiratory Infections
BID	Background Information Document
CAGR	Compounded Annual Growth Rate
CAR	Co-ordinated Avifaunal Road-count
COPD	Chronic Obstructive Pulmonary Disease
CSP	Concentrated Solar Power
CWAC	Co-ordinated Waterbird Count
DEA	Department of Environmental Affairs
DNI	Direct Normal Irradiance
DTEEA	Department of Economic Development, Tourism and Environmental Affairs
EC	Electrical Conductivity
ECO	Environmental Control Officer
EDI	Electro-deionization
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Programme
ERM	Environmental Resources Management
GDP	Gross Domestic Product
GHG	Green House Gas
GN	Government Notice
GRU	Groundwater Resource Units
I&APs	Interested & Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer

NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NGOs	Nongovernmental Organizations
NGDB	National Groundwater Database
QDGS	Quarter Degree Square
RO	Reverse Osmosis
SAHRA	South African Heritage Resources Agency
SANBI	South African Biodiversity Institute
SDF	Spatial Development Framework
ToR	Terms of Reference
WUL	Water Use License

Abbreviations

%	Percent
cm	Centimetres
CO_2	Carbon Dioxide
GWh	Giga Watt Hour
ha	Hectares
kg	Kilograms
km	Kilometres
km^2	Square kilometres
kV	Kilovolt
m	Metres
mamsl	Meters above mean sea level
mbgl	Meters below ground level
MW	Mega Watts
m^2	Square meters
R	South African Rand
$	US Dollar

Definitions and Terminology

Alternative:

A possible course of action, in place of another, that would meet the same purpose and need (of the proposal). Alternatives can refer to any of the following but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.

Cumulative Impacts:

Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combines to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

Direct impacts:

Impacts that are caused directly by the activity and generally occur at the same time and at the same place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

'Do nothing' alternative:

The ‗do nothing‘ alternative is the option of not undertaking the proposed activity or any of its alternatives. The ‗do-nothing‘ alternative also provides the baseline against which the impacts of other alternatives should be compared.

Environment:

The surroundings within which humans exist and that are made up of:

– the land, water and atmosphere of the earth;

– micro-organisms, plant and animal life;

– any part or combination of (i) and (ii) and the interrelationships among and between them; and

– the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being. This includes the economic, social, cultural, historical and political circumstances, conditions and objects that affect the existence and development of an individual, organism or group.

Environmental Assessment:

The generic term for all forms of environmental assessment for projects, plans, programmes or policies. This includes methods/tools such as environmental impact assessment, strategic environmental assessment, sustainability assessment and risk assessment.

Impact:

The positive or negative effects on human well-being and / or on the environment.

Environmental Management:

Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental Management Programme:

An operational programme that organizes and coordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Indirect impacts:

Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supplies water to a reservoir that supplies water to that activity). These types if impacts include all of the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and Affected Parties (I&APs):

Individuals, communities or groups, other than the proponent or the authorities, whose interests may be positively or negatively affected by the proposal or activity and/or who are concerned with a proposal or activity and its consequences.

Lead Authority:

The environmental authority at the national, provincial or local level entrusted in terms of legislation, with the responsibility for granting approval to a proposal or allocating resources and for directing or coordinating the assessment of a proposal that affects a number of authorities.

Mitigate:

The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.

Scoping:

The process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addresses in an environmental assessment. The main purpose of scoping is to focus the environmental assessment on a manageable number of important questions. Scoping should also ensure that only significant issues and reasonable alternatives are examined.

Significance:

Significance can be differentiated into impact magnitude and impact significance. Impact magnitude is the measurable change (i.e. magnitude, intensity, duration and likelihood). Impact

significance is the value placed on the change by different affected parties (i.e. level of significance and acceptability).

It is an anthropocentric concept, which makes use of value judgments and science-based criteria (i.e. biophysical, social and economic).

Stakeholder engagement:

The process of engagement between stakeholders (the proponent, authorities and I&APs) during the planning, assessment, implementation and/or management of proposals or activities.

Humansrus Solar Thermal Energy Power Plant

SCOPING REPORT

1 Executive Summary

SolarReserve SA (Pty) Ltd., proposes to construct and operate the proposed Humansrus Solar Thermal Energy Power Plant in the proximity of Daniëlskuil and Postmasburg in the Northern Cape. As such, SolarReserve has appointed the independent consultants to conduct the scoping and the EIA for the proposed project. The general project details are contained in table 1 below.

Table 1: General project information

Requirement	Details
Description of all affected farm Portions	Farm 469, the Hay RD
21-Digit Surveyor General code of affected farm portion	C 03100000000046900000
Copies of deeds of all affected farm portions	Copy of title deed contained in Appendix J
Photos of areas that give a visual perspective of all parts of the site	Site photographs contained in Appendix C
Photographs from sensitive visual receptors	Photographs from sensitive visual receptors contained in Appendix C
Plant design specifications	A circular heliostat field with a mirror reflective surface area of approximately 1 100 000 m^3, that reflects the sunlight to the approximately 200 m high central receiver tower, where the heat transfer fluid, molten salts, is heated up. A thermal energy collection and storage system with molten salt loop and hot and cold salt storage tanks harnesses the heat utilised in the steam generation system, which drives the steam turbine generator. The final design specifications will be finalised prior to the EIAR phase. The power plant will be dried cooled.
Type of technology	CSP, Central Receiver Tower, with molten salt as heat transfer fluid
Structure heights	Tower/receiver approximately 200 m high, heliostats between 12 and 15 m high and pylons approximately 32 m high.

Requirement	Details
Surface area to be covered	Approximately 600 ha / 6 km^2
Structure orientation	Central tower and power block with a circular heliostat field
Laydown area dimensions	This will be concluded during the EIA Phase.
Assembly Plant Dimensions	Approximately 3 000 m^2 (200 m x 15 m)
Generation capacity	107 MW. For scoping purposes an estimation was used. A more accurate capacity to be provided when plant designs have been finalised.
Generation capacity of the facility as a whole at delivery points	100 MW Generation capacity estimated around 100 MW as per the IPP application lodged with Eskom for grid connection. The final plant capacity will be determined during the detailed design stage.

An Environmental Impact Assessment (EIA) application was lodged with the Department of Environmental Affairs (DEA) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) and the EIA Regulations. The EIA process will determine the potential impact of the facility and whether it can be sustainably constructed and operated by negating potential negative impacts through the identification and implementation of suitable mitigation measures.

The proposed project aims to utilise the abundant and renewable solar resource to generate electricity and effectively create Green House Gas emission saving, whilst creating employment, skills development opportunities and stimulating the local and national economies. The experience and expertise of the proponent and the successes with similar projects worldwide will introduce new technology and create knowledge and develop new skills in the country.

This Scoping Report provides the background to the project, describes the site, introduces the proposed technology and alternatives and identifies possible impacts on the environment. It also outlines the Public Participation Process that was followed, presents the Plan of Study for EIA that will be adopted during the EIAR phase and makes recommendations to be considered during the EIAR process.

2 Introduction

SolarReserve SA (Pty) LTD (hereafter referred to as SRSA), Kensani Capital Investments and Intikon Energy have entered into a Joint Development Agreement for the proposed development of a CSP, Central Receiver Power plant on the Farm 469, the Hay RD, situated in the Northern Cape, for the purposes of generating electricity. The proposed development will be situated in the Tsantsabane Local and Siyanda District Municipalities. Electricity generated will be fed into the national power grid. The nature of the proposed development is two-fold and will entail the construction of a Central Receiver Tower or Concentrated Solar Power plant (hereafter referred to as CSP Plant) and a Photovoltaic Plant (hereafter referred to as PV Plant) on the same property.

The site has been identified for two projects: a PV project and a CSP project. All three parties are shareholders for both projects. ERM was appointed by Intikon to conduct the PV EIA and SRSA appointed WP and SSI to conduct the CSP EIA. The shareholders will decide which of the two projects will be built on the site based on the approval of a generating license by NERSA. The footprints for each of the projects are independent of each other.

The primary aim of this Scoping Report is to present the environmental case for the proposed CSP Plant, and will thus go into depth on the proposed PV development, but will mention the applicable components pertaining to the PV development. The EIAR report for the PV project has already been submitted to the DEA for approval by ERM on the 23 May 2011.

It is deemed necessary to define the relationship status between the existing developer (i.e. Intikon Energy and Kensani Capital Investments) and the proposed new developer, SRSA. An agreement was entered into by the parties between Kensani Capital Investments, Intikon Energy and SRSA with regards the development of such a CSP plant on the Farm 469, the Hay RD, in the Northern Cape. The agreement allows SRSA to commence with an Environmental Impact Assessment (EIA) on the same property, formerly assessed by Intikon Energy for the development of the proposed PV plant. The dual development concept was referred to the Department of Environmental Affairs (DEA) for comment, and it was indicated that two applications may be lodged on the same property for development, albeit a different technology to be implemented. The Environmental Authorization (EA) process for the PV Plant has already commenced under a separate EIA application to DEA. Confirmation from the DEA Legal Division was received stating that concurrent applications for different projects on the same property are allowable. This confirmation is also contained in Appendix A.

The EIA (***DEA Reference: 12/12/20/1903***) for the proposed PV development was undertaken by Environmental Resources Management Southern Africa Pty Ltd (hereafter referred to as ERM) as independent environmental consultants. The EIA for the proposed PV development is in the final EIA stages and the Environmental Impact Report (EIAR) was submitted to Department of Environmental Affairs (DEA) for review and approval on 19 May 2011.

The EIA for the CSP development was initiated in 2011, with the application submitted to the DEA on 15 June 2011**,** placing each of the proposed projects in different development phases. WorleyParsons RSA along with SSI Environmental Consultants were appointed as independent Environmental Assessment Practitioners (EAP) to conduct the EIA process for the proposed CSP development.

2.1 Project Overview

The proposed Humansrus Solar Thermal Energy Power Plant entails the construction of a solar thermal power plant and associated infrastructure and services for the provision of renewable electricity to the national power grid. This Greenfields project entails the transformation of agricultural land to accommodate the proposed plant. The infrastructure and structures for the proposed project include *inter alia*:

- Heliostat array and the CSP tower;
- The power block;
- Water reticulation and purification works;
- Sewer reticulation and treatment works;
- Roads and storm water infrastructure;
- Substation and overhead power lines;
- Construction accommodation and ablution facilities;
- Stores and materials lay down area;
- Concrete batching plant;
- Vehicle workshops and wash bays;
- Fuel storage area;
- Temporary waste storage facility; and
- Hazardous material stores.

Prior to the commencement of any construction activities it is required that all required environmental authorizations be obtained in relation to all the relevant national legislation.

2.2 Purpose of this Report

This Scoping Report has been compiled as part of the EIA process in accordance with the regulatory requirements stipulated in the EIA Regulations (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), as amended. This document serves to:

- Provide a description of the proposed activity.
- Provide possible alternatives for the proposed activity.
- Outline the legislative context.
- Provide a background study into the environmental setting of the proposed activity.

- Need and desirability
- Identify possible impacts of the proposed activity – positive and/or negative –on:
    - The natural environment;
    - The social environment;
    - The economic environment;
- Identify issues/concerns/alternatives through a Public Participation Process; and
- Provide a Plan of Study for EIA.

A number of specialist assessments were conducted specifically for this scoping report but available and applicable specialist reports were also used to identify the impacts and to determine the additional specialist studies required to address/mitigate impacts.

The following assumptions and limitations underpin the during the EIA phase.

2.3 Assumptions and Limitations

The following assumptions and limitations underpin the approach to this EIA study:

- The information received from the stakeholders, specialist assessments are current and valid at the time of the study;
- A precautionary approach was adopted in instances where baseline information was insufficient or unavailable;
- The Intikon EIA for the proposed PV Plant on the same property is adjudicated independently from this EIA even though the cumulative impacts of both plants will be addressed in this EIA.
- Mandatory timeframes will apply to the review and adjudication of the reports by the competent authority and other government departments; and
- No land claims have been registered for the proposed site at the onset and registration of the study.
- Due to the complexity of the technology to be implemented the Scoping Report will provide preliminary estimations on sizes and proposed infrastructure and or components. These items will only be finalised during the Environmental Impact Phase of the project. For this reason it needs to be kept in mind that all technical specifications will only be finalised during the EIAR Phase.

2.4 Structure of this Report

The Scoping Report comprises the following aspects:

- The background and description of the various elements of the project;
- The legislative context of the study;
- The details of the proponent and EAP;
- The need and desirability of the project;
- A description of the scope of the project;
- The property description of the proposed site;
- A discussion of the alternatives;
- Baseline descriptions of all the biophysical and socioeconomic aspects;
- A description of the Public Participation Process conducted for the Scoping Phase;
- Impact identification; and
- A plan of study for EIA giving a detailed impact assessment methodology and timeframes.

2.5 Details of the Environmental Assessment Practitioner

The Environmental Regulations require that relevant details and expertise of the independent Environmental Assessment Practitioners (EAP) be included in the scoping report. The appointed EAPs for this study are WorleyParsons RSA (Pty) Ltd and SSI Engineers and Environmental Consultants. The latter was appointed only to conduct the specialist studies for the EIA process.

Worley Parsons RSA provides sustainable environmental solutions to challenges in all industry sectors. The group offers services covering the entire project life cycle from feasibility studies right through to maintaining environmental integrity during operations. With more than 33 years experience in South Africa, the group‘s intimate knowledge of the region‘s unique challenges enables it to tailor solutions to deliver maximum value to customers and apply this knowledge to the broader African and international customers. As a leading service provider to the resources and energy sectors, WorleyParsons delivers projects for its customers across the hydrocarbons, minerals & metals and power industries.

WorleyParsons employs over 1 100 people in South Africa with more than 20 offices countrywide. Our professionals also provide expertise in site assessments and audits, land use planning, environmental and social impact assessments, permitting and regulatory management, remediation planning, and environmental strategies to reduce risks and liabilities.

Our international capabilities include 20 years ESHIA experience on major projects worldwide with 4 800 impact assessments worldwide.

SSI Engineers and Environmental Consultants (Pty) Ltd (SSI) is a broad based consulting company, which has been in business for over 86 years, comprising numerous qualified and experienced environmental scientists and engineers. An Environmental Management Unit (EMU) was originally launched inside SSI in 1994, but merged with Bohlweki Enviro-Waste (Pty) Ltd (founded in 1995 by the late Rufus Maruma) in 1997 to become Bohlweki Environmental (Pty) Ltd. Bohlweki Environmental subsequently grew into one of the leading Black- owned and purely environmental consulting companies in South Africa.

In 2005, SSI became the majority shareholder in Bohlweki Environmental and in 2008 took 100% ownership of the company. This paved the way for the operation of Bohlweki as an environmental consulting operational unit within the SSI structure (i.e. SSI Environmental). This also extends SSI's international reach via DHV, the Netherlands based majority shareholder of SSI. SSI has 22 offices in all the major centres of South Africa. The firm currently has a fulltime staff complements of approximately 1 000 and is able to provide a diverse array of technical, project management, facilities management, and professional services related to the provision of all basic infrastructures in the built environment. SSI has attracted and developed a team of highly qualified and experienced personnel who provide services and solutions in the following core areas:

SSI comprises 35 professional staff with many years combined experience offering the full spectrum of environmental services and has an excellent track record in Environmental Assessment work, but also in-house personnel with extensive experience in strategic and spatial environmental planning.

2.6 Project Proponent

The Project Company, ―Humansrus Ltd", is a Special Purpose Vehicle that will be incorporated in October 2011. This Joint Venture Project Company is 100%owned by SolarReserve LLC, Kensani Investment Capital and Intikon Energy.

Kensani Capital Investments is an investment holding company for the economic upliftment and empowerment of women in South Africa and is a Broad-Based Black Economic Empowerment business. Kensani is an informed and experienced player in the infrastructure sector and areas of expertise include project finance and infrastructure investments in the South African empowerment sector. Together the team has over 50 years of collective experience in investment banking and has the knowledge and expertise to analyse and implement viable transactions. Given Kensani's successful infrastructure track record, Kensani is now focussed on leveraging its expertise into fast growing South African Renewable Energy Sector

SolarReserve is a Santa Monica, California-based developer and owner of utility-scale CSP projects utilizing exclusive, best-in-class technology with inherent storage capability. SolarReserve's primary focus is securing sites, transmission access, permitting, and power purchase agreements; engineering, procurement, and construction services; and securing financing for utility-scale CSP power projects. The Company has developed a diverse portfolio

of CSP projects and development opportunities that encompass 3 000 MW of project potential and approximately 25 individual sites of approximately 140 000 acres (56 000 ha), including some sites with multiple tower potential. SolarReserve holds an exclusive global license to the Molten Salt Power Tower technology developed by Rocketdyne, with the initial license term extending until 2027. SolarReserve has a development pipeline of more than 1 100 MW in Solar PV and a geographically diverse portfolio of more than 3 000 MW of CSP projects.

Intikon Energy was established in Cape Town in 2009 with the intention of entering into the rapidly emerging renewable energy business in South Africa. It is owned collectively by CS Solea Pty Ltd (―CS") and Triangle Ventures Pty Ltd (―Triangle"). The company combines South African and international renewable energy development experience. Mr Paul Warmeant, Managing Director of Intikon Energy in South Africa, helped to establish South Africa‗s pilot wind farm (the Darling wind energy facility) in 2000 and was the director of the South African Wind Energy Association (SAWEA) from 2001-2002. The proponents involved with CS and Triangle have previously developed, in conjunction with Infigen Energy, Babcock & Brown and National Power Partners, two of the largest operational renewable energy projects in Australia; namely the Alinta Wind Farm, an 89 MW wind farm located east of Geraldton in Western Australia and Capital Wind Farm a 140MW wind farm located near Canberra. They are currently developing a further 400 MW of Australian wind farms and are currently leading a Solar Flagships bid in Australia for the delivery of 150MW of solar farms by 2015.

Other than developing wind energy projects, globally the team is working on several solar power developments including two projects in South Africa. Apart from solar and wind energy projects, Intikon Energy‗s business plan also incorporates the development of renewable biomass energy projects.

Intikon Energy is committed to developing projects in South Africa that will improve sustainability, contribute to climate change mitigation and the success of South Africa‗s renewable energy industry, whilst also improving quality of living for South African citizens through improved national energy security (Extract from ERM – EIA – 12/12/20/1903).

2.6.1 Background in CSP

The Molten Salt Power Tower technology, deployed by SolarReserve, has been demonstrated and refined in two demonstration projects in the late 1990s, Solar One and Solar Two. Both Solar One and Solar Two were developed jointly by the DOE, the Solar Energy Research Institute (now NREL), Rocketdyne, and a consortium of South Western Utilities.

Solar One, which operated from 1982 to 1986, was initially designed to operate as a direct-steam generation technology, similar to that being pursued by other CSP providers in the market today (i.e., solar energy is transferred directly to water circulating through the central receiver and the resulting steam flows directly to a steam turbine). Even with an oil and stone based thermocline storage tank, Solar One suffered from operational issues during periods of cloud cover and inclement weather. The thermal storage system could not respond fast enough

to rapidly changing solar conditions and the loss of solar energy even during brief intermittent cloud cover degraded the steam quality enough to interrupt plant operation.

As researchers knew that certain high temperature liquids can efficiently and cost-effectively store thermal energy, it was proposed that the DOE support a successor named Solar Two to test a receiver using molten salts as the thermal transfer fluid. The thermal storage system would be tested for continuous operation over successive 24-hour periods and also to be ―dispatched" during peak demand periods. In addition, the demonstration facility would target more effective operational performance compared to the operating challenges of the more weather affected direct-steam based Solar One facility.

The molten-salt receiver used in the Solar Two demonstration facility was designed and manufactured by the aerospace and advanced power system engineering teams at Rocketdyne, then an affiliate of The Boeing Company and subsequently acquired by UTC in 2005.

Following the successful demonstration of the Rocketdyne-designed and built CSP molten salt receiver and associated systems on Solar Two and its inclusion in UTC‘s Pratt & Whitney division in 2005, Rocketdyne –via UTC‘s Hamilton Sundstrand subsidiary, which took initial responsibility for Rocketdyne‘s advanced energy activities following Rocketdyne‘s entry into UTC – entered into negotiations with US Renewables Group on the establishment of a company focused on the commercial deployment of this key CSP technology. This culminated in the first Exclusive License Agreement between Hamilton Sundstrand and the newly formed SolarReserve, LLC in December of 2007.

In 2009, Rocketdyne‘s advanced energy activities were reorganized into Pratt & Whitney Rocketdyne, Inc. (joining Rocketdyne‘s propulsion systems activities already organized within Pratt & Whitney). As a result, SolarReserve, Hamilton Sundstrand, and Rocketdyne entered into negotiations on the transfer of SolarReserve‘s agreements with Hamilton Sundstrand to Rocketdyne, concurrently with the transfer of responsibility for Rocketdyne‘s CSP activities from Hamilton Sundstrand to Rocketdyne. These discussions culminated in the execution of the Amended and Restated Exclusive License Agreement (the ―ELA") dated January 7, 2010 with Rocketdyne, whereby Rocketdyne licenses to the Company the rights to use, sell, and market the intellectual property of Rocketdyne associated with CSP technology using a molten salt thermal energy storage and delivery system following the assignment by Hamilton Sundstrand to Rocketdyne of the 2007 license agreement. The ELA also sets out the terms in which Rocketdyne grants SolarReserve the exclusive right to use, sell, market, and manufacture Rocketdyne‘s heliostat technology.

Since SolarReserve‘ formation in 2007, the Company has worked closely with Rocketdyne to advance the commercial-scale design and project implementations of the Molten Salt Power Tower technology, heliostat technology, collector system and balance of plant design.

As many as 100 Rocketdyne professionals – comprising engineers, technical specialists and other personnel – have been deployed at various times in support of this program on a full-time equivalent basis. This deep base of highly skilled technical expertise has considerably leveraged SolarReserve‘s access to advanced engineering and technological resources in advancing its CSP projects.

2.7 EIA Approach & Methodology

The proposed project entails the conducting of a mandatory EIA as required by the relevant legislation and requires four primary activities to be undertaken to ensure the successful completion of the process. These four activities form the Scope of Work for the study and are described as follow:

2.7.1 EIA Process Development and Initiation

It is required that proper planning be conducted in order to ensure that the EIA is conducted according to the legislative requirements and that the process is sound. In order to develop a sound EIA process it is required that an extensive legal gap analysis is conducted and a proper program developed, scheduling all the required activities. The initiation of the EIA process must involve consultation with institutional stakeholders in order to identify potential impacts, alternatives and key burning points relating to the project early in the process. During the initiation of the EIA it is important that the project alternatives are identify and assessed.

2.7.2 The Scoping Process

The Scoping process must involve the identification of key issues, concerns, alternatives and impacts, over and above what was identified and assessed during the initiation phase. The vehicle for this process is the public participation process (PPP), whereby Interested and Affected Parties (I&APs) has to be identified and engaged with to exchange information and to establish a platform of engagement. The information needs to form the basis from which to prepare the Scoping Report (SR) as well as the various terms of reference for the required Specialist Studies. The environmental baseline needs to be determined from which to assess the likely impacts of the proposed development. Issues raised in the course of scoping must be presented in both the Scoping Report and the Issues and Response Report.

2.7.3 Detailed Impact Assessment

The impacts, alternatives and issues identified during the scoping needs to be assessed during this phase of the process by means of the identified specialist assessments. Mitigation measures must be proposed and the likely residual impacts highlighted in the Environmental Impact Assessment Report (EIAR). It is crucial that the PPP be continued throughout this phase as well in order to involve I&APs and ensure transparency in the reporting.

2.7.4 Environmental Management Programme

A crucial aspect of the EIA process is the formulation of the Environmental Management Programme (EMP). This programme must be contained within the Environmental Impact Assessment Report and is a concurrent activity to the Detailed Impact Assessment phase of the

project. It must state the actions to be implemented during the construction, operation and decommissioning phases of the proposed project in order to achieve the mitigation targets.

2.8 Approach to the Study

A systematic approach will be adopted for the successful completion of the EIA in line with the regulated process. The diagram in Figure1 below indicates the sequential process that will be followed for this study

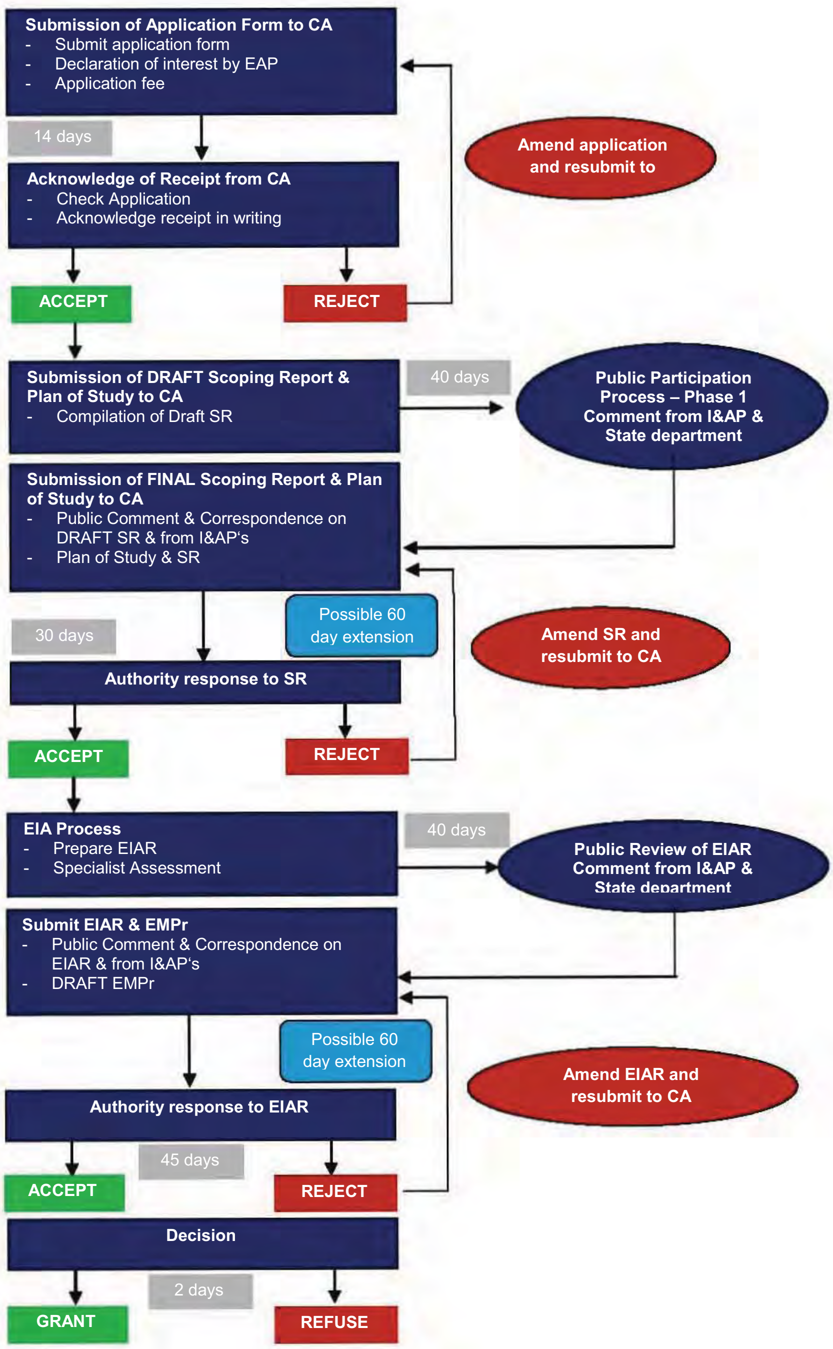


Figure 1: EIA Process

3 Project Description

The proposed joint development of Renewable Energy (RE) projects aims to introduce both PV and CSP technology to the area but under separate EIA applications. The proposed PV Plant development will entail the installation and operation of solar panels (photovoltaic (PV) arrays) with a projected output of approximately 160 megawatts (MW), whereas, the proposed CSP plant, will entail the construction and operation of a central receiver tower plant with a projected output of up to 100 MW. As agreed to by the shareholders, the output of the PV plant will be adjusted to accommodate the CSP plant as and if needed.

For the purpose of this Scoping Report (SR) the CSP development will be discussed, with reference to the PV development where applicable.

The CSP is a concentrated solar thermal energy power plant facility on a farm in the Northern Cape Province. The site is located on the Humansrus Farm (Farm 469,the Hay Rd), approximately 5 km southeast of the Groenwater community and 30 km east of Postmasburg, as indicated in Figure 2, and falls within the jurisdiction of the Tsantsabane Local Municipality of the Siyanda District. The project will be capable of producing approximately 480 000 gigawatt-hours (GWh) of renewable energy annually, with a nominal net generating capacity of 100 megawatts (MW). It is envisaged that the CSP plant will be operated as a mid-merit or base load plant. The power plant will be dried cooled. Total construction and development costs of the plant are estimated at R6.5 billion.

Technology proposed for the CSP development is the use of a central receiver/tower which is equipped with an integrated thermal storage system. The proprietary receiver and storage components are provided through an exclusive license with United Technologies Corporation‘s subsidiary Hamilton Sundstrand Rocketdyne (―UTC” or ―Rocketdyne”). The integrated salt storage technology proposed was demonstrated successfully at the SolarReserve LLC‘s Solar Two facility in Barstow, CA (built and operated jointly by the US Department of Energy and Rocketdyne) in the late 1990‘s.

SolarReserve‘s technology generates power from sunlight by focusing the sun‘s thermal energy from the heliostat field i.e. sun tracking mirrors onto a central receiver tower. The liquid salt is circulated through tubes in the receiver, collecting the energy of the sun. Once the liquid salt has been heated to a temperature of 560 degrees Celsius it is routed to an insulated storage tank i.e. the ―hot” tank, where it can be stored with minimal energy losses. The heated, molten salt is routed from the ―Hot” tank to a heat exchanger for the production of energy. Steam is produced by the heat exchanger and expanded through the standard Rankin cycle steam turbine which rotates a generator to produce electricity.

The molten salt is hereafter circulated back to the ―cold” storage tank and the cycle repeated. Due to the energy storage ability of the proposed technology, a CSP plant of this nature, sized at 100 MW, can generate electricity for up to 24 hours a day during the summer months and between 12 to 16 hours a day in the spring, autumn and winter months. The proposed plant will utilise hybrid cooling technology to condense the water used during the steam cycle. Implementing this cooling technology allows for the use of considerably less water compared to that of a wet cooled solar thermal power plant.

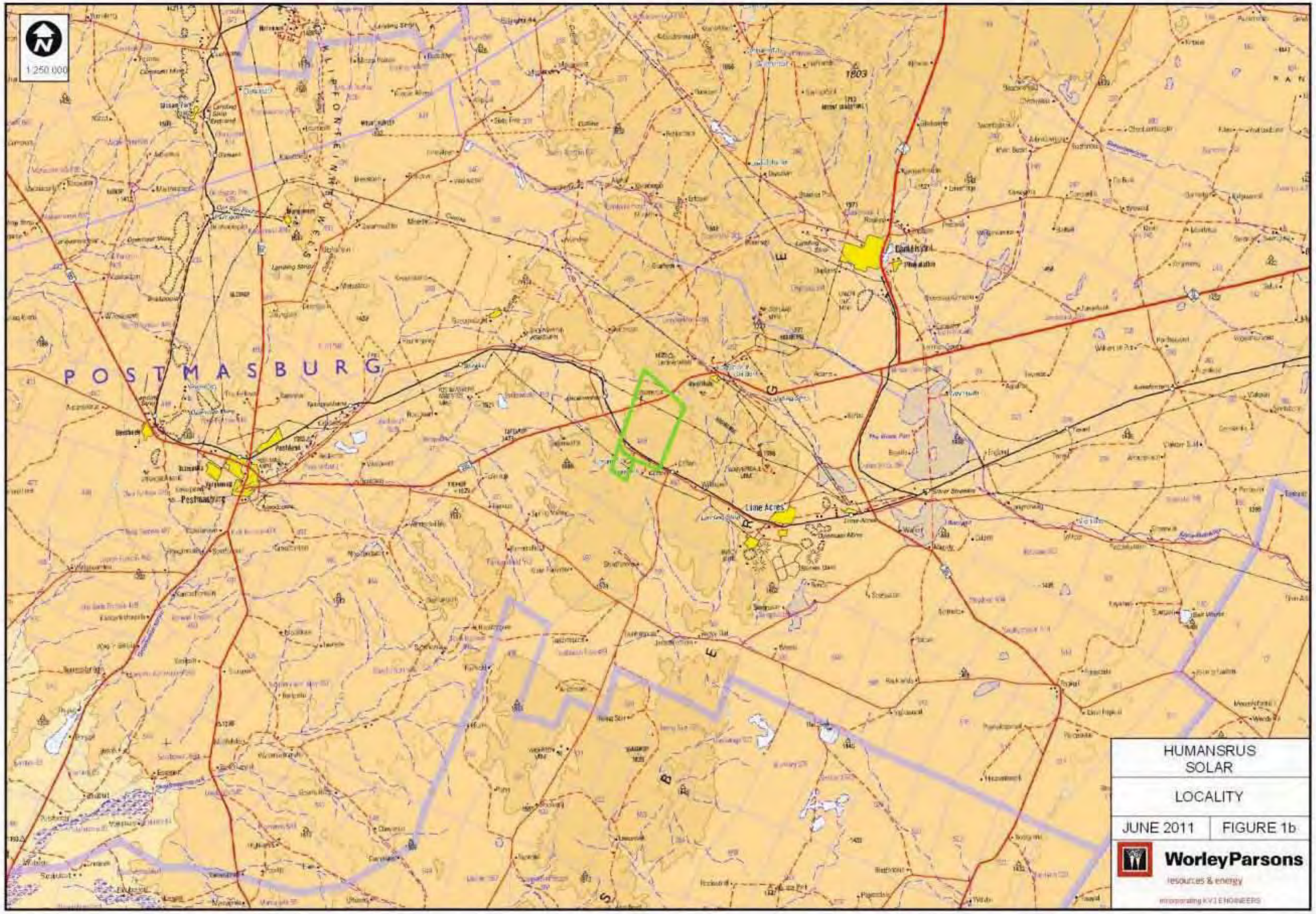


Figure 2: Locality Map

The CSP plant (Figure 3) primarily comprises of four subsystems as summarised below:

– **Solar Field** - consists of all services and infrastructure related to the management and operation of the heliostats;

– **Molten Salt Circuit** - includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;

– **The Power Block** – consists of inter alia the steam turbine is where the electricity is generated; and

– **Auxiliary facilities and infrastructure** - includes the condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

It is anticipated that the construction of the plant would stretch over a 30 month period and that more than half of the total capital project costs could potentially be spent in South Africa on procurement of local materials, services, and labour. It is envisaged that the project will make a notable contribution towards the achievement of the job creation targets set in the New Growth Path by creating employment opportunities throughout the country during the peak of construction and sustainable employment opportunities during operations.

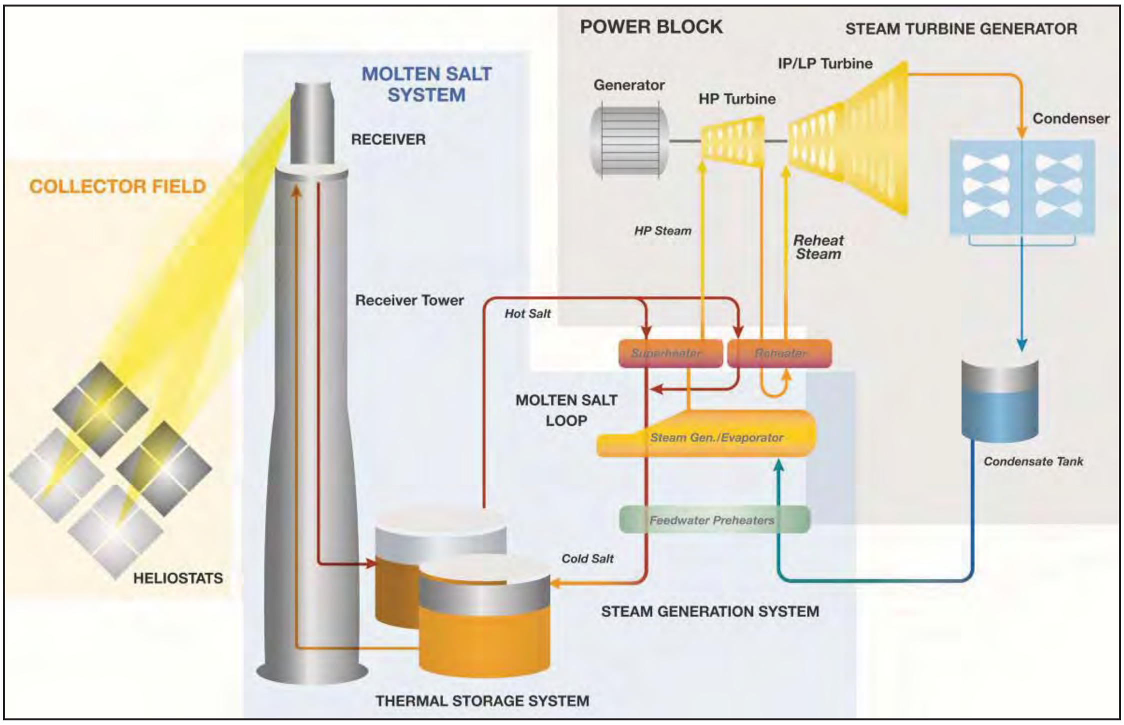


Figure 3: Process flow of a typical Solar Thermal Energy Power Plant operation

3.1 Construction Overview

It is anticipated that a temporary contractor‘s housing facility will be utilised for the duration of the plant construction period. It is estimated that in total approximately 600 persons will be employed by the facility – over the estimated 30 month construction period. Habitation will be staggered over this period and the maximum number of persons housed at any given time will not accrue to 600 but the estimated numbers will be confirmed during the detailed EIA phase. It is proposed that temporary/portable housing, ablution and sewer treatment facilities be procured from external service providers. Potable water for domestic use at the facility will be sourced from Sedibeng Water Board and wastewater and sewage will be treated with the use of a modular sewer treatment plant with capacities to be confirmed during the EIAR phase.

Primarily construction will entail amongst other the following activities:

– Site establishment and the construction of access roads and services;
– Site clearing and heavy earthworks; and
– Construction and assembly of the tower, buildings, heliostats and infrastructure.

3.2 Operation Overview

In simplified terms operation entails the production of power through the conversion of solar energy to electricity. The inputs into the plant during operations include:

– Solar radiation;
– Water;
– Salt; and
– Consumables, including but not limited to:
  – Diesel;
  – spare parts and equipment;
  – hydraulic fluids;
  – chemicals;
  – lubricants; and
  – detergents.

The products/outputs from the plant includes *inter alia:*

– Power;
– Solid waste (hazardous and non hazardous); and
– Liquid waste or effluent (hazardous and non hazardous).

The four primary subsystems of the plant each comprises of a number of activities, systems and cycles and has to work in unison to produce power and each of these subsystems has to be

kept and maintained in good working order to ensure that the power production is constant without any downtime during crucial operating hours. Although much of the plant and operations are automated operators and maintenance staff will be required to ensure that the plant is well maintained and functions optimally,

Operation of the facility will entail the regular maintenance of the site and infrastructure, management of waste facilities and the replacement of consumable items and/or damaged equipment to ensure that the plant operates optimally. This maintenance will as far as possible be scheduled to times that the plant is not operational to improve productivity. Unscheduled repairs and maintenance will likely occur as a result of breakdowns and emergency situations.

3.3 Technology Overview

SolarReserve LLC has the exclusive world-wide license with Rocketdyne for the molten salt, central power tower technology that was demonstrated at the ‗Solar Two' power plant in California. Figure 3 below indicates the central receiver technology.

The DOE made the following statement shortly after Solar Two was decommissioned:

―The 10 megawatt Solar Two power tower pilot plant near Barstow, California, successfully completed operations in April, 1999, having met essentially all of its objectives. Over the three-year operating lifetime, daily operation of Solar Two became relatively routine, with various performance records broken on a fairly regular basis". US Department of Energy" - Sunlab Snapshot, March 2000. The project is a ‗Central Receiver Tower' design, consisting of ―heliostats" (large mirrors) which reflects the rays of the sun onto a receiver at the top of a central tower.

The project will consist of the following main components:

- Central 200 meter concrete slip-form tower;
- 24 Panel Receiver with thermal rating of 530 MW;
- Circular field of approximately 17 150 dual-tracking heliostats, each approximately 65 m^2, creating a 1 100 000m^2) reflection surface area ;
- A 105 MW Rankin Cycle condensation turbine with a reheating cycle and with an axial exhaust and uncontrolled extractions for generating electricity;
- Thermal storage tanks for storing the hot and cold molten salts;
- A system of air-cooled condensers designed to minimise the consumption of water;
- Water reticulation from the Sedibeng Bulk Water Supply Pipeline for industrial water use, and a water treatment system to provide water that will be treated for both domestic and process use. The use of groundwater will be considered if water is not available from the Sedibeng pipeline;
- One evaporation pond with three compartments with a combined area of approximately 7 ha, to process all wastewater discharge including but not limited to the water treatment system and oil water separator;

- Two emergency 3.0 MVA diesel generators;
- Two x 25 MW Liquid gas auxiliary burners(or one diesel boiler)for start up;
- Associated equipment such as: pumps, transformers, exchangers and construction buildings; and
- The associated electrical substation, an electrical connection line, road access and water supply pipes.

The general operation of the planned solar thermal power generation plant is summarised in the Figure 3 above.

The receiver and the molten salt circuit will be provided through an exclusive licence with Rocketdyne. There are many benefits of this unique technology, listed below are only a few:

- This technology is in the early stages of commercialization, placing South Africa in the ideal position to capitalise on the opportunity to create a world leading business in the fields of Research and Development (R&D), support, manufacturing, implementation, construction, financing, equity participation, operation and maintenance;
- Achieving South Africa's commitment to reducing greenhouse gas emissions though the implementation of world leading technology;
- Have the opportunity to partner with a world leading technology developer and backed by one of the premier technology companies in the world; and
- Because the molten salt stores energy, the energy collection and generation are de-coupled, so the stored energy can be extracted to produce electricity upon demand. The capability to store energy provides flexibility to generate electricity in large quantities for short periods of time or in smaller quantities over longer periods of time, thereby matching the seasonal and varying electricity demands of the state.

Figure 4: An example of a power plant using central receiver technology. This is the Solar Two 10MW demonstration plant that was built in the United States (image courtesy NREL).

3.4 Water Supply and Use

SRSA has made a conscience decision to ensure all of its power plants are dried cooled. SRSA has investigated various options in securing water for its power plant. The sources of the water supply and water treatment requirements are outlined in this section.

After consultation and discussions an application for raw water has been submitted to the Vaal Gamagara Bulk Water Supply Pipeline Authority of the Sedibeng Water Board. The Vaal Gamagara Pipeline is operating at full capacity currently and contingency plans are being investigated to increase the capacity thereof to accommodate more users. The water will be put through a pre-treatment system and further purified for use as boiler make-up water and for pressure-washing of the heliostat field.

The alternative will be investigated of utilising boreholes as a source of water. Geohydrological assessments will determine whether this is a viable option and determine the number of boreholes required based on their yields. It is required that each borehole should have sufficient capacity to supply water for the plant needs throughout the expected operational life of the plant.

Water will be delivered to a large raw water storage tank, also used to provide site fire protection water, and water for the potable water system. Raw water is pumped from the

storage tank to the water treatment system for demineralized water production. The project will require approximately 273 000 m^3 per annum of raw water.

The water treatment process includes two multi-stage Reverse Osmosis (RO) units, and electro-deionization (EDI) equipment. Pure demineralized water from the process is pumped into a separate demineralized water storage tank. Demineralized water is added to the de-aerator for steam plant makeup, for steam cycle blowdown quench water, and for heliostat washing. Waste water from water treatment system, including 1st pass RO reject and EDI, as well as a portion of the steam cycle blowdown are discharged to the evaporation ponds.

The plant will have a raw water tank with an anticipated capacity of approximately10 000 m^3. The major portion of the raw water is for plant use while a smaller portion of the raw water (2 500 m^3) will be reserved for fire water. The project will operate (generate electricity) an average of about 10-18hours per day, 7 days a week throughout the year, with the exception of scheduled shutdowns for maintenance. However, the water treatment plant will operate an average of approximately 60 percent of each day, in order to minimize water treatment system size and capital cost, and to use off-peak energy at night.

The required Water Use License (WUL) from the Department of Water Affairs (DWA), required in terms of Section 21 of the National Water Act (Act 36 of 1998) is in process of being applied for. The water balance for the proposed project is contained in Appendix I.

3.5 Waste management

Waste management is the process whereby all wastes produced at the proposed plant are firstly minimised or reduced, properly collected, treated (if necessary), re-used and disposed of as a final resort. Wastes include process and sanitary wastewater, nonhazardous waste and hazardous waste, both liquid and solid.

3.5.1 Liquid waste

3.5.1.1 Wastewater Collection, Treatment, and Disposal

The primary wastewater collection system will collect process wastewater from all of the plant systems, including the boiler and steam system drains and water treatment process equipment. To the extent practicable, process wastewater will be recycled and reused to reduce the amount of effluent generated and disposed of. The aggregate discharge from this waste stream will be sent to double-lined evaporation ponds where the water will be retained on site to evaporate, leaving solid waste constituents behind. The anticipated volume of effluent disposed of in the evaporation ponds amount to approximately 4 m^3/h. The plant will include a potable water treatment system to treat raw water to potable quality water for personnel health, safety and sanitary uses around the facility. The system will be sized to accommodate between 40 and 60 operations and maintenance personnel.

3.5.1.2 Plant Drains and Oil/Water Separator

General plant drains will collect containment area wash down, sample drains, and drainage from facility equipment drains. Water from these areas will be collected in a system of floor drains, hub drains, sumps, and piping and routed to the wastewater collection system. Drains that potentially could contain oil or grease will first be routed through an oil/water separator. Water from the plant wastewater collection system make up a portion of the waste disposed of in the evaporation ponds.

3.5.1.3 Boiler Blowdown

The boiler blowdown stream consists of water purged continuously from the boiler during normal operations in order to control the concentration of dissolved solids, silica and pH in the boiler following accepted practices and guidelines for corrosion control. Boiler blowdown flow is purged directly from the boiler steam drum and discharged to a flash tank. Demineralised water is injected into the blowdown flow to limit the temperature of (quench) the blowdown water in order to prevent rapid flashing and over-pressurization when the blowdown water reaches the flash tank which is vented to atmospheric pressure. The flash tank collects and retains a minimum volume of water and drains excess volumes in equilibrium discharging to the evaporation ponds in a relatively continuous flow. When the power plant is operating normally under steady-state conditions, cycle feed water makeup rate and boiler blowdown rate is equal. Flows may vary during transient conditions such as start up, load-changes and shut-down.

3.5.1.4 Sanitary Waste

Sanitary waste streams will be generated at both the administrative building and at the operations building and maintenance areas within the power block. Each area will have a kitchen as well as the requisite quantity of toilets and or showers to support the crew size. At these locations, a septic tank and leach field will be used to capture and treat the flows. As and when required, the septic tank (solids holding tank) will be cleaned out by a vacuum truck and the wastes will be trucked and disposed at a licensed facility. This activity will adhere to the plant safety program as administered by plant personnel.

3.5.2 Solid waste

The Plant will produce maintenance and plant wastes typical of power generation operations. Generation plant wastes include oily rags, broken and rusted metal and machine parts, defective or broken electrical materials, empty containers, broken mirrors, salt that has leaked and hardened, and other solid wastes including the typical refuse generated by workers. Solid wastes will be temporarily kept on site and trucked offsite for recycling or disposal at a suitable recycling facility or licensed landfill site in the vicinity.

3.5.3 Management of Hazardous Materials and Waste

SRSA has assessed and recorded all possible hazardous materials and wastes. There will be a variety of chemicals stored and used during construction and operation of the Plant. Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and most other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Concrete containment pits and drain piping design will allow a full tank capacity spill without overflowing the containment. For multiple tanks located within the same containment area, the capacity of the largest single tank will determine the volume of the containment area and drain piping. Drain piping for reactive chemicals will be trapped and isolated from other drains to eliminate noxious or toxic vapours.

Safety showers and eyewash stations will be provided adjacent to, or in the vicinity of, chemical storage and use areas. Plant personnel will use approved personal protective equipment (PPE) during chemical spill containment and cleanup activities. Personnel will be properly trained in the handling of these chemicals and instructed in the procedures to follow in case of a chemical spill or accidental release. Adequate supplies of absorbent material will be stored onsite for spill cleanup.

Several methods will be employed to properly manage and dispose of hazardous wastes generated by the Plant. Lubricating oil will be rigorously analyzed to ensure maximum equipment reliability and operational life. When end-of-life lubricating oil is replaced, the spent oil will be flushed from the system and recycled by a properly licensed waste oil recycling contractor. Spent lubricating oil filters will be changed at the appropriate frequency and disposed of in a Class H landfill. Salt spills from the system or salt samples extracted pose no significant concerns with respect to hazardous waste. As such, any salt handled outside the closed salt circulation and storage systems will be treated as a controlled substance in terms of the relevant regulations. Plant personnel and maintenance workers will be trained to handle hazardous wastes generated at the site in accordance with all applicable regulations and protocols.

3.5.4 Waste Management Licensing

The most suitable locations on the property will be identified to establish the effluent evaporation ponds. The waste will be classified to ensure that the design of the ponds will be in accordance with the Minimum Requirements of latest National Regulations for Waste Disposal. The design will be submitted to the National Department of Environmental Affairs for approval. The waste management license application form, the Environmental Impact Assessment Report, design of the effluent evaporation pond will form the waste management application that will be sent to the DEA for approval and a license to be issued. The license will contain strict conditions according to which the waste should be managed at the plant.

3.6 Solar Resource

The utilisation of solar power generation rests on the abundance of solar energy required to be transformed to electricity. South Africa and the Northern Cape in particular, are very suitable for the harnessing of solar energy. This is primarily due to the fact that there are predominantly sunny days all year round. However the case may be, the potential of a solar resource still needs to be quantified and the most important measure of solar resource for concentrating solar power projects is Direct Normal Irradiance (DNI).

The average monthly distribution of resource is shown below (Source:*3Tier"s Solar Prospecting Tool (http://www.3tier.com/en/package_detail/solar-prospecting-tools/)*). The annual average DNI for the Humansrus site is – 8.6 ± 0.8 kWh / m^2 / day or 3 139 kWh / m^2 / year. A Meteorological testing station (MET) was installed on the Humansrus site and has been operational since May 2011.

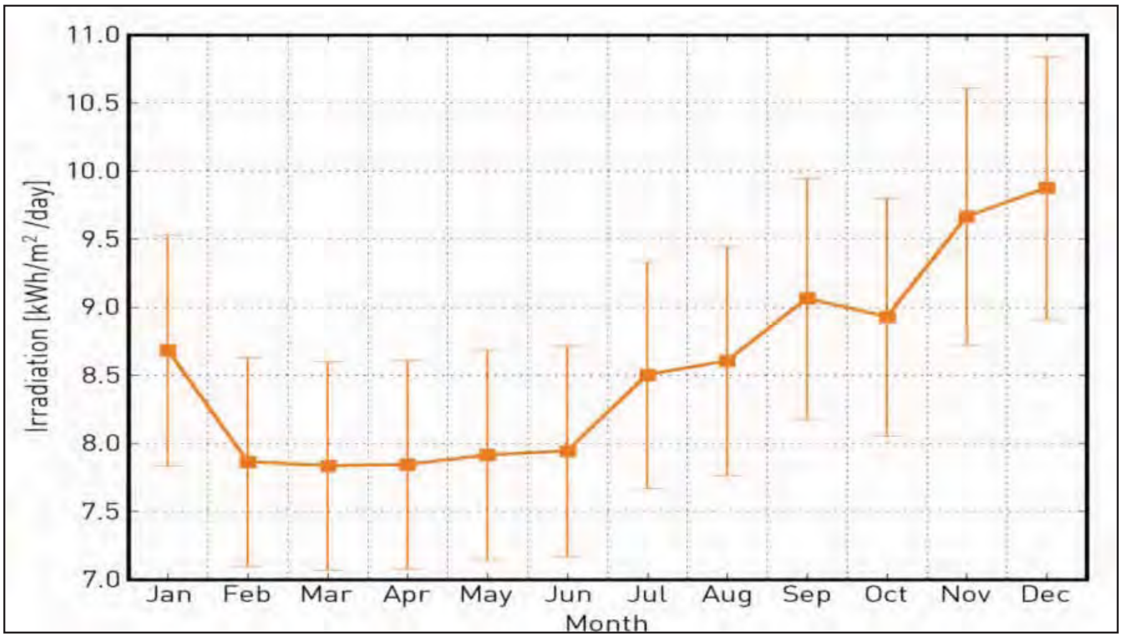


Figure 5: Chart of Direct Normal Irradiance at the Humansrus site (Source: 3Tier's Solar Prospecting Tool).

3.7 Network Integration

The power that is generated by the proposed facility is intended to feed into the national power grid. The network integration options for the project are contained in Appendix H. Applications for a 15 MW construction supply and 100 MW connections to the grid have been submitted to Eskom for approval. It is proposed that a medium voltage collection system will be implemented to conduct the electricity to a substation which will connect the facility to the national grid via any one of two existing 132 kV overhead transmission lines, one which passes along the south-western boundary or another to the north of the site. Figure 6 shows the routing options from

the proposed CSP substation at the tower. Please refer to Appendix H to view the three design options for the integration of the power lines from the plant with the existing 132 kV Eskom power lines.

3.8 Property Description

The proposed development will be located on the Farm 469 Hay RD (Humansrus). The site is situated approximately 5km south-east of the Groenwater community and 30 km east of Postmasburg, and falls within the jurisdiction of the Tsantsabane Local Municipality of the Siyanda District, in the Northern Cape.

The farm owner is Allan Scholtz, who is the son of the registered title deed holder according to will and testament findings. The property is registered as follows:

Table 2: Registered Land Owner

Ownership	Property Description	Size (ha)	Title Deed Nr.
Scholtz Johanna Magdalena Alberta	Farm 469 Hay RD (Humansrus)	± 2229.5	T880/1988

3.8.1 Access Roads and Site Access

The site will be accessed via the R385 or D3381. Within the site area, existing farm tracks will be up-graded and new gravel roads may be constructed to facilitate movement of construction and maintenance vehicles. Site access roads that are developed will be up to 6 m wide with associated infrastructure including drainage trenches adjacent to the road according to the road agency guidelines.

3.9 Project Rationale

SRSA intends to invest equity in all of its projects and maintain that equity over a long period of time, for this reason SRSA has a truly vested interest in the long term success of the proposed project and the renewable energy sector as a whole. The achievement of this goal can only be realised when it is aligned with the policies, plans and targets for the sector set by the South African government.

The primary objectives of SRSA are:

- Where the parties work together to disperse knowledge;
- To create jobs in a new industry in order to position ourselves as a world leading South African industry capable of being deployed to other markets around the globe; and

– To reduce the price of electricity produced through a concerted joint R&D program which will look to improve performance and reduced the cost of installation, operation and maintenance.

The technology proposed by SRSA enables South Africa to construct, operate and maintain an efficient, economic, reliable, safe and environmentally-sound, solar-powered generating facility. The facility will help meet the regional and national objectives mandated for renewable electric energy. The site selected is located in an area where there is excellent solar resource.

The project cost is approximately R 6.5 billion, 70% of which could potentially be spent in South Africa on procurement of local materials, services, and labour. It is estimated that the project could create up to 22 000 jobs throughout the country during the peak of construction and about 65 sustainable employment opportunities during operations. Given the aforementioned, the project will make a notable contribution towards the achievement of the job creation targets set in the New Growth Path.

The Project is designed to meet the increasing demand for clean, renewable electrical power in South Africa. The multiple benefits associated with developing renewable energy infrastructure have been recognized by both local regional and National policy-makers. Development of solar resources reduces reliance on foreign sources of fuel, promotes national energy security, diversifies energy portfolios and contributes to the reduction of greenhouse gas emissions at the same time creating a large number of jobs within a new industry at the same time raising the core knowledge bases of the country. In addition, the Kyoto Protocol, as a result of concern about climate change, establishes the obligation of reducing green-house effect gas emissions by industrialised countries including South Africa. Energy efficiency and the use of renewable energy sources are presented as sustainable solutions leading to a reduction in $C0_2$ emissions into the atmosphere.

South Africa has committed to a target in the *Integrated Resource Plan for Electricity 2010-2030*, that 17.8 GW of primary energy consumption should come from renewable sources by 2030.In addition to these environmental and legislative reasons, the fact is that renewable energy sources mean a reduction in the country‘s energy dependence on carbon fuels, increasing the safety and quality of the energy supply and providing a valuable source of employment.

South Africa‘s climate is ideal with regards to solar resources, with a broad time band of sunlight and a high level of energy delivered by area of land. Utilising this solar resource in combination with SolarReserve‘s exclusive molten salt storage system makes it an ideal system in the generation of renewable energy. Further to its environmental attributes, the project will contribute much needed on-peak power to the electrical grid serving the region. The additional demand for power continues to grow in other regions as older technology fossil fuel plants reach the end of their shelf lives. The additional demand for power in South Africa over the period 2009 until 2020 is shown below, as submitted to NERSA by Eskom, (Eskom‘s Multi-Year Price Determination 2 (MYPD 2) Application (2010/11 to 2012/13):

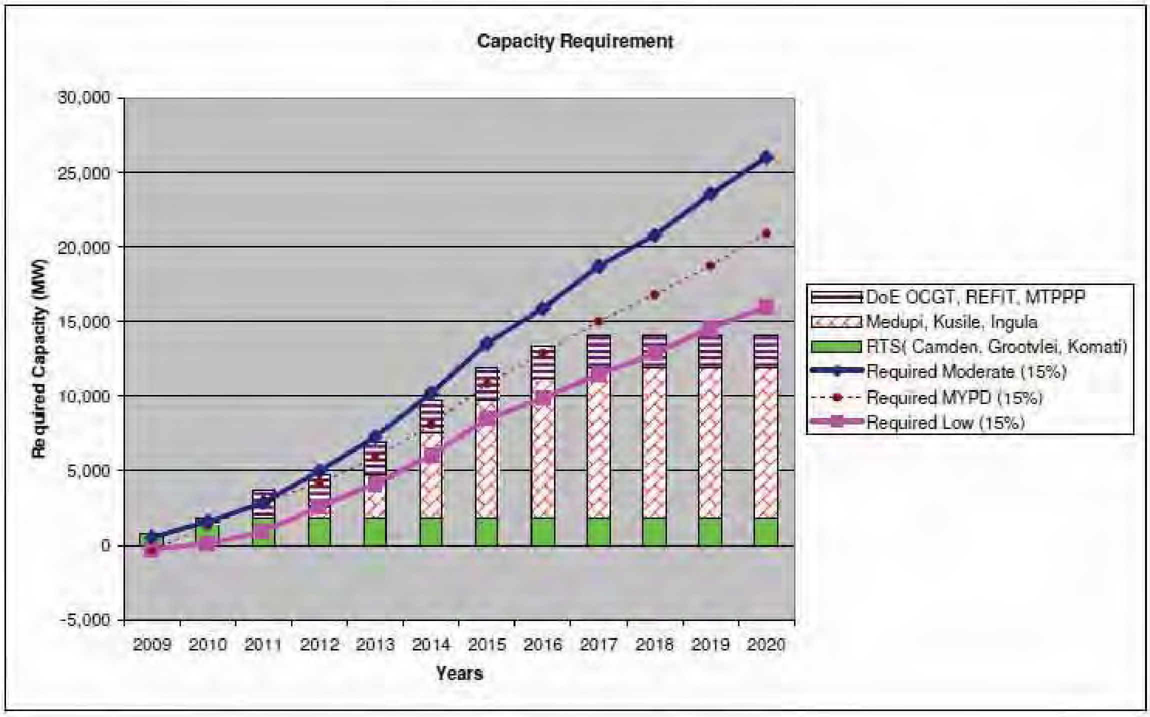


Figure 6: Additional power demand in South Africa(2020)

Power demand in South Africa is growing at a rate whereby power cuts due to shortages are anticipated within the next three years. Demand for electricity rose by 5.4% 2010 in comparison to 2009 with an annual forecast growth of 1.3% per Eskom's MYPD 2 Application (2010/11 to 2012/13). In order to meet these demanding requirements, which is a clear indication of the country's future growth prospects, South Africa must facilitate the rapid build out of capacity in order not to limit the countries potential.

	Low (GWh)	% Growth	Reference (GWh)	% Growth	Moderate (GWh)	% Growth
2010/11	220,260	1.0%	229,260	5.4%	226,790	4.0%
2011/12	224,737	2.0%	235,674	2.8%	232,816	2.7%
2012/13	232,388	3.4%	241,974	2.7%	245,288	5.4%
2013/14	239,536	3.1%	250,250	3.4%	256,755	4.7%
2014/15	248,621	3.8%	260,787	4.2%	270,774	5.5%
2015/16	258,921	4.1%	274,336	5.2%	285,856	5.6%
2016/17	265,399	2.5%	283,503	3.3%	297,547	4.1%
2017/18	271,946	2.5%	292,756	3.3%	309,650	4.1%
2018/19	279,163	2.7%	302,025	3.2%	320,790	3.6%
2019/20	286,388	2.6%	310,901	2.9%		

Figure 7: Future sales growth: (Eskom's MYPD 2 Application (2010/11 to 2012/13)

The project offers the following key benefits:

- Job creation: The project will make a notable contribution towards achievement of the New Growth Path targets related to job creation, and particularly the 2020 target of creating 300 000 jobs to green the economy. The project will create many jobs during construction and more sustainable employment opportunities during operation. Importantly, it will improve the employment situation in the local economy and contribute to skills development of the involved workers.
- Economic development: The project will stimulate the development of national and local economies during operation. This will result in the expansion of the existing manufacturing industries and the creation of new businesses in the country. From a local economic perspective, it will diversify the local economic structure and reduce its dependency on the mining sector.
- Green House Gas emission savings: The project will make a direct contribution towards the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity, as outlined in the Integrated Resource Plan (IRP2) dated February 2010. The potential Green House Gas (GHG) emission savings from generation of electricity that could be achieved by the project are about 487 200 tons of CO2 - equivalent.
- Reduced power line losses: The project will be located in the Northern Cape, which means that it will provide support to the grid system in areas that is in need for reliable supply of electricity generating facilities that could negate power line losses.
- Water savings: The project will minimize the use of water compared to the conventional power generation technologies by utilizing an air cooled condenser.
- Power generation flexibility: The project can provide flexibility for the region‘s renewable power supplies by being able to generate electricity for a short period of time or electricity over a longer period of time without changing the size of the solar array but by changing the power generating capacity.

4 Project Alternatives

4.1 Site Location Alternatives

An integrated site selection study was done in order to identify a suitable site for the proposed solar power plant.

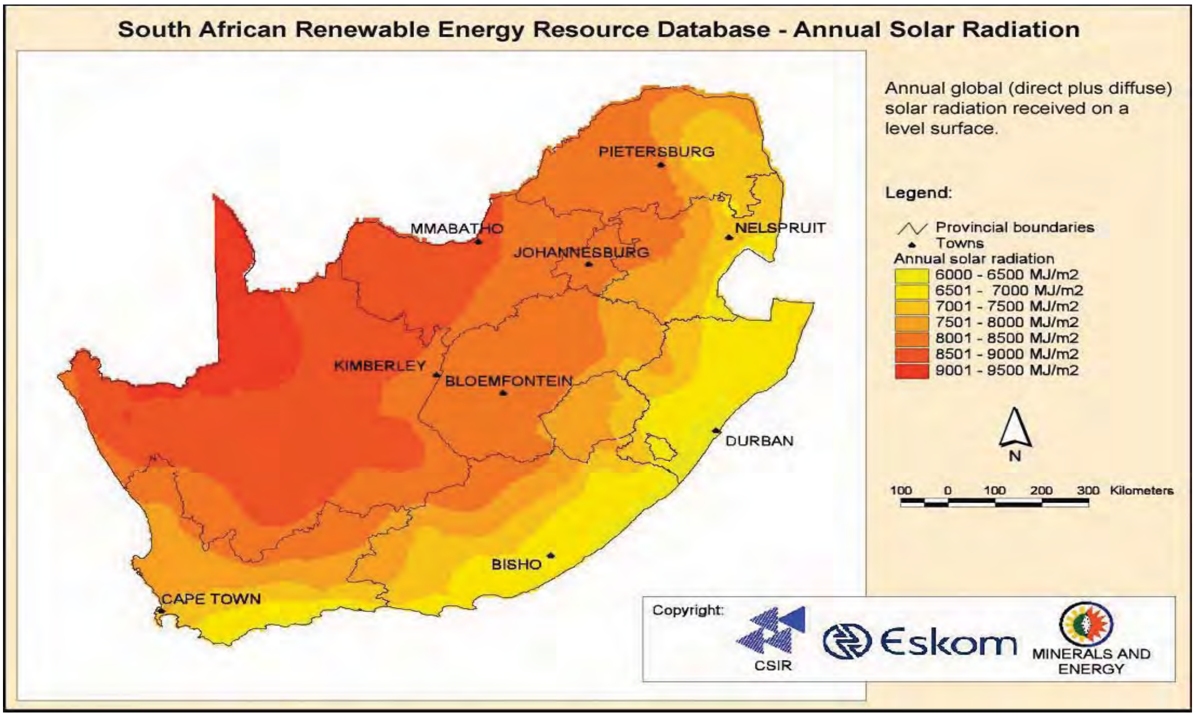


Figure 8: Annual incoming short wave radiation for South Africa

The proposed solar energy site on the farm Humansrus is considered highly desirable due to the following considerations:

– Solar resource: Analysis of available data from existing weather stations suggests that the site has sufficient solar resource to make a solar energy facility viable (Figure 8).

– Site extent: Sufficient land was secured under long-term lease agreements with the land owner to enable sufficient power supply and to allow for a number of heliostats to make the project feasible.

– Land suitability:

  - Sites that facilitate easy construction conditions (relatively flat land with few rock outcrops or water-bodies) were favoured during site selection.

  - Location of the site in relation to its close proximity to the Sedibeng Pipeline.

  - The site position will strategically strengthen the national grid.

  - Close to energy intensive mining area.
  - Surrounding ridges and hills act as a screen to reduce the visual impact.
  - Avoidance of obvious environmentally sensitive areas.
- Landowner support: The selection of sites where the land owners are supportive of the development of renewable energy is essential for ensuring the success of the project.
- Consideration of the above criteria resulted in the selection of the preferred site. No further site location alternatives are considered in the EIA process.

4.2 Site Layout Alternatives

The heliostats layout and project component design may undergo a number of iterations based on technical aspects of the project such as detailed site specific solar data and construction conditions, and the environmental and social considerations which will be explored during the EIA process.

From a technical perspective, the layout depends on a number of factors including:

- local topographical conditions and the aspect of the site in relation to the sun's daily movements;
- the intensity of the solar resource at the site as determined from on site measurements and data modelling; and
- Other local meteorological conditions such the amount of suspended particles in the air (dust).

An indicative project layout will be developed using the resource data that is currently available. After initial field surveys by the EIA team, particular areas posing environmental and social constraints will be identified. The technical team will then generate a revised development layout taking these environmental and social constraints into consideration.

The output of this process will encompass the consideration of layout alternatives and will be used in the assessment of impacts in the EIA report.

4.3 Technology Alternatives

4.3.1 Concentrated Solar Power (CSP) Systems

There are three CSP systems that were considered for the proposed project. The three systems are the most prominent systems in use worldwide and each system is concisely described below. Ultimately it was determined that the power tower system is the most feasible option for the proposed site and the local conditions and the designs and calculations for the proposed plant were based on the utilisation of this system.

4.3.1.1 Linear systems

Linear CSP systems typically consist of a large number of parallel rows of parabolic (u-shaped) reflectors that track the sun from east to west during the day and concentrate the sunlight on a pipe that runs down the focal line of each trough. The concentrated sunlight is amplified 30 to 100 times its normal intensity on the pipe containing heat transfer fluid (oil). The fluid flows through the pipe and is used to boil water and generate steam. The steam is used in a conventional steam turbine to generate electricity.

Linear Fresnel reflector concentrating systems are configured similarly to that of the linear CSP. It uses Fresnel lenses and mirrors to concentrate the sunlight onto a fixed receiver tube above the mirrors.

The mirrors are mounted on trackers that are configured to follow the sun and ensure that the rays are concentrated on the focal point of the receiver. The mirrors are flat or slightly curved and are not as optically efficient as the trough reflectors.

4.3.1.2 Power Tower

Power tower systems utilize many flat, sun-tracking heliostats (mirrors) to concentrate sunlight onto a receiver on top of a central receiver tower. Heat transfer fluid flowing through the receiver is heated by the concentrated sunlight and the heated fluid generates steam, which by means of a steam turbine generates power.

Molten salt is the preferred heat transfer fluid for the power tower system due to its superior heat transfer and heat storage capabilities which enables it to be effective in generating steam even when the sun is not shining or during cloudy conditions.

4.3.1.3 Dish Engine

The dish engine uses mechanical energy rather than steam to generate electricity. A large mirrored dish tracks the sun and concentrates the sunlight onto a receiver at the focal point of the dish. The receiver is integrated into a high efficiency combustion engine that has thin tubes containing helium or hydrogen gas that expands when heated. The tubes run on the outside of the engine‘s four piston cylinders and open into the cylinders.

As the gas is heated to high temperatures it expands in the cylinders driving the pistons and effectively drives an electric generator. This system does not lend itself to thermal storage and will only generate electricity when the sun is shining.

4.3.2 Heat transfer mediums

There are 3 main heat transfer mediums used in utility scale concentrating solar power facilities. Oil, or Therminol, is the liquid used in a typical parabolic trough solar power project (molten salt is typically not used as there are many kilometres of horizontal piping, unlike a central tower project, which has only short lengths of almost exclusively vertical tubing). The main heat

transfer mediums used in central power tower projects are steam (-Direct Steam" method) or molten salt.

The comparative advantages of these heat transfer mediums are summarised in Table 3 below:

Table 3: Comparative Advantages

Oil	Direct Stream	Molten Salt
Issues:	**Issues:**	**Advantages:**
– 1.6 km of tube per MW – Sourcing Vacuum Tubes – Toxic Therminol – Curved, Stressed Glass – Requires Natural Gas – Loses Energy at Night – Requires large volume of water – Low temperature change – No inherent storage – Low quality steam	– High pressure piping (thick wall, expensive, safety) – Two phase flow (erratic flow control, high stress, turbine erosion, more complex start up) – Typically requires natural gas – No inherent storage – Complex water / steam control	– Primary heat transport – Meters of tube, not kilometers – Inherent storage – Dispatchable / On Demand – No Natural Gas required – No energy loss at night – High quality steam – Standard steam turbine

4.3.3 Cooling Alternatives

In thermal power generation there are predominantly three types of cooling systems that are in use. These are wet cooling, dry cooling and hybrid wet/dry cooling systems. These systems were evaluated and compared and the most suitable alternative selected for the proposed project.

4.3.3.1 Wet Cooling

Evaporative wet cooling is widely considered to be the most common method for new power plants due to its economical and high performing cooling technique. This technique however consumes high volumes of water, in access of 1 million cm^3 per annum. Waste heat energy dissipated from the power plant is rejected to the air through evaporation of the cooling water. The cooling water evaporates in a cooling tower. As a result of the continuous evaporation, water treatment chemicals and minerals contained in the water become concentrated over time and require that a portion of the cooling water (-blowdown") be drained to remove high concentrations of accumulated salts and particulates. This is a potential source of an environmentally hazardous substance.

4.3.3.2 Dry Cooling

Dry cooling uses considerably less water than dry cooling and is becoming more prevalent in new power plants due to the limitations on water in arid areas, where most solar thermal power

plants are established. All of the waste heat from the plant is rejected to the air. Air has a much lower capacity to carry heat and is considered less efficient than water as a cooling medium. Large fans are required to remove the heat from the pipe array in the cooling system and often these fans use a portion of the power generated by the plant. This effectively causes dry cooling to have a reduced thermal efficiency compared with wet cooling. The dry cooling system does not create any environmentally hazardous blowdown. In summary dry cooling uses less water but the plant produces slightly less power as a result.

4.3.3.3 Hybrid Wet/Dry Cooling

Hybrid cooling involves a combination of wet and dry cooling. Hybrid designs are aimed at reducing water consumption in comparison with wet cooling and enhance the plant‘s performance in warm weather when the thermal efficiency of dry cooling is least effective. Hybrid systems either involve separate wet and dry systems that operate in parallel or use water to cool the air used in the air cooled condenser. This system uses a fraction of the water of wet cooling and the turbine performance can be maintained on or close to design conditions. Considerably less blowdown will be resultant when compared with wet cooling. It is less expensive than an air-cooled plant and more expensive than a water-cooled plant.

4.4 No-go Alternative

The –no-go” alternative is mandatory and has to be considered as a definite alternative. It entails that the development does not take place and that the proposed site remain in its current state and that the current land use and activities be continued. Currently the proposed site is in an undeveloped state with the most notable activities being the mining of red jasper on the north western boundary and the utilization of the land for grazing of horses, cattle and game. There are two notable cattle paddocks/kraals on the proposed site utilizing groundwater for watering purposes. Should the *status quo* be maintained it would entail that the site will continue to be utilized for the current agricultural practices with no projected growth in the creation of additional jobs. The current proportionate contribution to the GDP will be maintained and no formal skills development is expected to take place. The current low environmental impact associated with long term sustainable farming practices will be maintained and no change in land use or zoning would be required. The *status quo* needs to be measured against the proposed facility to determine whether the environmental and socio-economic benefits warrant the approval thereof or whether the *status quo* should be maintained.

5 Legislative Overview

5.1 The National Framework

A summary of all legislation pertaining to and the relevance thereof on the proposed Humansrus Solar Thermal Energy Power Plant and the permitting thereof, are contained below. This legislation includes the following:

- The Constitution of the Republic of South Africa (Act No.108 of 1996);
- National Environmental Management Act (Act No. 107 of 1998)
- National Environmental Management: Waste Act (Act No. 59 of 2008);
- National Environmental Management: Air Quality Act (Act No. 39 of 2004);
- Mineral Petroleum Development Resources Act (Act No. 28 of 2002);
- National Water Act (Act No. 36 of 1998);
- National Heritage Resources Act (Act No. 25 of 1999);
- National Environmental Management: Biodiversity Act (Act 10 of 2004)

5.1.1 Constitution of South Africa

Section 24 of Chapter 2, the Bill of Rights, of the Constitution of South Africa is the cornerstone of the protection and conservation of the environment through responsible and sustainable development for the benefit of the citizens of this country and future generations. It reads as follow:

24) "Everyone has the right –

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -

i. prevent pollution and ecological degradation;

ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

In terms of the proposed development the Constitution upholds the rights of all the surrounding citizens to a clean and healthy environment and that the environment is protected through sustainable development practices whilst promoting economic and social development. The impact of the proposed project on the environment and citizens of the Republic must be determined *"through reasonable legislative and other measures"*.In order to give effect to Section 24 numerous environmental laws, of which the National Environmental Management Act is but one, were instituted to protect and manage the environment and to promote sustainable development.

5.1.2 National Environmental Management Act

The relevant legislation pertaining to the Environmental Authorization for development projects and this application in particular is the National Environmental Management Act (NEMA) (No. 107 of 1998) as amended, and the EIA Regulations of 2010 promulgated under NEMA. NEMA requires that activities be investigated that may have a potential impact on the environment, socio-economic conditions and cultural heritage. Various activities of the proposed project will definitely impact on the environment and requires assessment by means of an EIA. The results of the EIA must be reported to the relevant authority. Procedures for the investigation and communication of the potential impact of activities are contained in Section 24 (7) of the Act.

Section 24(C) of the Act defines the competent decision-making authority which is normally the provincial environmental department. However, as set out in Section 4.1 of the ‗Guideline on Environmental Impact Assessments for Facilities to be Included in the Electricity Response Plan', GN 162 of 2010, all EIA applications from Independent Power Producers (IPPs) or those involving co-generation, where these are included in the National Energy Resource Plan (NERP), the DEA shall be the competent authority.

5.1.3 EIA Regulations

On 18 June 2010 new EIA Regulations (Government Notice No R.544, 545 and 546) were promulgated in terms of Section 24(5) of NEMA. These Regulations came into effect on 2 August 2010and was further corrected in December 2010, superseding the regulations of 21 April 2006. The Regulations will determine whether a Basic Assessment or EIAR is applicable to a proposed project based on the listed activities in the Regulations. In relation to the proposed project a Scoping and EIAR will be required due to certain listed activities in the EIA Regulations.

5.1.4 Activities Applied for in Terms of the NEMA

In terms of Government Notices No. R544, R545 and R546 published in the Government Gazette no. 33306 of 18 June 2010 of the National Environment Management Act, 1998 (Act No. 107 of 1998) an Environmental Impact Assessment Process is required for the above-mentioned project. The following listed activities are being applied for:

Table 4: Listed activities in terms of Government Notice No. R544.

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
R. 544, 18 June 2010	Activity 9	The construction of facilities or infrastructure exceeding 1 000 meters in length for the bulk transportation of water, sewage or storm water –

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
		with an internal diameter of 0,36 meters or more; or with a peak throughput of 120 liters per second or more, excluding where: such facilities or infrastructure are for bulk transportation of water, sewage or storm water drainage inside a road reserve; or where such construction will occur within urban areas but further than 32 meters from a water course, measured from the edge of the watercourse.
R. 544, 18 June 2010	Activity 10	The construction of facilities or infrastructure for the transmission or distribution of electricity – outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.
R. 544, 18 June 2010	Activity 11	The construction of: canals; channels; bridges; dams; weirs; bulk storm water outlet structures; marinas; jetties exceeding 50 square meters in size; slipways exceeding 50 square meters in size; buildings exceeding 50 square meters in size; or infrastructure or structures covering 50 square meters or more where such construction occurs within a watercourse or within 32 meters of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.
	(12)	The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010;
R. 544, 18 June 2010	Activity 13	The construction of facilities or infrastructure for the storage, or for the storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
		meters;
R. 544, 18 June 2010	Activity 22	Construction of a road, outside urban areas; with a reserve wider than 13, 5 meters or, where no reserve exists where the road is wider than 8 meters, or for which environmental authorization was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity in Notice 545 of 2010.

Table 5: Listed activities in terms of Government Notice No. R545.

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
R. 545, 18 June 2010	Activity 1	The construction of facilities for the generation of electricity where the electricity output is 20 megawatts or more.
R. 545, 18 June 2010	Activity 3	Construction of facilities or infrastructure for the storage, or storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic meters;
R. 545, 18 June 2010	Activity 15	Physical alteration of undeveloped, vacant or derelict land for residential, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; Except where such physical alteration takes place for: linear development activities; or agriculture or afforestation where activity 16 in this Schedule will apply.
R. 545, 18 June 2010	Activity 26	Commencing of an activity, which requires an atmospheric emission license in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), except such commencement requires basic assessment in terms of Notice of No R 544 of 2010.

Table 6: Listed activities in terms of Government Notice No. R546

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
R. 546, 18 June 2010	Activity 2	The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
		meters. In Eastern Cape, Free State, Kwa-Zulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces: Outside urban areas, in: (bb) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;
R. 546, 18 June 2010	Activity 4	The construction of a road wider than 4 meters with a reserve less than 13,5 meters. In Eastern Cape, Free State, Kwa-Zulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces: Outside urban areas, in: (cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.
R. 546, 18 June 2010	Activity 10	The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic meters. In Eastern Cape, Free State, Kwa-Zulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces ii. Outside urban areas in; (cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans
R. 546, 18 June 2010	Activity 12	The clearance of an area of 300 square meters or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. Within critical biodiversity areas indentified in bioregional plans;
R. 546, 18 June 2010	Activity 13	The clearance of an area of 1hectare or more of vegetation where 75% or more of the vegetative cover constitutes vegetation, except where such

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
		removal of vegetation is required for: The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act no 59 of 2008) in which case the activity is regarded to be excluded from this list. Critical biodiversity areas and ecological support areas as identified in the systematic biodiversity plans adopted by the competent authority. In Eastern Cape, Free State, Kwa-Zulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces ii. Outside urban areas, in: (cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;
R. 546, 18 June 2010	Activity 14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act no 59 of 2008) in which case the activity is regarded to be excluded from this list; In Eastern Cape, Free State, Kwa-Zulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces All areas outside urban area
R. 546, 18 June 2010	Activity 16	The construction of: jetties exceeding 10 square meters in size; slipways exceeding 10 square meters in size; buildings with a footprint exceeding 10 square meters in size; or infrastructure covering 10 square meters or more where such construction occurs within a watercourse or within 32 meters of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces ii. Outside urban areas in; (dd) Sensitive areas as identified in an

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
		environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority; (ff) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.

5.2 National Environmental Management: Waste Act

In terms of Schedule 1of the National Environmental Management: Waste Act (NEMWA), certain activities will require environmental authorization. With regards to the proposed project there are activities that are applicable and will require authorization prior to the commencement of the activities.

5.2.1 Activities applied for in terms of the NEM: Waste Act

It is required in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718 of 2009 that prior to the commencement of any construction activities the competent authorities must review and authorize the EIA required for the following activities and issue a waste license accordingly:

Table 7: Listed activities in terms of Government Notice No. R718 of 2009

Number and date of the relevant notice:	Activity No(s) (in terms of the relevant notice) :	Listed activity description:
GNR. 718, 03 July 2009	Category B (1)	The storage including the temporary storage of hazardous waste in lagoons.
	Category B (5)	The treatment of hazardous waste using any form of treatment regardless of the size or capacity of such a facility to treat such waste.
	Category B (11)	The construction of facilities for activities listed in Category B

5.3 National Environmental Management: Air Quality Act

The National Environmental Management: Air Quality Act (NEMAQA) requires that certain listed activities, which are ‗problem' processes, obtain an Atmospheric Emission Licence. In terms of the list of activities for Section 21 of NEMAQA the proposed project will require an Air Emission License due to the utilization of diesel generators that are classified as a *"liquid fuel combustion installation".*

5.4 Mineral Petroleum Development Resources Act

The proposed activity will require the use of borrow material during construction and the borrow material will be obtained from borrow pits with suitable material in close proximity to the site. The utilization of a borrow pit is classified in terms of the Mineral Petroleum Development Resources Act (MPRDA) as a mining activity and will require a mining permit if the pit is smaller than 1.5 ha and will be utilized within 2 years of the authorization thereof.

5.5 National Water Act

The National Water Act (NWA) compels any water use in terms of Section 21 of the Act to be licensed. Various activities of proposed project are classified as water uses and will require a Water Use Licence. These activities in terms of Section 21 include but are not limited to:

a) Taking water from a water resource;

b) Storing water;

c) Impeding or diverting the flow of water in a watercourse; and

i) Altering the bed, banks, course or characteristics of a watercourse.

5.6 National Heritage Resources Act

With regards to the heritage resource management there are certain listed activities in Section 38 of the National Heritage Resources Act (NHRA) that require assessment of the potential impact on the heritage resources. The applicable activities related to the proposed Humansrus development includes but are not limited to the following:

(1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

(a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(c) any development or other activity which will change the character of a site—

(i) exceeding 5 000 m^2 in extent; or

(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or provincial heritage resources authority,

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

5.7 National Environmental Management: Biodiversity Act

The objectives of the National Environmental Management: Biodiversity Act (NEMBA) in relation to the proposed Humansrus Project are:

(a) within the framework of the National Environmental Management Act, to provide for-

(i) the management and conservation of biological diversity within the Republic and of the components of such biological diversity;

(ii) the use of indigenous biological resources in a sustainable manner;

5.8 Provincial or District Policies, Guidelines and Frameworks

In order to put the proposed project in a regional context it is necessary to investigate the applicable Provincial or District environmental and development policies, guidelines or frameworks. From this point of view it was determined from the Siyanda District Municipality Environmental Management Framework that the area is reliant on groundwater and that the utilisation of the resource is nearing its limits with little potential for further development of the resource. Detailed geohydrological assessments should determine the potential for the utilisation of this resource and the possible impact on the resource in terms of utilisation and pollution.

6 Public Participation Process

6.1 Overview of the Public Participation Process undertaken during the Scoping Phase

The Public Participation process for the project is conducted in accordance with Chapter 6 of the EIA Regulations. The outcomes of the Public Participation Process up to date is contained in the Issues and Response report (Annexure D). The primary aims of the Public Participation (PP) Process during the Scoping Phase were:

- To inform Interested and Affected Parties (I&APs) of the proposed project;
- To identify issues, comments and concerns as raised by I&APs;
- To promote transparency and an understanding of the project and its consequences;
- To serve as a structure for liaison and communication with I&APs; and
- To provide local knowledge and input in identifying potential environmental (biophysical and social) impacts and ―hotspots" associated with the proposed development.

6.2 Identification of Key Stakeholders

The first step in the PP Process was to identify key stakeholders, including:

- National and Provincial Government Representatives:
    - Department of Environmental Affairs (DEA);
    - Department of Water Affairs (DWA);
    - Department of Agriculture, Forestry and Fisheries (DAFF);
    - South African Heritage Resources Agency (SAHRA); and
    - Relevant Northern Cape Provincial Authorities (ex. Environment & Conservation, Agriculture).
    - Relevant Local and District Municipalities:
    - Siyanda District Municipality;
    - Tsantsabane Local Municipality; and
    - Kgatelopele Local Municipality.
- Parastatals – Eskom, Civil Aviation Authority;
- Affected and surrounding landowners;
- Environmental Non-Governmental Organizations (e.g. Wildlife Society of South Africa, BirdLifeSA);
- Community based organisations; and

- Other (i.e. Sedibeng Water. Air Traffic and Navigation Systems, Lime Acres Mine)

All I&AP information (including contact details), together with dates and details of consultations and a record of all issues raised is recorded within a comprehensive project database. This database will be updated on an on-going basis throughout the project, and will act as a record of the communication/public consultation process.

6.3 Advertising

As per the statutory requirements of the 2010 EIA Regulations, the project was advertised in the following local newspapers on 14 July 2011:

- *Diamondfield Advertiser (English); and*
- *Kalahari Bulletin (Afrikaans and Setswana).*

The advertisement provided an abstract on key aspects of the proposed project (project description, location, application process and contact details of the Environmental Assessment Practitioners). Furthermore the advertisement requested I&APs to register, and to become involved in the project by submitting comments and highlighting issues of concern to the WorleyParsons RSA and SSI Environmental. The primary aim of the newspaper advert was to ensure that the widest possible group of I&APs were informed of the project.

The notification of the availability of the Draft EIAR for public review will be published in the same newspapers in conjunction with the notification of any public meetings to be hosted.

6.4 Background Information Document

A Background Information Document (BID) for the project was compiled in predominant languages of the area namely: English, Afrikaans and Setswana. The aim of this document was to provide a brief outline of the proposed project, the EIA Process, specialist studies to be undertaken, alternatives being investigated, the PP Process and lastly explained how I&APs could become involved in the project. The briefing paper, together with a *"registration and comment"* sheet was distributed to identified stakeholders and I&APs via either post or e-mail, inviting them to register for the proposed project and submit details of any issues and concerns that they may have. An introductory letter was sent to all I&APs and Stakeholders together with the briefing paper and comments sheet.

Furthermore BIDs were placed at:

- Kgatelopele Local Municipality Public Library (222 Barker Street, Daniëlskuil);
- Tsantsabane Local Municipality Public Library (Bo Street, Postmasburg); and
- Tsantsabane Local Municipality mobile Public Library in Groenwater.

6.5 Site Notices

Site notices were prepared according to the requirement set out in the EIA Regulations. The site notices included basic information regarding the proposed project, application process, I&AP registration and contact details of the Environmental Assessment Practitioners. Three site notices (English, Afrikaans and Setswana) were place date the northern boundary of the development site in close proximity to the site entrance from the R385 – refer to Figure 9.

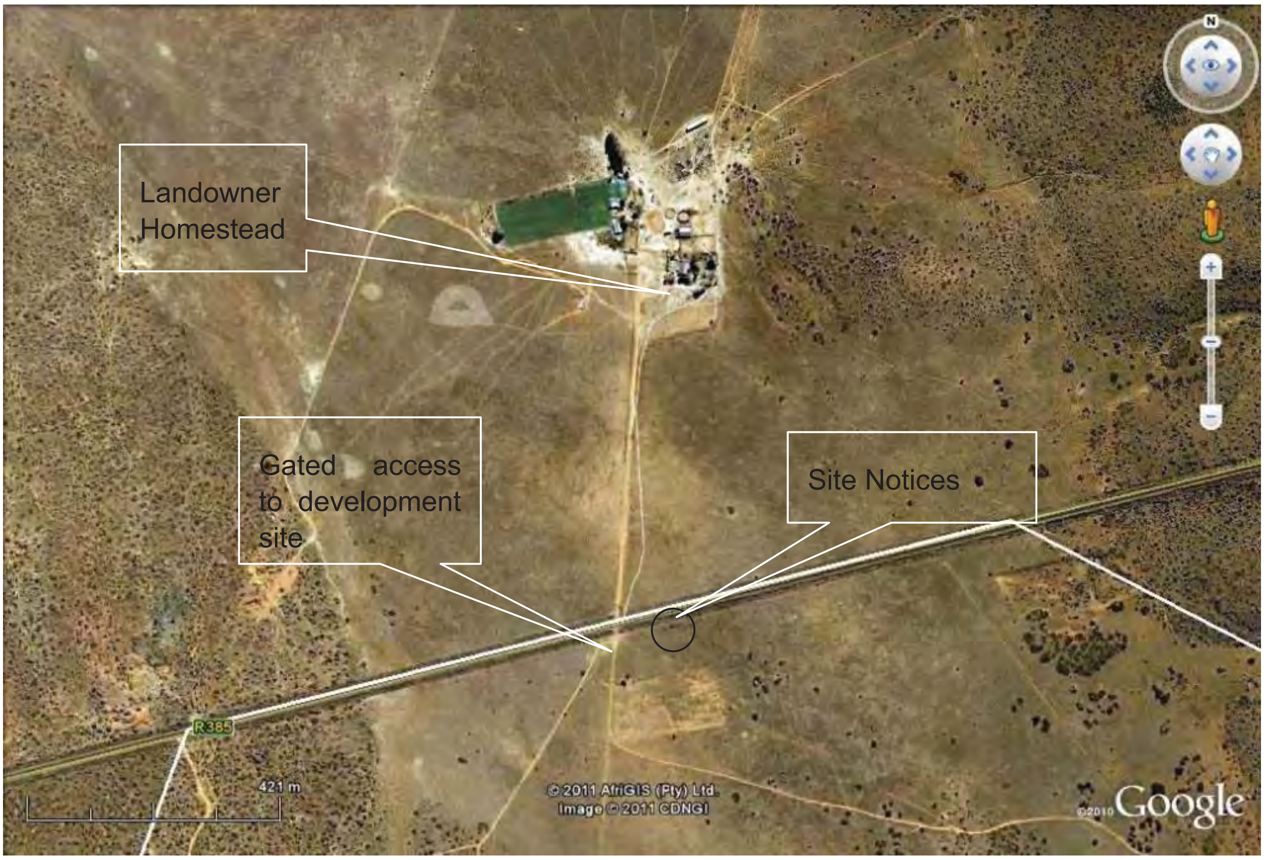


Figure 9: Site notice

6.6 Pamphlets and Notices

The site notice was printed on A5 sized paper (pamphlets) and distributed via the South African Post Office Services post boxes in Postmasburg (± 1 100 post boxes) and Daniëlskuil (± 800 post boxes).

Furthermore sets of A4 and A3 site notices were placed on notice boards at the following amenities frequented by I&APs in both the Postmasburg and Daniëlskuil areas:

- Postmasburg:
    - Tsantsabane Local Municipality;
    - Postmasburg Agricultural Centre;
    - SPAR; and
    - Saverite.
- Daniëlskuil:
    - Kgatelopele Local Municipality;
    - OK Foods;
    - Friendly Grocer; and
    - Saverite.

6.7 Review of Draft Environmental Scoping Report

6.7.1 Public Review of Draft Environmental Scoping Report

The draft Environmental Scoping Report was available for public review at the following locations in close proximity to the study area, which were identified as readily accessible to I&APs:

- Tsantsabane Local Municipal offices;
- Postmasburg Public Library – Bo Street, Postmasburg;
- Kgatolopele Local Municipal offices;
- Daniëlskuil Public Library – 222 Barker Street, Daniëlskuil;
- Mobile Public Library in Groenwater;
- The following website: WorleyParsons RSA : www.kv3engineers.com.

The availability of this draft report was advertised in the Diamondfield Advertiser and Kalahari Bulletin on 18 August 2011. On-site notices were also placed on the perimeter of the site, pamphlets were distributed in the post boxes of Daniëlskuil, Postmasburg and Lime Acres and posters were placed on community notice boards at the following venues:

Daniëlskuil

- Friendly Grocer;
- OK Foods;
- Kgatelopele Local Municipality; and
- Siyanda District Offices of the Department of Social Services and Population Development.

Lime Acres

- Lime Acres Family Store

Owendale village

- Entrance gate to the Owendale village

Postmasburg

- SPAR; and
- Saverite.

A 60-calendar day period was allowed for this review process from 18 August 2011 to 17 October 2011. Stakeholders and I&APs on the project database were notified of the availability of this report via post or e-mail. The report was also distributed to all the commenting authorities for review and comment in electronic or hard copy format.

6.7.2 Final Environmental Scoping Report

The compilation of the Final Scoping Report entailed the consideration and inclusion of all relevant comments received from the public during the review of the Draft Scoping Report. The final document was submitted to DEA as well as Northern Cape Provincial Department of Environment Affairs and Conservation for authority review and decision-making and/or commenting purposes.

6.8 Consultation and Public Involvement

Through consultations with I&APs and Stakeholders, issues for inclusion within the Final Scoping Report were identified and recorded. Consultations took place in the form of formal meetings with I&APs and other stakeholders. The primary aims of the meetings were to:

- Disseminate background information regarding the proposed project to I&APs;

- Supply more information regarding the EIA Process and the findings of the specialist studies undertaken during the Scoping Phase;
- Answer questions regarding the project and the EIA Process;
- Obtain feedback from I&APs with respect to the proposed project; and
- Receive input regarding the Public Participation Process.

Three public meetings with I&APs were held during the public review period of the Draft Scoping Report. The meetings were held at:

- The Postmasburg Town Hall on 25 August 2011 at 17:30; and
- Groenwater Community Hall (approximately 5 km west of the Humansrus site) on 26 and 29 August 2011 at 17:30.

The purpose of the public meetings were to discuss the key findings of the Scoping Phase and provide the representatives with an additional platform to provide input to the EIA Process.

Stakeholders and I&APs were notified of the public meetings through the following methods:

- Invitation letter sent via either e-mail, registered mail and/or fax;
- Telephonic dialogue with key Stakeholders;
- Distribution of pamphlets; and
- Liaison with the relevant Ward Councillors and Ward Committee Representatives.

The minutes of the public meeting were compiled, distributed to attendees of the meetings and included in this Final Scoping Report for record purposes.

Networking with I&APs, will further continue throughout the duration of the project.

6.9 Social Issues Trail

Issues and concerns raised during the Scoping Phase Public Participation Process were compiled into an Issues Trail. This information are incorporated within the Final Scoping Report before submission to the relevant environmental authorities.

7 General Description of the Study Area

7.1 Biophysical Environment

7.1.1 Agricultural Potential

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted to undertake a soil investigation for the proposed development site. The objectives of this study, which is a desk-top investigation that forms part of the Scoping Phase assessment, are:

– To obtain all existing soil information and to produce a soil map of the specified area; as well as

– To assess broad agricultural potential.

7.1.1.1 Terrain

The site is generally flat to gently sloping and lies at a height of approximately 1500 metres above sea level (although small areas of slightly steeper topography occur close to the north-eastern boundary). No permanent drainage ways occur in the study area, with only one small seasonal stream running through the south-western portion.

7.1.1.2 Climate

The climate of the area can be regarded as typical of the northern Karoo interior, with a low, generally summer rainfall distribution, warm to hot summers and cold to very cold winters (Koch & Kotze, 1986). The main climatic indicators are given in Table 8 below.

Table 8: Climate Data

Month	Rainfall (mm)	Min. Temp (°C)	Max. Temp (°C)
January	62.6	17.1	33.2
February	71.9	16.5	31.5
March	84.3	14.5	29.0
April	45.3	9.3	26.0
May	19.1	4.7	22.8
June	7.8	1.0	19.3
July	3.1	0.6	19.8
August	7.2	3.0	22.4
September	7.5	7.1	26.3
October	20.0	11.2	28.9
November	29.1	13.7	30.7
December	50.1	15.6	32.0
Year	***407.9 mm***	***18.2°C (Average)***	

Very warm temperatures (>42°C) may be experienced in summer, while frost in winter (end of March to early September) is not uncommon, and may be severe on occasion.

7.1.1.3 Geological Parent Material

The geology of the area comprises rocks of the Griqualand west Sequence (Geological Survey, 1977). In the west, lava of the Ongeluk formation occurs, while in the east, jaspelite, crocodilite and shale of the Daniëlskuil Formation is present. Much of the central area is covered by wind-blown Quaternary sand deposits.

The area under investigation is covered by a total of three land types, namely:

– **Ae214, Ae215** (Red structureless soils, high base status); and

– **Ib237** (Rocky areas with shallow soil).

7.1.1.4 Soils

A summary of the dominant soil characteristics of each land type is given in Table 9 below (the colours correspond to those used in Figure 10).

The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in **bold type**.

Table 9: Soil types in study area

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Potential (%)
Ae214	Hutton 36	300-1200	31%	Red, sandy loam to sandy clay loam soils on hard rock	High:7.0 Mod: 41.3 **Low: 51.7**
	Hutton 33/36	100-300	30%	Red, loamy sand to sandy clay loam soils on hard rock	
Ae215	Hutton 33	450-1200	81%	Red, sandy soils on hard rock and calcrete	High:0.0 **Mod: 92.5** Low: 7.5
	Hutton 30	450-1200	8%	Red, very sandy soils on hard rock and calcrete	
Ib237	Rock	-	61%		High:0.0 Mod: 14.0 **Low: 86.0**
	Hutton 30/33	50-300	25%	Red, sandy topsoils on rock	

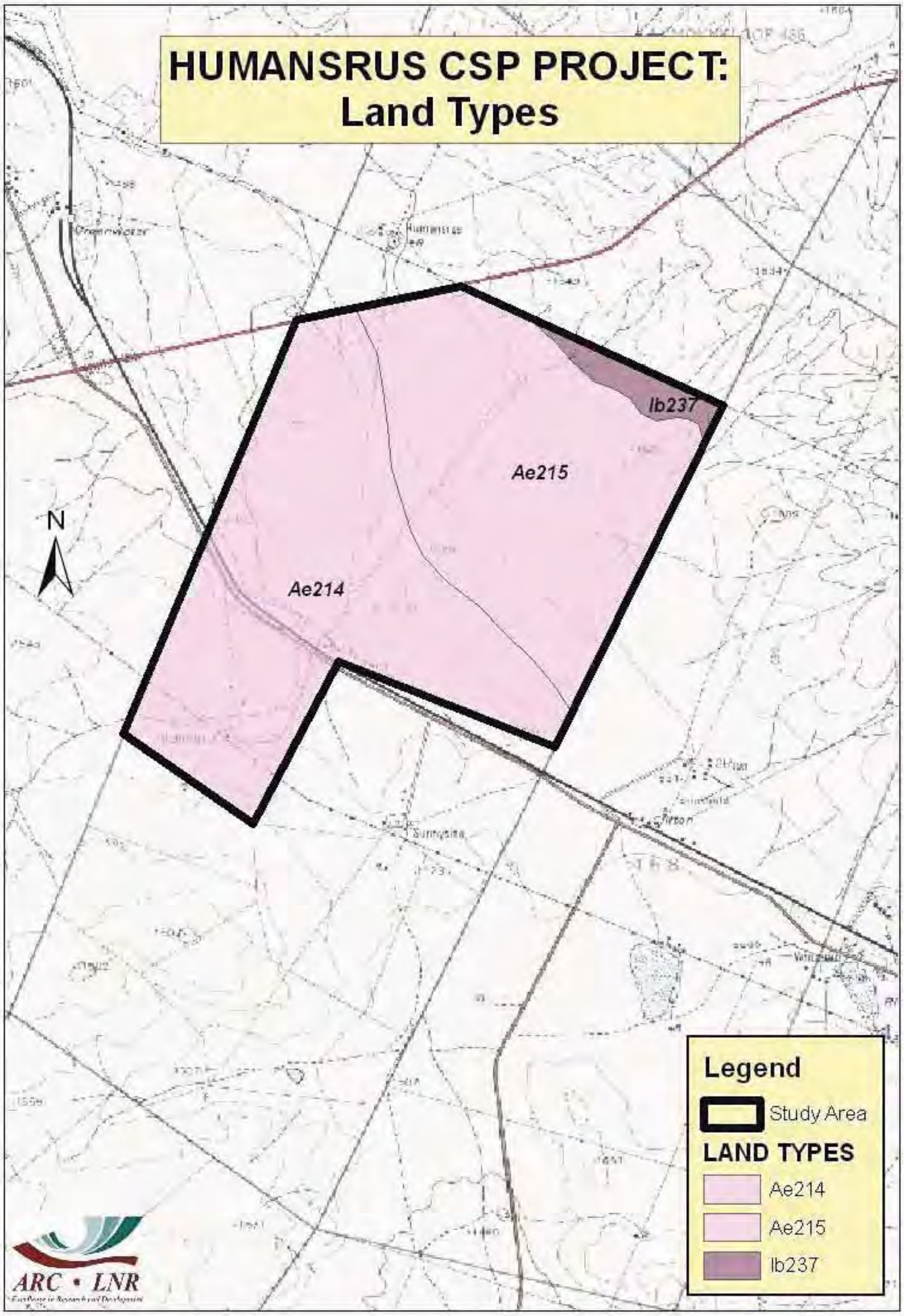


Figure 10: Land Types

7.1.1.5 Agricultural Potential

Much of the central part of the area (land type Ae215) comprises moderately deep to deep soils (300-1200+ mm deep) onto rock, while the remainder has more shallow soils (land type Ae214) or rock (land type Ib237). However, the low rainfall in the area (Table 9) means that the only means of cultivation would be by irrigation with no signs of any agricultural infrastructure and certainly none of irrigation.

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 15-20 ha/large stock unit (ARC-ISCW, 2004).

7.1.2 Air Quality

SSI Environmental was requested by SolarReserve SA (Pty) Ltd to carry out an Air Quality Impact Assessment for the development of a proposed Solar Thermal Energy Power Plant near Postmasburg. The Air Quality Assessment aims to investigate the impacts associated with the construction, operation and eventual decommissioning of the proposed plant, and associated infrastructure, as well as provide guidance on possible mitigation measures to reduce environmental impacts.

7.1.2.1 Regional and Local Climate and Atmospheric Dispersion Potential

The nature of the local climate will determine what will happen to pollution when it is released into the atmosphere (Tyson & Preston-Whyte, 2000). Pollution levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion of pollution.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson & Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air lies directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth's surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson & Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth's surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth's surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson & Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversions is most common over Southern Africa (Tyson & Preston-Whyte, 2000).

Figure 12 provides an indication where various meteorological measurements have taken place within the immediate vicinity of the plant site in the past. All sites with the exception of the Kimberley sites have however been discontinued since the early nineties so no recent data is available for presentation within the region. All the sites with the exception of Kimberley are agricultural stations and recorded measurements for temperature, humidity, rainfall as well as incidents of thunderstorms, hail and fog. A summary of this historical data collected is presented in the subsections which follow. Kimberley represents the South African Weather Services weather office, where over and above the variables listed above wind data is also recorded. Due to the data availability for Kimberly, this site has been used to determine the general meteorological conditions for the area. However as the site is approximately 140km from Kimberly microclimatic conditions will vary, therefore site specific meteorological data will be used for all modelling purposes and for the Environmental Impact Report.

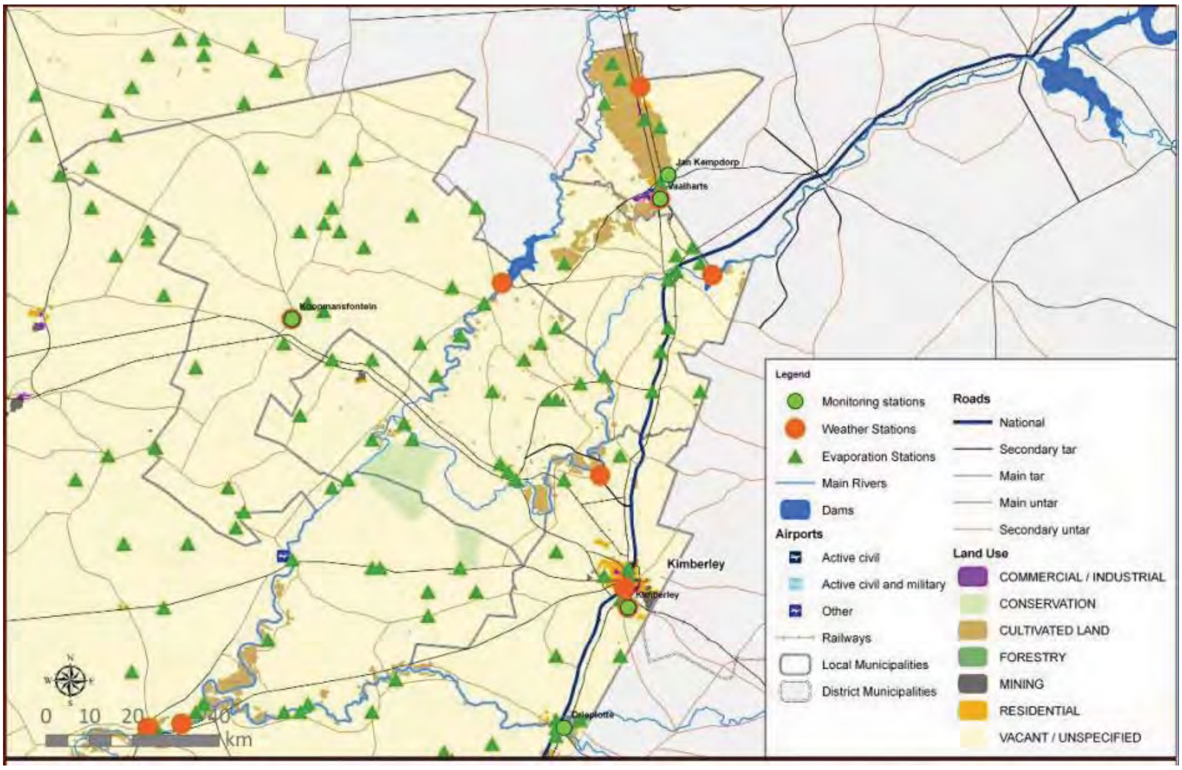


Figure 11: Location of meteorological sampling points within the region.

7.1.2.2 Temperature

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella and Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity. Temperature also provides an indication of the rate of development and dissipation of the mixing layer. This is the zone within the upper atmosphere where air movement takes place and where pollutants released can more easily be diluted by mixing with surrounding air before it reaches ground level.

Daily summer temperatures within the region range between ~18.5 °C and ~25.4°C with an average of ~21.3 °C. Winter temperatures range between ~8.7 °C and ~17.5 °C with an average of ~12.4 °C as is indicated in Figure 12.

Of the five sites assessed, the temperature profile differs very slightly. With marginally lower temperatures recorded at the Kimberley and Diepplotte sites (Figure 12).

The highest maximums recorded in the District range from 39.9 °C to 41.2 °C respectively. With the lowest recorded temperature recorded at -10.6 °C at the Koopmansfontein site.

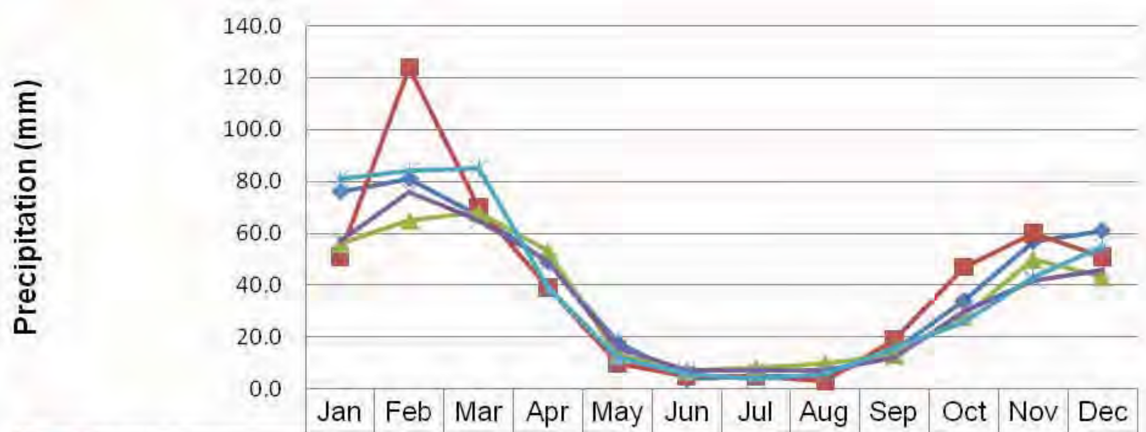
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan Kempdorp	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Vaalharts	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Diepplotte	24.8	23.6	21.2	16.7	12.4	8.8	8.7	11.3	15.6	18.7	21.6	23.7
Kimberley	25.3	24.1	22.0	17.9	13.9	10.7	10.8	13.1	17.2	19.9	22.4	24.3
Koopmansfontein	23.7	22.5	20.5	16.6	12.5	9.2	9.1	11.4	15.6	18.5	21.0	22.8

Figure 12: Mean Temperature Profile for five sample sites within the Region (Summary data from the South African Weather Services)

7.1.2.3 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella and Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Total monthly rainfall figures for the five sites assessed are depicted in Figure 13. The area under investigation lies in the summer rainfall region of South Africa, receiving an average total annual rainfall of ~484 mm.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	76.0	81.0	67.0	49.0	18.0	4.0	5.0	5.0	15.0	34.0	57.0	61.0
Jan Kempdorp	51.0	124.0	70.0	39.0	10.0	5.0	5.0	3.0	19.0	47.0	60.0	51.0
Diepplotte	56.0	65.0	68.0	53.0	13.0	7.0	8.0	10.0	13.0	28.0	50.0	43.0
Kimberley	57.0	76.0	65.0	49.0	16.0	7.0	7.0	7.0	12.0	30.0	42.0	46.0
Koopmansfontein	81.0	84.0	85.0	39.0	12.0	6.0	4.0	6.0	16.0	26.0	43.0	55.0

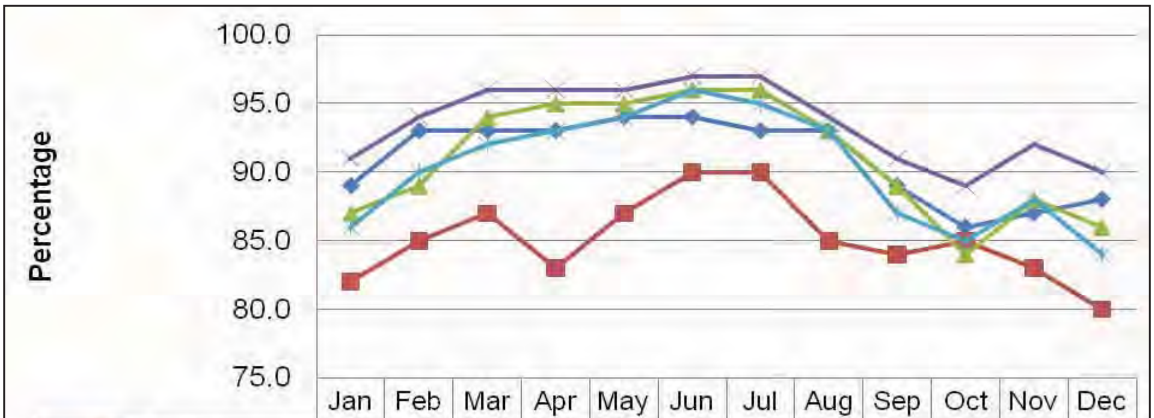
Figure 13: Average Monthly Rainfall Profile for five sample sites within the Region (Summary data from the South African Weather Services).

Of the data collected for the various sites within the region, no real variation in rainfall patterns could be observed. The number of rain days does however vary with more rain days noted at the Kimberly site to the southeast and at the Koopmansfontein site to the west, indicating that even though the same amount of rainfall fell in these areas this rainfall is distributed over a longer period.

7.1.2.4 Relative Humidity

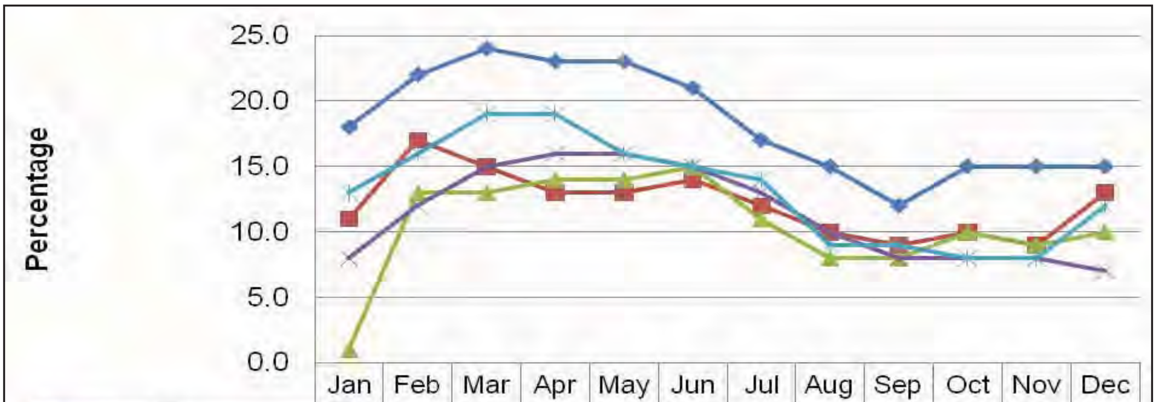
When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

Within the region being assessed incidence of humidity above 70% occur quite often. This is illustrated in Figure 14, with a slightly lower level of maximum humidity recorded at Jan Kempdorp. Figure 15 similarly presents the lowest humidity figures recorded at these sites over the periods sampled; of significance is the marked difference in humidity between Jan Kempdorp and Vaalharts which are situated geographically quite closely to each other.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	89.0	93.0	93.0	93.0	94.0	94.0	93.0	93.0	89.0	86.0	87.0	88.0
Jan Kempdorp	82.0	85.0	87.0	83.0	87.0	90.0	90.0	85.0	84.0	85.0	83.0	80.0
Diepplotte	87.0	89.0	94.0	95.0	95.0	96.0	96.0	93.0	89.0	84.0	88.0	86.0
Kimberley	91.0	94.0	96.0	96.0	96.0	97.0	97.0	94.0	91.0	89.0	92.0	90.0
Koopmansfontein	86.0	90.0	92.0	93.0	94.0	96.0	95.0	93.0	87.0	85.0	88.0	84.0

Figure 14: Maximum Monthly Humidity Profile for five sample sites within the Region (Summary data from the South African Weather Services)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	18.0	22.0	24.0	23.0	23.0	21.0	17.0	15.0	12.0	15.0	15.0	15.0
Jan Kempdorp	11.0	17.0	15.0	13.0	13.0	14.0	12.0	10.0	9.0	10.0	9.0	13.0
Diepplotte	1.0	13.0	13.0	14.0	14.0	15.0	11.0	8.0	8.0	10.0	9.0	10.0
Kimberley	8.0	12.0	15.0	16.0	16.0	15.0	13.0	10.0	8.0	8.0	8.0	7.0
Koopmansfontein	13.0	16.0	19.0	19.0	16.0	15.0	14.0	9.0	9.0	8.0	8.0	12.0

Figure 15: Minimum Monthly Humidity Profile for five sample sites within the Region (Summary data from the South African Weather Services)

7.1.2.5 Thunderstorms, Hail and Fog

The analysis of the occurrence of certain meteorological variables such as the development of thunderstorms, hail and fog, provides an indication of the severity and variability of climatic conditions in the area being investigated.

Incidents of thunderstorms, hail and fog were reported at four of the five sites. Thunderstorms were noted to occur more often at Kimberley with a total average of 55 days per year expected, this compared to only 25 days for Vaalharts, 47 days for Diepplotte and 39 days for Koopmansfontein. It appears that the southern and eastern portions of the region experience more thunderstorms than the north and west.

A similar profile is presented with the comparison of hail and fog occurrences in the District. Both these phenomena however occur infrequently

7.1.2.6 Wind Field

Wind is important in that it cleans by diluting and dispersing pollutants but it can also transport pollutants over large distances. Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

- Period, day-time and night-time average wind roses for the South African Weather Service's Kimberley Airport station are depicted in Figure 16 a), b) and c) for the period January 2001 to December 2001 respectively. Similarly, period, day-time and night-time average wind speed frequency distribution graphs are presented in Figure 16 a), b) and c);
- From the period wind rose (Figure 16a) it is note that winds predominate from the north for 23% of the time. Wind speeds in the range of 3.6 - 5.7 m/s occurred for 29.1% of the time, with higher wind speeds in the range of 5.7 – 8.8 m/s and from 8.8 - 11.1 m/s noted to occur for 16.8% and 3.1% of the time respectively (Figure 16a). These higher wind speeds are noted to occur from the north;
- When comparing day-time and night-time wind profiles a higher incidence of southwesterly winds are noted during night-times (Figure 16c). Southwesterly winds increase in frequency from 5% to 7% of the time when comparing day-time and night-time conditions. North-northeasterly and southerly winds also increase in frequency during night-time from 8-11 % and 4-6 % respectively. As is to be expected during night-time wind speeds are noted to be lower when compared to day-time conditions, predominating in the range of 0.5 – 5.7 m/s; and
- From this wind profile it is noted that sources impacting on air quality would most likely impact more significantly on sensitive areas to the south of these activities. With wind speeds in the calm (0.5 – 5.7) to moderate (5.7 – 8.8) range predominating indicates that the dispersion potential for the area can be considered to be poor to moderately good.

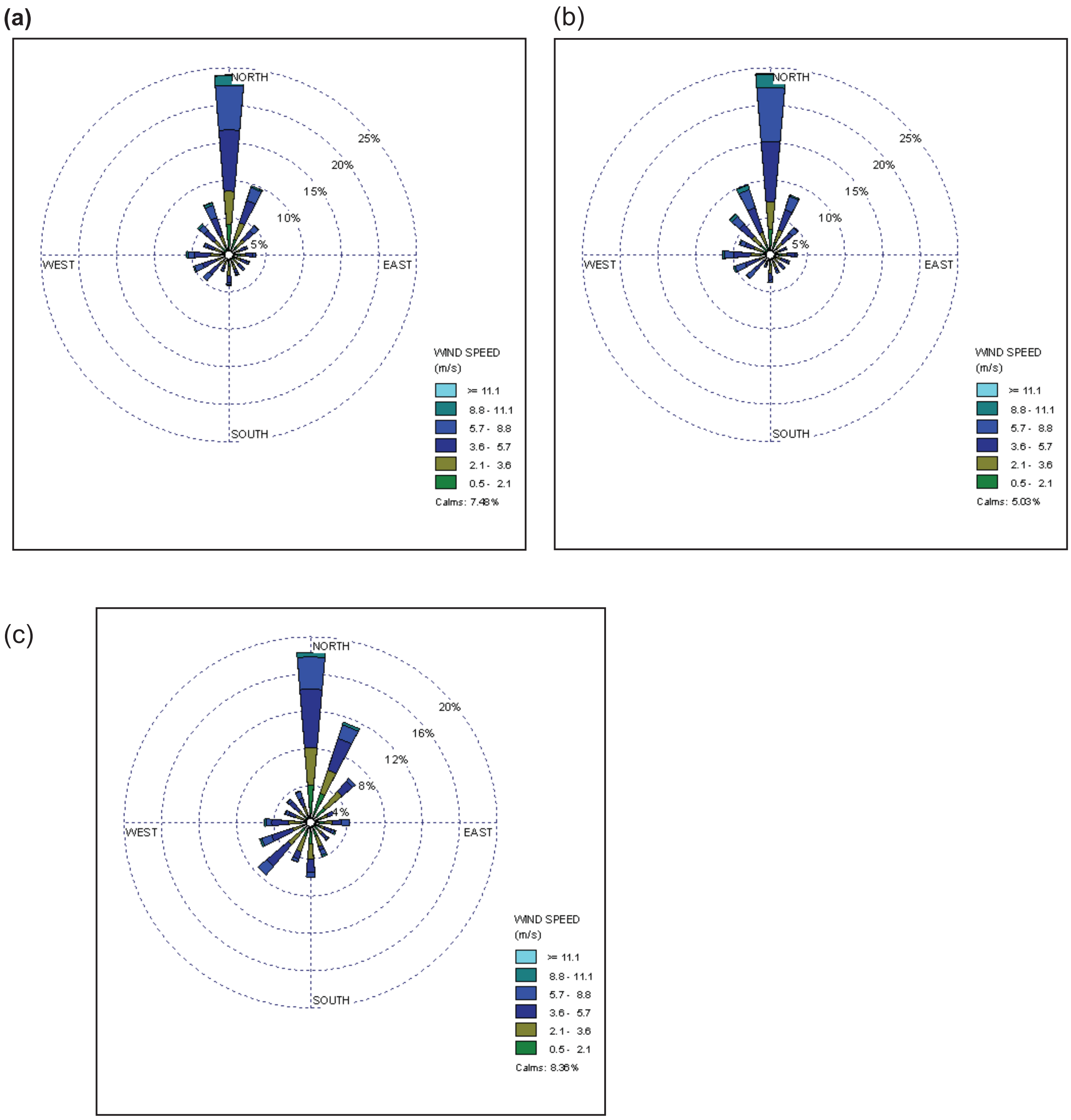


Figure 16: Kimberley Wind Rose (a) Period (b) Daytime (c) Night time (a, b and c)

7.1.2.7 Atmospheric Stability

Atmospheric stability (indication of the amount of mixing and movement of air possible in an area) is commonly categorised into one of six stability classes. These are briefly described in Table 10.

Table 10: Stability Class.

A	Very unstable	Calm wind, clear skies, hot daytime conditions
B	Moderately unstable	Clear skies, daytime conditions
C	Unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Figure 17 depicts the estimated atmospheric stability for the Kimberley area in the form of a rose. The rose indicates how the atmospheric stability differs from different wind directions. It can be noted however that there is not a marked difference in the variability of stability class types with wind direction.

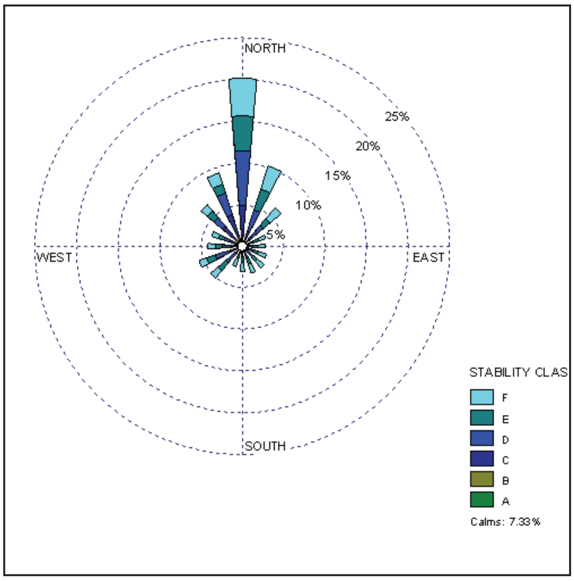


Figure 17: Kimberley Stability Class Frequency Distribution by wind direction

Figure 18 indicating that a neutral stability class occurs for 24.3% of the time, stable atmospheric conditions can be expected to occur for 18.2% of the time with very stable conditions noted for 22.5 % of the time. The predominance of atmospheric stability for the region in the neutral to very stable range, suggests that very little movement and potential for mixing of pollutants and the consequent dilution of a pollution plume exists. Thus when pollutants are released they will tend not to dissipate quickly from source.

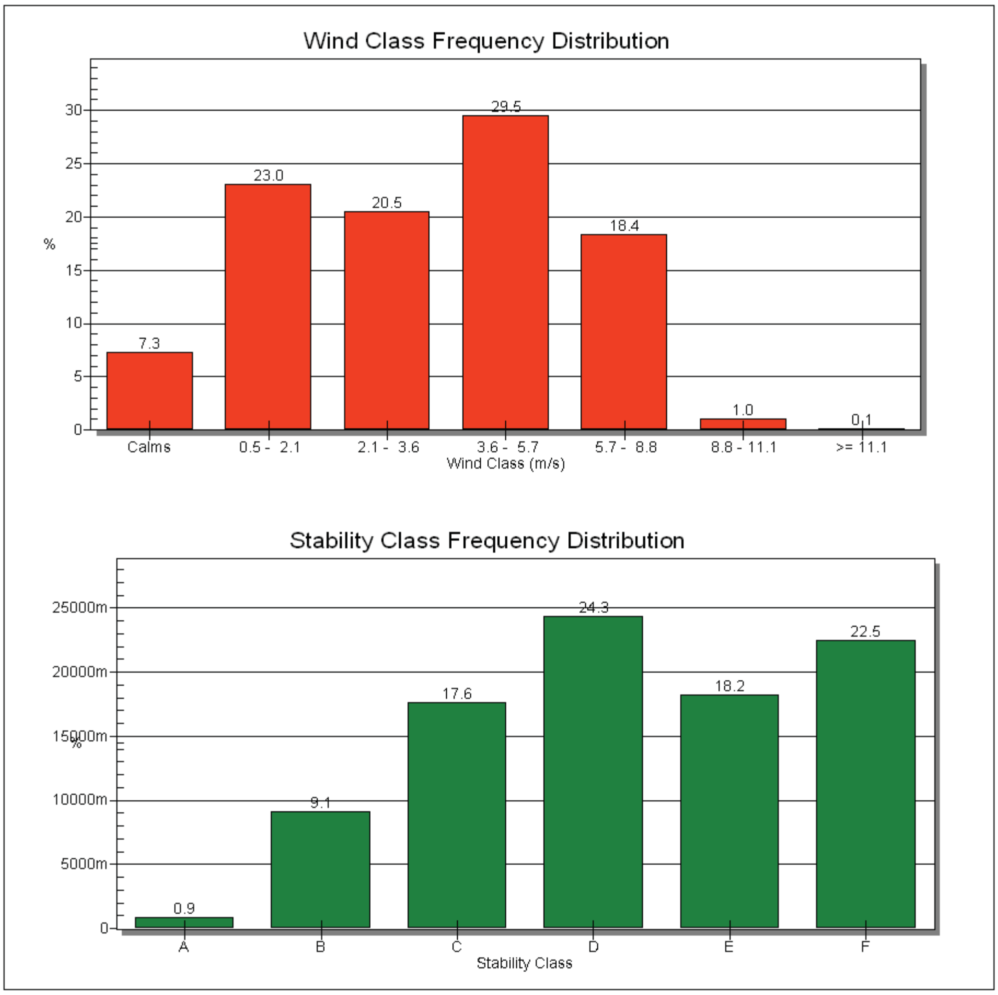


Figure 18: Kimberley Stability Class Frequency Distribution by wind speed

7.1.2.8 Other Polluting Sources in the Area

Based on site visits and 1:50 000 topographical maps; the following sources of air pollution have however been identified. These are important to consider in terms of assessing the cumulative impact potential on air quality in the region:

- Agricultural activities;
- Vehicle entrainment and exhaust gas emissions;
- Mining activities

- Veld Fires; and
- Domestic Fuel Burning.

A qualitative discussion on each of these source types is provided in the subsections which follow.

7.1.2.8.1 Agriculture

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. Mixed farming is practised in the area. The farming includes maize, wheat, grain sorghum, sunflower seed, drybeans and soybeans. Vegetables are produced under irrigation. The types of livestock assessed included pigs, sheep, goats, chickens and cattle. Emissions assessed include ammonia and hydrogen sulphide (USEPA, 1996).

7.1.2.8.2 Vehicles

The force of the wheels of vehicles travelling on unpaved roadways causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic (USEPA, 1996). Due to the nature of both mining and agricultural activity, road networks can often be of a temporary nature, and are thus unpaved. An extensive unpaved road network exists in the area.

Due to the high degree of transport of product from the site expected during mining operations, exhaust tailpipe emissions from vehicles is a significant source of particulate emissions. Exhaust fumes contain nitrogen, oxygen, carbon monoxide, water vapour, sulphur dioxide, nitrogen oxide, volatile hydrocarbons and polyaromatic hydrocarbons (PAHs) and their derivatives, acetylaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

7.1.2.8.3 Mining

Mining results in significant sources of fugitive dust emissions which primarily occur due to wind erosion of extensive poorly controlled tailings impoundments. Such sources are frequently associated with localised nuisance dust that contributes to the concentration of fine particulate matter in the atmosphere. Whereas high dust fallout rates have been measured to occur in close proximity to poorly controlled tailings impoundments, the contribution of such impoundments to airborne fine particulate concentrations is lower. Other emissions generated due to mining operations are generally associated with surface mining activity. Dust fallout and

inhalable particulate emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing, screening and milling of ore and ore products). Subsurface mining operations result in small quantities of particulate, sulphur dioxide (SO2), nitrogen dioxide (NO2) and carbon monoxide (CO2) being released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground.

7.1.2.8.4 Veld Fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amounts of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads. The factors that affect the rate of spread are (1) weather (wind velocity, ambient temperature, relative humidity); (2) fuels (fuel type, fuel bed array, moisture content, fuel size); and (3) topography (slope and profile). However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier *et al*, 1995).

7.1.2.8.5 Domestic Fuel Burning

It is anticipated that low income households in the area surrounding the site are likely to use coal and wood for space heating and/or cooking purpose. The problems facing Metsimatala (also known as the Groenwater Community) around the impact of air pollution generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[*a*]pyrene (Ezzati and Kammen, 2002).

Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest Mozambique Air Quality Objectives, for instance, required the monthly average concentration of PM_{10} (particulate matter < 10 µm in diameter) to be < 200 $\mu g/m^3$ (annual average < 100 $\mu g/m^3$). In contrast, a typical 24-hr average concentration of PM_{10} in homes using biofuels may range from 200 to 5000 $\mu g/m^3$ or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥ 50000 $\mu g/m^3$ in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

Based on the above a detailed assessment will be undertaken during the EIA Phase.

7.1.2.9 Sensitive Receptors

The residential, educational and recreational land uses are considered to be sensitive receptors. For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible.

The following 1:50 000 topographical cadastral maps were used:

- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989; and.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982.

The proposed plant is located to the east of Postmasburg. A number of small villages such as Groenwater and the Lime Acres Mining Area are located in close proximity to the proposed site.

Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust settling on the leaves of plants can result in damage to plants and inhalation of dust may result in sickness and associated lung diseases for wildlife and humans which will be present in the vicinity of the proposed plant. A more detailed inventory of settlements and sensitive receptors will be obtained on site visits and with assistance of the public participation specialists working on the project.

7.1.3 Avi-fauna

7.1.3.1 Regional Overview

The Northern Cape region is one of the most arid in southern Africa. In examining the region as a whole in terms of avifauna, it is important to relate the avifauna to the biomes and vegetation types present in the area:

- **Nama karoo biome:**This biome comprises mainly low shrubs and grasses, trees such as Acacia karoo and exotic species such as Prosopis glandulosa are restricted to watercourses. Compared to “succulent karoo”, “nama karoo” has a much higher proportion of grass and tree cover. The “karoo” used loosely to mean both “nama” and “succulent karoo”, supports a particularly high diversity of species endemic to southern Africa. Avifauna characteristically comprises ground dwelling species of open habitats. The tree lined watercourses allow penetration of several species typical of arid woodland such as the Kori Bustard and Karoo Korhaan. Several species are almost entirely confined to the “Nama karoo” such as the Red Lark and Sclaters Lark. Because rainfall in the “nama karoo” is in summer and the neighboring “succulent karoo” has winter rainfall, there is opportunity for species to migrate seasonally between the two. Two species suspected to do so (on the basis of atlas data) are the Ludwig‘s Bustard and Larklike Bunting; and
- **Woodland biome**: Woodland covers much of the northern and eastern parts of the country and is defined as having a distinct grassy under story and a woody upper story of trees and shrubs. Tree cover can range from sparse such as in the southern Kalahari, to almost closed. The more arid woodland types such as the Kalahari vegetation types are typically fine leaved and dominated by acacias and typically occur on nutrient rich, often alluvial soils in the western regions.

Kalahari vegetation types are characteristic, with many species that occur in the moister woodlands avoiding the Kalahari, probably due to the absence of surface water. At the same time there are no species truly endemic to the Kalahari, most of them also spread to other woodland types. Two species which have their ranges centred on the Kalahari however, are the Fawn-colored Lark and Kalahari Robin, representing possibly the closest to endemic species of the Kalahari.

Six vegetation types are present in the surrounding areas of the site, namely Ghaap Plateau Vaalbosveld, Kuruman Mountain Bushveld, Kuruman Thornveld, Olifantshoek Plains Thornveld, Southern Kalahari Mekgacha, and Southern Kalahari Salt Pans. Two vegetation types Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld are present within the site itself, with the former representing the majority of the area.

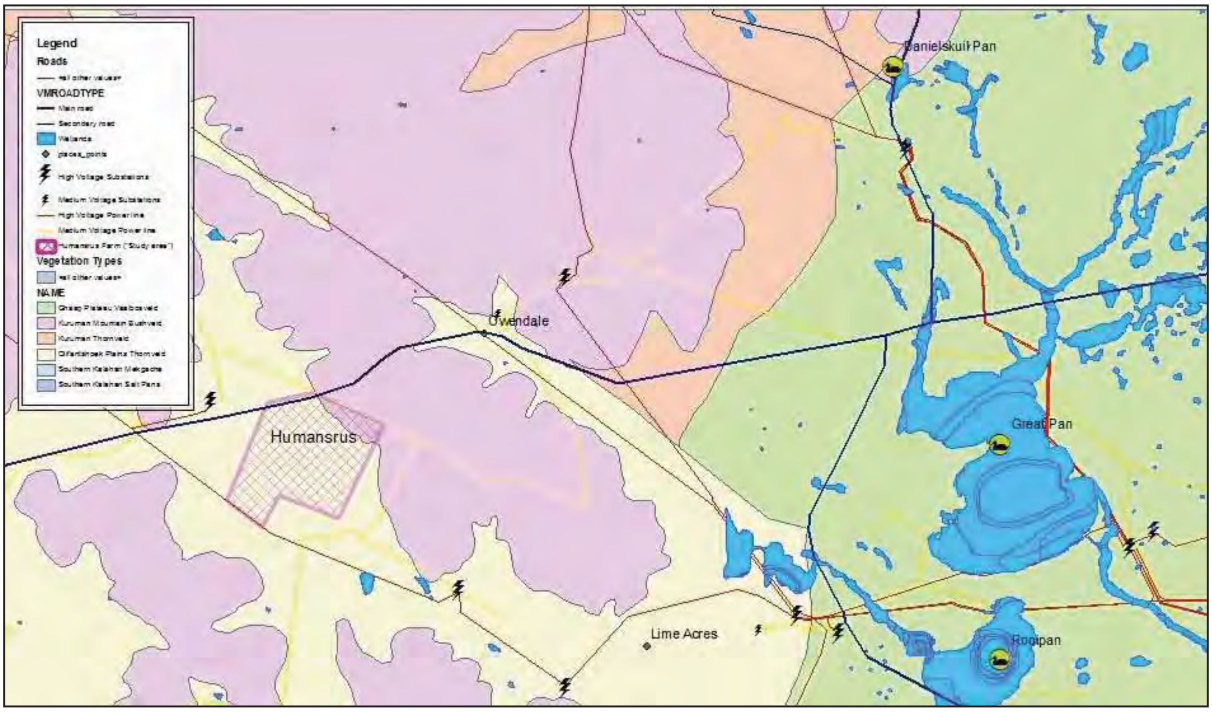


Figure 19: Vegetation types are present in the surrounding areas of the site

7.1.3.2 Presence of Red Data bird species

Table 11 shows report rates for the Red Data species in the study area (Harrison *et al* 1997). Report rates are an expression of the number of times a species is counted in a particular square expressed as a percentage of the number of times that square was counted. A total of 168 species have been recorded for the QDGS, which had been relatively well counted with 77 cards submitted. Eleven species recorded are listed in the red data book (Barnes, 2000)

Table 11: Red Data species recorded in the quarter degree square (2823AD) covering the study area (Harrison et al 1997)

Species	Cons. status	Report Rate (%)
Tawny Eagle	VU	1
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
Kori Bustard	VU	1
White-backed Vulture	VU	17
Black Harrier	NT	1
Black Stork	NT	5

Species	Cons. status	Report Rate (%)
Secretarybird	NT	9
Greater Painted-snipe	NT	1
Greater Flamingo	NT	5
Total species		***168***
# cards submitted		***77***

Legend: CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened.

An evaluation of CAR data revealed that there were no Co-ordinated Avifaunal Road-count routes (CAR) through or near to the site. The site does not fall within an Important Bird Area (IBA) and there were no IBA‘s within close proximity to the site.

Three Co-ordinated Waterbird Count (CWAC) sites were identified to the east of the study area, namely Daniëlskuil Pan, Great Pan, and Rooipan.

7.1.3.3 Bird Micro-habitats

An examination of the micro habitats available to birds within the study site was conducted. These are generally evident at a much smaller spatial scale than vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. The following micro-habitats were identified on site:

– **Drainage Lines and Wetlands**

Few wetland areas were observed on site. There is a –vlei” area situated parallel to the rail line at the south west of the site which appears to flow toward a small dam (see section below). The desktop study revealed the presence of Salt Pans and CWAC sites in the surrounding area (discussed above).

Drainage lines and wetlands are an important form of habitat to numerous species. Drainage lines are often surrounded by natural grasslands, which may provide habitat for species such korhaans, cranes, larks and pipits. Various waterfowl, such as ducks and geese, may make use of these areas.

– **Man-made Dams**

Artificially constructed dams have become important attractants to various bird species in the South African landscape. Various waterfowl frequent these areas and crane species often use dams to roost in communally. Birds such as flamingos and African Spoonbills may make use of these areas. Therefore dams are a key element of this study, and should be classed as no-go areas for this project.

Figure 20: A small dam observed, close to the western boundary of the farm

– **Grassland**

Grassy areas make up the majority of the site and fall within the areas classified as Olifantshoek Plains Thornveld. Grasslands represent a significant feeding area for many bird species such as Blue Crane, Secretary bird, Kori Bustard and Northern Black Korhaan.

The grassland patches are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl, as well as small mammals such as Suricates (see Figure 21). This in turn may attract large raptors because of both the presence and accessibility of prey.

Figure 21: Grassland observed on site

– **Bushveld, Woodland and Thicket patches**

Small patches of Acacia thickets and bushes were observed, usually close to disturbed areas such as homesteads and kraals. As one moves to the periphery of the site, away from the flat grassy areas, the elevation rises and small trees and bushveld appear (depicted as ―Kuruman Mountain Bushveld").

These areas attract smaller passerine species such as Robins and Shrikes. Weavers and Sparrow-weavers use the tree as structures for nesting and Raptors such the Southern Pale Chanting Goshawk may use these areas for perching.

Figure 22: A woodland and Thicket patch observed on site

– **Water-trough points**

Through overgrazing and the clearance of vegetation by cattle at these feeding and watering points, a microhabitat favoured by certain species has been created.

Small species such as robins and wagtails are attracted to the water trough itself to drink, while the open, short grassy areas are favoured by terrestrial species such as coursers and lapwings. Francolins and korhaans were also observed foraging in these areas during the site visit.

Figure 23: A central water point for cattle on site. Note the short grazed grassy areas

Table 12 shows the micro habitats that each Red Data bird typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis below represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where impacts on those species will be most significant.

Table 12: Preferred Micro-habitats and likelihood of occurrence on site of Red Data species recorded in the relevant QDGS

Species	Preferred Micro-habitat	Likelihood of occurrence on site
Tawny Eagle	Woodland and Bushveld	Unlikely
Martial Eagle	Woodland, savannah and Shrublands	Possible
Lesser Kestrel	Arable lands and Grasslands	Likely
Blue Crane	Farm Dams, cultivated lands and grassland	Likely
Kori Bustard	Grasslands and Bushveld	Unlikely
White-backed Vulture	Savannah Woodlands and Bushveld	Possible
Black Harrier	Cultivated lands and Grasslands	Unlikely
Black Stork	Rivers and Kloofs	Unlikely
Secretarybird	Cultivated lands and Grasslands	Possible
Greater Painted-snipe	Dams and Wetlands	Unlikely
Greater Flamingo	Dams and wetlands	Possible

7.1.3.4 Focal species

After determining the red data species that are likely or may possibly be found on site, as well as identifying the microhabitats, the focal species for the study were identified. Table 13 below shows the report rates for selected species that have been recorded in the quarter degree squares covering the study area (Harrison *et al* 1997). Focal Red Data species have been included, as well as a selection of non Red Data species which are considered to have particular relevance to this study such as raptors, doves, pigeons and aerial foragers such as swallows and swifts. Those species observed during the site visit are also indicated.

Table 13: Report rates for selected Focal Red Data species and a selection of other species that are considered particularly relevant to the study (Harrison et al 1997)

Species	Cons Status	Report Rate (2823AD)
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
White-backed Vulture	VU	17
Secretarybird	NT	9
Greater Flamingo	NT	5
Grey Heron*		56
Cape Teal		57
Verreaux's Eagle		55
Booted Eagle		4
Black-shouldered Kite*		69
Jackal Buzzard		0
Pale Chanting Goshawk		39
Rock Kestrel		79
Greater Kestrel		12
Helmeted Guineafowl*		55
Red-crested Korhaan		1
Black Korhaan* (pre-split)		34
Crowned Lapwing*		90
Blacksmith Lapwing*		91
Pied Avocet		25
Black-winged Stilt		56
Spotted Dikkop*		3
Double-banded Courser*		8
Namaqua Sandgrouse		36
Rock (Speckled) Pigeon		65
Red-eyed Dove*		29
Cape Turtle Dove*		44
Laughing Dove*		96
Namaqua Dove		79
Barn Owl*		4

Species	Cons Status	Report Rate (2823AD)
Spotted Eagle Owl		1
White-rumped Swift		57
Little Swift		58
European Swallow (Barn)		32
White-throated Swallow		10
Greater Striped Swallow		70
Rock Martin		79
Brown-throated Martin		9
Pied Crow*		56
Mountain Chat		81
Familiar Chat*		78
Ant-eating Chat*		86
Karoo Scrub-Robin		55
Kalahari Scrub-Robin*		55
Black-chested Prinia*		66
Cape Wagtail*		95
Common Fiscal*I		94
White-browed Sparrow-weaver*		84
Sociable Weaver		1
House Sparrow*		83
Scaly-feathered Finch*		12
Red-billed Quelea*		34
Yellow Canary*		92

*Legend: CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened, * = recorded during site visit*

7.1.4 Biodiversity

7.1.4.1 Biophysical Attributes

7.1.4.1.1Surface Water

The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the south western part of the study area; evident from the Google Earth images. In addition to the presence of these non-perennial streams, it would appear as if wider floodplains are associated with the streams. The region is generally classified as relative dry and the ecological functionality of these areas would therefore be important on a local and regional scale on a temporary basis. The northern part of the study area is characterised by mountainous terrain and seasonal flow from these areas created floodplains at the foothills of the mountains. These areas are mostly characterised by wide, flat and sandy beds. Due to the rapid nature of the drainage, the habitat is normally not characterised by riparian or wetland related species.

No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

Land Cover

Land cover of the region of the study comprises extensive untransformed habitat with limited areas characterised by development, agriculture, mining and other forms of habitat transformation.

7.1.4.1.2 Declared Areas of Conservation

No declared area of conservation is present within the general surrounds of the study area. The study area however does fall within the Griqualand West Centre of Endemism.

7.1.4.2 Regional Ecology

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area. The Kalahari savanna is a sandy, arid region in the western interior. Within the Kalahari savanna system, seven major vegetation types have been described. Two of these vegetation types are present within the study area, namely:

- **Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld) -** This vegetation is characterised by rolling hills with gentle to moderate slopes and hill pediment areas with an open shrubveld with Lebeckia macrantha prominent in places with a well developed grass layer. The conservation status of this unit is set at Least Threatened, but none of this vegetation type is formally conserved in statutory conservation areas. The transformation status is low, but some parts are heavily utilised for grazing purposes. Species of conservation importance that are present in this vegetation type include the Griqualand West Endemics *Lebeckia macrantha, Justicia puberula, Tarchonanthus obovata, Euphorbia wilmaniae, Digitaria polyphylla, Sutera griquensis* and the Endemic *Euphorbia planiceps*; and
- **Kalahari Mountain Bushveld (Kuruman Mountain Bushveld) -** This vegetation type comprises the pediment areas of the major mountains in the region as well as some of the ridges to the west. The vegetation comprises very wide and diverse units on plains with usually open tree and shrub layers with *Acacia luederitzii*, *Boscia albitrunca* and *Searsia tenuinervis*. The grass layer is typically poorly developed and sparse. Red aeolian sands characterise the substrate. The conservation status of this vegetation type is set at Least Threatened, with only 0.3% statutorily conserved in the Witsand Nature Reserve. Only about 1% of the area has been transformed and erosion is low. Species of conservation importance that are present in this vegetation type include the Kalahari and Griqualand West Endemics *Acacia luederitzii* var. *luederitzii*, *Lebeckia macrantha*, *Hermannia burchelli*, *Justicia puberula*, *Putterlickia saxatilis*, *Tarchonanthus obovata*, *Anthephora argentea*, *Sutera griquensis* and the Endemic *Amphiglossa tecta*.

7.1.4.3 Regional Floristic Diversity

The SANBI database indicates the known presence of only 165 plant species within this particular ¼ degree grid (2823AD). This relative low diversity is the result of poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity.

7.1.4.4 Plant Species of Conservation Importance

The SANBI database indicates the following protected tree species as being present in this ¼ degree grid:

- Acacia *haematoxylon*; and
- Boscia albitrunca.

Although not captured in the database, it is also likely that *Acacia erioloba* (Camel Thorn) will be present within the area. In addition it has been indicated that *Olea europaea* subsp. *europaea* of exceptional size is present in the study area. These individuals, although not a protected species of this province, might qualify as remarkable trees and special mitigation measures might be needed to protect the individuals.

No Red Data plants are known to occur in the study area, or the immediate surrounds. However, the regional floristic diversity indicates a relative poor knowledge of the vegetation of the area. It is therefore likely that Red Data flora species might be present, but yet undiscovered.

7.1.4.5 Regional Faunal Probabilities

A total of 56 Red Data animals (excluding avifauna) are known to occur in the Northern Cape Province. Of these species, 13 are listed as Data Deficient (DD), 21 are listed as Near Threatened (NT), 12 are listed as Vulnerable (VU), 5 are listed as Endangered (EN) and 5 species are listed as Critically Endangered (CR).

It is estimated that approximately 79% of these species have a low probability of occurring in the immediate region of the study area, 11 species are estimated to have a moderate probability of occurring and one a high probability of occurrence in the immediate region of the study area.

7.1.4.6 Preliminary Macro Habitat Types

Macro habitat types (with estimated preliminary sensitivities) identified from aerial images includes the following:

- **Floodplains –** Grassy habitat associated with the wide, flat levees of the non-perennial streams. Woody species generally absent and soils expected to be sandy and deep;
- **Localised Rocky Outcrops** – Characterised by small and localised areas where boulders and rocks are present with little substrate and vegetation, also appears to be relative degraded due to the presence of several informal roads;
- **Mountain Woodland –** Situated in the north-eastern section of the study area, characterised by relative steep slopes, high rockiness and mountainous habitat, comprising relative dense woodland. Expected to be relative pristine as these habitat types are generally not extensively utilised;

- **Non-perennial streams –** Streambeds of non-perennial streams with relative wide banks and levees, characterised by the absence of a prominent woody layer;
- **Shrubveld Plains –** Plains habitat where woody species are present mostly as low shrubs or scattered trees, dominated by herbaceous species, mostly on deep, sandy soils; and
- **Woodland Plains & Hills –** Plains and low hills with a prominent woody layer. The composition of this woody layer is likely to be different to that of the Mountain Woodland habitat type. This unit is also likely to be split upon finer investigation as there will likely be significant variation in the floristic composition of the variations and the rockiness of the terrain based on the prevalence of specific biophysical attributes.

7.1.4.7 Macro Habitat Sensitivities

Estimated habitat sensitivities ascribed to the macro habitat types is based on the assumption that the vegetation is representative of the regional vegetation type. An assessment of the status of the habitat types, in relation to the regional vegetation type will form part of the Impact Assessment phase.

- Floodplains – *Medium-high sensitivity* due to infrequent inundation following rain periods;
- Localised Rocky Outcrops – *Medium-high sensitivity* due to the limited availability of this particular habitat type. Evidence from Google Earth images indicate a potentially degraded status;
- Mountain Woodland – *High sensitivity*, likely to be relative pristine, presence of steep slopes generally associated with important and sensitive floristic species, communities and faunal assemblages; and
- Non-perennial streams – *High sensitivity* due to the association with wetland habitat types.

7.1.5 Geohydrology

7.1.5.1 Physiography and Climate

The Farm Humansrus is located in a north-west – south-east running valley with two semi-parallel ranges of hills occurring on the western and eastern sides of the farm. This valley is controlled by faults on the two flanks with the eastern hills formed by hard, weather-resistant banded ironstone and jaspilite. The eastern hills form part of the Asbestos Hills stretching from Kuruman in the north to Prieska in the south.

The elevation of the study area varies between 1 460 mamsl in the far north-west and 1 630 mamsl on the eastern side of Humansrus. Hills on the western side of the valley are more gentle with only a few points where the elevation reaches >1 600 mamsl. The central valley on Humansrus farm is elevated between 1 500 and 1 540 mamsl.

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000 are summarized in Table 14. The data indicate that January is the hottest

month with an average maximum daily temperature of 32°C and June the coldest with an average maximum daily temperature of 18°C. During June and July the average minimum daily temperature drops to <3°C.

Table 14: Temperature data for Kimberley (South African Weather Service)

KIMBERLEY CLIMATIC AVERAGES 1960-2000													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP	32.6	31.2	28.9	25	21.5	18.4	18.8	21.4	25.7	28	30.1	32.1	26.2
MIN TEMP	17.7	17.3	15.2	10.7	6.2	2.8	2.5	4.7	8.8	11.9	14.5	16.5	10.7
AVE TEMP	25.2	24.3	22	17.9	13.9	10.6	10.6	13.1	17.3	19.9	22.3	24.3	18.5
KIMBERLEY CLIMATIC ABSOLUTES 1960-2000													
HIGHEST TEMP	40.4	39.9	37.8	34.9	31.3	26.6	26.8	31.2	36.6	37.6	39.2	40.9	40.9
LOWEST TEMP	6.5	5.6	2	-2.8	-5.7	-7.9	-8.1	-7.8	-5.5	-0.5	2.5	3.8	-8.1

The data also indicates that the absolute maximum temperature recorded during the period was 40.9°C and the lowest -8.1°C.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in Table 15 below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 15: Precipitation statistics for the Humansrusarea (Source: South African Rain Atlas)

Average monthly precipitation in mm) at Measuring Station Coordinates: S28°18' E023°22'													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean:	64.7	76.3	77.8	42.5	15	5.2	3.6	5.6	11.2	22.2	31.3	45.9	401.1
Standard Deviation:	46	50.9	49.7	35.2	18.6	10.1	8.2	11.2	17.0	24.1	28.4	36.5	107.9

The data indicate that 84% of the precipitation occurs during the months November to April. This phenomenon is characteristic of a summer rainfall area. March is the wettest month with an average precipitation of ~78 mm, whilst July is the driest with <4 mm.

The rainfall distribution for this area is indicated in Figure 24. Rainfall generally decreases from the site (Humansrus) to the west, south and south east. The highest precipitation occurs in the mountainous area west and south west of Daniëlskuil, where the MAP exceeds 520 mm. The lowest precipitation occurs at two isolated localities south east of Danëlskuil and Lime Acres respectively. These areas have a MAP of less than 360 mm.

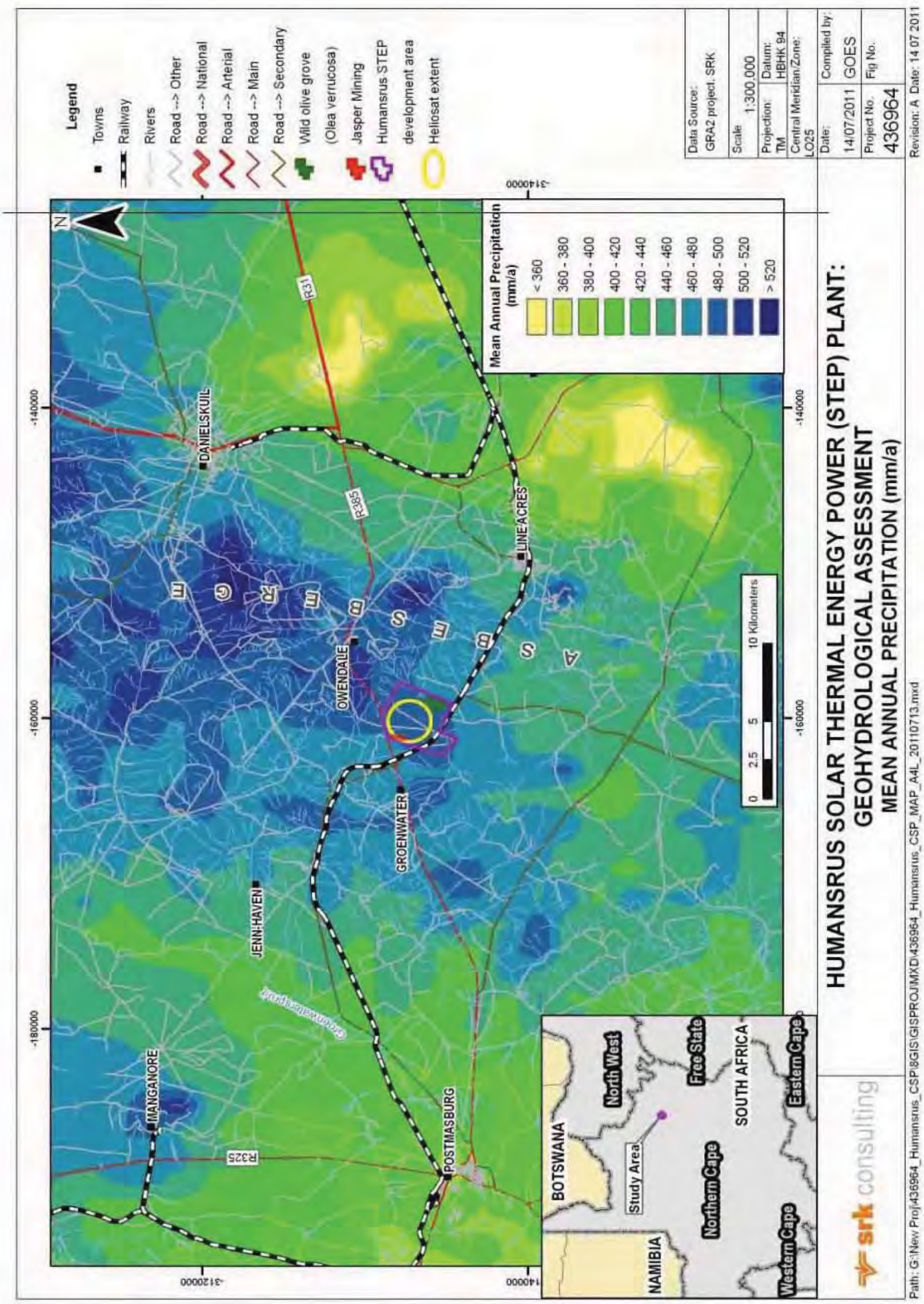

HUMANSRUS SOLAR THERMAL ENERGY POWER (STEP) PLANT:
GEOHYDROLOGICAL ASSESSMENT
MEAN ANNUAL PRECIPITATION (mm/a)
Legend
Towns
Railway
Rivers
Road --> Other
Road --> National
Road --> Arterial
Road --> Main
Road --> Secondary
Wild olive grove
(Olea verrucosa)
Jasper Mining
Humansrus STEP
development area
Heliosat extent
Mean Annual Precipitation (mm/a)
< 360
360 - 380
380 - 400
400 - 420
420 - 440
440 - 460
460 - 480
480 - 500
500 - 520
> 520
0 2.5 5 10 Kilometers
DANIELSKUIL
LIME ACRES
OWENDALE
GROENWATER
JENN-HAVEN
MANGANORE
POSTMASBURG
R31
R385
R325
BOTSWANA
NAMIBIA
North West
Free State
SOUTH AFRICA
Study Area
Northern Cape
Western Cape
Eastern Cape
Data Source: GRA2 project. SRK
Scale 1:300,000
Projection: TM
Datum: HBHK 94
Central Meridian/Zone: LO25
Date: 14/07/2011
Compiled by: GOES
Project No. 436964
Fig No.
Revision: A Date: 14 07 2011
srk consulting

Figure 24: Rainfall distribution in the Humansrus area

7.1.5.2 Geology

The geology of the study area, which is located on the eastern flank of the Dimoten Syncline striking in a general north-south direction, is depicted in Figure 25. The geological map indicates that significant parts of the study area are covered by Recent deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersected argillaceous, loose and well weathered material up to 30 mbgl, however this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales andbanded ironstone, which were deposited after a period of erosion forming a unconformity in this specific area. The upper part of this Formation consists of a 1–3 mthick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic andesitic lavas of the Ongeluk Formation. This Makganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the STEP Plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus (see Figure 25). The area between these faults has apparently been displaced downwards to form a graben structure.

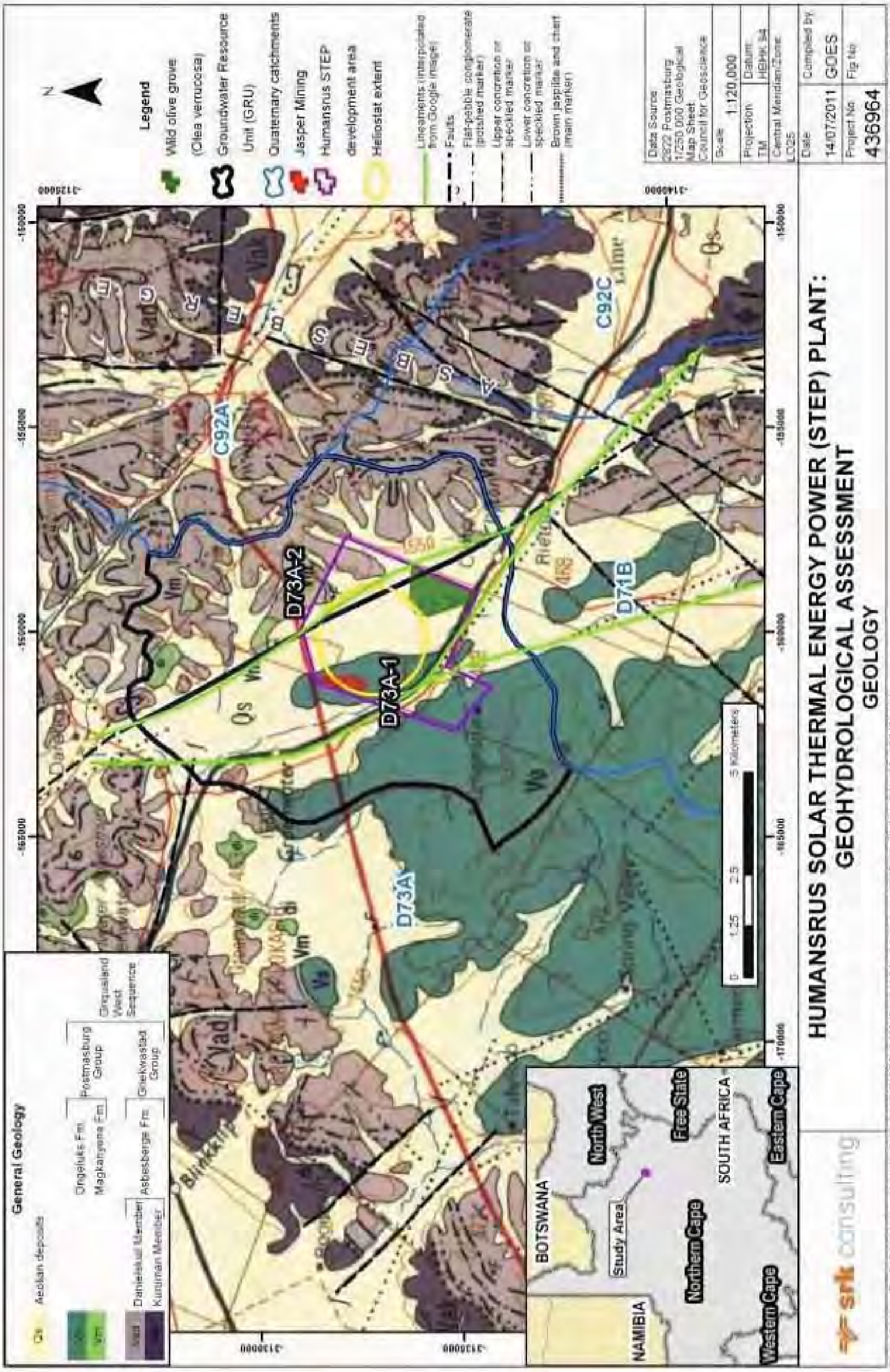


Figure 25: Geology of the Humansrus area (after Council for Geoscience)

7.1.5.3 Hydrogeology

7.1.5.3.1 Aquifer Type

Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers (Figure 26). This type of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operates in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shale and mudstone, which rather deform than fracture under stress.

Some unconfined interganular aquifers (also known as primary aquifers) also occur in and near the main drainage channel of the area at Groenwater station north-west of Humansrus. Here the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. All these result in a poorly developed primary aquifer that is very vulnerable to droughts.

7.1.5.3.2 Hydrocensus Results

The hydrocensus results are summarized in Table 16 with the localities of these boreholes indicated in Figure 27. Forty-one (41) boreholes and one (1) spring were surveyed on the Farm Humansrus and its surrounds.

Four (4) anomalously high yielding boreholes were located in the area, i.e. boreholes HS2, GR10, GR11 and GR12. These boreholes are located on the two graben-faults in the area with boreholes GR10, GR11 and GR12 on the western fault and borehole HS2 on the eastern fault. Borehole HS2 intersected highly fractured lava and tillite, as evident from drill cuttings around the borehole. It was reportedly yield tested by Mr Scholtz at 40 ℓ/s. However, during removal of the test pump, it got stuck in the borehole at 60 mbgl, probably as a result of the borehole collapsing due to an insufficient length of casing been inserted. This borehole cannot be used and a new borehole needs to be drilled adjacent to it for production purposes, if required. Borehole HS4, which is also located on or close to the eastern fault, has only a maximum immediate yield of 1 ℓ/s. It is believed that this relative shallow borehole (54 m) was not drilled deep enough to intersect the main fault and hence the relative low yield. Borehole GR11 is a replacement borehole drilled for borehole GR10 and is ~5 m from the latter. This borehole and borehole GR12, were previously used to irrigate ~25 ha of lucerne.

The average borehole yield of the surveyed boreholes is 4.6 ℓ/s. This value is skewed by a few extraordinary high yielding boreholes. Therefore the median borehole yield of 1.4 ℓ/s gives a much better indication of the borehole yield that can be expected from a successful borehole drilled in this area. Boreholes drilled to intersect the graben faults could be much higher yielding, possibly 20 ℓ/s to as high as 40 ℓ/s.

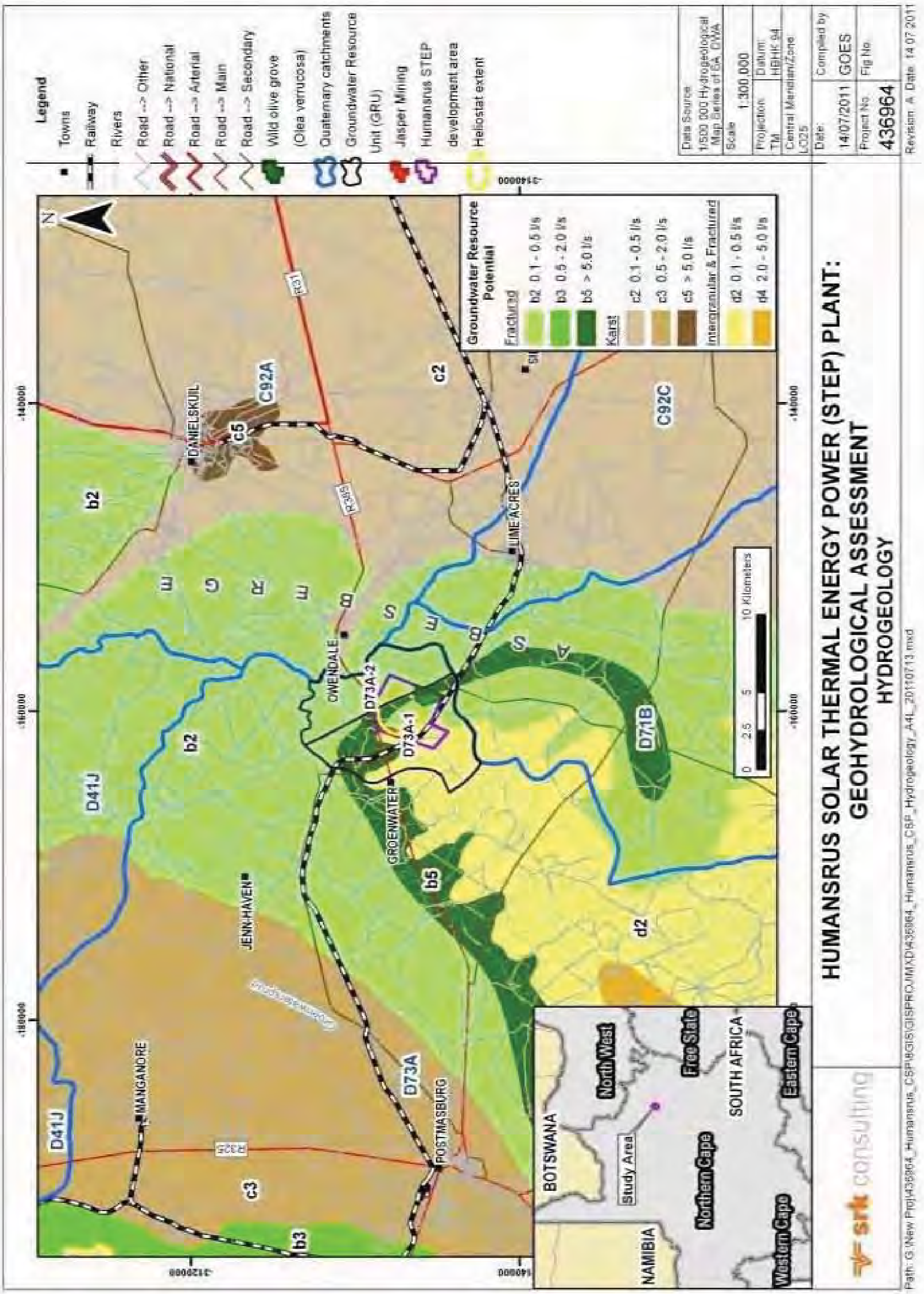

HUMANSRUS SOLAR THERMAL ENERGY POWER (STEP) PLANT:
GEOHYDROLOGICAL ASSESSMENT
HYDROGEOLOGY
Legend
Towns
Railway
Rivers
Road --> Other
Road --> National
Road --> Arterial
Road --> Main
Road --> Secondary
Wild olive grove (Olea verrucosa)
Quaternary catchments
Groundwater Resource Unit (GRU)
Jasper Mining
Humansrus STEP development area
Heliostat extent
Groundwater Resource Potential
Fractured
b2 0.1 - 0.5 l/s
b3 0.5 - 2.0 l/s
b5 > 5.0 l/s
Karst
c2 0.1 - 0.5 l/s
c3 0.5 - 2.0 l/s
c5 > 5.0 l/s
Intergranular & Fractured
d2 0.1 - 0.5 l/s
d4 2.0 - 5.0 l/s
Scale 1:300 000
436964
GOES
14/07/2011
srk consulting
POSTMASBURG
DANIELSKUIL
GROENWATER
OWENDALE
JENN-HAVEN
MANGANORE
LIME ACRES
D73A-1
D73A-2
D71B
C92A
C92C
D41J
D73A
BOTSWANA
NAMIBIA
SOUTH AFRICA
North West
Northern Cape
Free State
Western Cape
Eastern Cape
Study Area

Figure 26: Aquifer type and yield potential in the Humansrus area (after the DWA 1:500 000 scale hydrogeological map series data)

Table 16: Summary of hydrocensus results of the Humansrus area

Bh Nr	Date	Latitude	Longitude	Eleva-tion (mamsl)	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Pump intake (mbgl)	Use	pH	EC (mS/m)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Land reform												
GR1	15-Jul-11	-28.29228	23.31879	1499	73	4.0	19.00	None		Domestic			G47253, Pump removed
GR10	15-Jul-11	-28.28773	23.34227	1476		20.0	5.87	None					
GR11	15-Jul-11	-28.28773	23.34225	1477	60	20.0	7.05	None					Replacement bh for GR10
GR12	15-Jul-11	-28.27770	23.33874	1467	28	10.0	2.12	None					
GR13	15-Jul-11	-28.25558	23.32697	1458	0		0.00	None		Irrigation	7.22	132	Spring
GR14	15-Jul-11	-28.25672	23.33109	1461	9			WP 100mm cylinder	5	Domestic, Stock	7.70	33	Closed
GR15	15-Jul-11	-28.27567	23.33025	1488	91		19.49	None					
GR16	15-Jul-11	-28.26194	23.35528	1495	73		18.79	WP 75mm cylinder		Stock	7.45	43	
GR17	15-Jul-11	-28.25250	23.35111	1493	52			WP 60mm cylinder		Stock	7.37	61	
GR2	15-Jul-11	-28.29878	23.31550	1496	60			50mm Mono		Domestic			Pump out of order, Closed
GR3	15-Jul-11	-28.28208	23.31056	1485	64	3.5	29.11	40mm Submersible	55	Domestic	7.90	97	Pumping water level, Pump yield = 0,7 ℓ/s
GR4	15-Jul-11	-28.27552	23.31678	1479	32	0.3	27.59	None					Tested by SRK in 2007, Likely partially collapsed
GR5	15-Jul-11	-28.27740	23.30551	1463	50	4.1	17.33	None					Tested by SRK in 2007
GR7	15-Jul-11	-28.27743	23.30550	1464	78	1.4	17.07	None					Drilled by SRK 2008, Blow yield
GR8	15-Jul-11	-28.27703	23.33501	1470	11			Handpump					Closed
GR9	15-Jul-11	-28.27719	23.33510	1471	15		4.00	40mm submersible					Out of order
Farm:	Humansrus – Owner: Mr. Allen Scholtz												
HS1	14-Jul-11	-28.27903	23.36406	1491	50	1.8	27.27	40mm Submersible	45	Domestic, Stock	7.15	52	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	14-Jul-11	-28.27681	23.36466	1467	107	40.0	28.02	None					Water strike at 98 mbgl Fractured lava and tillite
HS3	14-Jul-11	-28.28088	23.36538	1493	36	0.2		None					Roots at 10 mbgl
HS4	14-Jul-11	-28.29156	23.37531	1530	54	1.0		WP 90mm cylinder	42	Stock	7.90	54	Bees in borehole
HS5	14-Jul-11	-28.32079	23.35028	1525	54	1.8	18.27	WP 90mm cylinder	42	Stock			Out of order, Water flows in @ 10 mbgl
HS6	14-Jul-11	-28.28322	23.39720	1627	210	0.5		None					Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk												
SE1	14-Jul-11	-28.32690	23.36535	1519	84	3.6		WP 65mm cylinder	45	Stock			Baseplate closed
SE10	14-Jul-11	-28.32897	23.37159	1515	60	2.5		None					Collapsed at 6.8 mbgl
SE2	14-Jul-11	-28.32920	23.36567	1521	24	0.3		WP 65mm cylinder	24	Stock			Baseplate closed
SE3	14-Jul-11	-28.32963	23.36553	1522	33	0.5	17.00	WP 65mm cylinder	30	Domestic, Stock			
SE4	14-Jul-11	-28.32989	23.36586	1522	35	1.0		40mm Submesible	30	Domestic, Stock	7.23	90	Baseplate closed
SE5	14-Jul-11	-28.32921	23.36266	1516	35	1.9		WP 100mm cylinder	18	Stock			Baseplate closed
SE6	14-Jul-11	-28.33779	23.35252	1567	150	0.3	78.44	WP 65mm cylinder	81	Stock	7.70	70	Water strike at 75 mbgl
SE7	14-Jul-11	-28.32590	23.34681	1534	15	0.1	12.35	Solarpump	14	Stock	7.90	59	Alt Nr GW9
SE8	14-Jul-11	-28.32722	23.34662	1537	30	0.0		None					Dry
SE9	14-Jul-11	-28.32923	23.37240	1516	60	4.2		None					Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk												
CN1	15-Jul-11	-28.32497	23.39030	1506			31.71	WP 60mm cylinder	39	Domestic			
CN2	15-Jul-11	-28.32503	23.38942	1535				50mm Mono	42	Domestic, stock	6.85	32	Closed, Pump yield = 0.9 ℓ/s
CN3	15-Jul-11	-28.32493	23.38938	1535		0.3	29.65	None					
CN4	15-Jul-11	-28.32333	23.38965	1541			32.46	WP 60mm cylinder	36	Stock			
CN5	15-Jul-11	-28.32609	23.38891	1534		0.7	25.79	None					Was equipped with 40mm Subm., intake @ 45m
CN6	15-Jul-11	-28.32919	23.38791	1528			19.31	None					
CN7	15-Jul-11	-28.32916	23.38609	1523		0.9	12.22	None					Blocked 0.2m below water level
CN8	15-Jul-11	-28.32973	23.38429	1526				None					Blocked at 16.7 mbgl, Dry
CN9	15-Jul-11	-28.33991	23.38789	1517			9.27	WP 60mm cylinder	21	Stock	7.25	51	
CN10	15-Jul-11	-28.34507	23.38803	1514			9.18	WP 60mm cylinder	24	Stock	7.20	59	
					Average	4.6					7.4	64.1	
					Median	1.4					7.4	59.0	

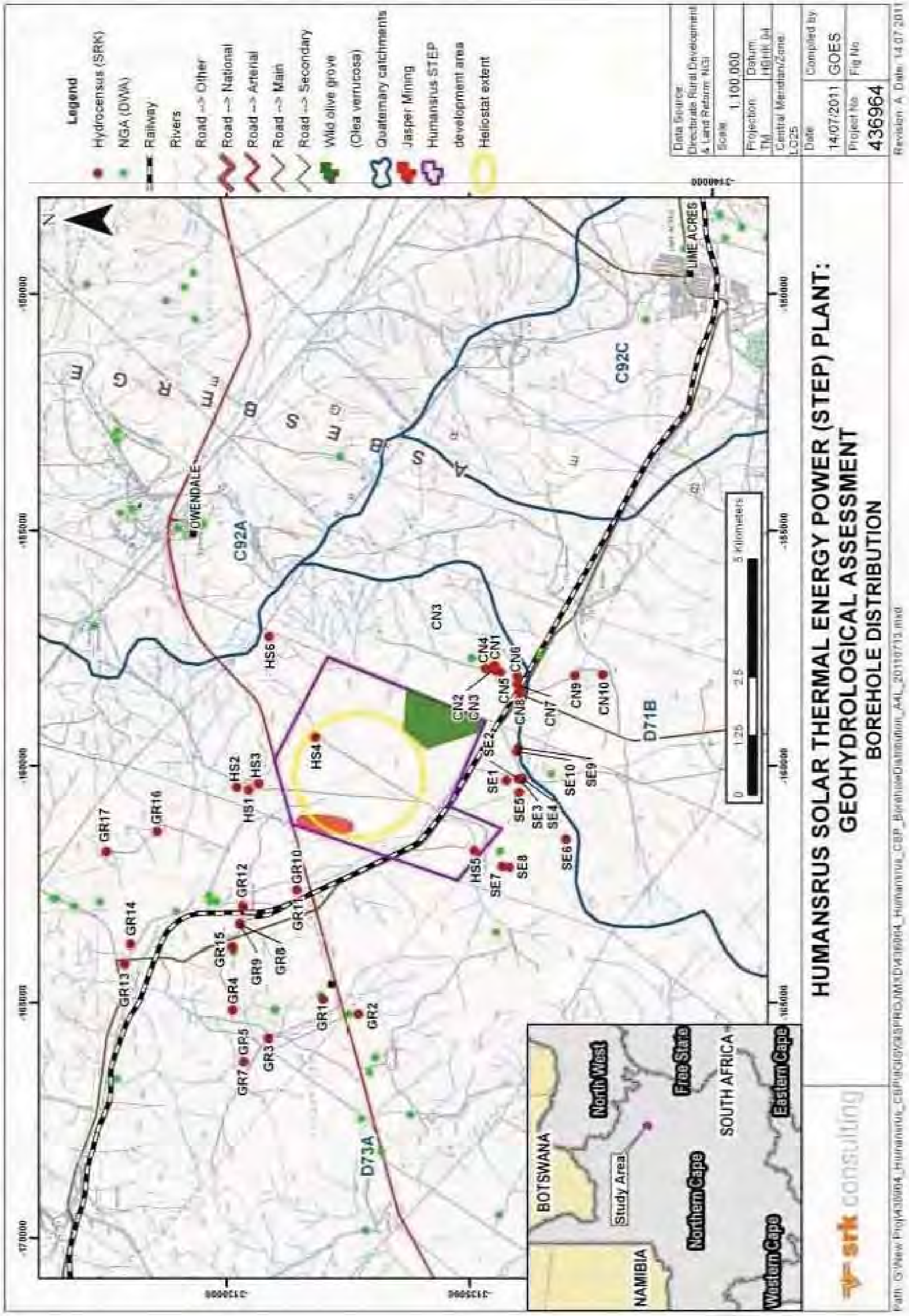

HUMANSRUS SOLAR THERMAL ENERGY POWER (STEP) PLANT:
GEOHYDROLOGICAL ASSESSMENT
BOREHOLE DISTRIBUTION
Legend
Hydrocensus (SRK)
NGA (DWA)
Railway
Rivers
Road --> Other
Road --> National
Road --> Arterial
Road --> Main
Road --> Secondary
Wild olive grove
(Olea verrucosa)
Quaternary catchments
Jasper Mining
Humansrus STEP
development area
Heliostat extent
Scale 1:100 000
Date 14/07/2011
Compiled by GOES
Project No 436964
srk consulting
BOTSWANA
NAMIBIA
SOUTH AFRICA
Study Area
Northern Cape
North West
Free State
Western Cape
Eastern Cape
LIME ACRES
OWENDALE
C92A
C92C
D71B
D73A

Figure 27: Localities of surveyed boreholes in the Humansrus area

7.1.5.3.3 Current Abstraction

The estimated abstraction from the Farm Humansrus and the surrounding areas is summarised in Table 17. In the case of electric pumps, the estimates are based on pump yields and daily operating hours as reported by the owners. For windpumps a 24 hour/day operation at 12% of the maximum yield was assumed (which is determined by the cylinder size). This assumption is based on the author's personal experience in the Karoo area. Based on these assumptions a total abstraction of approximately 104 000 m^3/annum is calculated for the study area. Nearly 66% (~68 000 m^3/annum) of this volume is abstracted in the Groenwater rural area, of which ~54% is for domestic use and 46% (31 500 m^3/annum) spring flow at GR13.

No large scale irrigation currently takes place in the area and most of the abstracted groundwater is used for stock watering and domestic use. However, groundwater was previously abstracted from boreholes GR11 and GR12 at a rate of ~ 180 000 m^3/annum to irrigate 25 ha of lucerne. This abstraction continued for several years and was only ceased after this portion of Groenwater was bought by the Department of Rural Affairs and Land Reform (*pers. Comm. Mr. Scholtz*).

7.1.5.3.4 Groundwater Resource Potential

The Humansrus area falls within the Quaternary Drainage Region D73A (see Figure 25 and Figure 27) for which the amount of water available under General Authorisation is listed under Zone A of the Groundwater Taking Zones, where no water may be taken from this drainage regions except as set out under Schedule 1 and small industrial users (DWAF, 2004). ***Therefore, if the water demand is to be satisfied from the groundwater resources a Water Use Licence Application will have to be submitted.***

Two Groundwater Resource Units (GRU's) were defined for this area. These are based on surface drainage, measured groundwater elevations and lineaments such as faults and dykes. The boundaries of these GRU's are indicated in Figure 25. The GRA2 grid datasets (DWAF, 2005) were used to derive the MAP, effective recharge and groundwater resource potential for these GRU's. As boreholes cannot intersect all the available recharge in an area, an exploitability factor (DWAF, 2005) was used to calculate the volume of groundwater that can actually be abstracted through boreholes. Current abstraction based on the hydrocensus data was subtracted from this value to determine the current Groundwater Exploitation Potential. These calculated values are summarised in Table 18.

The GRA2 data indicate that the Humansrus GRU (D73A-1) has an estimated average mean recharge of approximately 627 000 m^3/annum, i.e. 2% of the MAP of 476 mm. The mean annual recharge in the Humansrus area is shown in Figure 28. The groundwater exploitation potential was calculated to vary from 326 000 m^3/annum for dry seasons to 437 000 m^3/annum for wet seasons, i.e. a mean of approximately 381 000 m^3/annum. The volume of groundwater that is potentially stored in the aquifers of the Humansrus GRU has been calculated as approximately 9.1 million m^3.

Based on information supplied by SSI, the maximum water demand of any of the three types of STEP Plants that is under consideration, is 246 200 m^3/annum for the Hybrid Cooled Zero Discharge Plant.

Table 17: Estimated groundwater abstraction in the Humansrus area

Bh Nr	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Use	Estimated Annual Abstraction (m^3)	Comments
Farm:	Groenwater				TOTAL	68,223	
GR1	73	4.0	19.00	None	Domestic	11,000	Pump removed, Abstraction was ~11,000 m^3/a
GR10		20.0	5.87	None			
GR11	60	20.0	7.05	None			Previous abstraction 120,000 m^3/a
GR12	28	10.0	2.12	None			Previous abstraction 60,000 m^3/a
GR13	0		0.00	None	Irrigation	31,500	Spring - rough estimate - difficult to measure flow
GR14	9			WP 100mm cylinder	Domestic, Stock	3,406	Closed
GR15	91		19.49	None			
GR16	73		18.79	WP 75mm cylinder	Stock	1,514	
GR17	52			WP 60mm cylinder	Stock	1,135	
GR2	60			50mm Mono	Domestic	7,900	Pump out of order, Previously pumped at ~7,900 m^3/a
GR3	64	3.5	29.11	40mm Submersible	Domestic	11,038	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	32	0.3	27.59	None			Tested by SRK in 2007, Likely partially collapsed
GR5	50	4.1	17.33	None			Tested by SRK in 2007
GR7	78	1.4	17.07	None			Drilled by SRK 2008, Blow yield
GR8	11			Handpump		730	Closed
GR9	15		4.00	40mm submersible			Out of order - not used anymore
Farm:	Humansrus				TOTAL	17,082	
HS1	50	1.8	27.27	40mm Submersible	Domestic, Stock	10,512	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	107	40.0	28.02	None			Water strike at 98 mbgl Fractured lava and tillite
HS3	36	0.2		None			Roots at 10 mbgl
HS4	54	1.0		WP 90mm cylinder	Stock	6,570	Bees in borehole
HS5	54	1.8	18.27	WP 90mm cylinder	Stock		Out of order, Water flows in @ 10 mbgl
HS6	210	0.5		None			Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside				TOTAL	10,549	
SE1	84	3.6		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE10	60	2.5		None			Collapsed at 6.8 mbgl
SE2	24	0.3		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE3	33	0.5	17.00	WP 65mm cylinder	Domestic, Stock	1,135	
SE4	35	1.0		40mm Submesible	Domestic, Stock	1,971	Baseplate closed
SE5	35	1.9		WP 100mm cylinder	Stock	3,406	Baseplate closed
SE6	150	0.3	73.44	WP 65mm cylinder	Stock	1,135	Water strike at 75 mbgl
SE7	15	0.1	12.35	Solarpump	Stock	631	Alt Nr GW9
SE8	30	0.0		None			Dry
SE9	60	4.2		None			Collapsed at 8 mbgl
Farm:	Clifton				TOTAL	8,089	
CN1			31.71	WP 60mm cylinder	Domestic	1,135	
CN2				50mm Mono	Domestic, stock	3,548	Closed, Pump yield = 0.9 ℓ/s
CN3		0.3	29.65	None			
CN4			32.46	WP 60mm cylinder	Stock	1,135	
CN5		0.7	25.79	None			Was equipped with 40mm Subm., Intake @ 45m
CN6			19.31	None			
CN7		0.9	12.22	None			Blocked 0.2m below water level
CN8				None			Blocked at 16.7 mbgl, Dry
CN9			9.27	WP 60mm cylinder	Stock	1,135	
CN10			9.18	WP 60mm cylinder	Stock	1,135	
					TOTAL FOR STUDY AREA	103,942	

Table 18: Groundwater exploitation potential of the Humansrus area

Groundwater Resource Unit	Area (m^2)	Area (km^2)	No. of cells	MAP (mm/a)	Recharge Factor (%)	Average Mean Annual Recharge (m^3/a)	Average Mean Annual Recharge (mm/a)	Groundwater Exploitation Potential (m^3/a) Wet Season	Groundwater Exploitation Potential (m^3/a) Dry Season	Volume of Water stored in Aquifer (m^3/a)	5m Drawdown Storage Volume (m^3/a)
Quaternary Catchment											
D73A	1,558,947,048	1,558.95	63,737	407	2.10%	23,021,400	8.6	19,554,500	15,472,300	333,785,000	25,459,600
Groundwater Resource Units (GRU's)											
D73A-1	42,490,000	42.49	4,249	476	2 00%	627,462	9.4	437,116	325,853	9,097,502	693,916
D73A-2	27,820,000	27 82	2,782	487	2 00%	410,826	9.9	340,868	268,020	5,956,520	454,336
TOTAL						***1,038,287***		***777,984***	***593,873***	***15,054,022***	***1,148,252***
Humansrus CSP Development Area											
Development Area	13,560,000	13 56	1,356	488	2.10%	200,244	10.1	170,089	134,581	2,903,322	221,452

Hourly water demand ranges from 41.5 m^3/hour (11.53 ℓ/s) under full load to 8.35 m^3/h (2.32 ℓ/s) during off times. Note: For this study, as a worst case scenario, this maximum demand figure was used for comparison to the sustainable amount of water available for exploitation.

Comparing this maximum water demand (worst case scenario) to the exploitation potential of the Humansrus GRU (D73A-1), it is evident that this demand is well within (65%) the long term yield capacity of the aquifers of the GRU.

7.1.5.3.5 Depth to Water Table and Inferred Groundwater Flow Directions

Depth to water table at Humansrus varies from 18 to 28 mbgl.

The hydrocensus data and data from the NGDB were used to plot the groundwater elevations on the topographical map, from which the groundwater flow directions were inferred (Figure 29). The groundwater elevations normally mimics the surface elevation contours and generally flows from higher lying to lower lying areas. The inferred flows are from the surrounding high lying flanks of the valley towards the centre lower lying floor of the valley at Humansrus and then along the valley towards the north-west. These groundwater elevations indicate that the southern part of the surveyed area (i.e. the farm Clifton and part of the farm Sunnyside) falls outside the Humansrus GRU in another drainage region (D71B).

7.1.5.3.6 Groundwater Quality

The groundwater salinity (expressed as Electrical Conductivity in mS/m) of the Humansrus area is shown in Figure 30. The groundwater quality varies throughout the area with the best quality of groundwater occurring in the recharge areas, i.e. the jaspilite and banded ironstone hills in the eastern and northern parts of the study area. However, the groundwater quality throughout

the area is generally good and based on the field measured Electrical Conductivity's (EC), which ranged between 32 and 132 mS/m (mean EC = 59 mS/m), suitable for human consumption. Noticeable anomalies in the field measured EC's were recorded near potential pollution sources (e.g. stock pens) in areas with shallow water levels.

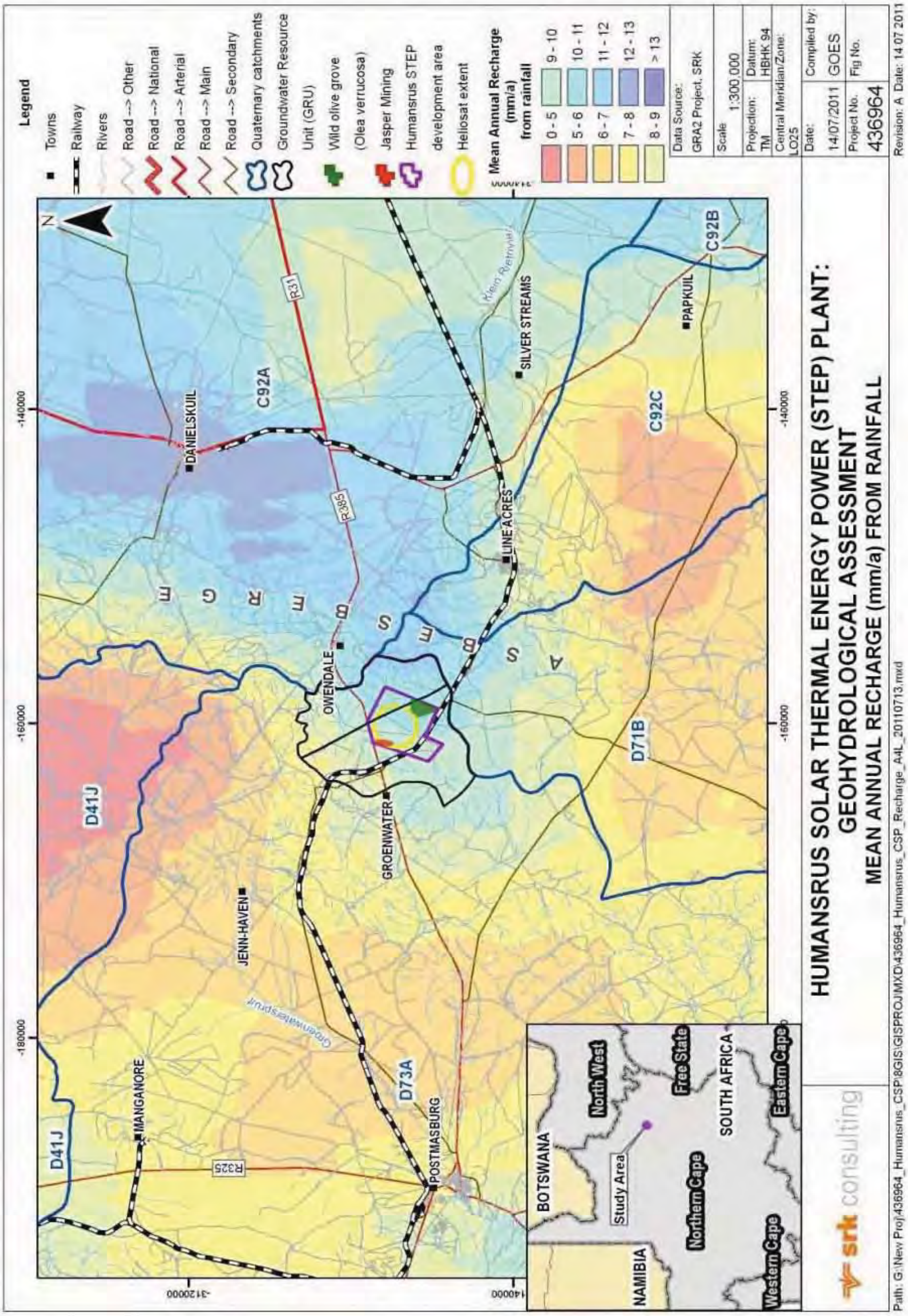

HUMANSRUS SOLAR THERMAL ENERGY POWER (STEP) PLANT:
GEOHYDROLOGICAL ASSESSMENT
MEAN ANNUAL RECHARGE (mm/a) FROM RAINFALL
Legend
Towns
Railway
Rivers
Road --> Other
Road --> National
Road --> Arterial
Road --> Main
Road --> Secondary
Quaternary catchments
Groundwater Resource Unit (GRU)
Wild olive grove (Olea verrucosa)
Jasper Mining
Humansrus STEP development area
Heliosat extent
Mean Annual Recharge (mm/a) from rainfall
0 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
> 13
Data Source: GRA2 Project, SRK
Scale 1:300 000
Projection: TM
Datum: HBHK 94
Central Meridian/Zone: LO25
Date: 14/07/2011
Compiled by: GOES
Project No. 436964
Fig No.
Revision: A Date: 14 07 2011
srk consulting
Path: G:\New Proj\436964_Humansrus_CSP\8GIS\GISPROJ\MXD\436964_Humansrus_CSP_Recharge_A4L_20110713.mxd
DANIELSKUIL
SILVER STREAMS
PAPKUIL
LINE ACRES
OWENDALE
GROENWATER
JENN-HAVEN
MANGANORE
POSTMASBURG
C92A
C92B
C92C
D71B
D41J
D73A
R31
R385
R325
Klein Riet
Groenwaterspruit
BOTSWANA
NAMIBIA
North West
Free State
Northern Cape
Western Cape
Eastern Cape
SOUTH AFRICA
Study Area
-140000
-160000
-180000
-3120000
-3140000

Figure 28: Mean annual recharge in the Humansrus area

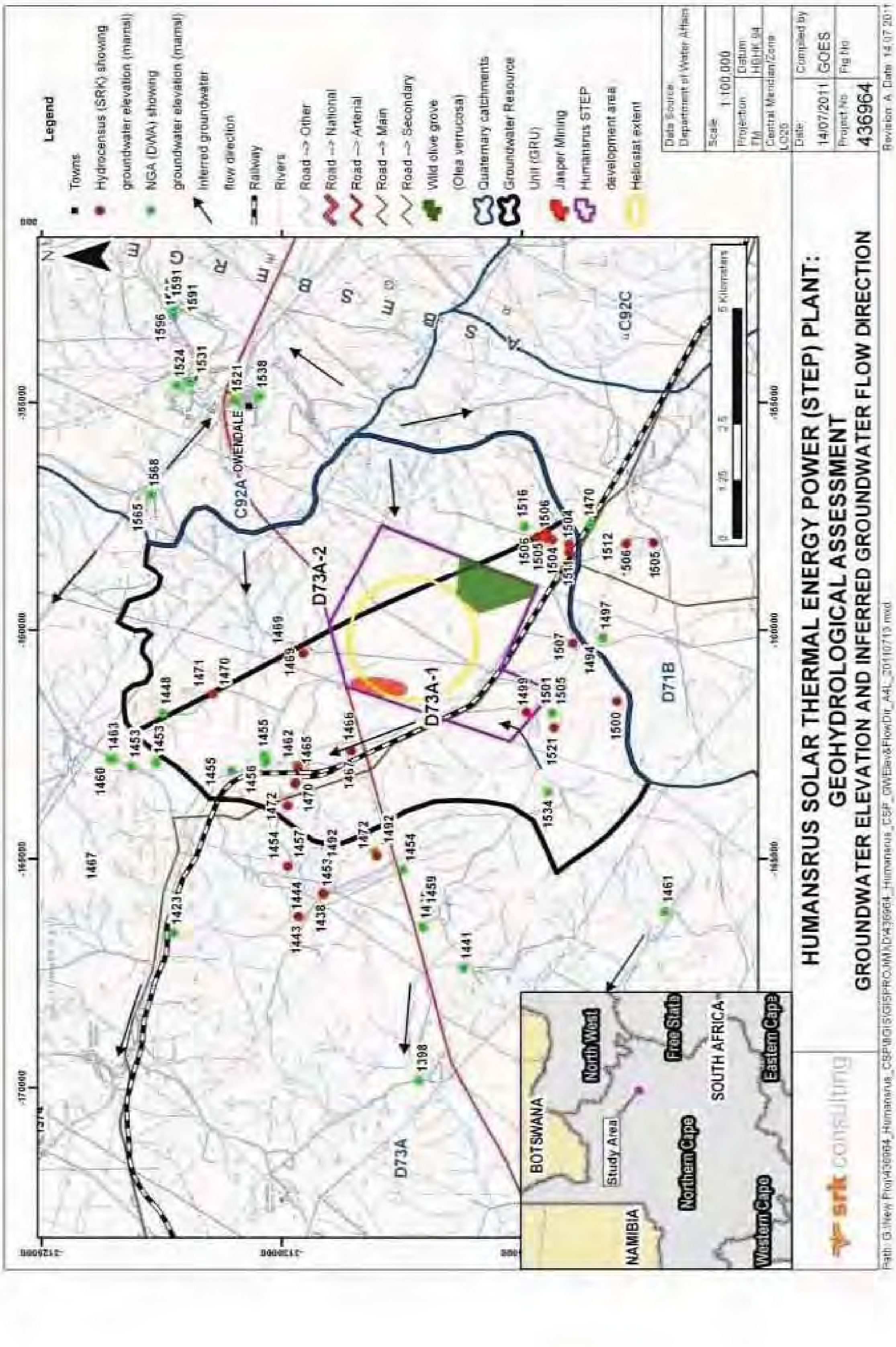


Figure 29: Groundwater elevations and inferred flow directions in the Humansrus area

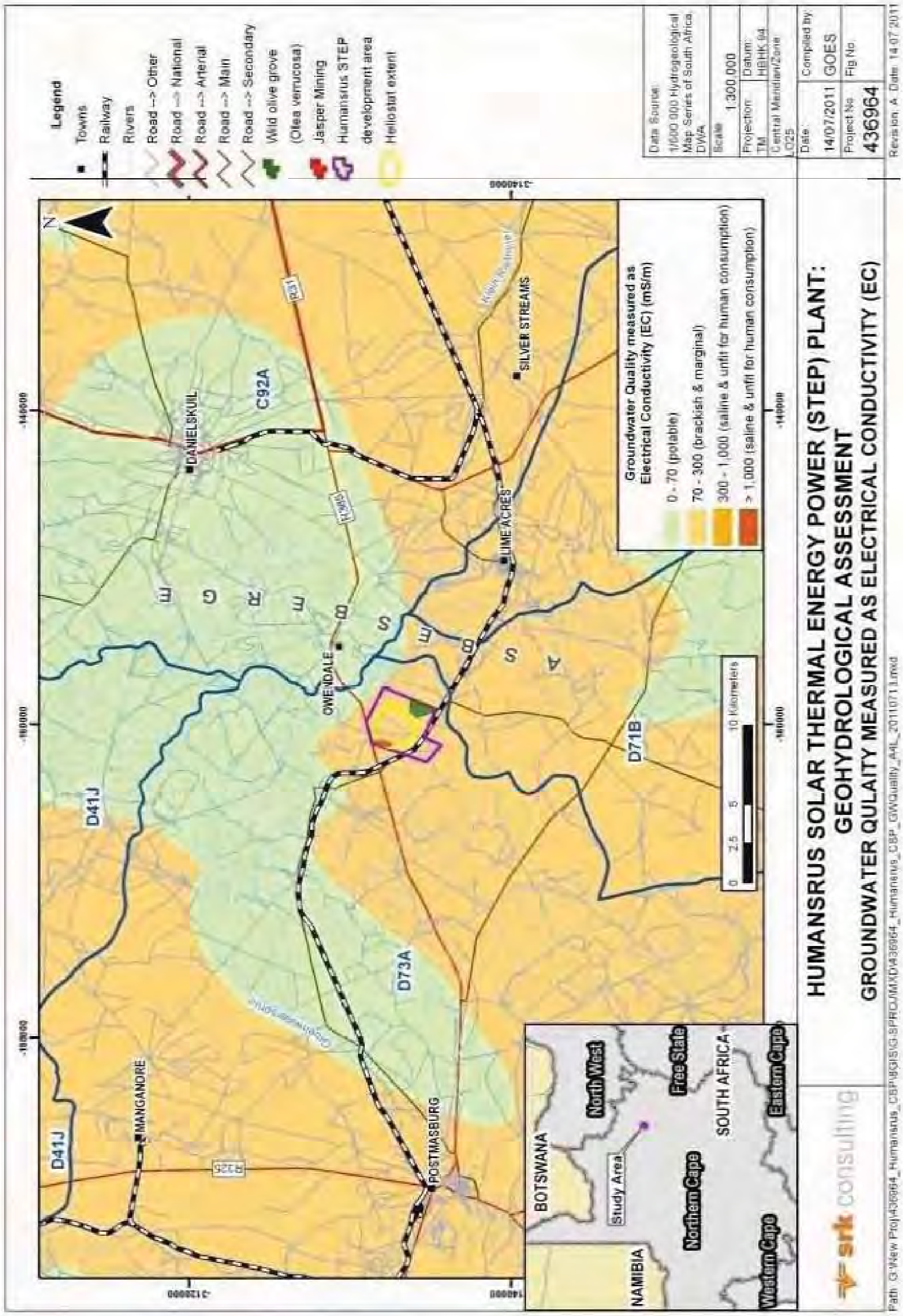


Figure 30: Groundwater salinity in the Humansrus area

This indicates that the aquifers are easily polluted by surface pollution sources due to a rapid recharge and relative quick vertical infiltration.

The average EC and pH values of the surveyed boreholes are 66.8 and 7.5 respectively and correlate well with the median values. This means that there are not highly anomalous values for these parameters which skew the average values. Borehole GR14 and the spring GR13 are in the same area with largely different EC values. The relative high EC measured at the spring can likely be attributed to surface pollution from animals drinking at this open water source. Boreholes GR14 and CN2 are drilled in the Daniëlskuil Member (jaspilite) of the Asbestos Hills Formation and yield groundwater with very low EC values. The Asbestos Hills Formation in this area is characterized by a very good groundwater quality.

7.1.5.3.7 Aquifer Vulnerability

Figure 31 shows aquifer vulnerability as determined by evaluating seven parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible away from the high risk areas in the north and east. Best position will be in the south-western parts of the farm where the aquifer vulnerability is lowest.

7.1.6 Geotechnics

The purpose of the Geotechnical report is to provide preliminary foundation and earthworks recommendations based on the visual and tactile assessment of site conditions, together with the laboratory test results. The reports will be submitted to the EPC contractor who will then conduct the detailed geotechnical assessments.

7.1.6.1 Desk Study and Reconnaissance Survey

The published geological map of the area (2822 Postmasburg, scale 1:250 000, dated 1977) shows the site to be underlain by possibly lava, agglomerate, chert and jasper of the Ongeluk Formation, tillite jaspilite and dolomite of the Makganyene formation and gently-dipping jaspilite and crocodilite of the Asbestos Hill Formation.

The soil cover is represented by quaternary Aeolian sand.

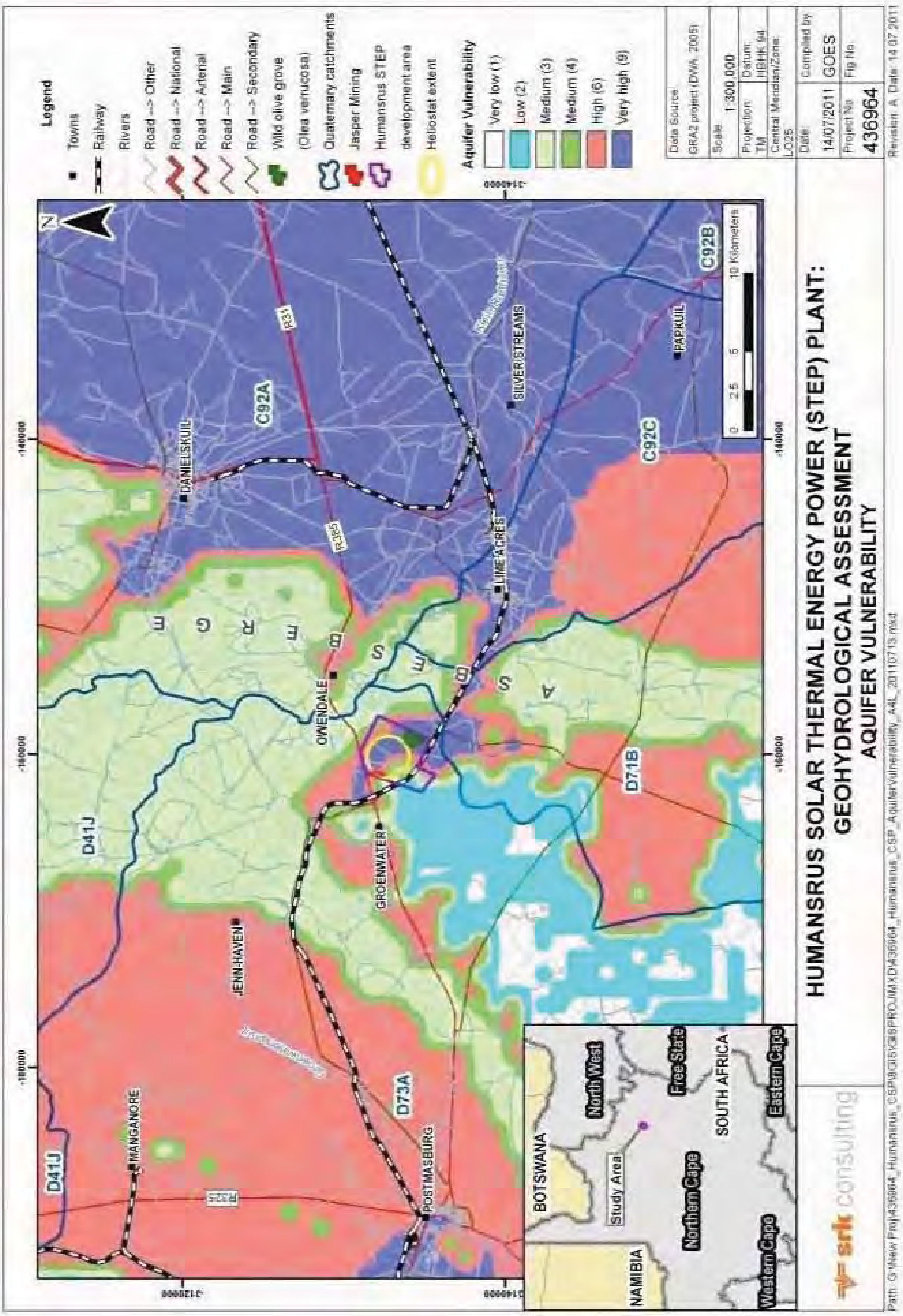

HUMANSRUS SOLAR THERMAL ENERGY POWER (STEP) PLANT:
GEOHYDROLOGICAL ASSESSMENT
AQUIFER VULNERABILITY
Legend
Towns
Railway
Rivers
Road --> Other
Road --> National
Road --> Arterial
Road --> Main
Road --> Secondary
Wild olive grove
(Olea verrucosa)
Quaternary catchments
Jasper Mining
Humansrus STEP
development area
Heliostat extent
Aquifer Vulnerability
Very low (1)
Low (2)
Medium (3)
Medium (4)
High (6)
Very high (9)
Data Source:
GRA2 project (DWA, 2005)
Scale: 1:300,000
Projection: TM
Datum: HBHK 94
Central Meridian/Zone: LO25
Date: 14/07/2011
Compiled by: GOES
Project No: 436964
Fig No.
Revision: A Date: 14 07 2011
DANIELSKUIL
OWENDALE
LIME ACRES
SILVER STREAMS
PAPKUIL
GROENWATER
JENN-HAVEN
MANGANORE
POSTMASBURG
C92A
C92B
C92C
D41J
D71B
D73A
R31
R385
R325
0 2.5 5 10 Kilometers
NAMIBIA
BOTSWANA
Study Area
North West
Free State
SOUTH AFRICA
Northern Cape
Western Cape
Eastern Cape
srk consulting

Figure 31: Aquifer vulnerability map of the Humansrus area

Topographically the site slopes gently in a south-westerly direction from 1550 masl to 1530 masl at a very flat grade of 1V:300H or less than 0.5%.

The site area occurs in an arid warm, dry region (TRH 4, 2.1). Residual soils are expected to be thin and gravely and mechanical disintegration is the only mode of weathering. Pedogenic soils are expected to be calcareous (calcrete).

The mean annual surface temperature is between 17.5 and 20.0°C and the potential for evaporation are between 2 200 and 2 400 mm (modified after DWAF, 1986). Mean annual precipitation is 300 to 400 mm. The type of weathering of the underlying bedrock is expected to be very slight (Fookes et al, 1971).

The erodibility of the subsoils in the area is expected to be low with a corresponding Erodibility Index (EI) of between 16 and 20 (Verster and WRC, 1992).

Seismologically, the site is characterised by seismic intensity of V (MMS) with a 10% probability of being exceeded at least once in a 50 year period (Geological Survey, 1992). This translates to a predicted maximum horizontal ground acceleration of less than 50 cm/s^2 or 0.025 g (CGS, 2003). Under these conditions, the probability of liquefaction is considered unlikely (Welland, 2002).

The total lightning risk (estimated for 2006-2007), based on flashes per km^2 and positive polarity lightning measurements, has been determined at severe (Gill, 2008).

7.1.6.2 Inspection Pits and Exposures

The main portion of the investigation comprised the excavation of 20 inspection pits using a Komatsu WB 93R TLB machine (see Figure 32 below).

Figure 32: Komatsu WB 93R TLB Machine

The depth of the 20 inspection pits ranged from between 0.65 m and 3.2 m below existing ground level. No ground water was encountered in any of the inspection pits and throughout the site. However, during periods of prolonged rainfall, particularly during the summer season, increased groundwater seepage flow can be anticipated, particularly at the soil / rock interface. Perched groundwater flows at the soil / rock interface. The following general soil profile was recorded as follows across the site:

Table 19: Summary of Soil Profile (Mudrock in Northern Sector)

Depth (m-m)	Origin	EABC* (kPa)	Description
0.0-075	Hillwash	N/A	Moist, red brown, loose, silty fine sand.
0.75-1.75	Residual	100-200	Moist, yellow orange brown, firm to stiff, silty sandy clay with ferricrete nodules.
1.75+	Saprolite to weathered bedrock	250+	As above but medium dense, gravely sand to very soft rock lava.

**EABC = estimated allowable bearing capacity*

The following Table 2 shows the summary of the geotechnical constraints on the site:

Table 20: Summary of Geotechnical Parameters and Constraints

Geotechnical Condition	Parameter	Constraint and recommendations
Potential expansiveness/activity	PI = 18% and clay <5%.	The upper lava residuum may be moderately expansive but tested as inert.
Collapsibility	Expect collapse in the upper hillwash layers, generally very loose sandy silt.	Low to medium collapse at low to medium loads in the upper transported sands.
Erodibility Compressibility	CL-CH:SM to ML	Significant in hillwash layers
	GM:SM with LL < 50%	Nil to low possibility of compressibility in all other layers.
Bearing capacity & subgrade	Competent weathered bedrock at 1.75 m depth average.	Weathered bedrock to provide 250 kPa or more.
Seepage	No seepage encountered in any of the inspection pits over the site during the investigation.	De-watering during construction will probably not be required. Subsoil drainage measures should only be required in deep cuts.
Construction materials	CL-CH and ML (generally A.4 to A&.6)	Most materials arising will not be suitable for construction purposes. Careful selection is advised in

Geotechnical Condition	Parameter	Constraint and recommendations
		weathered lava and hillwash.
Excavatability	Anticipate soft excavation up to TLB refusal depths. Anticipate Intermediate to hard below these depths	Soft (SANS 1200) to 1.75 m average in transported, residual, and weathered rock. Only 15% of IP refused at <1m below surface. Expect intermediate to hard excavation below this level.

7.1.6.3 Laboratory Test Results

The laboratory results indicate that the residuum is coarse-grained with a fairly high compacted CBR but high PI that excludes the soil for use as a construction material (Table 21).

The layer does not seem to improve in quality with depth and does not show an indication of high compressibility (LL<50%).

Table 21: Summary of Foundation Indicator Test Results (Residual Lava)

IP	Depth (m)	LL (%)	PI (%)	LS (%)	GM	CBR @93%*	TRH 14	PRA & USCS
13	0.8-1.9	47	18	9.0	2.22	25	G8	A.6 & OL

*Estimated from GM-PI relationship (after O Schnitter).

7.1.7 Hydrology

Pan evaporation in the area is estimated at between 2 200 and 2 600mm.a-1, considerably more than the rainfall (Middleton and Bailey, 2009). The region is therefore in permanent water deficit and standing surface water soon evaporates or infiltrates. Runoff can be anything from 0-25 mm.a-1 (Middleton and Bailey, 2009). Surface water generated by rainfall is confined to intense convective storms and quickly subside. Surface water storage (as in dams) is highly inefficient because of the high evaporation rate.

Humansrus has a rocky hill slope on its east side and a central but lower ridge. The zone between the central ridge and the eastern topography is the location of the planned CSP. This area is covered by gently sloping Kalahari Sands with an even topography. No natural drainage lines are observed here and any surface water that occurs here during storms infiltrates.

In the lower-lying zones of the project area, soils are sandy with a relatively high infiltration capacity (recent Kalahari cover); with a deeper Hutton profile (See MacVicar et al., 1997). On the central ridge in the Humansrus property and to the east, soils are very shallow, stony and rocky. Annual recharge to groundwater in the area is about 3-10 mm/annum (see Beekman et al., 1996).

Runoff from the soil surface is low and occurs in circumstances of intense rainfall. There is only one identifiable drainage channel, located on the west side of Humanrus, adjacent to the railway

line. Non-perennial, it is dry most of the time. Water flows only very briefly during heavy and intense storms.

7.1.8 Wetland

Wetland Consulting Services (Pty) Ltd was appointed by SSI to undertake the specialist wetland delineation and assessment as part of the EIA process currently being undertaken by the Environmental Assessment Practitioners (i.e. WorleyParsons RSA and SSI Environmental) for the proposed Solar Thermal Energy Power Plant near Postmasburg in the Northern Cape. The need for the wetland delineation was identified based on the vegetation study undertaken for the site which identified a non-perennial drainage line and associated floodplain on site.

7.1.8.1 Catchments

The study area is located within Primary Catchment D, and more specifically within quaternary catchment D73A. The catchment is drained by the Groenwater Spruit. Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990). Figure 33 indicates the position of study area in relation to the affected quarternary catchment. Note: the low mean annul precipitation, which indicates that the study area is located within an arid environment.

Table 22: Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990)

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
D73A	297 781	322.66	14.6	4.5 %

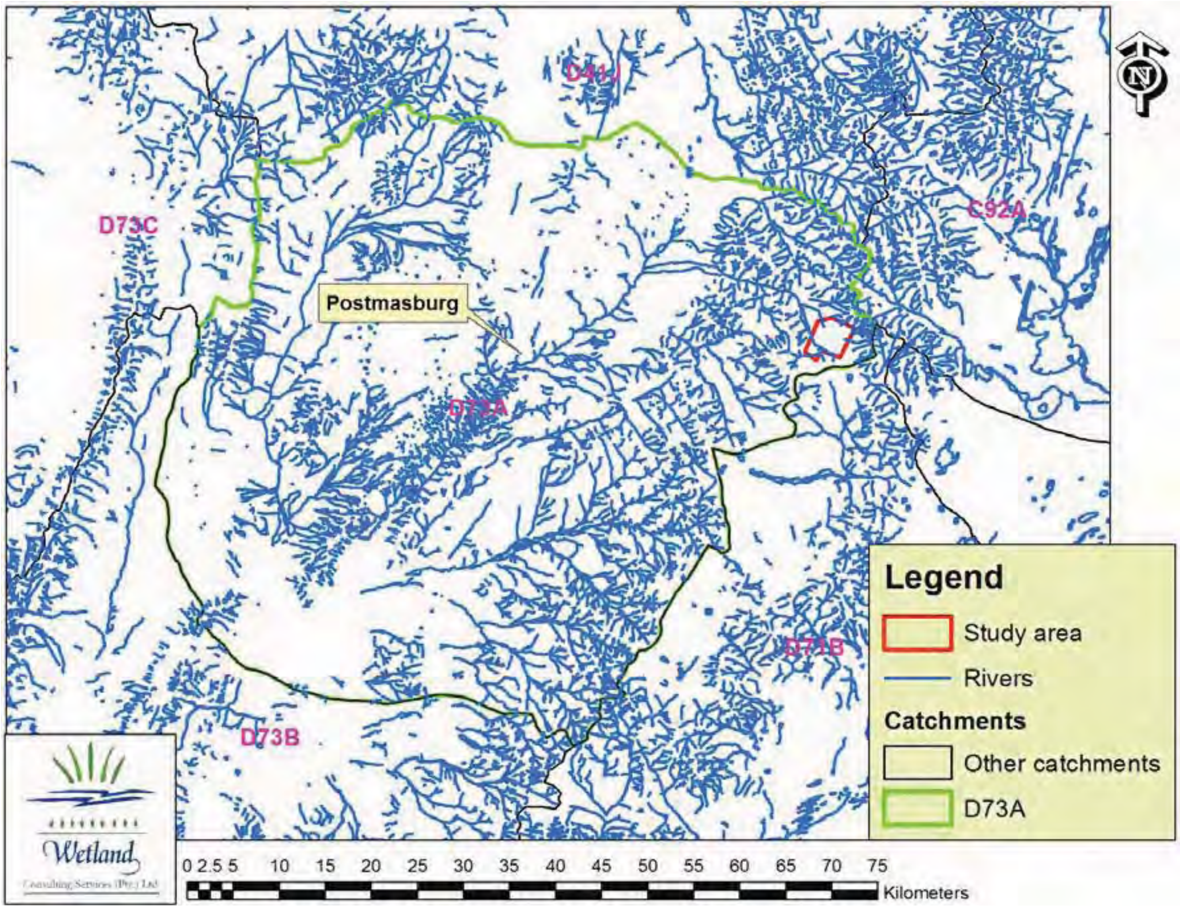


Figure 33: Map showing the study area in relation to the quaternary catchment

7.1.8.2 Wetland and Riparian Delineation and Classification

The 1:50 000 topographical map of the area (2823AD) indicates a number of non-perennial drainage lines within the study area. Numerous small drainage lines are shown draining onto the site from the mountains to the north and east of the site before petering out on the flat central region of the study area. In the south western portions of the site the upper reaches of the Groenwater Spruit are shown as draining across the study area in a roughly northerly direction.

The field work undertaken during July 2011 revealed that only the Groenwater Spruit and its tributary have associated riparian habitat. The remaining drainage lines indicated on the 1:50 000topographical maps represent low points within the landscape along which water is expected to flow only occasionally following heavy storm events, but which do not differ in vegetation structure or composition from the adjacent vegetation, and do not have a defined channel. The soils within these areas also showed no hydromorphic features and were typical reddish brown terrestrial soils, presumably of the Hutton soil form. These ―drainage lines" were thus not classed as either wetlands or riparian zones (refer to Figure 34).

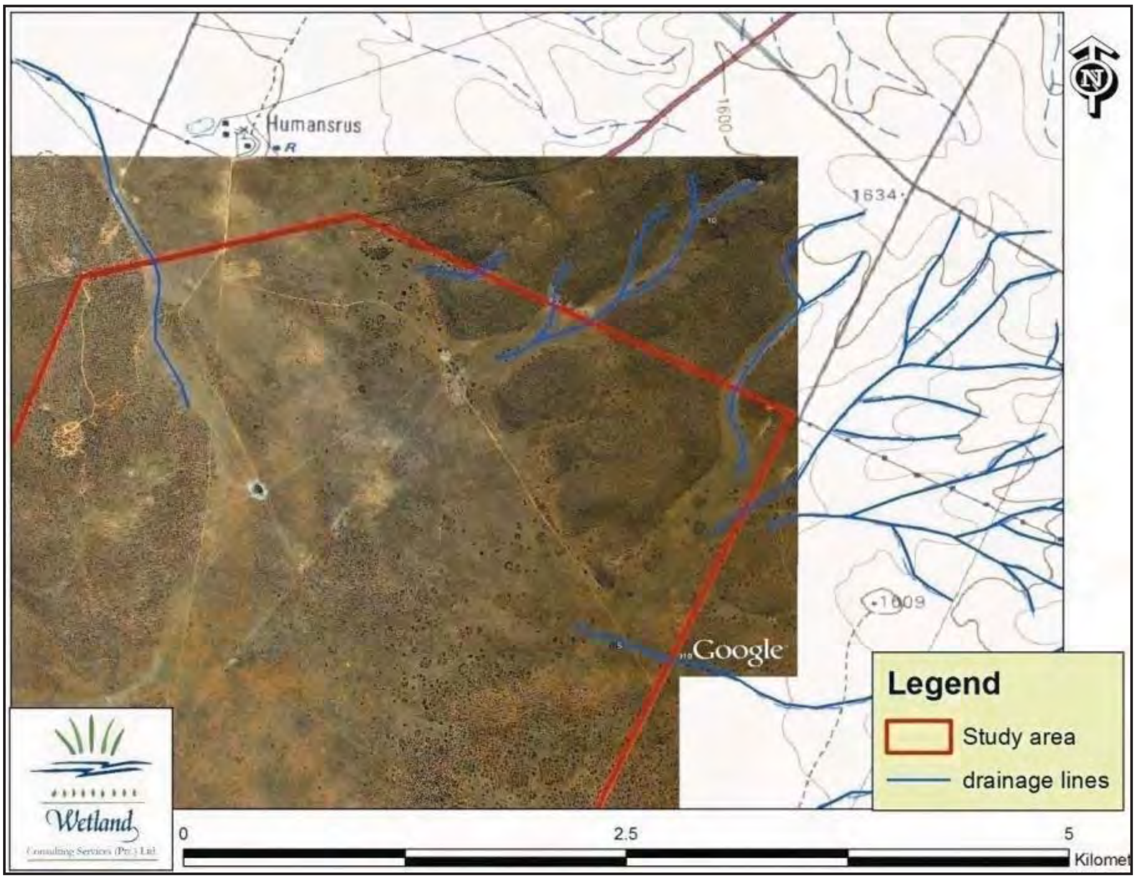


Figure 34: Map of the northern reaches of the study area indicating the drainage lines indicated on the 1:50 000 topographical maps of the area.

Following heavy rain, surface runoff from the rocky hills to the north and east of the study area is expected to accumulate within these low points where the sandy soil allows easy infiltration of surface water into the soil. Water is thus not retained within the upper reaches of the soil profile for an extended period that would allow the formation of wetland or riparian habitat. Rainfall that has infiltrated the soil is expected to be mostly lost to evapo-transpiration or deeper infiltration into groundwater, though some lateral seepage at depth through the soil profile is possible. To them north of the Farm Humansrus a spring is located on the Farm Groenwater (as indicated by the local farmer) at the northern end of the plain that extends into the central portions of the study area. It is possible that water infiltrating the sandy soil on site plays a role in supporting this spring. This is however mere speculation and will need to be confirmed by the groundwater and geotechnical studies of the site.

The riparian habitat delineated along the Groenwater Spruit and its tributary is illustrated in Figure19 below. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5% of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified. The reach of the Groenwater

Spruit located upslope of the railway line and gravel road is characterised by a clearly defined, incised channel characterised by a rocky substrate.

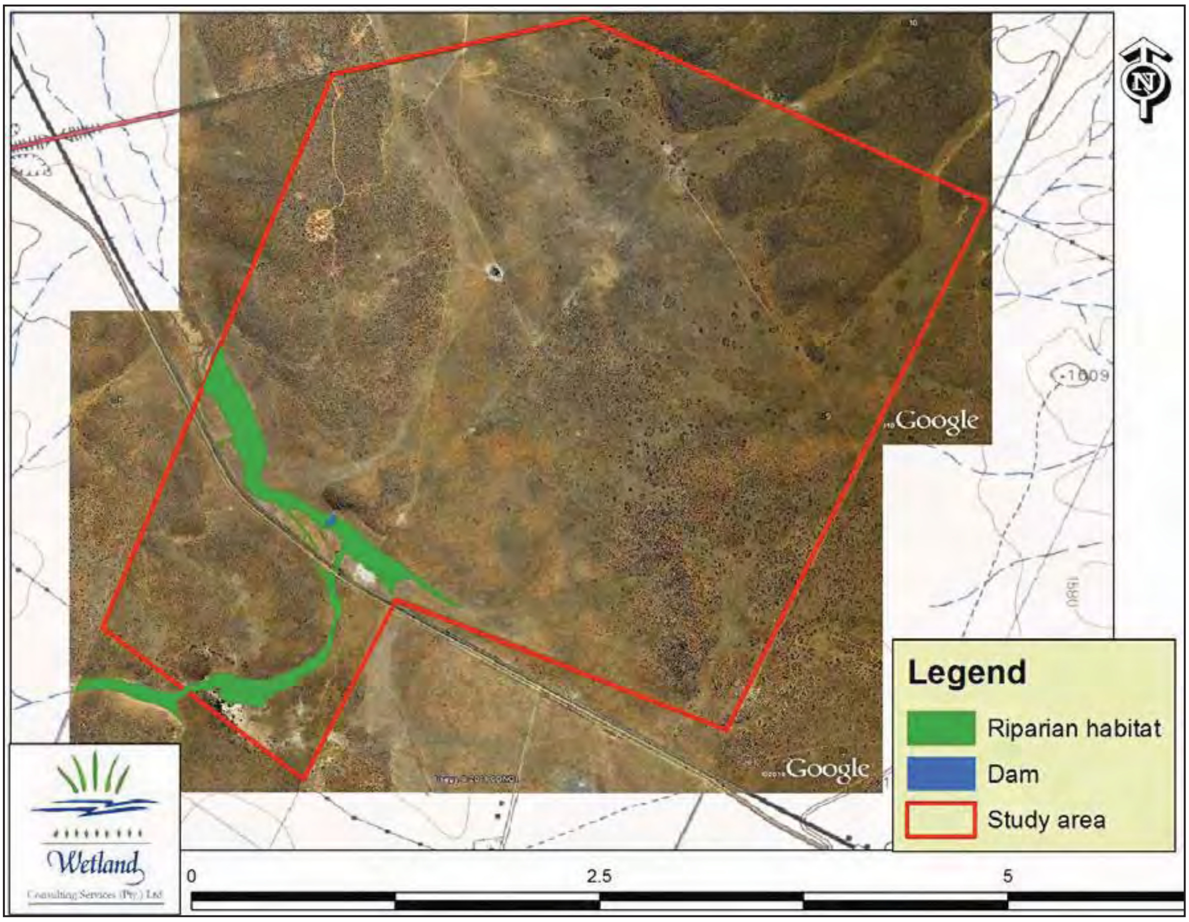


Figure 35: Map of the delineated riparian habitat associated with the Groenwater Spruit

Adjacent side slopes were also generally rocky. Isolated pools of water were observed in this area. Along this section of the riparian habitat a number of tree and shrub species were observed, including *Olea europea, Rhus lancea* and *Acacia tortilis*. Grass species included *Themeda triandra, Aristida congesta, Aristida spp., Eragrostis chloromelas* and *Juncus rigidus*. Though classified as a riparian zone, isolated patches along the water course did display some wetland characteristics and subsurface water seepage, most notably a small spring located upslope and outside of the study area in close proximity to the site boundary, as well as the area located immediately below the old farm house.

To the north of the railway line upstream and immediately downstream of the small dam, the Groenwater Spruit and its tributary flow along a poorly defined channel. This section of the riparian habitat is completely devoid of trees and is dominated by various grass species. The timing of the study precluded accurate identification of many of the grass species due to the significant frosting back of vegetation that had already taken place, as well as heavy grazing by

livestock. Typical species however included various *Aristida* spp., *Themeda triandra*, *Juncus rigidus*, *Eragrostis* spp, *Melinis repens*, *Sporobolus* spp. and *Cynodon dactylon*.

The lower reaches of the Groenwater Spruit on site are again characterised by a clearly defined, incised channel, the channel being broad and fairly shallow. Once again the riparian habitat is tree-less and dominated by grass species. Soils along this section of the riparian zone were typical of terrestrial soils with no signs of seepage into the stream channel. The channel was also completely dry downslope of the railway crossing.

7.1.8.3 Water Quality

At the time of the site visit in July 2011 the Groenwater Spruit on site was mostly dry with surface water restricted to small isolated pools of standing water within the stream channel. No flowing water was observed. Areas of standing water were heavily utilised and trampled by livestock.

The water quality was sampled in the Groenwater Spruit from the largest observed extent of surface water, located below the old farmhouse (-28.320424°S; 23.352987°E). No flowing water was present at the time of sampling, and remaining areas of standing water were heavily impacted by livestock reliant on these areas for drinking water. The impact of the livestock on the water is indicated by elevated nitrate concentration of the water, resulting from cattle droppings in the water. Generally the water quality is however of an acceptable standard. The target water quality guidelines for aquatic ecosystems were exceeded for both Selenium and Zinc, though this is expected to be the natural condition of the stream and is not taken as being indicative of pollution.

7.1.8.4 Functional Importance of Riparian Habitat

The riparian habitat on site is associated with an ephemeral and highly variable stream in terms of flow characteristics, which are reflected in the riparian vegetation which is in many places poorly developed and often resembles the adjacent terrestrial habitat. Nonetheless, the riparian habitat is expected to play a role in various functions, including:

- **Erosion control –** the riparian vegetation stabilises river banks through the binding action of the plant roots, as well as slowing down flows through the surface roughness provided by the vegetation, further reducing erosion risk. As the riparian habitat on site is dominated by non-woody species, the surface roughness provided by the riparian vegetation is however somewhat limited;
- **Flood attenuation –** the main flood attenuation function of the riparian habitat is performed when flows overtop the stream channel and spread out across the riparian habitat. This slows down flood velocities;
- **Biodiversity support –** the riparian habitat provides habitat differing from the surrounding terrestrial habitat and can thus support species not generally found elsewhere on site. Given the arid environment, riparian habitats within the general area are rather limited, further increasing the importance of this function;

- **Water supply –** the riparian habitat and associated stream represent the only natural surface water supply within the study area and thus provides important drinking areas for a variety of species, particularly bird species (e.g. Namaqua Sandgrouse were observed utilising the remaining pools of water in the stream); and
- **Ecological corridors –** riparian areas often provide ecological corridors for the movement of fauna along the riparian habitat to other areas of suitable habitat; and
- **Direct use benefits –** on site, these appear to be limited, though the riparian habitat does provide livestock grazing to cattle, goats and horses.

7.1.8.5 Present Ecological State

The Present Ecological Status of the riparian habitat is considered to be in a B/C category (see Table below), indicating a ***largely natural to moderately modified*** system.

Table 23: Ecological categories used for the VEGRAI scoring system (modified from Kleynhans 1996 & Kleynhans 1999).

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural Largely natural with few modifications	90-100
B	A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

The upper catchment of the Groenwater Spruit is mostly undeveloped and changes to catchment run-off quantity and quality are expected to be minimal, with the supporting hydrology of the system still largely intact. This is reflected in the overall fairly good condition of the riparian habitat on site.

7.1.8.6 Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a water course in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The riparian habitat on site is considered to be of ***high*** ecological importance and sensitivity and is placed in an ***ecological management class of B***. This rating is based mostly on the ecological and hydrological importance of the riparian habitat as direct human benefits provided by the system under current conditions are limited.

7.2 Social Environment

7.2.1 Heritage Impact Assessment

PGS Heritage & Grave Relocation Consultants was appointed to undertake a Heritage Impact Assessment that forms part of the EIA for the Solar Thermal Energy Power Plant Project.

7.2.1.1 Archival Findings

7.2.1.1.1 Palaeontology

The south-western and north-eastern portions of the study area are underlain by Late Precambrian (Early Proterozoic) sediments of the Late Precambrian **Transvaal Supergroup** within the Prieska Subbasin shown in Figure 36.

The **Daniëlskuil Formation** (Vad) of the **Ghaap Group** (Asbestos Hills Subgroup) consists of some 200m of banded iron formations (BIF) that are almost 2.5 billion years old (Eriksson *et al.* 2006 and references therein). The only fossils that are likely to occur here are microbial assemblages embedded within finer-grained cherts or forming stromatolites (microbial mounds; Almond & Pether 2008).

The fossil record of the Early Proterozoic **Postmasburg Group** of the Transvaal Supergroup is very sparse (Almond & Pether 2008). Stromatolitic bioherms (microbial reef mounds) up to 5m long and 3m thick that are made up of manganese-rich laminated carbonates are recorded from the glacially-influenced **Makganyene Formation** (Vm) by Polteau *et al.* (2006). These carbonate rocks are interbedded with glacial diamictites in the Prieska Subbasin. The intimate association of warm-water carbonates and cold-water glacial deposits at low palaeolatitudes is of palaeoclimatic significance (See also Polteau 2000, 2005). No fossils are recorded from the overlying **Ongeluk Formation** (Vo), dated at approximately 2.2 Ga (billion years) which consists largely of basaltic and andesitic lavas that were erupted both subaerially and under water (Eriksson *et al.* 2006).

The central part of the study area is largely blanketed by unconsolidated aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (Qs), the geology of which is reviewed by Partridge *et al* (2006).


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Figure 36: Extract from 1: 250 000 geological map 2822 Postmasburg (Council for Geoscience, Pretoria) showing geology of the Humansrus study area in the Asbesberge (red polygon)

7.2.1.1.2 Archaeology

Stone Age

The Early inhabitants of Griqualand, both west and east, were the San people historical referred to as the Bushmen. Henderson (2000) describes some of the empirical evidence that points to the presence of the San people in the interior regions of South Africa. Among the things Henderson describes are the stone tool scatter and rock engravings near water course and/or sources such as springs; engravings are also noted as a common feature in small Koppies that define the landscape of the interior regions of South Africa.

Such evidence is corroborated with finds made in the study area in an initial study conducted in the survey area in 2010 by Webley. The field work found concentrations of Stone Age material around the dry pan in the southern section of the study area (Figure 38).

Figure 37: Low density scatter of MSA finds (Webley, 2010)

Other material culture found in the region that point to the presence of San people in the region include remains of ostrich shell-beads and ostrich egg-shell that were used by the San people to carry water and as drinking vessels. James Backhouse (1844), describing his journey to Klaarwater (modern-day Griquatown) in 1839, notes stopping at Spuigslang Fountain where he observed Bushmen women and their children coming to the fountain for water using egg-shell for bottles and vessels. Henderson identifies the same localities in her 2000 report namely ‗Spuigslang Fountain' and the ‗Farm Spoedaan' in the Hay District. The similar egg-shell remains that Backhouse notes to have seen being used by the Bushmen women and children have been found in the area south-east of Hay District (Henderson, 2000).

General consensus between archaeologists working in the Northern Cape is that archaeological remains are mostly grouped around water sources (river systems, springs and pans) and other geographical structures such as ranges of hills or shelters found in broken country. These observations by various archaeologists in the 1970-1990, have been corroborated by more recent archaeological surveys for developments such as PGS (2009-2010), Webley & Halkett (2008), Webley et al. (2010), Webley & Halkett (2010), Morris (2008, 2010) and, Van Reyneveld (2005).

Archaeological excavations done at two specularite mines Doornfontein (Beaumont & Boshier, 1974) and Blinkklipkop (Thackery & Beaumont, 1983) produced artefacts and radiocarbon data dating back to 800 AD. The data also reflects an occupation from around 800AD up to around 1850AD, with glass beads, metal items indicating European contact in the upper layers.

Rock Art

The Northern Cape is well known for its rock art in the form of rock painting and engravings, with the archaeological databases at the National Museum in Bloemfontein and the McGregor Museum in Kimberley containing hundreds of documented rock art sites with archaeological field work on projects such as transmission line construction leading to the discovery of new sites (PGS, 2010).

Known engraving sites close to the study area are at:

- Daniëlskuil: Ouplaas (Morris & Beaumont, 1994), Townlands (Collins, 1973; Wilman, 1933);

- Lime Acres: Carter Block (Morris, 2008; Wilman, 1933); and
- The farm Lemoenkloof just north of the study area (pers. Comms with Mst. Scholtz).

Iron Age

Iron Age expansion southwards past Kuruman in to the Ghaap plato and towards Postmasburg is dated to the 1600‘s (Humphreys, 1976 and Thackeray, 1983). Definite dates for Tswana presence in the Postmasburg area are around 1805 when Lichtenstein visited the area and noted the mining activities of the Tswana (probably the Thlaping) tribes in the area.

The area of Daniëlskuil was named by the Thlaro as Thlaka la tlou (reeds of the elephant) and with the Thlaping they settled the area from Campbell in the east to Postmasburg and towards the Langeberg close to Olifantshoek in the west before 1770 (Snyman, 1988).

The Korana expansion after 1770 started to drive the Thlaro and Thlaping further north towards Kuruman (Shillington, 1985)

Post 1800‘s

Ouzman (2005) traces the Korana to what he calls ―pre-colonial Kora” in the Cape Province and their father (of ―frontier Korana”) to James Bloem, a ‗white‘ Prussian from Thuringa who immigrated to the Cape in 1780, escaping to Namaqualand after accusations of murdering his wife.

Humansrus Farm History

The survey diagram of the general area (SG3296/1878) (Webley, 2010) identifies the adjoining farms Groenwater and Lemoenkloof (Figure 39) but Humansrus is not named suggesting it acquired its name after 1878.

An overlay of the 1878 map with a recent 1:50 000 topographical map revealing two main roads traversing the study area. The one road branches of towards Daniëlskuil while the main road continues on through the area of the current Groenwater Station and further north. Snyman (1988) confirms these routes as being in existence since 1816 when the original route from Griquastad via Postmasburg to Kuruman changed to go via Daniëlsrus, which was a shorter route.

Figure 38: Survey diagram (SG3296/1878) for the general area. The Farm 469 is indicated by the circle. Lemoenkloof and Groenwater are situated on the northern and western boundaries. There are no homesteads shown on Farm 469.

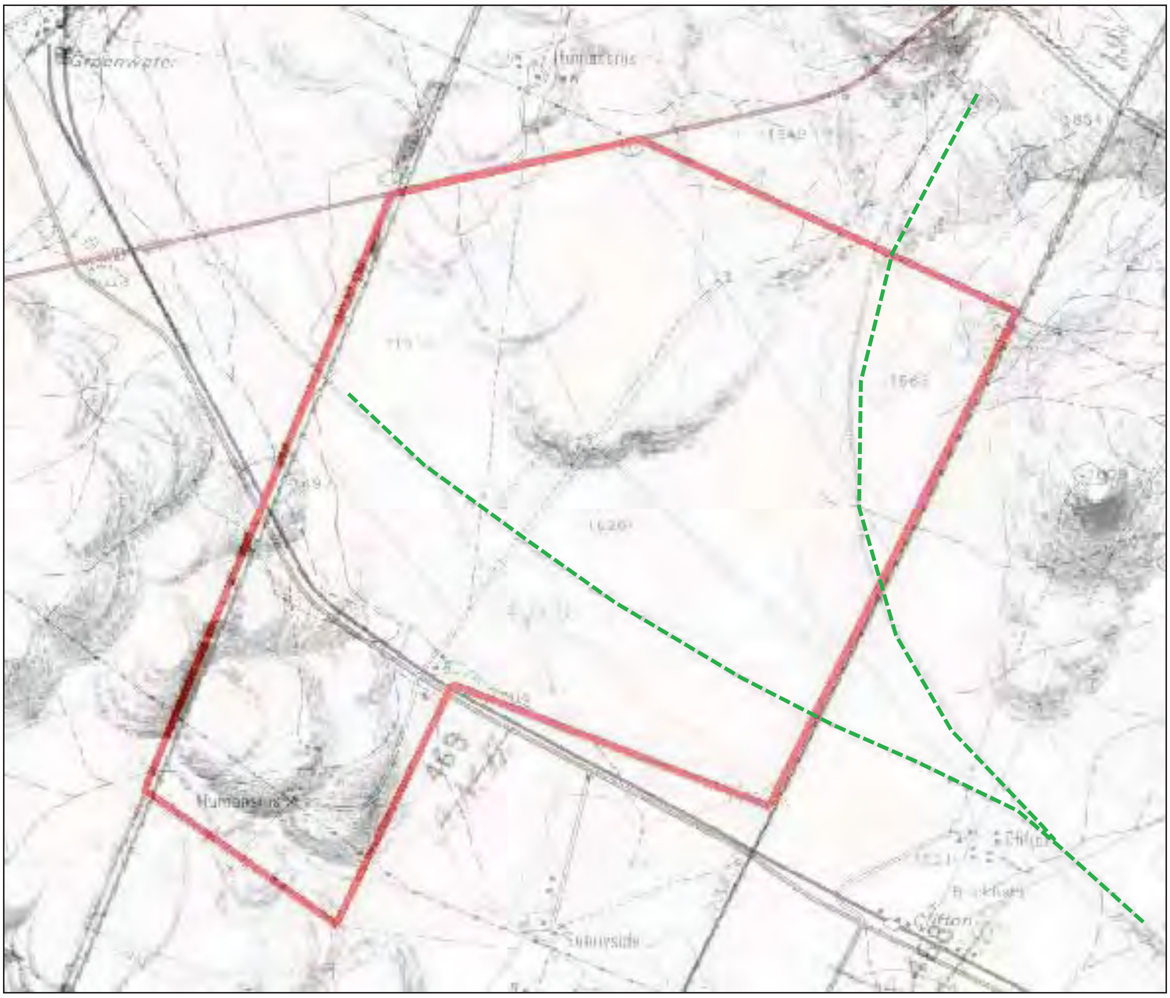


Figure 39: Survey diagram (SG3296/1878) with overlay of current 1:50 000 topographical map (Wagon routes in dashed green)

Webley (2010) indicates that the current owner's (Mr. Scholtz) grandfather purchased the portion of the farm on which the old Humansrus house is located, during the 1940's. No other information on the Human family other than the headstone in the family graveyard close to the ruins of the original farmstead is available - Hester G. Schoeman (ne Human) born 23 September 1877 - died 28 May 1913. Some tentative research indicates the grave of an A.J. Human (born in 1878) located in the Daniëlsrus cemetery – a possible family link that could be researched further if required.

7.2.1.2 Findings of Scoping Report

7.2.1.2.1 Palaeontology

No further palaeontological studies are recommended for this development.

Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably in situ, and alert SAHRA as soon as possible so that appropriate action (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.

7.2.1.2.2 Archaeology for Humansrus

The possibility of archaeological finds in the study area has been indicated by previous research in the greater Daniëlskuil-Postmasburg and Ghaap plato area. This is confirmed by a short reconnaissance survey by Webley (2010) and an initial site visit by an archaeologist from PGS of the study area. Concentrations of Stone Age artefact around the dry pans and rivers were found as well as spot finds in the flat sandy areas.

Although the current owners indicated no knowledge of rock art it is recommended that special attention is given to rocky areas as such sites could be prevalent.

7.2.1.2.3 Historical

As the area of Groenwater was settled since 1880 as a location for the Thlaping and Thlaro the possibility of scattered homesteads cannot be excluded and the report of Webley (2010) indicates the existence of structures only demarcated by single rows of rocks, indicating the position of the house foundations.

The position of the two wagon routes through the study area also leaves the possibility for ephemeral camp sites and outspans in the study area.

To be able to compile a heritage management plan to be incorporated into the Environmental Management Programme the following further work was required for the HIA for inclusion in the EIA:

– Archaeological walk through the whole of the study area, with specific attention given to the areas around pans, outcrops, wagon route alignments and historical structures will be required.

7.2.2 Noise

As part of the EIA, a noise impact assessment has been undertaken by Jongens Keet Associates (JKA). The study was undertaken by Mr Derek Cosijn and Dr Erica Cosijn.

7.2.2.1 Regional Overview

7.2.2.1.1 Topography

The topography of the area can be defined as hilly terrain. The development site itself is relatively flat.

7.2.2.1.2 Land Use

The area to the east of Postmasburg is predominantly agricultural, interspersed with mining activities. Other significant land uses in the area are:

– Residential.
    - *Various farmhouses and farm labourer residences;*
    - *The residences in Groenwater Village (Metsimetala) and the village to the west of the Groenwater Siding;*
    - *The Owendale residential township;*
    - *The Lime Acres Mine residential township; and*
    - *The Goedgedacht/Jenn-Haven residential township.*
– Educational. There are three schools in the study area:
    - *Refentse Primary school in Groenwater Village; and*
    - *Two schools in Lime Acres Mine Village.*
– Recreationally facilities at the mine at Lime Acres and at Owendale.

7.2.2.1.3 Roads

There are two major roads and several tertiary roads servicing the area:

– Provincial Road TR07001 (Route R385) from Postmasburg to Kimberley; and
– Provincial Road DR3381 from intersection with road TR07001 (Route R385) near Groenwater Railway Siding to Road D3359 (near to the Lime Acres Mine).

7.2.2.1.4 Railway Lines

The Postmasburg - Beaufort-West railway line passes to the south-west of the development site dividing a small portion to the south from the main site. The line carries 14 trains per day (data obtained from Transnet Freight Rail).

7.2.2.1.5 Factors of Acoustical Significance

The hilly terrain will influence the propagation of the noise from the new power plant. A significant meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels.

Temperature inversions have a significant effect on the noise propagation character of the area. Temperature inversions tend to increase noise levels at some distance from a source. A temperature inversion is formed when air near the ground is cooler than the air above. This occurs mainly at night or to a lesser extent during cloudy days away from large bodies of water. Stable conditions with high humidity and very low velocity wind conditions are necessary. As cool air is denser than warm air, sound rays are refracted towards the cooler air, that is, towards the ground.

7.2.2.1.6 Noise Sensitive Receptors

The residential, educational and recreational land uses are considered to be noise sensitive receptors (NSR) - refer to Figure 40.

For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible.

The following 1:50 000 topographical cadastral maps were used:

- *SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989; and*
- *SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982*.

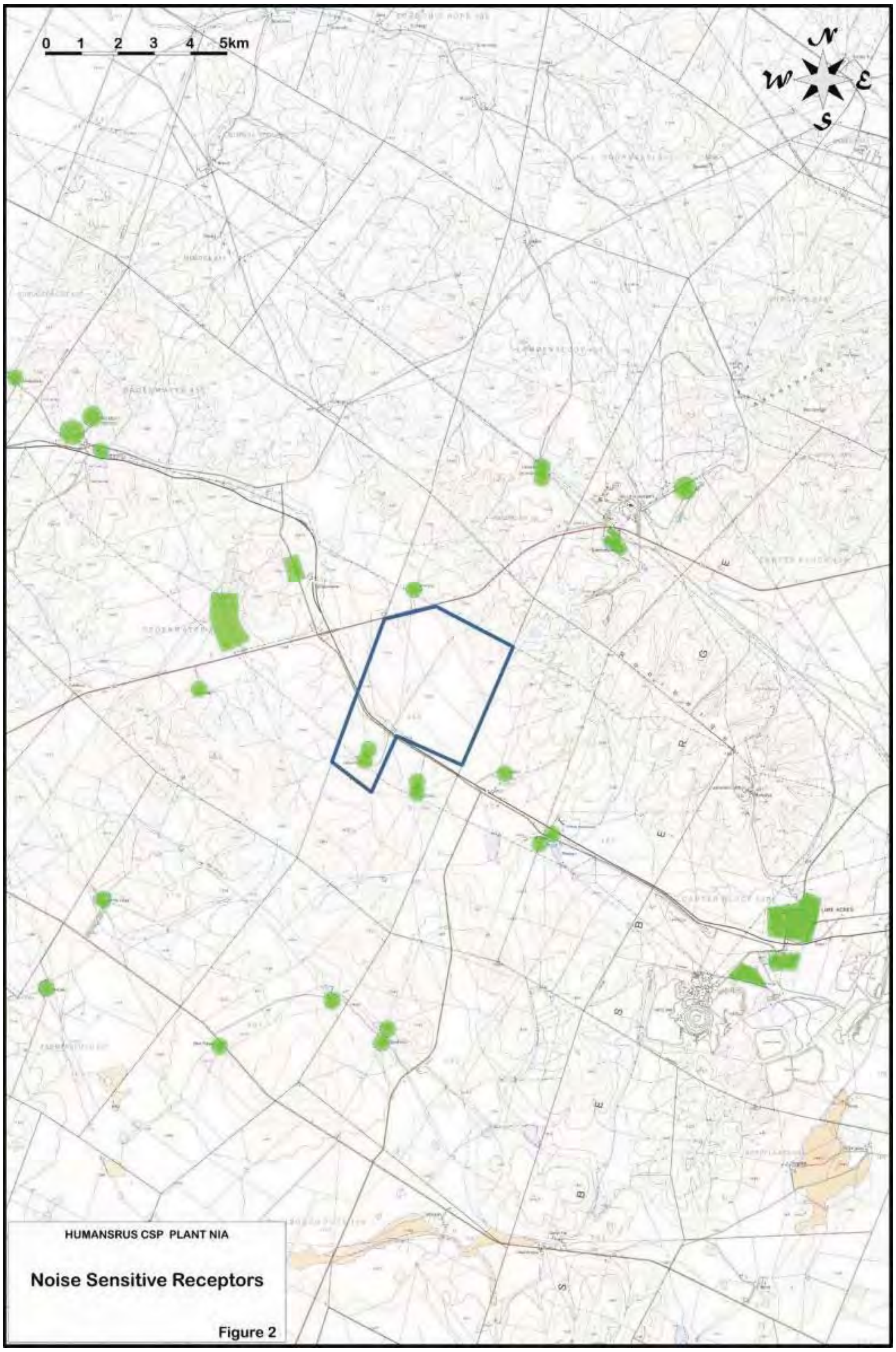


Figure 40: Noise sensitive receptors

7.2.2.2 Noise Sources and Noise Sensitive Areas

7.2.2.2.1 Noise Sources

The main noise sources presently affecting the study area and the additional sources that will affect the area once the CSP Plant is commissioned are:

- Road traffic noise from the traffic on Road TR07001 (Route R385) and Road DR3381;
- Railway traffic on the line on the Postmasburg – Beaufort-West line;
- The Lime Acres Mine;
- The Groenwater Asbestos Mine;
- Noise from general farming operations;
- On Farm Humansrus just north of the development property, the farmer mills corn three days per week and also has a rock crushing facility that operates sporadically; and
- Future: CSP (proposed by SolarReserve SA) and Photovoltaic Plants (proposed by Intikon).

7.2.2.2.2 Noise Sensitive Areas

The noise sensitive sites/areas in the study area that are potentially affected by the development of the CSP Plant on this site are the suburban areas, settlements and farm residences, schools and recreational areas listed under the section titled *"Noise Sensitive Receptors"*.

7.2.2.3 The Residual (Existing) Noise Climate

The areas remote from the main roads are quiet and are typical of a rural/agricultural noise environment. In the residential townships of Groenwater, Groenwater Siding West, Goedgedacht/Jenn-Haven, Lime Acres Mine and Owendale the existing residual noise climate is typical of a suburban environment. The noise climate in areas close to Road TR07001 and Road R3381 are degraded.

7.2.2.4 Predicted Noise Climate

7.2.2.4.1 CSP Plant Generated Noise Footprint

With the construction of the CSP Plant the noise climates close to these facilities will alter. The main noise sources at the CSP Plant will be from the cooling fans (at the EPGS), the salt pumps and the steam generating unit. The noise from the cooling fans will be the loudest. It is

predicted that the noise from the CSP Plant could be the following at the given offsets from the cooling fan installation:

Offset from the Plant		Noise Level (dBA)
1000m	-	54
2000m	-	46
3000m	-	41
4000m	-	37
5000m	-	34

Assuming daytime operations, noise sensitive sites (in a rural setting) further than 2 100 metres away from the Plant will not be impacted by the noise from the Plant. If, for any reason, night-time operations are allowed then noise sensitive sites within 4 750 metres of the Plant will be impacted. The construction of the power generation unit of the CSP plant is recommended at an offset of at least 2 500 to 5 000 metres from the nearest noise sensitive receptor, depending on the intended periods of operation.

7.2.2.4.2 CSP Plant Generated Traffic

The total volume of traffic generated by the CSP Plant will be very small in comparison to the total volume of traffic on the adjacent main roads.

7.2.3 Socio-Economic

Urban-Econ Development Economists was appointed to undertake a socio-economic impact assessment study.

7.2.3.1 Project Location

The proposed development is located approximately 30 kilometres north-east of the town of Postmasburg. The site falls within the Tsantsabane Local Municipality (LM), which in turn forms part of the Siyanda District Municipality (DM) - one of the five districts of the Northern Cape Province of South Africa.

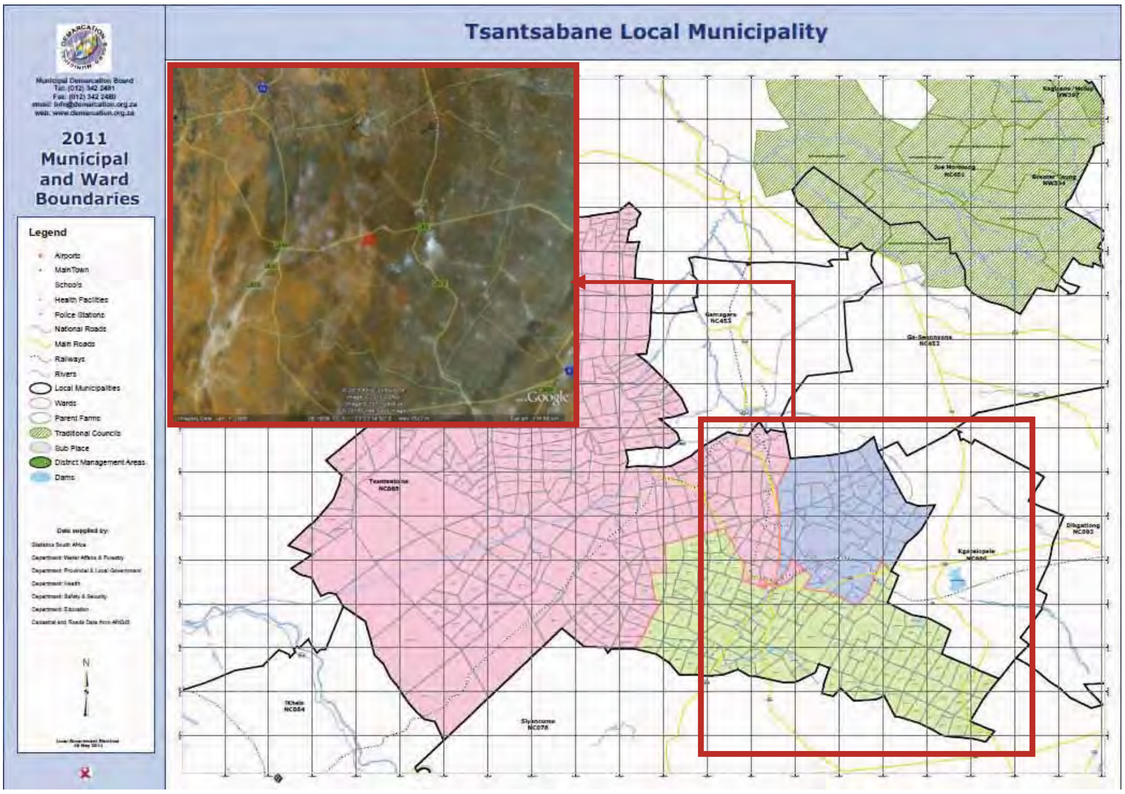


Figure 41: Site location within the Northern Cape Province

Other towns within 50 kilometres of the proposed site are Daniëlskuil (approximately 30 km) to the north-east and Lime Acres (approximately 27 km) to the southeast. It is estimated that most of the people who will be employed by the proposed project will come from the nearby settlements and above-mentioned towns. As far as procurements of services and equipment during construction and operation of the project are concerned, some of these will be sourced from the Northern Cape. Given the fact though that its economy is not diversified, it could be argued that a significant portion of these services will be sourced from the rest of South Africa. Given the above, the following delineation of the study areas is assumed:

- Primary study area includes the site and the Tsantsabane LM;
- Secondary study area includes the Siyanda DM and Northern Cape, and
- Tertiary study area is South Africa.

7.2.3.1.1 Population size and growth

In 2011, South Africa's population is expected to be above 50 million (Table 24), with 1.1 million people residing in the Northern Cape area. The Siyanda DM is housing 247 611 people, or

22.5% of the provincial population while the Tsantsabane LM has a population of 29 150 people, i.e. just above 10% of the DM's population.

Table 24: Population size (2011) and historical growth rates (1995-2011)

Study area	2011	Historical growth rates			
		1995-2000	2000-2005	2005-2010	1995-2011
South Africa	50 430 328	1.7%	1.3%	1.1%	1.4%
Northern Cape	1 101 318	1.2%	0.4%	0.3%	0.6%
Siyanda DM	247 611	1.4%	0.5%	0.4%	0.8%
Tsantsabane LM	29 150	0.7%	0.9%	1.2%	0.9%

Source: Urban-Econ calculations based on Quantec, 2011

As indicated in the table above, the Compounded Annual Growth Rate (CAGR) of the primary study area's population between 1995 and 2011 was 0.9%. It was higher than the CAGR of the Siyanda DM and the provincial population during the same period, but lower than that of South Africa's population. Whilst the population of the Siyanda DM, Northern Cape and South Africa experienced a slowdown in their growth rates, the primary study area's population growth rate has been increasing (Table 24). This could be explained due to the fact that mines constitute a prominent land use in the area, which is home to the Assmang Iron Ore Mine at Beeshoek and the newly established Kolomela under Kumba.

7.2.3.1.2 Household numbers and size

South Africa have 13 385 517 households, which means that the average household size in the country is 3.8. The Northern Cape is estimated to have above 281 015 households and a bigger average household size than in the country. The Siyanda DM has 61 453 households and the biggest average household size in all of the study areas (4.1). The primary study area is expected to have 7 485 households and almost the same average household size (3.9) as the rest of the Province and country.

Table 25: Household numbers (2011), household size (2011) and its historical growth rate (1995-2011)

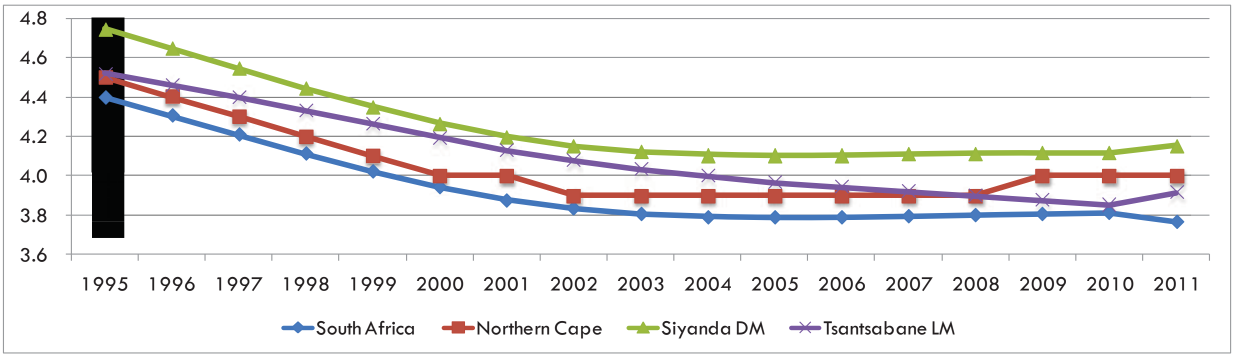
Study area	HH number	Average HH size	Household number historical growth rates			
			1995/00	2000/05	2005/10	1995/11
South Africa	13 385 51	3.8	4.0%	2.1%	1.0%	2.3%
Northern Cape	281 015	4.0	3.6%	1.1%	-0.2%	1.5%
Siyanda DM	61 453	4.1	3.5%	1.3%	0.3%	1.7%
Tsantsabane LM	7 485	3.9	2.3%	2.0%	1.8%	2.0%

Source: Urban-Econ calculations based on Quantec, 2011

Over the years, as indicated in Table 25, the rates at which the numbers of households in the secondary and tertiary study areas were increasing have been slowing down, which mirrors the trend observed with respect to population dynamics in these study areas. In the primary study area, the trend though was different – with the population growth rate increasing, the household growth rate was also slowing down. When compared with population growth rates, it could be noted that the household growth rate in South Africa was on par with the population growth rate between 2005 and 2010. In the Northern Cape and the Siyanda DM, household growth rates were however significantly lower than their population growth rates, which means that the average household size in these areas has been slightly increasing.

The main factors that affect the household growth include, besides the population increase, the change in age structure and incidence rate, or the likelihood of people of a certain age to start a new household. The significant difference between a household growth rate and a population growth rate, though, is usually attributed to the change in age structure.

Household size is also influenced by many other factors such as culture, traditions, education levels, income levels, etc. Over the years, it has been observed that the size of an average household in the country has been declining (Figure 42).



Source: Urban-Econ's calculations based on Quantec, 2011

Figure 42: Household size dynamics (1995 – 2011)

As illustrated in Figure 42, the average household size in South Africa in 1995 was 4.4, whilst in 2011 it was 3.8. In the secondary and primary study areas, the average household size also dropped significantly between 1995 and 2011, although it should be noted that in the Northern Cape, the Siyanda DM and the Tsantsabane LM, the average household size was slightly higher than in South Africa. In the last three years, a slight increase in the average household size in all areas is observed, which could suggest that the trend of the sharp decline in the household size observed between 1995 and 2002 has been reversed.

7.2.3.1.3 Income and expenditure patterns

Income distribution is one of the most important indicators of social welfare, as income is a primary means by which people are able to satisfy their basic needs such as food, clothing,

shelter, health, services, etc. Changes in income inflict changes in the standard of living, more specifically: a positive change in income can assist individuals, households, communities and countries to improve living standards.

There is a direct linkage between the household expenditure and economic growth. Increase in household expenditure means a greater demand for goods and services, which means an increase in production and positive change in the size of an economy. As has been seen in 2005-2006 in South Africa, robust increase in disposable income coupled with low interest rates in the country stimulated an increase in consumption by households, in particular durable and semi-durable goods, which in turn had a positive impact on the country‘s economy. Knowledge of the volume of the disposable income and the expenditure patterns of households, therefore, can provide vital intelligence with respect to the sectors that are most dependent on the household income and therefore would be most affected in the case of change in household income.

Table 26 shows income distribution in study areas as captured in the Community Survey 2007. More recent data, unfortunately, are not available, whilst historical information is not robust and reliable enough to escalate the latest figures and estimate the situation in 2011 with great confidence.

Table 26: Income distribution (2007)

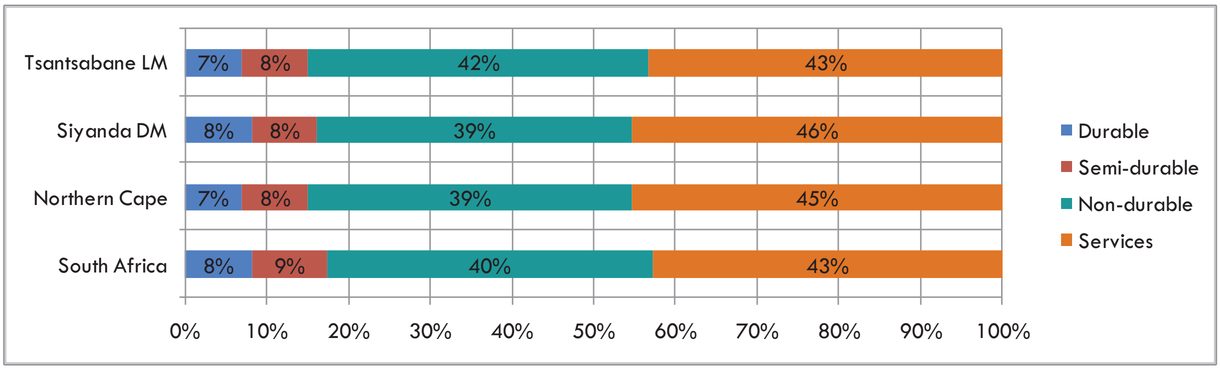
Income category (per annum)	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM	
No income	8.2%		6.8%		4.9%		11.4%	
R1 - R4 800	5.0%		3.5%		2.0%		3.1%	
R4 801 - R9 600	9.0%	60.2%	7.9%	58.2%	9.3%	57.9%	7.9%	59.4%
R9 601 - R19 200	18.9%		20.2%		22.1%		16.7%	
R19 201 - R38 400	19.1%		19.8%		19.6%		20.3%	
R38 401 - R76 800	11.4%		13.2%		12.3%		15.3%	
R76 801 - R153 600	7.6%		8.0%		6.8%		8.9%	
R153 601 - R307 200	5.3%		4.7%		3.7%		3.6%	
R307 201 - R614 400	2.8%		2.2%		1.7%		2.5%	
R614 401 - R1 228 800	0.9%		0.6%		0.6%		0.6%	
R1 228 801 - R2 457 600	0.3%		0.2%		0.1%		0.3%	
More than R2 457 600	0.2%		0.2%		0.1%		0.1%	
No response	11.1%		12.6%		16.8%		9.4%	
TOTAL	100%		100%		100%		100%	
Weighted ave. (2011 prices)	R8 920		R8 048		R6 938		R6 509	

Source: Urban-Econ calculations based on Community Survey 2007, 2011

Based on the 2007 figures it could be concluded that the household income situation mirrored some of the patterns observed in the Northern Cape and in the rest of the country. First of all, the percentage of households earning less than R3 200 per month (R38 400 per annum) in the Tsantsabane LM area was slightly higher than in the Siyanda DM and the Province, but lower than in the rest of the country in 2007. Overall, more than half of households earned less than

R3 200 per month in all the study areas and the country in 2007. At the same time, though the percentage of households without any income at all was significantly higher in the primary study area than in any other study area analysed. From an average household income perspective, an average household in the primary study area earned more or less the same as an average household in the Siyanda DM, what means that there are more households in the Tsantsabane LM with a higher income, but this average household income is significantly less than households in the Northern Cape and South Africa.

Figure 43 illustrates the expenditure pattern of households in the study areas. It shows that there are slight differences between expenditure patterns of households in the Tsantsabane LM and other study areas, particularly the Siyanda DM. In the primary study area, households tend to spend the same share of their disposable income on services and non-durable goods, whilst in the Siyanda DM and the Northern Cape households tend to spend more on services than on non-durable goods. The share of disposable income spent by the Tsantsabane LM households on non-durable goods is also greater than the share of expenditure on these goods by households residing in the Siyanda DM, the Northern Cape and the rest of the country. The share of expenditure on durable goods and semi-durable goods is almost similar for all the study areas.



Source: Quantec, 2011

Figure 43: Household expenditure per main groups (2008)

Table 27 provides more detailed information on the items that households spend the largest share of their income on.

Table 27: Dominant expenditure items (2008)

Expenditure type	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Food, beverages and tobacco	26.3%	27.0%	26.4%	28.7%
Rent	12.4%	15.2%	15.3%	15.2%
Transport and communication	9.1%	9.1%	9.3%	8.5%
Medical services	5.9%	5.9%	5.9%	5.6%
Personal transport equipment	4.5%	3.9%	4.0%	3.7%
Clothing and footwear	5.0%	4.2%	4.1%	4.2%

Source: Quantec, 2011

As indicated in Table 27, expenditure on food, beverage, and tobacco products is the largest expenditure item amongst households in all areas, although households in the Tsantsabane LM tend to allocate a slightly bigger share of their income for these expenses than households in the rest of the province and country. Larger portions of the Northern Cape, Siyanda DM and the Tsantsabane LM households' incomes has to be allocated towards paying rent than is the case of households in the rest of South Africa. The Tsantsabane LM households also tend to spend a smaller share of their income on transportation than households in the Siyanda DM and the rest of the study areas. Expenditure on personal transport equipment in the primary area is lower than in the secondary and tertiary areas and spending on clothing and footwear is smaller than in South Africa, but the same as in the Northern Cape.

7.2.3.1.4 Labour market

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs. As such, employment and unemployment rates are important indicators of socio-economic well-being.

The composition of the labour force in the primary study area, Siyanda DM, Northern Cape and the country as reported by the Labour Force Survey is detailed in Table 2 4. Unfortunately, though, since the latest Labour Force survey does not report on the data for the District Municipalities, information for the study areas is sourced from the Quantec database and represents 2009 figures. This allows for a comparison between the study areas.

Table 28: Labour force statistics (2009)

Indicators	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Working age population	31 496 936	704 615	163 008	18 707
Non-EA	15 131 133	329 386	71 740	7 811
Labour Force	16 365 803	375 229	91 268	10 896
Employed	12 260 902	271 688	68 166	6 851
Unemployed	4 104 901	103 541	23 101	4 044
Unemployment rate	25.1%	27.6%	25.3%	37.1%
LF participation rate	52.0%	53.3%	56.0%	58.2%

Source: Quantec, 2011

In 2009, South Africa had about 31.5 million people within the working age population. Of these, about 15.1 million were non-economically active and 16.4 million formed part of the labour force. This means that the labour force participation rate in the country was 52.0%. The number of the employed people in South Africa was about 12.3 million, leaving 4.1 million people or 25.1% of the labour force unemployed.

The Northern Cape accounted for 2.3% of the national working age population, or 704 615 people. In 2009, just over 53% of the provincial working age population participated in the economy or were economically active. These people encompassed a labour force, which was divided into 271 688 employed and 103 541 unemployed people, indicating a 27.6% unemployment rate in the province.

Siyanda DM had a bigger percentage of the working age population participating in the economic activities than that of the province and the country. In Siyanda, 56.0% of the working age population were economically active, with a 25.3% of these people being unemployed.

The primary study area had a working age population of 18 707 people and a labour force of 10 896 people, of who only 6 851 were employed. This means that in light of the labour force figure, the unemployment rate in the LM was 37.1% - significantly higher than in the Siyanda DM, the Northern Cape and South Africa. The high labour force participation rate, however, means that a significantly higher percentage of people in the Tsantsabane LM than in all the other study areas were looking for jobs.

7.2.3.1.5 Economic Production and GDP-R

Interpretation of economic impacts requires a sound understanding of the size of the economy and its dynamics in the past. A number of indicators exists that can describe the economy of a region or an area. The most common variables that are used for the analysis include production and Gross Domestic Product per Region (GDP-R). The former represents the total value of sales of goods and services, or the turnover of all economic agents in a region; whilst the latter, using the output approach, means the sum of value added created by all residents within a certain period of time, which is usually a year. The trend at which the GDP-R has been changing in the past is also referred to as economic growth indicator. It is a measure of both the performance of an area and the well-being of the citizens of an area. Faster economic growth than population growth is taken as an indicator of a healthy economy and an improvement in citizens‘ well-being.

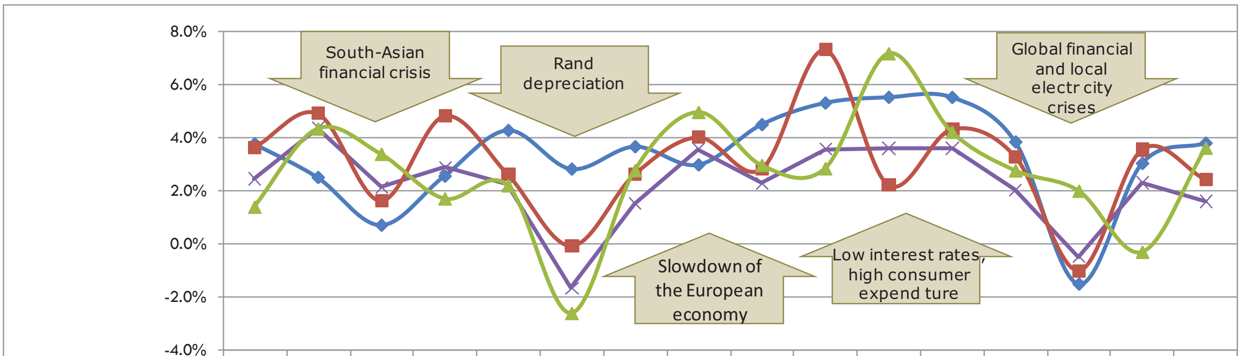
Table 29 provides an indication of the current estimated production and GDP-R values in the study areas. It shows that business sales in South Africa are expected to amount to R5 603 billion in 2011, in current prices which equates to R2 530 billion of gross value added. The Northern Cape accounted for about 2.0% of the national GDP-R in 2011, whilst the Siyanda DM and the Tsantsabane LM contributed 22.4% and 3.3% to the provincial economy respectively.

Table 29: Production and GDP-R figures (2011)

Study area	Production (R'ml)		GDP-R (R'ml)	
	Current prices	CAGR 1995-2010	Current prices	CAGR 1995-2010
South Africa	5 603 076	4.6%	2 530 484	3.3%
Northern Cape	104 039	3.2%	56 341	2.3%
Siyanda DM	23 380	4.2%	11 776	3.0%
Tsantsabane LM	3 476	3.8%	2 106	2.8%

Source: Quantec, 2011

Figure 44 illustrates the dynamics of the study areas and their sensitivity to the global and domestic changes in the economies.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*	2011*
South Africa	3.8%	2.5%	0.7%	2.6%	4.3%	2.8%	3.7%	3.0%	4.5%	5.3%	5.5%	5.5%	3.8%	-1.5%	3.0%	3.8%
Northern Cape	2.4%	4.3%	2.1%	2.9%	2.2%	-1.7%	1.5%	3.6%	2.3%	3.5%	3.6%	3.6%	2.0%	-0.5%	2.3%	1.6%
Siyanda DM	3.6%	4.9%	1.6%	4.8%	2.6%	-0.1%	2.6%	4.0%	2.8%	7.3%	2.2%	4.3%	3.3%	-1.0%	3.5%	2.4%
Tsantsabane LM	1.4%	4.3%	3.4%	1.7%	2.2%	-2.6%	2.8%	4.9%	2.9%	2.8%	7.2%	4.2%	2.7%	2.0%	-0.3%	3.6%

Source: Urban-Econ's calculations based on Quantec, 2011

Figure 44: GDP-R historical trends (1996-2009)

As illustrated in Figure 44, South Africa's economy has been sensitive to the changes on the global and regional arenas. The South Asian financial crisis in 1997-1998, Rand depreciation in 2001, slowdown of the European economy in 2003, and the major global financial and local electricity crises in 2008 all had an influence on the dynamics of the national economy one way or another. It seems that the Rand depreciation in 2001 had a greater effect on the primary and secondary areas, as this were the time when all of them had significantly lower growth rates than South Africa. Fluctuations in the global and regional economies, as well as the spin-off effects of these trends experienced in the country, also affected the growth prospects of provincial, District Municipality's and Local Municipality's economies.

The domestic electricity and global financial crises had a negative impact on the study area's economies in 2009. As illustrated in Figure 44, all of the analysed economies contracted, except with the Tsantsabane LM still showing positive growth. This could be explained by the fact that a significant portion of the JT Gaetsewe DM economy comprises of the mining, community and trade industry. The electricity and financial crisis experienced in 2008 had a negative impact on the production volume of the mining industry, therefore the steep decline from 2006. As a result, the size of this industry has shrunk already in 2008. The peak of the aftermath of the global financial crisis reached South Africa in 2009. This coupled with high interest rates and stricter credit policy and had a significant negative impact on the domestic demand. As a result, almost all industries experienced some level of contraction or stagnation which ultimately reduced the demand for their outputs and had a negative impact on their growth. Sectors that continued growing during this period included construction, community and government services, largely due to the investment and activity that took place in preparation for the 2010 World Cup.

The global economy, as well as South Africa's economy, is slowly recovering from the turmoil of the past few years, although it will take a few years before it reaches the level of economic growth that was observed before 2008.

7.2.3.1.6 Structure of economies

The structure of the economy provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure and trends of specific sectors.

Table 30 provides structures of study areas' economies in 2011 illustrating nominal (2011) prices and 2005 prices. It should be noted that the calculation of the structure of the economy in current and constant prices provides different results. This is due to the fact that prices on goods and services do not change proportionally over years. Prices on goods of one sector could grow faster than prices on goods or services in other sectors. The indication of the structure of the economy in basic prices or prices of 2005 as was done in this case illustrates the relative composition of the economy, but excludes the benefits or dis-benefits of that economy that might have been experienced due to price effects. This is why, the presentation of results in nominal prices is also important as it allows the illustration of the economy's structure taking into account the current market prices and therefore the effects thereof on the income or Gross Operating Surplus. The comparison of the structure of the economy in terms of basic and nominal prices also provides valuable insight into the sensitivity of that economy with respect to changes of commodity prices. An economy that generates a significant share of its GDP-R from certain commodities will most likely have a significantly different structure when compared between nominal and basic prices.

Table 30: Structure of the study areas' economies in 2011

Sectors	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM		
	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal %	Nominal R'ml
Primary sector	8.2%	11.1%	29.6%	36.7%	32.3%	40.2%	42.0%	49.1%	1035
Agriculture, forestry and fishing	2.3%	3.7%	6.6%	8.9%	14.7%	19.6%	1.3%	1.8%	37
Mining and quarrying	5.8%	7.4%	23.0%	27.7%	17.6%	20.7%	40.6%	47.4%	997
Secondary sector	23.2%	23.1%	7.3%	7.1%	10.6%	10.0%	5.5%	5.1%	107
Manufacturing	17.6%	17.2%	3.7%	3.6%	5.7%	5.4%	2.8%	2.7%	56
Electricity, gas and water	2.2%	2.0%	1.9%	1.7%	3.1%	2.8%	2.0%	1.7%	36

Sectors	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM		
	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal %	Nominal R'ml
Construction	3.5%	3.9%	1.7%	1.7%	1.8%	1.8%	0.7%	0.7%	14
Tertiary sector	68.6%	65.6%	63.1%	56.3%	57.1%	49.8%	52.5%	45.8%	965
Trade	13.7%	13.4%	12.4%	11.3%	14.6%	12.6%	6.5%	5.7%	119
Transport, storage & comm..	10.5%	10.7%	10.5%	10.0%	11.8%	10.8%	17.1%	15.7%	330
Finance, insurance, & business	24.0%	22.8%	15.2%	13.6%	10.8%	9.4%	10.8%	9.4%	197
Com. and gov. services	20.5%	18.9%	25.0%	21.5%	20.0%	16.8%	18.1%	15.1%	318
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	2 106

Source: Urban-Econ's calculations based on Quantec, 2011

As indicated in Table 30, South Africa's economy is a service economy, as the biggest share of its GDP-R is created by tertiary sectors, in particular the finance and business services sector and the community and government services sector. The primary sector that includes agriculture and mining contributes the smallest amount to the national economy, although they are strategically important for ensuring food security in the country and provision of electricity.

The structure of the Northern Cape's economy is entirely different to the composition of the national economy with the tertiary sector accounting for over 60% of its GDP-R and the primary sector playing a prominent role in the economy with just under 30% of its GDP-R. The comparison of the structure of the Northern Cape's economy in basic and nominal terms suggests that price effects have a significant impact on the structure of the economy. This is largely due to the fact that it contains a prominent primary sector, in particular the mining industry, as it is the price of commodities produced by the primary industry that can have a notable effect on the structure of any economy.

The structure of the Siyanda DM's economy is different to that of South Africa, but is quite similar to that of the Northern Cape. It is clear that it is more dependent on the primary and secondary sectors than that in the province. Because of it, its tertiary sector is smaller than the tertiary sector in the Northern Cape.

The Tsantsabane LM's economy, which generates almost half of its GDP-R from the tertiary sector, also has a different structure with respect to primary and secondary sectors than that of the country's economy. In constant prices, the primary sector accounts for 42% of the provincial GDP-R, but in nominal prices its share is significantly higher which indicates that such an economy would be highly sensitive to fluctuations ofprices on commodities, particularly those that are being mined in the area. Whilst its primary sector is vast, its manufacturing sector is small which also indicates that limited processing of the raw materials that are being mined in

the area is taking place in this Municipality. Following the biggest sector in the municipality – mining – are the community services sector, transport and finance sector.

7.2.3.1.7 Structure of Employment

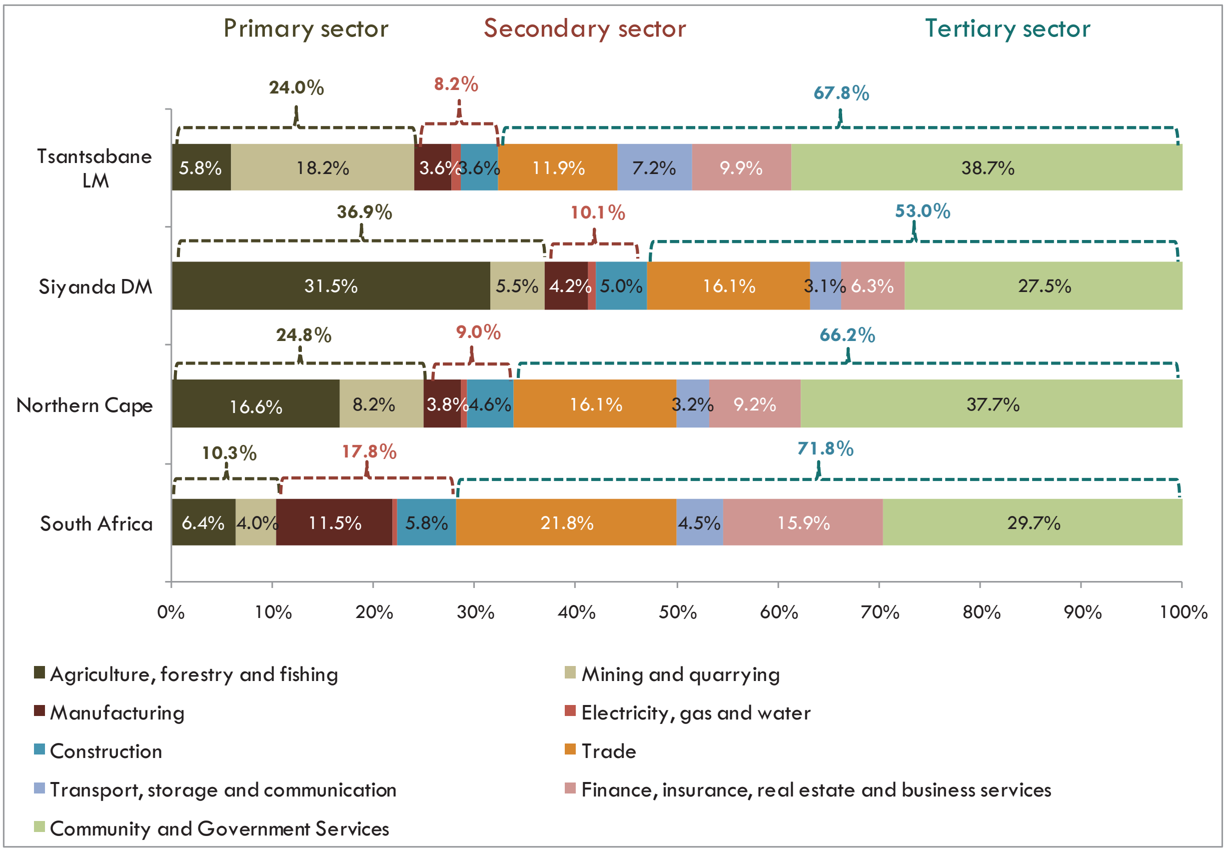
Figure 45 illustrates the structure of South Africa, Northern Cape, the Siyanda DM and the Tsantsabane LM economies from an employment perspective.

The employment structure presented largely corresponds with the structure of the economy with the tertiary sector making the largest contribution towards employment creation in all areas under analysis.

- More than two thirds of the people employed in South Africa work in the tertiary sector, in particular the community and government services sector and the trade sector. Agriculture, which accounted for 3% of the national GDP-R in 2011, on the other hand, provided 6.4% of all employment opportunities; whilst the contribution of the mining industry towards the employment in the country was smaller than its contribution towards GDP-R. Nevertheless, both of the sectors are labour-intensive and create a notable number of employment opportunities in the country, particularly in rural areas;
- Employment structure in the Northern Cape is dominated by the number of people who are working in the tertiary sector, specifically in the trade, community and government services. Its secondary sector creates 9.0% of jobs in the Province, whilst its primary sector creates 24.8%;
- Most of the people employed in the Siyanda DM are working in the tertiary sector too, specifically in the community and government services, trade and finance sector. Its secondary sector creates 10.1% of jobs, whilst its primary sector creates 36.9%; and
- The employment composition in the Tsantsabane LM is quite similar to that of the Northern Cape with the sectors providing the largest numbers of jobs being the community and government services, mining and quarrying, trade, and finance sectors. The mining sector, which contributes 53.6% to the GDP-R (in nominal prices), provides only 18.2% of employment opportunities in the area. At the same time, the trade, community and government sector‘s employment contribution is greater than its contribution towards GDP-R.

7.2.3.1.8 Basic service delivery and access to tenure

Access to basic service delivery and shelter are the indicators that allow understanding the standard of living of the households residing in the study areas. Comprehension of the extent to which households in the area have access to water, sanitation and electricity assists in understanding of the communities‘ plight and their needs. At the same time, knowledge of the types of dwellings that households reside in is valuable in developing a complete profile of the circumstances in which communities are living. All of above creates a baseline against which the potential impacts of the proposed activity could be assessed.



Source: Urban-Econ calculations based on Quantec, 2011

Figure 45: Employment structure (2011)

Table 31 provides information on the types of dwellings in which households live in the study areas. It indicates that 73% of households in the primary study area were living in formal dwellings and this figure also means that access to formal dwellings in the primary study area was the lowest amongst all study areas analysed. The Tsantsabane LM also had the highest percentage of households living in informal dwellings, such as a shack in a backyard of a formal dwelling or in an informal settlement.

This suggests that local communities do require formal housing, for example, the Tsantsabane LM where one out of four households is living in an informal dwelling and that any project that would potentially increase the influx of people into the area could portray up growth of the housing problem, thus housing provision during construction and operation by the project should be received during the EIA phase.

Table 31: Dwelling types (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Formal dwelling	80.3%	83.2%	79.0%	73.0%
Informal dwelling	14.0%	10.3%	12.8%	21.5%
Other	5.7%	6.5%	8.1%	3.5%
TOTAL	100.0%	100.0%	100.0%	100.0%

Source: Urban-Econ's calculations based on Quantec, 2011

Table 32 provides information on the access of households to electricity, using energy for lighting indictor as a proxy. The information presented in this table suggests that the primary study area's households have the least access to electricity compared to the other study areas. Only 78% of households in the Tsantsabane LM use electricity for lighting compared to 84.2% in the Siyanda DM and 85.8% in the Northern Cape. This information correlates with the situation of access to formal dwellings, as a smaller access to formal residence would suggest a smaller access to electricity.

Table 32: Energy for lighting (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Electricity	80.8%	85.8%	84.2%	78.3%
Other	19.2%	14.2%	15.8%	21.7%
TOTAL	100.0%	100.0%	100.0%	100.0%

Source: Urban-Econ's calculations based on Quantec, 2011

Table 33 shows households' access to water. The situation in this case is quite different to that observed with regard to access to electricity and formal dwellings. Almost 75% of households in the primary study area as well as in the Northern Cape itself have access to water inside their dwellings. This is considerably higher than the 64.3% of households living in South Africa who have access to water inside their dwellings. At the same time, more than 78% of households in the Siyanda DM have access to water from inside their yard. This is not indicative to the rural nature of these regions, where due to the settlement pattern water is quite often provided to the neighbourhood rather than to the dwelling itself. Nevertheless, 4.9% of households in the primary study area and 5.6% of households in the Siyanda DM still have to rely on other sources of water which are not very reliable, such as water vendor, rain water, etc.

Table 33: Access to water (2011)

Item	South Africa	Northern Cape	Siyanda LM	Tsantsabane DM
Water inside dwelling or a yard	64.3%	75.0%	78.9%	74.4%
Water from point outside the yard	24.9%	20.0%	15.5%	18.7%
Other water access points	10.9%	5.0%	5.6%	4.9%
TOTAL	100.0%	100.0%	100.0%	100.0%

Source: Urban-Econ's calculations based on Quantec, 2011

Table 34 provides information on access by households to sanitation. It indicates that 75.9% of households in the primary study area have a toilet, which is significantly higher than the 57.7% reported for South Africa. This is also a higher figure than that reported for the Siyanda DM and is also significantly higher than the percentage calculated for the Northern Cape at 72.2% and 67.6% respectively. This again is not indicative to the rural nature of these regions, where households who have access to toilets largely have access to pit toilets. This access to a chemical or flush toilet emphasises their access to water inside dwellings.

Table 34: Access to sanitation (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Chemical or Flush Toilet	57.7%	67.6%	72.2%	75.9%
Pit Toilet	25.8%	13.9%	9.5%	2.7%
Bucket system	2.7%	5.2%	6.1%	7.6%
Other	13.8%	13.3%	12.2%	13.9%
TOTAL	100.0%	100.0%	100.0%	100.0%

Source: Urban-Econ's calculations based on Quantec, 2011

7.2.4 Tourism

SiVEST was appointed to undertake a specialist tourism assessment for the proposed establishment of a Solar Thermal Energy Power Plant on the Farm 469, Hay RD (Humansrus). As part of the Scoping Report and in the context of land uses in the study area, it is important that the potential impact of the proposed development on existing and future tourism resources is assessed.

7.2.4.1 Defining Tourism

Tourism includes all trips away from one's usual environment, not just holiday/leisure trips. It also includes business, visiting friends and/or relatives, medical/health trips, and religious journeys, amongst others. Meanwhile a tourist (overnight visitor) is a visitor who stays at least one night in collective or private accommodation in the place visited (Statistics South Africa, 2009).

7.2.4.2 Tourism in the Northern Cape

Apart from business travel, transient travel and visiting friends and family, tourists visit the Northern Cape for ecotourism purposes due to its unique variety of natural, historical and cultural attributes. In addition, the annual floral display in the Namaqualand region is a famous

characteristic of the province. The concentration of historical sites around the Kimberley area and the Kgalagadi Transfrontier conservation area are also renowned provincial tourist attractions.

Nonetheless, based on several reports by South African Tourism (South African Tourism Index, 2010), the Northern Cape is the least visited Province in South Africa in terms of both domestic and foreign tourism. This is perhaps due to the fact that the Province has not capitalised on its full potential as a tourist destination and hence is largely undiscovered by both domestic and international markets. However, the province has the potential to become a well-visited adventure and ecotourism destination in South Africa recognised for its cultural heritage and natural resources. This can be achieved through promotion and development of tourism in the Province.

In terms of foreign tourism, generally, in 2007, the Northern Cape Province attracted 2.5% of foreign tourists (Annual Tourism Report, 2009). By 2008, the figure had dropped to 1.3% and by the fourth quarter of 2009 only 1.2% of foreign tourists visited Northern Cape Province (South African Tourism Index, 2010). Countrywide, these were the lowest proportions of tourists visiting a province (South African Tourism Index, 2010). By the third quarter of 2010, Northern Cape was still the least visited Province in the country with only 1.3% of foreign tourists. The number of nights spent by foreign tourists in Northern Cape decreased from 1.2% in the third quarter of 2009 to 1.0% in the third of 2010. In the third of 2010, the province earned R 0.2 billion in total foreign revenue (South African Tourism Index, 2010). Majority of foreign tourists visit for leisure and business purposes (South African Tourism Index, 2010).

At a domestic level, the percentage of travel incidence for the adult population of South Africa for the Northern Cape specifically, is 19% of the total share of the country (South African Annual Tourism Report, 2005). With respect to the total percentage of trips emanating from provinces of origin by domestic residents, the Northern Cape only makes up 2% (lowest percentage) thereby indicating that the province is not a significant source market for domestic tourism (South African Annual Tourism Report, 2005). Similarly, the Northern Cape holds the lowest percentage of visitors received at 1.6% of the total share of the country. Furthermore, according to the South African Annual Tourism Report (2005), a large component of domestic trips taken within the tourist‘s province of residence for those of the Northern Cape is intra-provincial as opposed to inter-provincial. This basically indicates that most of the travel by domestic tourists is predominantly done within the province. Three major components (more or less) equally represent the reasons for domestic travel in the Northern Cape. These being visiting family or relatives, holiday and business.

Tourism Destinations and Routes in Area of the Proposed CSP Plant

The proposed development falls within the Siyanda District Municipality (SDM) which is made up of six local municipalities; the study site is located in Tsantsabane Local Municipality which falls within this district.

Tourism is one of the most important economic sectors in the SDM (SDM, IDP, 2011/ 2012). The SDM with its contrasting landscapes is characterised by a variety of natural resources. These include National Parks and Nature Reserves as well as eco-adventures and safari lodges. Some of the National Parks and Reserves include the Kgalagadi Transfrontier Park; Spitskop Nature Reserve and Augrabies National Park. According to the SDM, (IDP,2011/

2012), the Spitskop Nature Reserve and Augrabies National Park are not managed by the SDM but have a critical role in influencing the region‟s tourism. The nearest Nature Reserve to the study area is the Witsand Nature Reserve.

Witsand Nature Reserve

The Witsand (White Sands) Nature Reserve, which lies approximately 65km to the south-west of Postmasburg, is the closest Nature Reserve to the area of the proposed CSP plant study site. The Witsand area was among the few reliable sources of permanent water in the early days and hence a number of human activities were concentrated here. In addition to that, Archaeologists discovered a number of Stone Age sites in the area.

The Witsand Nature Reserve is one of the few scenic eco-destinations in the Northern Cape. The reserve is characterised by flowing white dunes which are 10km long and 5km wide. The dunes are surrounded by red Kalahari dunes, Acacia woodland and the Langberg Mountain range. The dunes are also famous for their strange roaring sound made by the sands at Brulsand during disturbance between September and April. The Witsand Nature Reserve protects a highly sensitive ecosystem and a number of unique plants not found anywhere else in the world. Furthermore, the Nature Reserve attracts bird lovers due to its high diversity of arid region and bushveld birds including the Sociable Weaver and Africa's smallest raptor, the Pygmy Falcon. There are generally over 170 bird species in the reserve. The Nature Reserve is part of the Kalahari raptor route which will be elaborated on below. The reserve also offers self catering accommodation facilities, mainly chalets, bungalows, caravan and camping sites.

Kalahari Raptor Route

This is the only tourism route potentially affected by the proposed CSP Plant. The route starts from the Kuruman Raptor Rehabilitation Centre and extends to Upington and Prieska in the south. The Kuruman Raptor Rehabilitation Centre covers 600 ha and also offers self catering accommodation facilities. At this Centre, birds in rehabilitation can be viewed at close range.

The Kalahari Raptor Route follows a number of roads to the east and north of Upington. The parts of the route that are closest to the Postmasburg area are:

- Upington to Olifantshoek, a 170km tarred road; and
- Volop to Olifantshoek, a 140km gravel road.

The route forms part of the raptor conservation initiative initiated by the Raptor Conservation Group and the Northern Cape Department of Environment Affairs and Nature Conservation. The initiative includes monitoring of breeding populations, road surveys, farmer awareness programmes, establishing raptor conservancies, and modification of farm reservoirs and power lines to increase the safety of raptors in the area. The status of many raptor species is improving as a result, including that of the Tawny Eagle, Bateleur and Lappet-faced Vulture.

The Kalahari is home to 40 raptor and vulture species (of which 67 species are found in South Africa) and seven owl species (of which 12 species are found nationally). In addition, the Kalahari region also supports a vast selection of game farms and nature reserves such as the Tswalu Kalahari Reserve which is one of the largest private game reserves in South Africa, covering an area of 1 000 km² (100 000 ha).

7.2.4.3 Tourism in and around the Proposed CSP Plant

South Africa classifies tourism regions within provinces i.e. the ―Rest of Northern Cape" region which comprises of towns such as Postmasburg, Daniëlskuil, Upington, Van Zylsrus, Kakamas, Augrabies, Kuruman, Olifantshoek, Loeriesfontein, Askham, Nieuwoudtville and Prieska among others. Most important of these are the towns of Daniëlskuil, which is closest to the proposed Humansrus CSP plant (approximately 30km away) and the town of Postmasburg (slightly further than 30km away). The route tourists may typically use to get to Postmasburg from the Kimberley area is the R31 and R385. R385 traverses the northern boundary of the study site and is significant as such. The route used to get to Daniëlskuil from Kimberely is the R31. Tourists using this route will not be affected by the proposed development. However, those travelling towards Postmasburg from Kuruman via Daniëlskuil are likely to be exposed to the proposed development.

7.2.4.4 Tourism Trends and Supply

The study area falls within an area that is somewhat isolated from more popular tourist routes in the region of the Northern Cape Province. The closest towns where a number of tourism facilities/attractions are clustered are Postmasburg and Daniëlskuil. The R385, which traverses the northern boundary of the study site heads towards Postmasburg and is the main potential route that will be immediately affected by the proposed development. The study site, the town of Postmasburg and Daniëlskuil are described based on area characteristics in terms of land cover class (urban, rural, commercial agriculture/forest), tourist attractions and tourism growth potential.

7.2.4.4.1 Postmasburg

Postmasburg (originally known as Blinkklip/ Shining rock) is an urban area renowned for its mineral deposits since the early days and the rock art dating back 120 000 years ago at Beeshoek is evidence of presence of San / Bushman (Green Kalahari, 2011; Web Studio, 2008).

The first diamond in Postmasburg was discovered in 1918 through an open cast mine which became permanently inundated in 1935. The open cast mine is currently a 45 m deep ―big hole" with a variety of fish which attracts visitors. In addition, a substance known as ―sibilo specularite and hematite) was also primitively mined the town (Green Kalahari, 2011; Web Studio, 2008).

The town is currently characterised by land uses such as residential, small holdings as well as commercial. It is an important tourist area attracting business and, to a lesser extent, leisure tourists. The town is known for its unique green growth fed by a dam and a number of fountains. Furthermore, Postmasburg is characterised by a variety of adventure activities as well as cultural/ heritage attractions.

In terms of adventure and sport, activities such as 4x4 trails, hiking and biking are offered in the Witsands Nature Reserve (SA Venues.com, 2011; TourismRSA.com, 2011).

In addition, according to archaeological findings, the Khoisan mined specularite (a soft form of haematite which was used as a cosmetic in a few rituals) in the Blinkklipkop (“Shining Rock Hill”) area around 700 AD (SA Venues.com, 2011; TourismRSA.com, 2011).

Historical and Architectural attractions in Postmasburg include (SA Venues.com, 2011; TourismRSA.com, 2011).

- The old blue dolomite Dutch Reformed Church which was built in 1908;
- In close proximity to this church is the statue of Reverend Dirk Postma and
- The “Howitzer Gun” is found in the civic centre. This honours men of Postmasburg who died during World War II.

Other attractions in and around the study area include:

- The South African National Defence Force Army Battle School located at Lohatla outside Postmasburg since early 1980s plays a role in the town's economy (Green Kalahari, 2011; Web Studio, 2008);
- Beeshoek Golf Club;
- Mount Carmel Game Farm;
- Walker farm;
- Selfhelp farm;
- Papkuil farm; and
- Accommodation facilities.

The supply of accommodation facilities is concentrated mainly in and around Postmasburg which is approximately 30km away from the study site. Tourist accommodation facilities around the study area can be broken up into a number of different categories:

- Bed and breakfasts;
- Guesthouses;
- Guest farms;
- Hotels/motels/Inns/ lodges;
- Conference facilities;
- Backpacker venues;
- Caravan and Camping sites; and
- Chalets.

There are generally a number of tourism facilities in the wider area which indicates an excellent supply of tourist accommodation facilities in the area. Much of this is concentrated in the town of Postmasburg. Specific examples in include:

- Andrisha Motel;
- Silver Fox Pub and Restaurant;
- Postmasburg Hotel;
- Casa Cabalero B&B; and
- Abendruhe.

Witsands Nature Reserve, located approximately 65km to the Southwest of Postmasburg and the closest Nature Reserve to the area of the proposed CSP plant, offers self catering accommodation facilities (i.e. chalets, bungalows as well as caravan and camping sites).

7.2.4.4.2 Daniëlskuil

Daniëlskuil lies at the foot of the Kuruman Hills, 90km south of Kuruman. Tswana once occupied the land on which it is built before it became home to the Griqua. The name, ”Daniël‘s Den‟ was first found in documents by the missionary, Campbell, in 1820. The name derives from a natural crater in a limestone formation, reminding observers of the Biblical story of Daniël. Though small, the town thrives on limestone quarrying, diamond mining and a large farming community (SA Venues.com, 2011).

The small town of Daniëlskuil is characterised by land uses such as residential, agricultural holdings, mining, agriculture, game farming, small holdings, small commercial activities and enterprises In terms of accommodation facilities, there are various options available to tourists in and around the town, ranging from guesthouses to bed and breakfast accommodation facilities and safari lodges. Specifically, these comprise, but are not limited to, the following:

- Klein Papkuil Lodge;
- Little Eden Guest House;
- Mount Carmel Safaris;
- Rest a While Guesthouse (Rus ‗n bietjie) B&B;
- Vaalbos Guest House;
- Die Lapa Guest House;
- Finch Guest House, Lime Acres;
- Idwala Guest House;
- Serendipidity Guesthouse; and
- Plenary Hotel.

People travelling between Kuruman and Kimberley are likely to use the R31 passing through the town of Daniëlskuil. There are a few activities in and close to the town that may draw in tourists. An annual horse show is held which may attract participants from the surrounding region in addition to local entrants. Tourists may also be expected from the same areas. There are several heritage sites that can be found in close proximity to Daniëlskuil. These include the Wonderwerk caves, Boesmansgat (a unique natural sinkhole, renowned as the second deepest and largest of its kind in the world, located on the farm Mount Carmel), British Fort (built during the Anglo-Boer War, located on a hillock overlooking the village) and Gaol (limestone sinkhole in which early Griqua were mistakenly thought to have incarcerated prisoners). Other activities include hiking on Mount Carmel.

From a production point of view, the town is recognized for its proximity to nearby large scale mining activities. These mines include, but are not limited to, the following:

- Dwala Lime Mines;
- Finch Mine; and
- Lime Acres.

7.2.4.4.3 Tourism in the Vicinity of the Proposed Development

There are no tourism facilities in the immediate vicinity of the proposed development. Land use focuses on stock farming, and there are no tourism facilities immediately adjacent to the site.

The study site, location of nearest towns and main tourist sites are illustrated in Figure 47 below:.

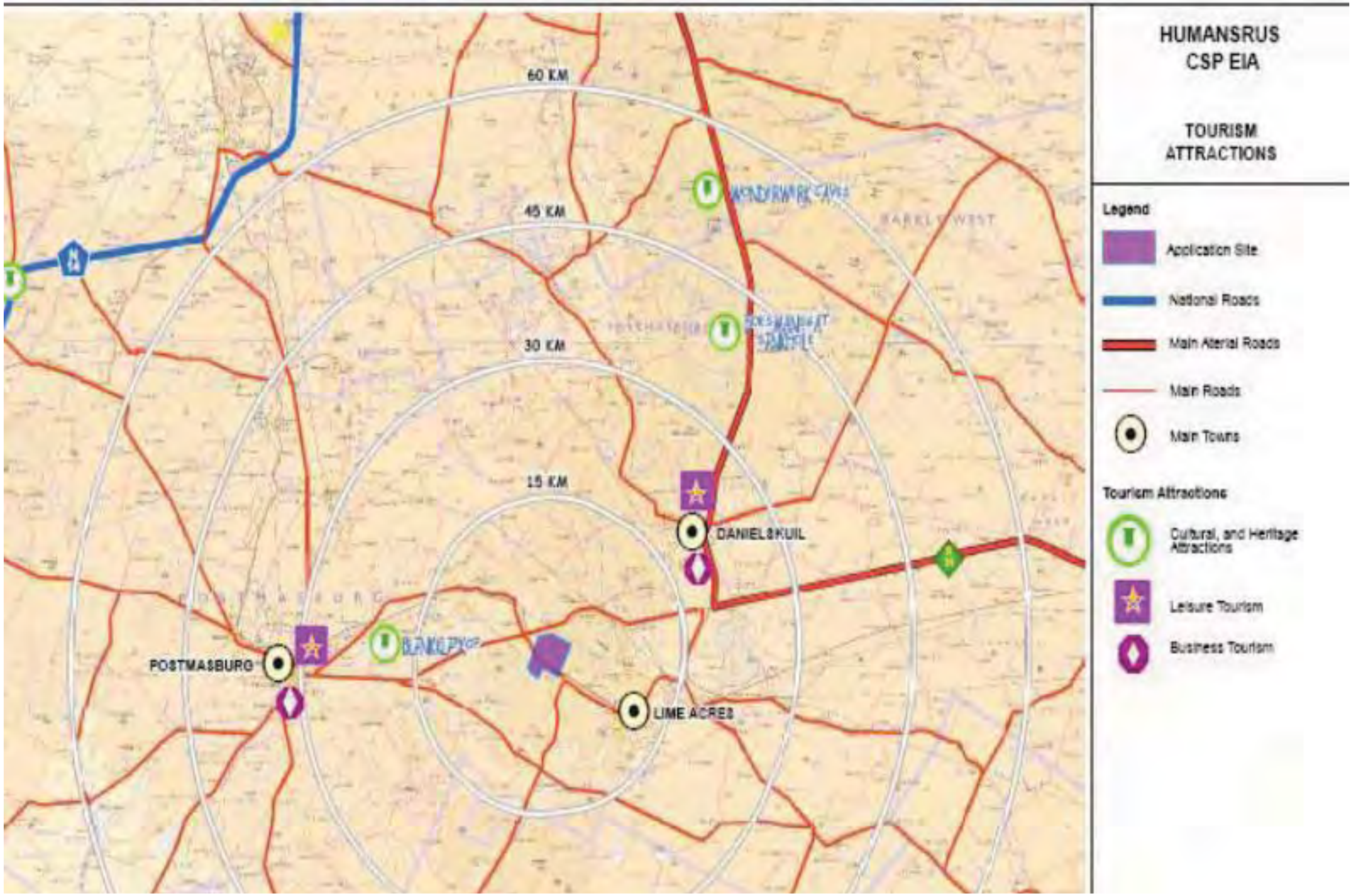


Figure 46: Tourism features within a 60km radius at the Humansrus site

7.2.4.5 Tourism Demand

7.2.4.5.1 Foreign and Domestic Tourists

Statistics provided by the South African Tourism Strategic Research Unit show that the Northern Cape is the least visited province (by foreign tourists) in South Africa and that this percentage dropped from 1.3% in 2008 to 1.2% in 2009. However, the number of nights spent by foreign tourists in Northern Cape increased between 2009 and 2010 (i.e. there was a percentage change of +0.2% from 0.7% to 0.9% (South African Tourism Index, 2010)). Furthermore, only R 0.1 billion was earned in total foreign revenue in 2010 (South African Tourism Index, 2010). The majority of foreign tourists visit for leisure and business purposes. In terms of the number of bed nights spent by foreign tourists in the region, there was a rise from 97 529 in 2009 to 128 230 in 2010 expressing a 31.5% change (South African Tourism Index 2010).

According to the South African Annual Tourism Report (2009), the main purpose of visit for domestic overnight trips in the Northern Cape centred on visiting friends or relatives (45.5%) followed by holiday and recreation purposes (32.7%). Other reasons for overnight stays include for funerals followed by business purposes and *"other"* making up the remainder. In terms of the length of stay by tourists to the Northern Cape, many stayed from between one to three nights (40%) whilst a slightly smaller number stayed four to seven nights 32.4%. The remainder staying for longer periods from eight to more than twenty two days. The bulk of the type of accommodation that tourists generally used was staying with friends and relatives (71.3%). Other types of accommodation that make up a much smaller component but were otherwise regularly used were guest houses (5.7%), bed and breakfasts (4.3%), self catering establishments (4%) and holiday homes (2.5%). Other types make up the remainder. This statistic shows that domestic tourists who do not have friends or relatives in the province rely mainly on guest houses, bed and breakfast accommodation and self catering facilities.

7.2.4.5.2 Business Tourism

Business tourism reflects the tourist who visits an area purely to do business. Any other tourism activities such as sight-seeing or game viewing for example, are secondary. The localities nearest to the Humansrus study site, that being Postmasburg and Daniëlskuil, were both mainly dominated by business tourism (pers. comm. 2011). However, as alluded to other sections, reports show that an equal proportion (to a greater or lesser extent).is related to holiday and visiting family and relatives for the greater region. Hence, at a local scale these statistics may not be indicative of the site specific tourism dynamics of these two small towns.

This type of tourism reflects the tourist who visits an area fundamentally for business purposes (meetings, exhibitions, etc.). Any other tourism activities e.g. sight-seeing or game viewing is secondary. Meetings are the most attractive segment within the business tourism market. The meetings market can be divided into three organisational types, Inter-Governmental Meetings Corporate Meetings, Association/NGO and Academic Meetings. Corporate meetings occur year round and school holidays make off-peak months more attractive. On the other hand, exhibitions also attract a largely number of tourists, mostly domestic tourists. It is anticipated that business tourism presents trends for high occupancy during the week and lower

occupancies over the weekend. The stays are normally longer than leisure based tourism. No information was available on average stay length. There is also lack of data on differences between local and foreign arrivals in this context.

Owners of the tourism facilities in the area rely to a large extent on business tourists for the success of their operations.

7.2.4.5.3 Leisure Tourism

Leisure is the primary purpose of visits to South Africa as a whole, and in 2007 it accounted for 61.3% of visitors to the country. Leisure tourism is made up of a number of sub-groupings i.e. site seeing, seaside holidays, family holidays on game farms, game viewing and photographic safaris and hunting. Other leisure activities include sport (golf and water sports), visiting restaurants and special events. Leisure tourism in the study area consists of several hiking and safaris venues relatively distanced from Humansrus. In addition, as previously stated, an annual horse show in Daniëlskuil may boost leisure tourism. Tourists can generally stay in the various accommodation facilities in the area. Visitors from the local area are also noted visiting local restaurants and pubs. There is no data (statistics) on the number of local and foreign leisure tourists that visit the study area.

7.2.4.5.4 Ecotourism

Ecotourism is a major attraction to the province. While several private safari lodges and nature reserves (For example, Witsand Nature Reserve) also offer ecotourism opportunities, these activities often do not take place within the same space at the same time. From the distinct drop off of occupancies at lodges and other bush accommodation during summer, the importance of increasing occupancy through ecotourism during the hunting season low peak period is seen to be important (KPMG, 2005).

7.2.4.5.5 Adventure tourism

Adventure tourism (4x4 trails hiking, and caravan parks) does to some extent take place in the surrounding area, although it does not constitute that main driver for tourism in the study area.

7.2.4.5.6 Hunting

Hunting (as a form of leisure tourism) is a relatively important sector of the tourism industry in this area. There has been a significant increase in game farming around the region and provide good opportunities for growth in hunting based tourism (Tourism Northern Cape, 2005). For lodges and other bush accommodation, this appears to be their main source of tourists. This sector has also been certainly the mainstay of leisure tourism in the greater area.

7.2.4.5.7 Historical/ Heritage

The greater region of the Northern Cape possesses several historical/ heritage sites that offer the tourism opportunities. Some of these in proximity to the study site are listed below:

- War Graves 1897;
- War Graves 1822;
- Moffatt's Mission Church 1833;
- Rock Paintings in Langberg;
- Koegelbeen Caves;
- Mary Moffatt Museum; and
- Livingstone Church.

7.2.4.5.8 *Passing through*

Tourism in the area can also be attributed to tourists passing through the area via the R31 on their way to and/or from popular regional centres – i.e. Kimberley, Kuruman, Upington as well to/from regional parks and reserves e.g. the Witsand Nature Reserve, Mokala National Park, Spitskop Nature Reserve, Kgalagadi Transfrontier Park etc. Various sectors of the tourism industry (such as Guest houses, lodges, hotels, motels and restaurants) located along this route benefit to some extent from the strategic location.

7.2.4.6 Future Tourism in and Around the Study Area

It should be noted that in terms of future tourism, there is a paucity of local information for the study area, and no area-specific initiatives have been identified to date. Moreover, the May 2010, Tsantsabane Local Municipality IDP does not provide detailed information regarding future tourism in the local area. However it indicates that a strategic objective is in place to develop a Tourism Development Plan by June 2011 so as to stimulate and enhance Local Economic Development. Therefore, due to the lack of information at a local scale at this stage, this section only presents future tourism information at a district level (i.e. Siyanda District Municipality) that is relevant to the study area.

According to the Siyanda District Municipality Integrated Development Plan (IDP) (5 year Plan), 2011/2012, local tourism should become the most important economic activity in the district in the next ten (10) years (Siyanda District Municipality, 2011/2012). In addition, given that there are a variety of natural resources in the district, the tourism potential for the area is great (Siyanda District Municipality, 2011/2012). The hot water springs and scenic natural areas in parts of the district present good development possibilities. But there is a need for innovative ideas and excellent marketing strategies in order to promote tourism and hence increase income (Siyanda District Municipality, 2011/2012).

Also, as discussed below, future industrial / infrastructural development could increase tourism (i.e. business tourism) development in the area by creating a demand for accommodation facilities for visiting technicians / engineers associated with such a development.

7.2.5 Visual

7.2.5.1 Landscape Character

The study area is situated in the Kalahari Mountain Bushveld (Low and Rebelo) savannah biome, which is typically found on rocky, shallow soils on the hills at an altitude of 450mm to 1250m. It is an open savannah dominated by Camphor Tree (Tarchonanthus camphoratus), Kanibus (Rhus undulate) and Broom Karee (Rhus dregeana) become the principal shrubs. The tree layer is poorly developed and individuals of Wild Olive (Olea europaea subsp. africana) and Black Thorn (Acacia mellifera subsp. detinens) are widely scattered. The grass layer is moderately developed depending on the rockiness of the area. The primary land-use is livestock farming of cattle, goats and sheep and it is a poorly conserved biome.

The project site comprises of anopen grassland valley between two small ridges to the west and east of it, which merge into a general ridgeline north of the site. These ridges have a reasonably developed savannah cover of small shrubby material. This is especially evident in the northern sectors of the site. Refer to View 4 in Figure 49 and Views 5 and 6 in Figure 50. South of the project site the valley is split by a small rise in topography that extends to the south east and the Lime Acres mining complex and town. The ‗central' grassland areas of the project site are used mostly for livestock grazing.

The higher hills to the far north, west (refer to Views 1 and 2 in Figure 48) and east (refer to View 7 Figure 51) of the project site are also dominated by a reasonably established savannah cover but there is a dearth of tall trees and the tree layer is generally poorly developed. Most tall trees within the study area are Blue Gums associated with farmsteads or urban developments.

The areas to the south of the project site are generally flatter and more open and dominated by grasslands, used mostly for grazing (refer to Views 9 and 10 in Figures 52). The south western section of the project site also has this character and the topography tends to rise to a shallow ridgeline running from the R385 to the Lime Acres farm road (refer to View 11 Figure 53). Further to the south west toward Lime Acres the landscape is again of a ‗rolling' nature and the road and other infrastructure are contained within a shallow valley between two ridges (see View 8 Figure 51).

The grassland valley system extends north of the project site and north of the R385 and is eventually ‗embraced' by reasonably high hills that extend further north. Figure 9 View 12 from a small settlement north west of the project site and View 3 in Figure 49 illustrate the character of the grasslands in this area.

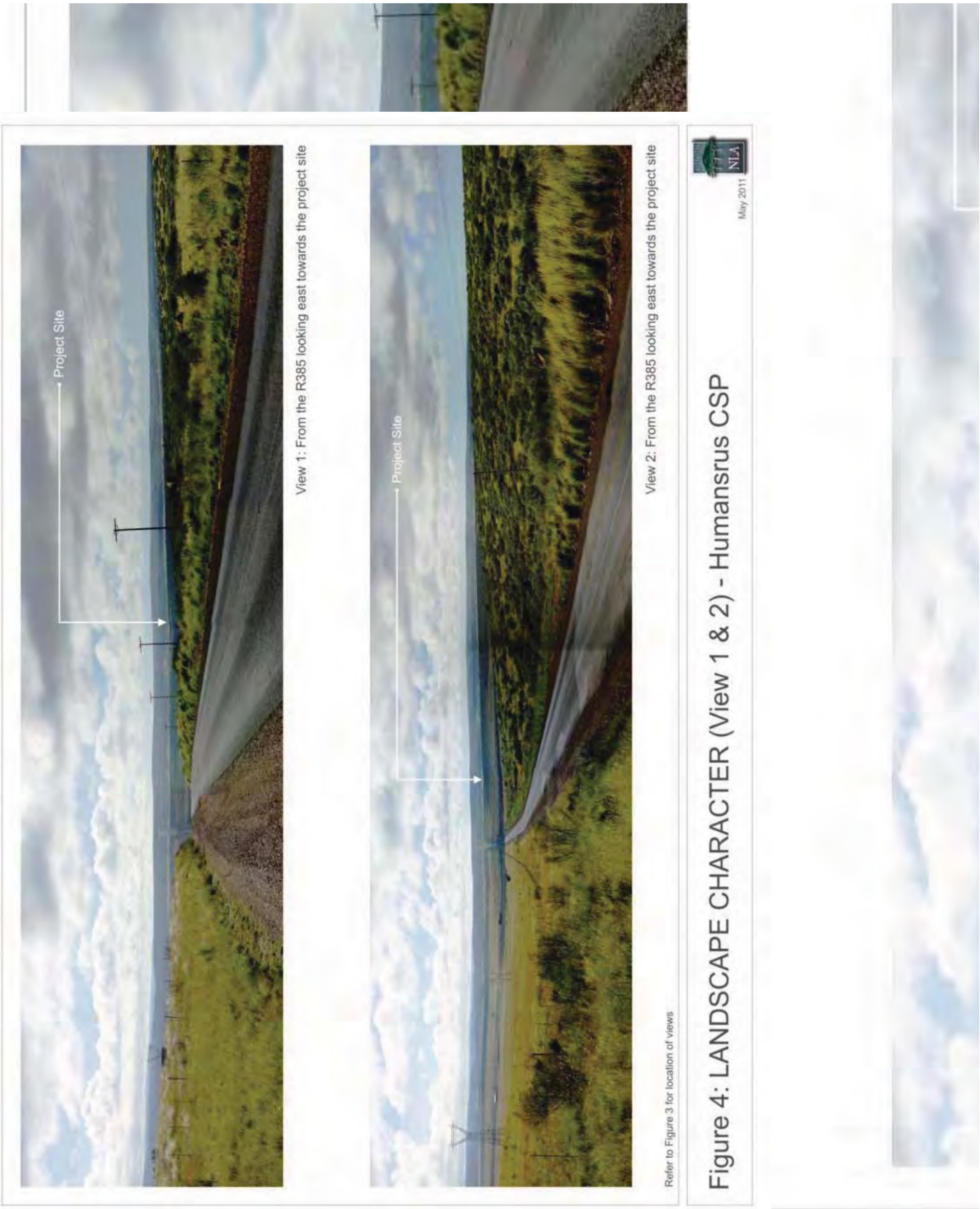


Figure 47: Landscape character (View 1 & 2)

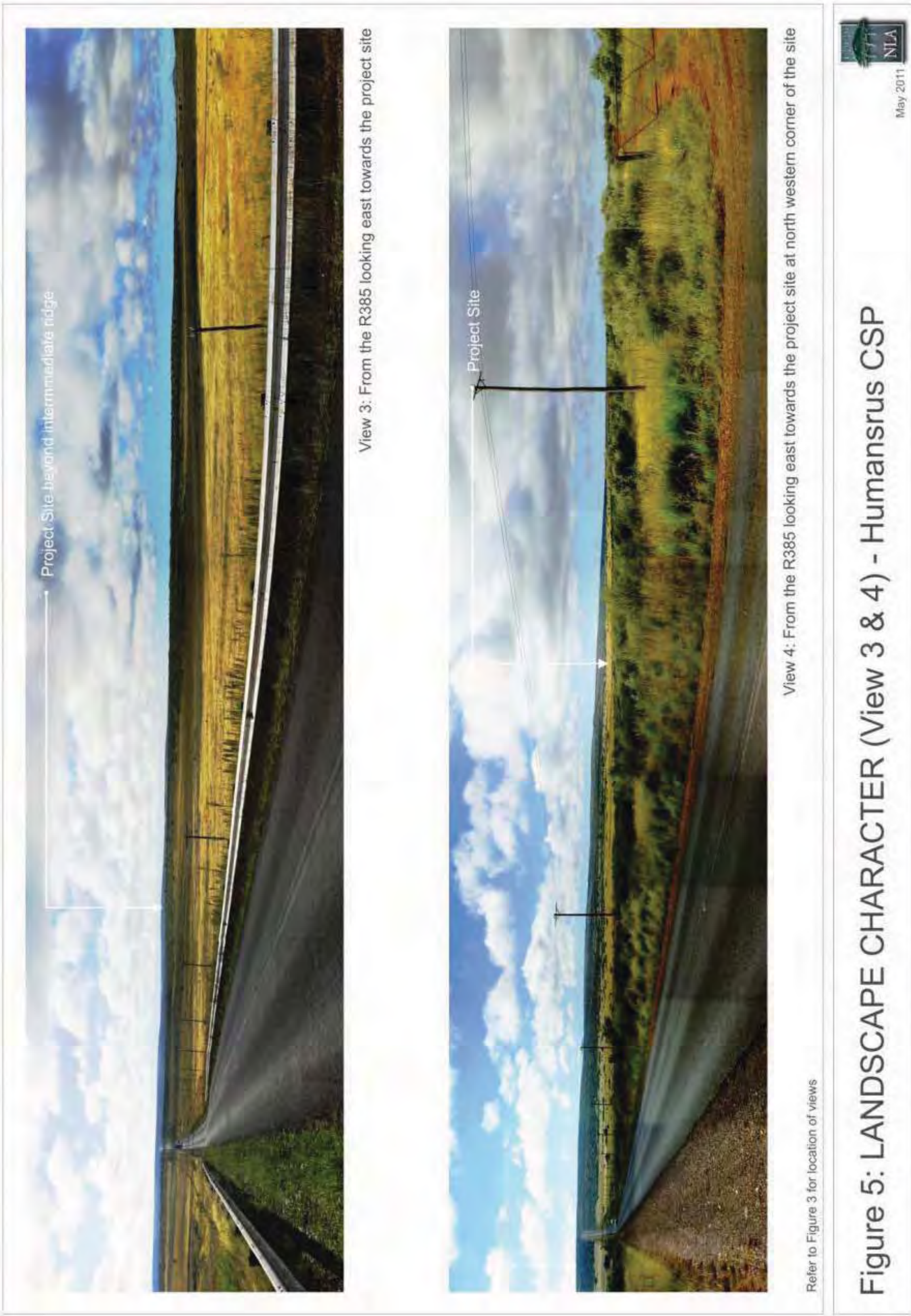


Figure 48: Landscape character (View 3 and 4)

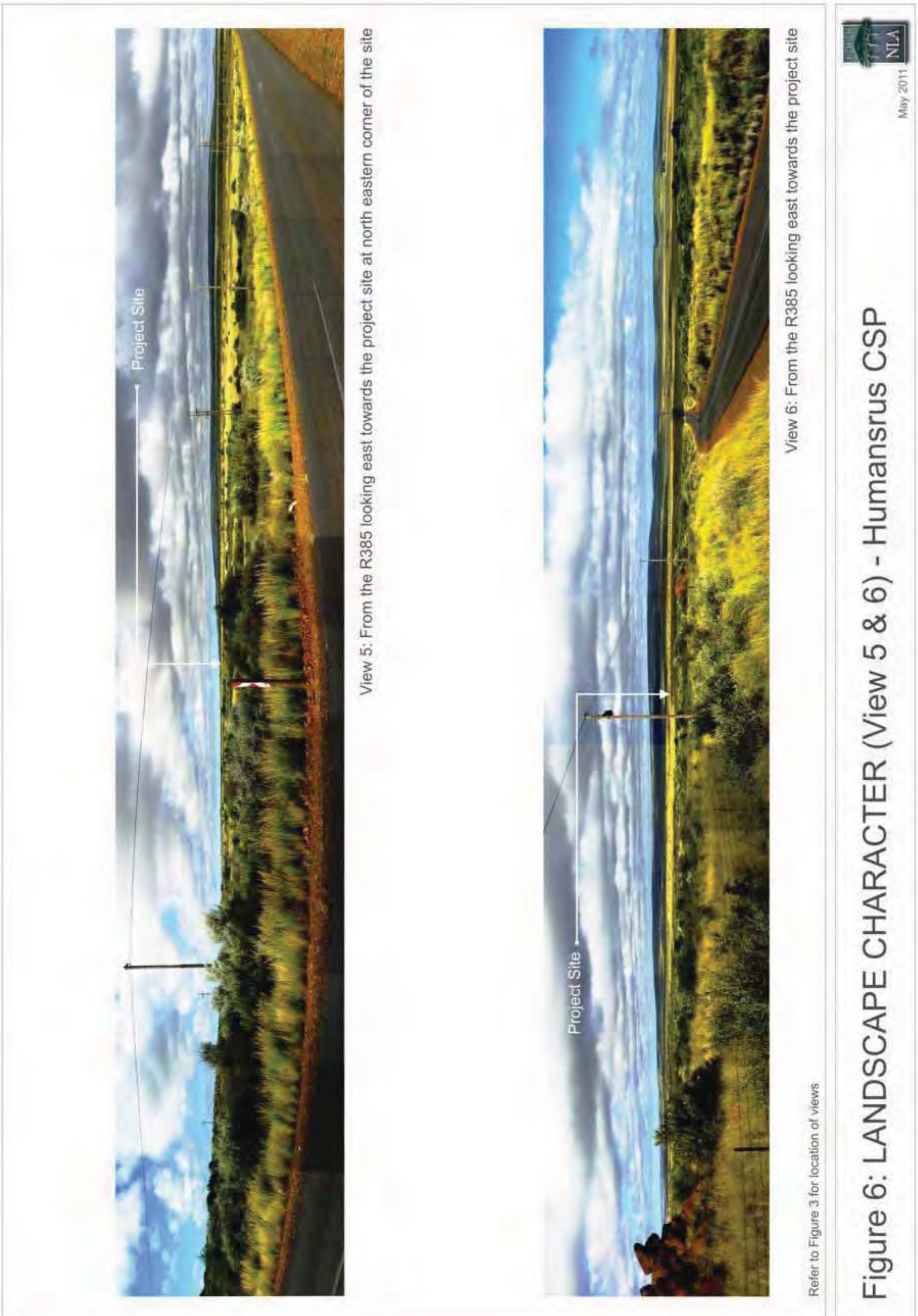


Figure 49: Landscape character (View 5 &6)

Throughout the study area railway, road and electricity infrastructure is evident and as the traveller nears Lime Acres, mining infrastructure and urban landscapes tend to dominate. Also, to the far north east of the project side beyond the hills, are the Owendale and Daniëlskuil mining activities (refer to the locality Map in Appendix G which identifies these areas and infrastructure).

Generally, the landscape that embraces the site in the north, west and east (Figures 47, 48 and 49) is a more distinctive and varied and tends to be more interesting than the characteristics of the study area to the south of the site, which is less diverse and more open (Figures 51 and 52).

7.2.5.2 Sense of Place and Aesthetic Value

Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more ~~"c~~ommon" elements. Generally, the greater the diversity of form, line, texture, and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications and therefore categorised as:

- High - distinctive landscape often with a strong sense of place;
- Moderate - common landscape; and
- Low - minimal landscape often with a weak sense of place and the presence of man-made structures and infrastructure that discordant and promote strong disharmony.

The study area can be divided into a number of primary *„landscape types"* each with its unique landscape characteristic, sense of place and aesthetic value. These include:

- Kalahari Mountain Bushland;
- Rolling grassland with drainage lines;
- Rural villages;
- Urban areas;
- Infrastructure and utilities; and
- Mining activities.

Using the criteria and values defined in Appendix A (Visual Assessment Report) along with the discussion on landscape character above, Table 35 below summarises the visual quality of the study area is rated across a range of values.

However, the value of the visual resource when the various landscape types are taken together (they are not perceived as one unit in the landscape as the eye is always roving and often embraces many of these landscape types in one view) and which are representative of the overall quality of the study area's landscape, the rating is *moderate* within the context of the sub-region. This is primarily due to the *„intrusion"* of mining, urban and infrastructure projects, which reduce the positive effect that the hills have on the scenic beauty of the study area. The

project site would also have *moderate* rating as its scenic value is compromised by the rail and power lines to the west of the site.

Figure 50: Landscape character (View 7 & 8)

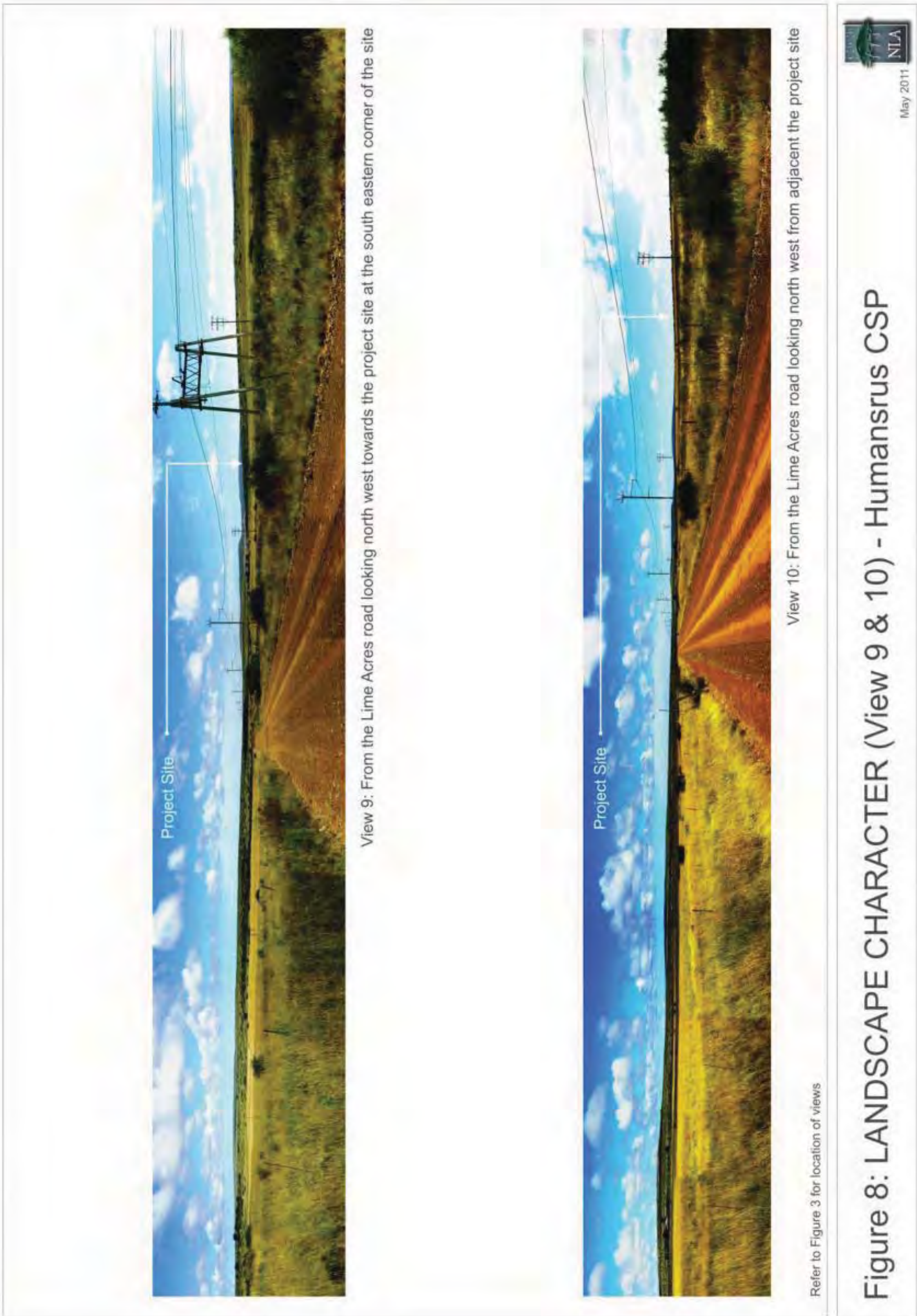


Figure 51: Landscape character (View 9 & 10)

Figure 52: Landscape character (View 11 & 12)

Table 35: Values of the Visual Resource - Scenic Quality

High Kalahari Mountain Bushveld	Moderate Rolling open grasslands with drainage lines rural villages and towns	Low Urban, Mining and Power and Rail Infrastructure
This landscape type is considered to have a *high* value because it is a: Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a strong sense of place. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.	These landscape types are considered to have a *moderate* value because they are: Common landscapes that exhibit some positive character but which have evidence of alteration /degradation/erosion of features resulting in areas of more mixed character. They are potentially sensitive to change in general and change may be detrimental if inappropriately dealt with but change may not require special or particular attention to detail.	These landscape types are considered to have a *low* value because they are: Minimal landscapes generally negative in character with few, if any, valued features due to their inherent characteristics or due to major negative man-made impacts. Scope for positive enhancement could occur.

7.2.5.3 Views and sensitive receptors

7.2.5.3.1 Viewing areas

The project site lies in a shallow valley between two ridgelines that mostly contain the visuals of the heliostats (orange viewshed footprint in Figure 53) to a band of approximately 5km to the east and west of the project site. Along the length of the valley north and south of the site, exposure is greater and would affect foreground and background views i.e. up to 10 km from the site.

The central receiving tower, which is 200m tall, would be visible from a far greater distance as in indicated in the viewshed in Figure 53. However, beyond 8km it would tend to recede into the background of views and at 16km it would be deemed as „*infrequently*" viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention.

Public views (sensitive viewing areas) to the project site would be experienced by people living, working and passing through the study area. The closest of these viewing areas and the most exposed to the impact of the project, are the R385, which passes immediately to the north of the site and the Groenwater / Lime Acres farm road which passes immediately to the west of the site. There are a few farmsteads and residential properties (along Groenwater road immediately north west of the site) that occur near the site and the project would appear in the foreground of

these views resulting in a potential high visual impact. The farmsteads (two) occur to the immediate north and south of the site. There are 3 farmsteads with potential middleground views of project activities. These are located immediately west (approximately 5km from the site) of the site and to the north east (5km) and south east (3km). Visual exposure at these greater distances is reduced but nevertheless could have an impact on these sensitive views.

The towns of Owendale, Lime Acres, Daniëlskuil at the settlement at Groenwater immediately north of the R385 and west of the site, would not see any components of the project as ridge lines block views towards the site.

At this stage it is not known if all the identified farmsteads are occupied. This would have to be verified in the assessment phase.

7.2.5.3.2 Sensitive receptors

Typically most sensitive receptors would include:

Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape (scenic routes);

- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;
- Occupiers of residential properties with views affected by the development.
- Other less sensitive receptors include:
- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value); and
- People travelling through or past the affected landscape in cars, on trains or other transport routes;

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

Given these criteria, the sensitive receptors for the study area would be:

- Visitors and people who live in the farmsteads / residential units; and
- People travelling through or past the affected landscape in cars and on trains;

During the site visit, no tourist facilities were identified in the immediate vicinity and nearby environs of the project site but this must be confirmed in the assessment phase of the project.

The focus of the impact analysis during the assessment phase will therefore be on these receptors and viewing areas. Refer to Figure 53, which identifies their location

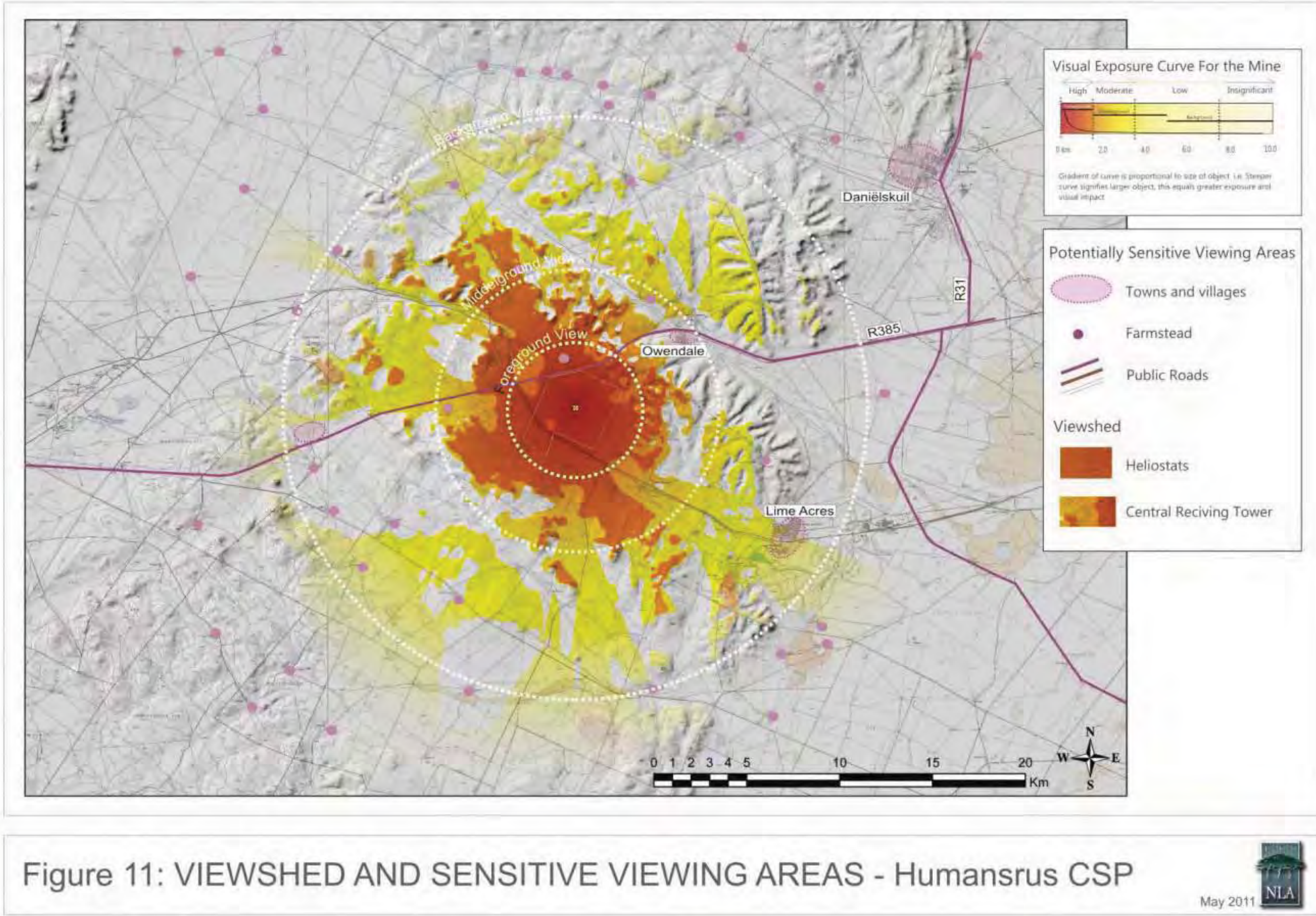


Figure 53: Viewshed and sensitive receptors

8 Potential Environmental Impacts

8.1 Introduction

A key part of the Scoping Process is the preliminary identification and consideration of issues and concerns that may impact (positively and/or negatively) with the biophysical and socio-economic environments. The issues that are identified as potentially significant during the Scoping Phase forms the basis on which the more detailed specialist studies are conducted during the EIA Phase. Each of the potential issues identified in the Scoping Phase will be briefly described in this section.

8.2 Description of Potential Impacts

The potential impacts on environmental and social resources arising from the proposed development include direct and indirect impacts. Potential impacts will also be linked to the different stages of the project which are identified as construction, operation and decommissioning.

Table 8provides an overview of likely aspects arising from each of the key project activities and considers their likely interaction with socio-economic and environmental resources and receptors

Table 36: Interaction between Project Activities and Receiving Environment

Project Activities	Receptor/Resource									
	Fauna	Flora	Soils	Hydrology	Traffic and Transport	Air Quality	Land Use and Agricultural Potential	Landscape and Visual Amenity	Heritage/Archaeology/Palaeontology	Socio-economics
Pre-construction and Construction										
Vegetation Clearance										
Construction of Access Roads										
Construction of Temp. Hard Standing										
Site Leveling and Grading										
Preparation of Solar Panel Foundations										

Project Activities	Receptor/Resource: Fauna	Flora	Soils	Hydrology	Traffic and Transport	Air Quality	Land Use and Agricultural Potential	Landscape and Visual Amenity	Heritage/Archaeology/Palaeontology	Socio-economics
Underground Cables/Overhead lines	■	■	■	■	■	■		■	■	■
Substation Construction	■	■	■		■	■		■	■	■
Solar Panel Delivery and Erection	■				■			■		■
Construction of Service Building	■	■	■	■	■	■		■	■	■
Hard Standing Area Rehabilitation	■	■	■	■			■	■		■
Waste	■	■	■	■			■	■		
Operation										
Solar Panel Operation	■						■	■		
Use of Access Tracks	■							■		
Use of Buildings	■							■		
Site Maintenance	■						■	■		
Waste	■	■	■	■			■	■		
Decommissioning										
Removal of Solar Panels	■	■						■		■
Removal of Foundations	■	■		■				■		■
Removal of Access Roads	■	■		■				■		■
Removal of Underground Cables	■	■						■		■
Waste	■	■	■	■			■	■		
Site Restoration & Rehabilitation	■	■	■	■		■	■	■		■

Note: This interactions matrix will be continually developed throughout the EIA process.

Key: Shaded box indicates potential interaction between the project and resource or receptor.

8.3 Potentially Significant Impacts

The following section describes potentially significant issues based on the initial site visit, discussions with the project team, issues and concerns raised by I&AP's during the PPP and available information about and from experience regarding the environmental effects of similar solar energy developments. It is likely that many of these impacts can be adequately addressed through the implementation of appropriate mitigation and management measures, however,

some require further specialist investigation as part of the EIA Report as indicated. The aspects that are potentially significant include the following:

8.3.1 Air Quality Impacts

8.3.1.1 Construction Phase

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access roads, and the plant area. These predicted impacts cannot be quantified, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities. Instead a qualitative description of the impacts will be provided. This will involve the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

Product Transport

- Scraping;
- Debris handling;
- Debris stockpiles; and
- Truck transport and dumping of debris.
- Power Plant
- Clearing of area for infrastructure;
- Debris handling;
- Debris stockpiles; and
- Truck transport and dumping of debris.

8.3.1.1.1 Creation and Grading of Access Roads

Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for

rehabilitation purposes. Often however, these unused roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

The periodic watering of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases.

8.3.1.1.2 Preparation of areas identified for the construction of the plant and supporting infrastructure

Removal of material usually takes place with a bulldozer, extracted material is then stored in piles for later use during rehabilitation procedures. Fugitive dust is generated during the extraction and removal of overlying material, as well as from windblown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the extracted material, usually by truck, to the stock piles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

To avoid the generation of unnecessary dust, material drop height should be reduced and material storage piles should be protected from wind erosion. This can take the form of wind breaks, water sprays or vegetation of piles. All stockpiles should be damped down, especially during dry weather.

It should be noted that emissions generated by wind are also dependent on the frequency of disturbance of the erodible surface. Each time material is added to or removed from a storage pile or surface, the potential for erosion by wind is restored. Any crusting of the surface binds the erodible material (USEPA, 1996). Dust created during the transportation can be limited by watering the road sections that are being used and by either wetting the material being transported or covering the back of the trucks, to limit the windblown dust from the load.

The removed topsoil will have to be transported to a designated collection point from where it can be recovered later during site rehabilitation. The removal of this material for storage should be done along designated roads which are properly maintained (watering), to reduce the amount of vehicle entrained dust which can be kicked up during these activities. In addition to

the use of dedicated, treated roads, the material transported can be wet or covered to limit the windblown dust being released from the load.

8.3.1.2 Overview of potential Impacts

The following components of the environment may be impacted upon during the construction phase:

- Ambient air quality;
- Local residents and neighbouring communities;
- Employees;
- The aesthetic environment; and
- Possibly fauna and flora.

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

Given the short duration and low level of activity expected during construction, but bearing in mind that no quantitative emission figures exist, no long adverse impacts are anticipated on these receptors. Impact of fugitive dust emissions on employees on site could however be significant during the construction phase, but will vary between phases, with level of activity and meteorological conditions.

Operational Phase

This section aims to deal with the predicted air quality impacts which result due to the proposed operations. Details regarding the source characteristics will be obtained from site layout plans and process specific information provided and a questionnaire filled in by the client. The sources to be included in this assessment can be categorised as follows:

- Material handling;
- Plant Installation; and
- Equipment Transport.

Once all site layouts and final geotechnical works are complete, information will then be sufficient for dispersion modelling and will be included in the Environmental Impacts Report.

Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and tailings impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option.

Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

8.3.2 Impacts on Avifauna Species and Habitats

8.3.2.1 Potential Impacts Relating to the CSP Plant

8.3.2.1.1 Collision with the heliostats (mirrors)

This is likely to impact on birds, but the extent to which it will occur is unknown at this stage. The impact on bird populations worldwide through them colliding with windows of buildings has been well documented (see www.flap.org). At Solar One, 81% of bird mortalities were through collision with structures, with >75% of these collisions having occurred with the heliostat mirrors themselves (McCrary et al 1986).

8.3.2.1.2 Collision with the central receiver tower

Bird collisions with tall infrastructure have also been well documented worldwide. However, this typically occurs with migratory species in flocking behaviour and has usually involved low visibility conditions such as fog. There are unlikely to be sufficient numbers of any particular bird species at the site of the CSP plant to constitute flocking behaviour thereby resulting in this risk. It is however likely that the occasional bird will collide with the tower.

8.3.2.1.3 Roosting on the central receiver tower

The tower will be a prominent structure in the landscape and may be an attractive roost for certain bird species. Although it will be too hot during operation, as it cools down during the evenings it may be a very attractive (particularly during winter) if it retains some warmth (although the temperature it retains remains to be seen). If it is well lit at night, this may attract insects, thereby attracting birds. If birds do roost on the tower, this is likely to simply be a nuisance for plant staff, as bird pollution will build up on any available surfaces.

8.3.2.1.4 Burning when in vicinity of the central receiver

It seems unlikely to be a significant impact as birds would presumably be repelled by the heat before they get within burning range. Certain particularly fast flying species may be impacted on, such as the doves, swifts, martins and swallows identified in table 3. Research at Solar One did not detect any fatalities through this mechanism (McCrary et al 1986).

8.3.2.1.5 Burning when entering the "standby focal points"

This impact is likely to occur at the CSP plant. The significance of the impact will depend on a number of factors which are unclear at this stage, for example: exactly how many focal points will exist; what size will they be; how long will they be in operation for each day. At this stage it is safe to say that some birds will in all likelihood be killed in the focal points. The significance of the impact will depend on just how many birds, and what species are killed. Furthermore, it seems unlikely that any mitigation for this impact will be possible. Monitoring at Solar One recorded that 19% of all bird mortalities were through burning in standby or focal points – mostly swifts and swallows (McCrary et al 1986).

8.3.2.1.6 Loss of habitat

Approximately three square kilometres will be taken up by the CSP plant in total. The vegetation in this area will should not be fully cleared automatically. Rather, only the areas where infrastructure has to be constructed should be cleared. Obviously construction activities on site will flatten and impact on certain areas of vegetation even if it is not cleared. Similar habitat is abundant in the greater area and it is anticipated that the bird species will move to surrounding areas.

8.3.2.1.7 Disturbance

Construction activities will no doubt disturb the birds in the area, particularly breeding birds – however due to the uniformity of the broader area, these birds can quite easily move off and find similar habitat nearby.

8.3.2.1.8 Nesting of Sociable Weavers and other species on the plant infrastructure:

The extent to which this occurs will need to be monitored closely. This is an impact of the birds on the plant rather than the plant on the birds. It is hoped that the constant moving and cleaning of the heliostats will make them unattractive nesting substrate for the birds. No nests were observed within the site boundaries, however, some nests (such as the one shown in Fig. 9 below) were observed in the surrounding areas.

8.3.2.2 Issues relating to associated infrastructure:

8.3.2.2.1 New power lines

Collision of large terrestrial birds with overhead power lines is likely to occur and is anticipated to be the most significant threat posed by associated infrastructure. Species most likely to be affected are korhaans and other large terrestrial species. The significance of this impact depends on the length of new line to be built. In this case it appears that new line will be required from the CSP Plant to a substation connecting with the High Voltage Line running to the South West of the site. The exact routing of this new line was not available at the time of the site visit, and the impact therefore cannot be fully assessed at this stage.

Electrocution of birds on pylons will depend entirely upon the exact pylon structure that for the new line – detail of which was not available at the time of this study. Electrocution risk is determined by the phase-phase and phase-earth clearances on a pole structure which differ greatly between different structures. Again, if the structure used is dangerous to birds, the significance of this impact will vary with the length of the line. Nesting of birds on pylons is in fact a positive impact on avifauna, but may impact negatively on the quality of electrical supply by causing electrical faults. In the case of Sociable Weaver nests, the nest material may pose problems to the pylons structural integrity through added weight, and there is an increased fire risk due to the fuel load of these massive nests. Disturbance of avifauna through construction and maintenance activities associated with the power line is not likely to be significant. Habitat destruction by construction activities is likely to occur, but not likely to be significant.

8.3.2.2.2 New roads

Disturbance of avifauna is likely to occur to some extent, but not likely to be too significant as there is already a gravel district road (along the rail line to the west of the site) as well as various

tracks through the farm and it is unlikely that extensive new roads would be, again depending on the exact layout of the CSP Plant within the farm.

Habitat destruction caused by road construction will have some impact on avifauna, but as discussed elsewhere the habitat in this landscape is relatively uniform and so this impact is unlikely to be too significant.

8.3.2.2.3 New pipe lines

This infrastructure is likely to have very similar impacts to the roads discussed above, except on a smaller scale. Should new pipelines be required for water supply to the CSP plant impacts of this on avifauna will be minor habitat destruction and minor disturbance.

8.3.3 Impacts on Fauna and Flora (Biodiversity)

No impacts were identified that could lead to a beneficial effect on the ecological environment since the proposed development is largely destructive as it involves the decimation of natural habitat.

Impacts resulting from the construction and operation of a CSP Plant have permanent and severe physical impacts on biota or the habitat in which they occur. Direct impacts, such as habitat destruction and modifications, are regarded immediate, long-term and of high significance. These impacts are mostly measurable and fairly easy to assess as the effects thereof is immediately visible and can be determined to an acceptable level of certainty. In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. A measure of estimation is therefore necessary in order to evaluate these impacts. Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

Ten impacts were identified that are of relevance to any development in a natural environment. Not all of these impacts might occur, or the extent of impact might be limited; the relevance of these impacts is therefore determined prior to being implemented in the Impact Assessment.

Impacts were placed in three categories, namely:

Direct impacts

– ***Destruction of threatened and protected flora species*** -This impact is regarded a direct impact as it results in the physical damage or destruction of Red Data or Threatened species or areas that are suitable for these species, representing a significant impact on the biodiversity of a region. Threatened species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they are frequently an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance. Red Data

species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Habitat changes, mostly a result of human interferences and activities, are one of the greatest reasons for these species having a threatened status. Surface transformation activities within habitat types that are occupied by flora species of conservation importance will definitely result in significant and permanent impacts on these species and their population dynamics. Effects of this impact are usually permanent and recovery or mitigation is generally not perceived as possible. One of the greatest drawbacks in terms of limiting this particular impact is that extremely little information is available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species in the study area. In order to assess this impact an approach it is therefore necessary to assess the presence/ distribution of habitats frequently associated with these species. Furthermore, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, resultant impacts will be limited to a large extent;

- ***Direct impacts on threatened fauna species*** **-** Direct threats to threatened fauna species is regarded low in probability, mainly as a result of the ability of faunal species to migrate away from areas where impacts occur. Probably the only exception to this statement will be in the event where extremely localised habitat that are occupied by threatened fauna species are impacted by construction and operational activities to the extent that the habitat no longer satisfy the habitat requirements of the particular species, or where an increase in the isolation and fragmentation factors renders the remaining habitat inadequate. It should also be noted that most of the threatened fauna species potentially occurring in the study area have relatively wide habitat preferences and ample suitable habitat is presently available throughout the study area. To place this aspect into context it is estimated that habitat loss and transformation resulting from non-invasive and often overlooked impacts, such as overgrazing, infestation by invasive shrubs and selective hunting probably are likely to contribute more to impacts on most threatened fauna species than power station developments;
- ***Destruction of sensitive/ pristine habitat types*** **-** The loss of pristine natural regional habitat (primary vegetation) represents loss of habitat and biodiversity on a regional scale. Sensitive habitat types include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is attributed to the floristic communities and faunal assemblages of these areas as they contribute significantly to the biodiversity of a region. Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular. The importance of regional habitat types is based on the conservation status ascribed to vegetation types. Micro-habitat conditions are changed as a result of the removal of the vegetation, affecting shade conditions, habitat competition, germination success of the herbaceous layer, etc. The removal of the dominant shrub canopy is likely to result in the establishment of a species composition that is entirely different than original conditions and the immediate

surrounds, in many cases also comprising species of an invasive nature, particularly shrubs.; and

- ***Direct impacts on common fauna species*** **-** The likelihood of this impact occurring is relatively low as a result of the ability of animal species to migrate away from direct impacts. The tolerance levels of common animal species occurring in the study area is of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact. It is also unlikely that the conservation status of common animal species will be affected as a result of direct and indirect impacts of construction on these species and their habitat.

Indirect Impacts:

- ***Floristic species changes subsequent to development*** **-** The transformation of habitat during the construction process will inevitably result in the establishment of habitat types that are not considered representative of the region. As a result of the severity of habitat manipulation, development areas are frequently invaded by species that are not normally associated with the region (exotic and invasive species). In addition, many species that are not necessarily abundant in the region will increase in abundance as a result of more favourable habitat conditions being created as a result of habitat manipulation activities (encroacher species). This effect is more pronounced in the floristic component, but changed habitat conditions in the habitat will inevitably imply changes in the faunal component that occupies the habitat. If left unmitigated, this risk will result in decreased habitat, increased competition and lower numbers of endemic biota, the genetic pool of species might eventually be influenced by the introduction of non-endemic species. Different faunal assemblages and plant communities have developed separate gene structures as a result of habitat selection and geographical separation and the introduction of individuals of the same species that might be genetically dissimilar to the endemic species might lead to different genetic selection structures, eventually affecting the genetic structure of current populations and assemblages.;
- ***Faunal interactions with structures, servitudes and personnel*****-** It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. While the structures are usually visible as a result of clearance around footprints, injuries and death of animals do occur sporadically as a result of accidental contact. Large mammals are mostly prone to this type of impact. In particular, primate species such as baboons and monkeys are known to climb structures. Alteration of habitat conditions within the development area does not necessarily imply a decrease in faunal habitation. These areas are frequently preferred by certain fauna species. The establishment of a dominant grass layer generally results in increased presence of grazer species, which might lead to an unlikely, but similar increase in predation within these areas. The presence of personnel within the servitude during construction and maintenance periods will inevitably result in contact with animals. While most of the larger animal species are likely to move away from human contact, dangerous encounters with snakes, scorpions and possibly larger predators always remain likely. Similarly, the presence of humans within areas of natural habitat could potentially result in killing of animals by means of snaring, poaching, road kills, poisoning, trapping, etc.; and

- ***Impacts on surrounding habitat/ species*** - Surrounding areas and species present in the direct vicinity of the study area could be affected by indirect impacts resulting from construction and operation activities. This indirect impact could potentially include all of the above impacts, depending on the sensitivity and status of surrounding habitat and species as well as the extent of impact activities.

Cumulative Impacts:

- Impacts on ***SA's conservation obligations & targets*** (VEGMAP vegetation types) - This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. A number of declared conservation areas are present within the study area. These conservation areas contribute to the national conservation strategies and targets. Impacts that could potentially affect the status of these areas are regarded unacceptable and should be avoided at all costs. Also, aligning the servitudes in proximity to conservation areas as a mitigation measure against impacting on the conservation areas is not always a good solution as it places a limitation on the future expansion of conservation areas. This will only be a solution in selected cases where extensive transformed habitat is available for the use of servitudes. Natural habitat in the general surrounds of conservation areas do act as a buffer for these areas, also as a potential source of genetic variability, particularly in the case of relative small conservation areas;
- ***Increase in local and regional fragmentation/ isolation of habitat*** - Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size. The danger in this type of cumulative impact is that effects are not known, or is not visible; with immediate effect and normally when these effects become visible they are beyond repair.
- ***Increase in environmental degradation*** - Cumulative impacts associated with this type of development will lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

A biodiversity study will be undertaken during the EIA phase to assess the impact on terrestrial flora and the identification of appropriate mitigation and management measures to be included in the EMP.

8.3.4 Noise Impacts

During the construction phase construction vehicles including excavation equipment and trucks may produce a noticeable increase in noise disturbance. Construction vehicles may create some noise and vibration along access routes.

Noise levels during operation are low. Noise associated with maintenance activities may create some disturbance but this will be low level and localised.

Potential noise impacts will be addressed in the EIA Report and appropriate mitigation measures will be included in the EMP.

8.3.5 Loss of Agricultural Land

The major impact on the natural resources of the study area would be the loss of arable land due to the construction of the various types of infrastructure. However, this impact would in all probability be of limited significance (due to the low potential soils and the fact that construction of the infrastructure will not involve deep excavations or large-scale topsoil removal) and would be local in extent. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state, with little impact, especially given the low prevailing agricultural potential.

The impact can be summarized as follows:

Table 37: Impact significance

Nature of impact	Loss of agricultural land	Land that is no longer able to be utilized due to construction of infrastructure
Status of impact	Neutral (N)	No cost or benefit to receiving environment
Spatial Scale of impact	Low (1)	Confined to site boundary
Time Scale of impact	High (3)	Lifespan of project
Probability of impact	Probable (2)	Likely to materialise
Severity of impact	Average (2)	Mitigation & rehabilitation will be possible
Significance of impact	Medium (8)	
Mitigation factors	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs.	

It does not appear, from a soils aspect, that there are any especially sensitive areas ("fatal flaws") within the site that should be avoided. In conclusion, due mainly to the low potential soils and prevailing climatic limitations for agriculture, it is extremely unlikely that any sort of detailed soil investigation will be necessary.

8.3.6 Loss of, or Damage to Archaeological or Cultural Resources

Impact on archaeological sites - As concluded from the archival research, the possibility of archaeological finds have been identified as being high and thus further field work is required to develop a comprehensive Heritage Management Plan. Unidentified archaeological sites and the discovery of such sites during construction can seriously hamper construction timelines. Field work can thus provide valuable information on such site in the study area and provide timeous management of such site through realignment of development or mitigation of such sites where needed; Excavations required for the installation of heliostats, building and road construction, laying of cables etc and land clearing could disturb or destroy features of cultural heritage interest. These potential impacts will be assessed through a heritage specialist study in the EIA phase along with the required submissions to South African Heritage Resource Agency (SAHRA).

8.3.7 Visual and Aesthetic Landscape Impacts

Visual resource impacts would result from the construction, operation, and maintenance of the proposed CSP project. Specifically, impacts would result from project components being seen from sensitive viewpoints and from effects to the scenic values of the landscape. Impacts to views would be the highest when viewers are identified as being sensitive to change in the landscape, and when their views are focused on and dominated by the change. Visual impacts would occur when changes in the landscape are noticeable to viewers observing the landscape from their homes or from tourism / conservation areas, travel routes, and important cultural features and historic sites, especially when the project occurs in foreground a middle ground views. The visual impacts that could result from the project would most likely be direct, adverse, and long-term and must be addressed in the assessment phase of the project.

A specialist visual impact assessment will be undertaken during the EIA phase to assess the visual impacts of the development and the identification of appropriate mitigation and management measures to be included in the EMP.

Dust generation may occur during vegetation clearance, site grading, transportation of materials for construction, and the construction of the solar power facility.

Dust will be a temporary impact associated with the construction phase of the project. Sensitive local receptors may need to be protected from dust through the implementation of certain management measures by the contractors responsible for the construction of the facility. No dust generation is expected to occur during the operational phase of the project, except for minimal dust created by maintenance vehicles along gravel roads, which will be infrequent.

Appropriate measures to manage impacts associated with dust generation will be developed during the EIA phase of the project and identified in the EMP.

8.3.8 Impact on Traffic during Construction

There may be a minor increase in traffic during the construction of in the facility as some trucks and earth-moving vehicles will bring infrastructure, equipment and construction materials onto site and undertake construction activities.

Further information regarding traffic levels and an assessment of significance will be provided in the EIA Report.

8.3.9 Impacts due to Waste Generation

Waste from the construction activities may arise from a range of sources producingthe following:

- Construction waste;
- Sanitary waste;
- Excavated material (e.g. rock and soil), and
- Domestic waste from construction workers and offices.

Following the construction phase, there will be limited waste production during the operational phase. The anticipated wastes during operation will include:

- Domestic waste;
- Industrial waste (oil, oily rags, scrap metal replaced machine components etc.)
- Sanitary waste from the septic tanks, and
- Residue from the evaporation ponds.

Specific requirements for waste management and disposal will be identified in the EMP developed during the EIA phase of the project. The waste license application process runs concurrent to the EIA process and a complete waste management plan will be compiled to fulfil the waste license authorization requirements.

8.3.10 Soils, Geology, Hydrology and Erosion Potential

The potential effects on soils and geology from construction and decommissioning include:

- The potential for soil properties at the site to be permanently altered due to site preparation (e.g. compaction of soil);
- Alteration of topography on a local scale through clearing and grading; and
- Site preparation and vegetation clearance activities which could cause instability and increased erosion potential.

It is not anticipated that any major watercourses or water-bodies will be directly impacted by the proposed development during construction and the water during this phase of the project will be sourced from Sedibeng Water Board. The project is expected to require large water-inputs

during operation and the utilization of groundwater is being investigated and a detailed assessment will be conducted as part of the EIA. However, removal of vegetation and the development on access roads, areas and non-permeable hard standing surfaces may impact surface water flow and run off within the site area and near surrounds during both the construction and operation phases.

The potential impacts discussed above will be investigated in the EIA Report which will be accompanied by the identification of appropriate mitigation and management measures, such as specific measures to manage surface run-off and stormwater designs, will be developed during the EIA phase and identified in the EMP.

8.3.11 Surface Water and Groundwater Contamination

The potential for surface water contamination is an important consideration in relation to the construction of the facility since increased sediment load in surface water runoff could impact on watercourses and drainage channels in the local area. The potential for groundwater contamination is associated with uncontrolled spills of hydrocarbons from construction vehicles during the construction phase. The extent and impact of potential groundwater or surface water contamination is largely dependent on the nature of the subsurface soil conditions, their transmissivity and susceptibility to erosion. The substrate in the area generally has low permeability although groundwater contamination could occur through joints, fractures and contact zones which are associated with the inter-granular and fractured aquifer of the area.

Basic precautions to prevent groundwater and surface water contamination during construction will be identified in the EMP developed during the EIA phase of the project.

8.3.12 Socio-Economic Impacts

The employment opportunities arising from the proposed CSP plant will be limited. Some local job creation will be associated with the construction activities but there will be only limited employment opportunities during the operational phase of the development. Landowners will, however, receive payment for the use of their land during the operational phase which would result in an additional income for the farm and increased tourism may occur in the area as a result of tourists wishing to view the facility. It is anticipated that the socio-economic impacts associated with the development in the construction and operational phase will be localized, including some benefits to the local economy and visual impacts. Overall, the potential socio-economic impacts that could be predicted at this stage and that will need to be investigated in the specialist study include:

- Strategic macro-economic impacts;
- Assistance in achieving government objectives;
- Impact on balance of payment due to possibility that certain equipment and machinery will be imported;
- Provision of electricity without putting additional pressure on water resources;

- Reduced emissions and potential to trade in carbon credits, and
- Potential to establish a new manufacturing industry.
- During the construction phase
- Temporary increase in production and GDP-R in industries supporting the construction;
- Temporary employment creation at the construction site and supporting industries;
- Temporary increase in government revenue due to the establishment of the plant;
- Permanent loss of production created by the current agricultural activities;
- Permanent loss of jobs associated with the existing agricultural activities on site;
- Influx of job seekers and associated crime concerns;
- Possible negative health impacts associated with migrants, and
- Temporary increase in households' income levels.
- During the operational phase
- Increase in production and GDP-R due to the plant's operations;
- Creation of sustainable employment opportunities at the plant and supporting industries;
- Increase in government revenue;
- Skills development;
- Improvement of living standards of positively affected households (thought employment);
- Increase in households' income levels;
- Change in standards of living of the directly affected households, and
- Impact on local tourism.

A specialist study will be undertaken in the EIA phase to assess the potential impacts of the project including those related to direct and indirect employment opportunities.

8.3.13 Human Health and Safety

As with any construction project, there is potential for impacts on human health and safety to occur as a result of accidents and unplanned events that may occur during the construction of the CSP Plant.

The risk of injury associated with the construction of the facility will be mainly limited to the subcontractors (as the site will be secured to avoid public incursion into the active development area), but there remains some risk of injury to other site users (i.e. farm workers). Basic safety precautions and protective measures will be specified in the EMP which, in turn, will be incorporated into subcontractor health and safety plans.

8.3.14 Potential Impacts on the Tourism Industry

The proposed CSP Plant site is located in close proximity to the rural villages of Humansrus, Groenwater and Owendale. The character of the landscape is mainly natural for this locality. The proposed CSP plant therefore could have a major influence on the landscape in terms of the scale, the physical footprint and the aesthetics of the area. The degree to which the proposed development will affect the local area will vary and can be based on both positive and negative aspects. In this light, the four major environmental impacts likely to result from the power plants include visual impacts, noise impacts, land-use change impacts and corporate demand. These are elaborated on below.

8.3.14.1 Visual Impact Relative to Tourism

Scenically beautiful areas where leisure tourism is practiced are more likely to be visually affected by CSP Plants than areas that exhibit anthropogenic objects associated with the built environment (such as concrete buildings or power lines). Generally, the natural character or scenic beauty of an area plays an important role in attracting tourists to any specific area. In terms of the aesthetic values, the study site presents a moderate to high value i.e. moderate being the common landscape and high being a distinctive landscape often with a strong sense of place (Humansrus Visual Report by Newtown Landscape Architects).

No accommodation and other tourist facilities were identified within the immediate area during field surveys. As such, it is unlikely that any negative impact will result from the proposed development from this perspective. However, tourists passing through via the R385 roadfrom Kimberley to Upington \Namibia via Postmasburg and Olifantsfontein and vice versa will most likely be affected by the proposed development from a visual point of view. As the proposed development is located directly adjacent to the R385 it may be directly visible. Moreover based on the proposed plant layout plan, the CSP plant will in very close proximity to R385. Furthermore, according to the visual report for this project (by Newtown Landscape Architects), the R385 as well as the Groenwater/ Lime Acres farm road are considered sensitive viewing areas for people passing through the area. The extent to which these roads are used by leisure tourists (those whose intention for taking the route is to appreciate the scenic value) will be determined during the EIA phase of this project.

In terms of the type of impact, the proposed development may either be positive or negative.

In a negative context, the proposed CSP plant will be an artificial anthropogenic structure which contrasts with the otherwise natural landscape. In this sense, the CSP plant could detract from the natural aesthetics of the locality. Most of the tourism for Postmasburg and Daniëlskuil centres on business tourism, hence, the degree of negative impact is expected to be minimal on this basis since the type of tourists most likely to be affected are not leisure tourists per se. additionally the R31 which passes close to the site is not a scenic tourist route, and thus the aesthetic quality of the route is unlikely to be adversely affected.

In a positive context, since the proposed development can be considered new technology to the area, it may be viewed as a tourist attraction which can draw tourists to the route. However this factor would be strictly dependent on the proponent establishing a visitor information centre

associated with the plant, which could then be advertised and draw visitors to the plant and the area. Additionally, local inhabitants could potentially view the plant as a symbol of progress and development in the area, especially if the plant was seen to be associated with increased job provision in the area and / or improved electricity provision. In this context the plant could be viewed as a positive symbol of the progress and development of the area. The findings of the visual study for the proposed development, as well as stakeholder input to the public participation process for the proposed development‘s EIA will be instructive in this context.

8.3.14.2 Noise Impact Relative to Tourism

Noise generation could be a factor during the construction phase. This phase will be temporary and it is not likely to be a significant factor impacting the tourism facilities in the area since there are no tourist facilities in the immediate vicinity of the study site. It is likely that noise impacts will only affect locals in Humansrus. Negligible noise impacts are expected during the operational phase.

8.3.14.3 Land-use Change Relative to Tourism

The proposed development of the CSP Plant will involve the transformation of the natural landscape into a man-made industrial-type facility, consequently resulting in land-use change. The development will constitute a complete transformation of a certain part of the study site. This type of land use change is in contrast to that of the surrounding area. Cattle farming and agricultural practices predominantly take place adjacent to the study site. Land uses to the west and east are vacant. In this light, the development may be viewed as a negative impact.

8.3.14.4 Corporate Demand

The corporate demand for tourism facilities is likely to increase in the area as a result of the proposed development (assuming this proposed development is approved and constructed). Various professional persons such as technical surveyors, engineers, environmental specialists, etc. are likely to spend nights at various accommodation facilities in the study area. This is expected during the pre-construction, construction, operation and decommissioning phases of the project to various degrees. Furthermore, the above teams are expected to visit various restaurants (which is a component of leisure tourism) while in the area. In general, the impact of the proposed development on corporate demand for tourism facilities is anticipated to be moderate during the construction phase since more workers will be required at this stage and minimal during the operational phase since the professional and maintenance team will be limited to a small group on individuals. From a corporate demand perspective, the impact would be likely to be positive.

8.4 Screening of Impacts

The preceding *Section 8.3* describes a number of potentially significant impacts associated with the proposed development. One of the purposes of Scoping is to offer a preliminary, qualitative assessment of potential environmental and social impacts associated with the project, thereby ensuring that those impacts that are potentially significant are assessed in the EIA Phase.

The following impacts have been identified and described above:

- Noise impacts;
- Loss of agricultural land;
- Loss to archaeological and cultural heritage;
- Visual and landscape impacts;
- Impact on flora, fauna and habitats;
- Impacts due to dust;
- Impact on traffic;
- Impact of waste production;
- Impact on soils, geology, hydrology and erosion potential;
- Impact on surface and groundwater;
- Socio-economic impacts; and
- Health and safety.

The impacts which require further investigation through specialist studies are the following:

- Loss to archaeological and cultural heritage;
- Visual and landscape;
- Natural vegetation and ecology;
- Waste;
- Hydrology, soils and geology; and
- Socio-economic.

Noise, dust, traffic, loss of agricultural land, waste generation, health and safety and health and safety impacts will be addressed in the impact assessment and controlled through the implementation of standard environmental management measures that will be included in the EMP.

8.5 Cumulative Impacts

As a result of an increase in interest and the number of EIAs for renewable energy developments (solar and other renewable technologies) it is important to follow a precautionary

approach in accordance with NEMA to ensure that cumulative impacts are addressed or avoided. The following aspects have been identified as potentially significant cumulative impacts that may result from the proposed development of the two solar energy facilities (Humansrus and Intikon) in close proximity to each other:

– Visual intrusion;
– Change in sense of place and character of the area;
– An increase in the significance of ecological impacts; and
– An increase in the significance of geological and hydrological impacts.

The cumulative impacts of the proposed CSP plant will be qualitatively assessed in the EIA Phase.

9 Plan of Study for EIA

9.1 Process Phases

The environmental studies required for the proposed project will be undertaken within the two phases, as follows:

9.1.1 Environmental Scoping Study

A desk-top issues-based Environmental Scoping Study has been undertaken for the proposed project. Existing information and input from specialists, the Authorities and Interested and Affected Parties (I&APs) was used to identify and evaluate potential environmental impacts (both social and biophysical) associated with the proposed project. No environmental fatal flaws associated with the proposed project were identified through the Environmental Scoping Study, although a number of potentially significant environmental impacts have been identified as requiring further in-depth study. Therefore, the EIA is required to be undertaken in order to provide an assessment of these potential impacts and recommend appropriate mitigation measure, where required. The EIA will also be used as an instrument to further identify, discuss and evaluate alternatives (i.e. site, technology and layout).

9.1.2 Environmental Impact Assessment (EIA)

All potentially significant environmental impacts (social and biophysical) associated with the proposed project have been identified in the Scoping Study and will be further investigated during the EIA through various specialist studies, and their significance assessed. Mitigation measures will be proposed, where required.

The EIA will aim to adequately investigate and address all environmental issues associated with the proposed CSP development in order to provide the DEA and Northern Cape Department of Environmental Affairs and Conservation with sufficient information to make an informed decision regarding the proposed project.

9.2 Particulars of the Applicant

The particulars of the applicant representing all shareholders are as follows:

Applicant:	SolarReserve SA (Pty) Ltd
Contact Person:	Terence Govender
Telephone Number:	(011) 784 7539
Facsimile Number:	(011) 7847549
E-mail address:	terence.govender@solarreserve.com

9.3 Environmental Consultant

The particulars of the Environmental Assessment Practitioner are as follows:

Consultant:	Worley Parsons RSA	For the management of the specialist studies: SSI Engineers and Environmental Consultants
EAP[1]:	Leanna Rautenbach	Frank Benedek
Telephone Number:	(012) 425 6421	(011) 798 6430
Facsimile Number:	(012) 460 9978	(011) 798 6010
E-mail address:	Leanna.rautenbach@worleyparsons.com	frankb@ssi.co.za

9.4 Environmental Study Team

Worley Parsons RSA and SSI Engineers and Environmental Consultants (only for the specialist study phase) have been appointed by SolarReserve SA (Pty) Ltd as independent Environmental Assessment Practitioners, to undertake the Environmental Impact Assessment for the proposed Humansrus Solar Thermal Energy Power Plant project. Details of the environmental study team and their associated tasks are as follows:

Team Member	Responsibility
Leanna Rautenbach (Worley Parsons RSA)	Leanna will be mainly responsible for the overseeing of the Environmental Investigative process as a whole. Her is responsibilities will include regular liaison with the Client and the environmental authorities and the various stakeholders, and on-going review of progress of all aspects of the project. She will be responsible for reviewing all Environmental Impact related reports on behalf of the client. This will include recommendations regarding appropriate mitigation measures. She will provide support in the management of the public participation process for the project and other project related issues.
JC Pretorius (Worley Parsons RSA)	JC will be mainly responsible for the compilation of all Environmental Impact Reporting. His responsibilities will further include regular liaison with the Client, stakeholders, environmental authorities, and on-going review of progress of all aspects of the project. In addition, he will be responsible for the compilation of a consolidated EIA Report and an EMP for the Project. This will include recommendations regarding appropriate mitigation measures. He will provide support in the management of the public participation process for the project.
Frank Benedek	Frank will be mainly responsible for specialist management. His

[1] EAP – Environmental Assessment Practitioner

(SSI Engineers and Environmental Consultants)	responsibilities will further include regular liaison with the Client and the environmental authorities, and on-going review of progress of all aspects of the project. He will provide input into the Scoping and EIA Phases, as well as into the EMP. In addition, he will be responsible for the review of specialist studies, and the compilation of a consolidated EIA Report and an EMP for the Project. This will include recommendations regarding appropriate mitigation measures. He will provide support in the management of the public participation process for the project.

9.5 Specialist Studies

The appointment of specialists to conduct specialist studies as part of an EIA exercise is done to fulfil the minimum requirements of Regulation 32 in the Government Notice No.R543 of June 2010.The contents of the specialist reports is determined in compliance with the requirements of Regulation 33(3) outlined in the same notice referred to above.

The various specialist reports for the proposed project will be appended to the Environmental Impact Report. The following specialists are sub-contracted to assist in investigating certain aspects of the environment that might be impacted by the proposed project.

Table 38: Specialist studies undertaken as part of the Scoping Study

Specialist Field	Organisation
Agricultural / Soils Potential	Agricultural Research Council - Institute for Soil, Climate and Water,
Air Quality Impact Assessment	SSI Engineers and Environmental Consultants
Avi-fauna Impact Assessment	Endangered Wildlife Trust
Biodiversity Assessment	Bathusi Environmental Consulting
Geohydrological Assessment	SRK Consulting
Heritage Impact Assessment	PGS Heritage & Grave Relocation Consultants
Hydrological Assessment	OneWorld Investments
Noise Impact Assessment	Jongens Keet and Associates
Visual Impact Assessment	MetroGIS
Socio-Economic Impact Assessment	Urban-Econ Development Economists
Tourism Assessment	SiVest

Specialist Field	Organisation
Social and Land Use Study†	Afrosearch
Visual Impact Assessment	Newtown Landscape Architects
Wetland Delineation and Assessment	Wetland Consulting Service (Pty) Ltd

The findings of the above-mentioned specialists will assist with:

- Nomination/selection of preferred project alternatives based on the detailed impact assessment to be undertaken during the EIA Phase; and
- Recommending measures to mitigate the impacts identified during the EIA Phase for inclusion in the Environmental Management Programme.

9.5.1 Agricultural / Soils Potential

The scoping level assessment conducted by the Agricultural Research Council concluded no areas of high agricultural significance (―fatal flaws") occur within the site. The assessment further concluded that that mainly due to the low potential soils and prevailing climatic limitations for agriculture, no detailed assessment during the EIA Phase will be required.

9.5.2 Air Quality Assessment

The terms of reference of the study includes the following:

- Determine and depict the baseline information (air quality) for the area whereby the existing state and climate is characterised;
- Characterise the likely ambient air quality that would prevail during normal and abnormal operations of the project;
- Formulation of emissions inventory and calculation of emissions to atmosphere emanating from the proposed operations:
- Identify which atmospheric emissions hold the potential to impact negatively on human health and the environment and describe the effects associated with each and relevant community health and environmental guidelines/standards.
- Characterise and quantify all forms of atmospheric emissions expected or proposed during the various phases of the proposed project life – construction, operations and decommissioning:
- To identify potential dust emissions from the proposed development during its various phases; and

- Ensure that fugitive emissions from evident sources are characterised and quantified as well as possible.
- Characterise existing air quality for the area, as well as significant other sources of emission that may act cumulatively in resulting in potential impacts;
- Identify and characterise sensitive potential receptors – these would include both human and ecological receptors, as well as to predict the health and nuisance impact of emissions on sensitive receptors in the area;
- To determine the cumulative impact of the proposed development on sensitive receptors in the area and the ambient air quality in general;
- Present mitigation and monitoring plan:
- To propose management and mitigation measures for air quality impacts from o the proposed development;
- To provide details regarding dust suppression methods and dust monitoring; and
- Detail whether the mitigation will reduce the intensity of the impact or the probability of the impact and revise the impact significance accordingly.
- Simulation/Modelling:
- Dispersion simulation to predict increases in ground level concentrations illustrated through contour plots and projected emissions dispersion;
- Simulate the potential dispersion of potential pollutants and compare predicted ambient concentrations with internationally and locally defined standards, limits or other appropriate thresholds; and
- Quantify the uncertainty of the model predictions as a result of incorrect input emissions data; inaccurate meteorological data and inadequate scientific formulation of the model. Present a statistical evaluation of the accuracy of the results; and
- Greenhouse gas emissions.
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports.The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.3 *Avi-fauna*

The objective of the study is to define and quantify the possible impacts that the construction and development of the proposed plant may have on avifaunal species.

The terms of reference provided to the specialist included the following:

- All applicable legislation and guidelines are to be duly considered during the assessment process;
- Describe the affected environment and determine the status quo: The existing environment must be described and the bird communities most likely to be impacted are to be identified. Different bird micro-habitats (foraging and / or breeding) must be described as well as all species associated with such identified habitats. The following information and sources must as a minimum be utilised:
- Satellite imagery;
- Red data information; and
- Bird Sensitivity Index associated with a relevant entity or presiding body.
- A description of the current state of avifauna in the study area, outlining important characteristics and components thereof, including species-specific habitats, existing bird populations, and roosting/nesting sites, which may be influenced by the proposed project or which may influence the proposed project during the construction and operational phases of the CSP plant. The identification of Red Data, threatened, and vulnerable species potentially affected by the proposed project;
- Mapping of sensitive avifaunal habitats and known locations of sensitive avifaunal populations;
- Assessment of impacts: The potential impacts (positive and negative, particularly cumulative impacts) on avifaunal habitats and populations during each project phase must be assessed and evaluated in terms of the assessment methodology prescribed by the environmental technical team project manager. Particular attention should be paid to avifauna mortality associated to direct collisions with CSP plant infrastructure (e.g. 200m tower, stacks and power lines) and electrocution via contact with planned power lines. Attention should also be given to bird pollution and mitigation measures (for impacts on birds and impacts on the power lines from birds) and cumulative impacts;
- Identification of a preferred alternative (e.g. plant location, power line alignment or site): It will in particular be required that a preferred power line alignment is identified for consideration in the integration process. Recommendations on route alternatives where additional alternatives could be identified need to be made, to avoid negative impacts;
- Propose and explain mitigation measures: Practical mitigation measures will be recommended, discussed and included in the EMP. The identification of mitigation measures for enhancing benefits and avoiding or mitigating negative impacts and risks (to be implemented during planning, construction and operation of the proposed project);

- Provide a brief description of current conservation plans and initiatives contained in relevant municipal and provincial documentation and include these in the avifaunal assessment. Such documentation includes: Environmental Management Frameworks (EMF), Metropolitan Open Space System (MOSS) plans, and Integrated Development Plans (IDP) for each area. There may be plans for new environmental targets and conservation initiatives, which could be put into operation in the future. Please consider these conservation initiatives as integral components of the impact assessment;
- Conduct a ―walk-through": Prior to construction, a detailed ―walk-through" of the line will be conducted, whereby sections of line will be identified on a span to span basis for mitigation with bird flight diverters; and
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required, and
- Formulate final recommendations.
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.4 Biodiversity

The objective of the biodiversity assessment is to identify and motivate the choice or requirements posed for each of the development alternatives that could avoid or minimize impacts on biodiversity. The terms of reference are:

- Undertake a desktop assessment of all relevant documentation and databases available. Review all previous faunal and floral reports/work applicable to the study area. This should include a consideration of all relevant biodiversity plans prepared in terms of the National Environmental Management Biodiversity Act ((No 10 of 2004) or under the auspices of SANBI or relevant provincial ordinance(s) etc.;
- Liaison with relevant environmental and / or nature conservation authorities and /or management bodies with regards to specific requirements that may be required for the biodiversity assessment. All communications need to be kept on record and provided in the report;
- Liaison with I&APs. All communications need to be kept on record and provided in the report. The specialists may be required attend Public Meetings scheduled as part of the EIA process in order to give a one-on-one account of the biodiversity assessment findings;
- Undertake the required field work within the designated timeframes and report thereon;
- Provide a description of the broad ecological characteristics of the site and its surrounds;

- In terms of biodiversity pattern, the following shall as a minimum be identified and described where appropriate:
- Community and ecosystem level;
- Species level; and
- Other pattern issues.
- In terms of biodiversity process, the following shall as a minimum be identified or described:
- The key ecological ‗drivers' of ecosystems on the site and in the vicinity, such as fire and grazing;
- Environmental gradients (e.g. upland-lowland), biome boundaries, soil interfaces or sand movement corridors on the site or in its vicinity; and
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- The condition and functioning of rivers and wetlands (if present) in terms of: possible changes to the channel, flow regime and naturally-occurring riparian vegetation;
- Undertake a desktop and field-based investigation of the flora and fauna of the site (excluding avifauna), integrating on site information with available data from atlases, research reports and other published sources;
- Assess the impacts on flora and fauna that are associated with the proposed development and describe relevant mitigation measures to reduce, avoid or minimise negative impacts to flora, fauna and habitats. The impact assessment methodology prescribed by the environmental technical team project manager must be used;
- Reflect time period when specialist assessment was undertaken;
- Aspects to be included in the report:
- The nature of the project, possible development alternatives and a summary of the activities likely to affect the receiving areas' biodiversity;
- The local and regional context of the fauna and flora species within the affected area, taking cognizance of the relevant biodiversity plans and bioregional planning documents for the study areal
- The fauna and flora species that is present in the area. Depicting the rare, endangered, threatened and red data species present;
- The current status of the environment as well as the local and regional conservation value of the various fauna and flora species;
- Assessment of the receiving environment in terms of the expected biophysical changes (in soil, water, air, flora, fauna) resulting from proposed activities. Assessing of the ecological / biodiversity processes that could be affected (positively and/or negatively) by the proposed development. The specialist needs to identify, from a biodiversity

perspective, the fatal flaws of the project, uncertainties and risks associated with the activities as well as the underlying assumptions and limitations of the assessment;

- A description and assessment of the significance of the impacts associated with the proposed activities on faunal and floral species. This should include consideration of the extent to which the development will result in the fragmentation of natural habitats;
- The Specialist need to predict, assess and evaluate potentially significant direct, indirect and cumulative impacts in terms of biodiversity patterns, processes and ecosystem services. The significance of these need to be calculated with and without the implementation of practicable management actions. The evaluation of significance should be linked to the thresholds of significance. Clear definition of these thresholds need to be rendered in the Methodology;
- Possible measures to avoid, minimize, and or compensate for significant biodiversity damage or loss, making reference to any legal requirements need to be identified and allocated. This section should entail a detailed description of the appropriate and practicable mitigation measures required to address and possibly limit and/or enhance the significance of impacts in terms of the construction and operational phase for the proposed development;
- In order to assess and address the expected environmental impacts adequately, remedial actions need to be included in the report – these measures need to be practicable, implementable, sustainable and affordable. It is no use if mitigation measures are recommended to the clients that are unattainable or impracticable. Mitigation measures need to be identified in terms of:
- Avoidance and or prevention, where by the impact is addressed during the construction or development phase – as to eliminate remedial or mitigation measures at later stages in the propjet;
- Mitigation which include actions such as restoration, reduction and rehabilitation of sites. These mechanisms should aim to reducing negative impacts and maximise benefits, or alternative to rectify negative impacts by restoring the affected environment to its previous condition, or rehabilitating it for a different land use;
- Compensation of offsets - the least favored approach and or last resort. These types of mitigation measures are only to be included into the Report if there is no other option. Compensation or offsets do not aim to positively enhance the biodiversity of the receiving environment, it merely compensates financially for its degradation;
- Spatial and temporal scale of the developments‘ impact. All direct, indirect and cumulative impacts need to be identified, defined, significance determined;
- Identify, map (vegetation and conservation value / sensitivity map) and describe the flora present, if any; and
- Identify any species of special concern viz. species with conservation status, endemic to the area or threatened species that exist or may exist on site. Provide a conservation importance rating of the vegetation on site (in local, regional and national terms). Mapping or modelling of the receiving environment in terms of sensitivity – the Specialist needs to

assess the proposed site as a whole, identifying areas suitable for development as well as no-go zones which are not to be disturbed. These components have to be delineated in terms of community and sensitive areas from a faunal and floristic perspective using GPS to fix locations (GIS).

- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.5 Geohydrology

The terms of reference for this study are:

- To provide a detailed description of the site topography, geological and geo-hydrological characteristics of the study area;
- Depiction and characterization of the groundwater regime in a regional geological and geo-hydrological context indicating the overall characteristics of the geological settings and aquifer parameters, and identification of immediate groundwater users;
- Data obtained from hydro census survey as well as the data obtained from the NGDB to be mapped:
- A desktop study to be undertaken for the analysis of data obtained from the National Department of Water Affairs' National Groundwater Database (NGDB);
- Site visit for purposes of the hydro census; and
- Consultation with relevant landowners to obtain additional borehole data, if available.
- Determination of pre-project groundwater quality by means of baseline groundwater quality monitoring and sampling;
- Assess the potential impacts (direct, indirect and cumulative) of the proposed development and the significance thereof on groundwater resources and downstream water users in the general area;
- Description of groundwater management measures related to all project phases;
- Groundwater monitoring protocols and a report containing groundwater monitoring data and analysis;

- A groundwater model illustrating the above mentioned analysis will be required; and
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.6 Heritage

The objectives of the study are to identify, assess and evaluate the potential heritage, cultural, paleontological and archaeological impacts associated with the construction, development, operation and decommissioning of the proposed CSP Plant.

The terms of reference for this study are:

- Undertake a desktop study with the purpose of gathering data regarding the known occurrence and distribution of heritage, cultural, paleontological and archaeological resources / sites and artefacts within and surrounding the study area. This study should include archival and literature research. The desktop study must in addition include a review of previous heritage investigations undertaken in the area, where relevant;
- Undertake a site survey of the development area with the purpose of identifying and defining areas of heritage, cultural, paleontological and archaeological interest. The areas of interest identified during the survey must be recorded (GPS coordinates) and documented (photographs);
- Provide a detailed description of the heritage, cultural, paleontological and archaeological areas of interest(‗status quo‘) documented during the site survey that could be affected by the proposed project;
- Generate a sensitivity map representing all identified heritage, cultural, paleontological and archaeological resources / sites using a GIS platform. The sensitivity map must indicate all ‗no-go‘ / ‗no-development‘ areas;
- Identify and assess the significance of the likely impacts (i.e. direct, indirect and cumulative) of the proposed project (including all project alternatives) on heritage, cultural, paleontological and archaeological resources / sites. The impact assessment component of the scope of works must be conducted according the prescribed impact assessment methodology;
- Outline any further studies that may be required during or after the EIA process;

- Make recommendations on the protection and management of any significant cultural, heritage and/or archaeological sites that occur within the study site;
- Provide recommendations for any ongoing monitoring that may be necessary for all phases of the project life-cycle (i.e. planning, construction, operation and decommissioning phases);
- Identify practicable mitigation measures to reduce negative impacts and enhance positive impacts on heritage, cultural, paleontological and archaeological resources and indicate how such measures can be implemented for the various phases of the project life-cycle (i.e. planning, construction, operation and decommissioning phases). The mitigation measures proposed will be included in the project Environmental Management Programme;
- Provide guidance on any permitting or any other relevant requirements that may be necessitated by the South African Heritage Resources Agency (SAHRA), the National heritage Resources Act (Act 25 of 1999) or any other relevant regulations and / or by-laws; and
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports.The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.7 Hydrology

The terms of reference for the hydrological study are:

- Undertake a desktop study to review all existing information available for the study area and relevant catchment;
- Undertake a site survey to identify all surface water resources occurring within the study area. It is recommended that an aerial photographic study to assess the extent of watercourses (perennial / non-perennial) occurring within the study area must initially be undertaken. The findings of this study must be verified and further complimented by the site survey findings;
- Mapping of all surface water resources identified during the desktop study and site survey using a GIS platform;

- Calculate the 1:50 and 1:100 year flood lines for all perennial and non-perennial watercourses occurring within the study area;
- Provide a baseline description of the hydrological and associated physical characteristics of the study area that may be affected by the proposed project activities.
- Identify impacts on watercourses (surface water) and run-off associated with the proposed project;
- Identify impacts associated with the proposed development on watercourses and provide mitigation measures for the identified impacts;
- Determine the variability in the amount of water required on an annual and seasonal basis as the project is implemented; and
- Determine and assess the expected, cumulative effects on water losses/gains resulting from the project operations;
- Mitigation measures to be identified for ensuring efficient use of water including alternatives to reduce the consumption of water such as water use minimisation, recycling, conservation and technological improvements;
- Identify all relevant legislation, permits and standards that would apply to the development;
- Describe the surface water conditions for all stages of the project, including:
- Assessment of water requirements in terms of, process water, potable water and non-potable, water requirements and sources for construction start-up, normal and emergency operating situations as well as decommissioning;
- Design factors considered;
- Permanent and temporary alterations or realignments of watercourses, wetlands and other water bodies. Identify the volume of water to be withdrawn from each source, considering plans for waste water re-use;
- Determine the location of sources/intakes and associated infrastructure (e.g. pipelines for water supply); and
- Describe best practice approaches to be considered for the crossings of watercourses or water bodies which may be required and provide example diagrams of each type crossing.
- Provide recommendations for a surface water monitoring programme to be implemented during the construction and operational phases of the project; and
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports.The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required, and

- Formulate final recommendations.
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.8 Noise Impact Assessment

The scope of work for the Noise Impact Assessment will be guided by SANS 10328:2003 (Edition 2) which specifies the methods to assess the noise impacts on the environment resulting from the operations of the CSP plant that might affect the receiving environment. The minimum requirements include –

- Purpose of the investigation;
- Description of the exiting environment – topography, surface conditions and meteorological conditions etc. during measurements;
- Define and identification of primary noise sources along with their respective levels – where applicable operating cycles and nature of the sound emission, composition and directional characteristics;
- Identification of noise sensitive developments or receptors and the impact of the noise on these – focusing on cumulative. Determine the sound emission and nature of the sound emission from each of the identified noise sources;
- Location of measuring or calculating points;
- Quantification of the noise impacts. Calculate the expected rating level of sound at the identified noise sensitive sites from the combined sound power level emanating from identified noise sources;
- Alternatives considered and the results of those recommendations.
- All applicable legislation and guidelines are to be duly considered during the assessment process;
- Assess the noise impacts at identified noise sensitive sites in terms of the requirements of SANS 10103.The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication; the Noise Control Regulations; the World Health Organisation; the World Bank;
- Investigate alternative noise mitigation procedures, if required;
- The calculation, analysis and assessment of noise impact requires details of the plant layout and quantitative data of all sources of noise of the power plant associated with the electrical power generation process including noise emission data of each of the noise sources, their location within the plant and the material of the bounding structures. The propagation of sound from each noise source through the bounding structures and subsequent propagation through the atmosphere is calculated to predict and subsequently assess the rating levels of combined noise at identified noise sensitive sites; and

- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.9 Socio-Economic Impact Assessment

The objective of the Socio Economic Impact Assessment should allow for a better understanding of the proposed development in terms of the local context. The study should present the baseline data on demographic, economic, employment and infrastructure requirements.

The terms of reference for study include the following:

- Obtain baseline information on the social conditions characterising the study area (individual, community, institutional and organisational level) with regards to future trends, current changes which will occur when the development is implemented. A baseline rendering of the area is to be presented in terms of demographic, labour and employment, economic and infrastructure components;
- Desktop study: present a baseline description will be derived from secondary data and primary data collection (using a combination of telephonic, face-to-face and focus group interviews):
- Census 2001 and Community Survey 2007 data to determine any significant social trends in the area;
- A desktop aerial study of the affected area through the use of Google Earth;
- Integrated Development Plans (IDP) of the affected District and Local Municipalities;
- Local Economic Development Plans for affected District and Local Municipalities;
- Spatial Development Frameworks (SDF) of the affected District and Local Municipalities; and
- Growth and Development Strategies/Plans of the affected District and Local Municipalities.
- Identify and assess socio-economic impacts (direct, indirect and cumulative) that may result from the construction and operation phases of the project, as well as to define how this will change the local economic and social composition. Assess the social benefits of

the proposed project in terms of development opportunities, improved safety and security, job opportunities and empowerment;

- Analysis of the following components in terms of the expected impacts to be generated and the change anticipated in the local community and economy:

Demographic:

- Size and composition of the population;
- Population growth;
- Educational level of the local community;
- Level of poverty; and
- Health status of the community.

Labour and employment:

- Economically active population;
- Unemployment status and rates;
- Labour absorption and employment rates; and
- Number of jobs created – direct and indirect.

Economic:

- Economic sectoral composition;
- GDP contribution; and
- Macro economic impact of the proposed development on the local economy.

Infrastructure:

- Assessment and overview of existing infrastructure in terms of water, sanitation accessibility, electricity etc.
- Recommend mitigation measures that address the local context and needs;
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.10 Tourism Assessment

The terms of reference for study include the following:

- Determine the tourism assessment area, i.e. the area likely to be impacted by the proposed CSP plant and associated infrastructure;
- Assess the existing and proposed future tourism product(s) within the tourism assessment area;
- Assess existing or potential tourism products that may be negatively impacted by the proposed project;
- Assess the future tourism appeal and/or prospects for the tourism assessment area;
- Determine the current and projected future average demand for tourism products in the tourism assessment area;
- Develop a tourism impact assessment (demand and economic impact) of the proposed project on the tourism industry specific to the study area. The methodology to be used for the impact assessment will be prescribed by the environmental technical team project manager;
- Recommend practicable and appropriate mitigation measures to reduce or mitigate potential impacts and/or enhance benefits; and
- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations, and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.11 Visual Impact Assessment

Depict and assess the visual aesthetic character of the study and general area in order to interpret and quantify the possible impacts of the proposed development on the receiving landscape and to identify potential sensitive receptors. The rationale for this study is that the construction and the operation of the CSP plant may alter the landscape character and sense of place of the local environment.

The terms of reference for study include the following:

- Identify all legislation, permitting requirements and standards that may be relevant to the proposed development;

- Describe the visual character of the site by evaluating components such as topography and current land use activities as examples. This will provide an overview of the status quo of the visual environment;
- Undertake a viewshed analysis in order to determine the visual exposure of the project. The viewshed analyses must take into account the dimensions of the relevant CSP plant structures and associated infrastructure;
- Identify farms/neighbouring properties affected by viewsheds and provision of outputs in Excel spreadsheets;
- Identify elements of particular visual quality that could be affected by the proposed project and determine the extent of the visibility of the project from surrounding areas;
- Identify sensitive receptors that occur within the project viewsheds including towns, lodges, tourist routes etc.;
- Determine the visual absorption capacity by means of graphic representation (photomontages) of the proposed development on 2D photographs taken from key locations surrounding the site;
- Describe and evaluate the visual impacts of the individual components of the proposed project from identified critical areas and view fields as well as the cumulative impacts which will be generated. The impact assessment component of the scope of works must be conducted according the prescribed impact assessment methodology;
- Weigh the resultant envisaged impacts of all project alternatives and create an alternative-ranking table, stipulating the potential impacts of each proposed alternative.
- Visual rendering – indicates the key visual attributes and considerations graphically and provide client with layers;
- Collate all available spatial data for at least a 80 km radius around the study area. Data to include the following vector layers: farms, road, rivers, wetlands, informal settlements, towns, land use data and elevation and the following raster data: topographic maps and aerial photos;
- Develop a 3D model of the study area using available aerial photos and 20 m contour data;
- Recommend mitigation measures to reduce the potential visual impacts generated by the components of the proposed project for inclusion into the Environmental Management Programme (EMP). Describe relevant and implementable mitigation measures to reduce, avoid, or minimise negative impacts and enhance positive impacts and recommendations - propose relevant aspects to be included in a visual monitoring programme;
- Detailed guideline measures to mitigate any visual impacts and an assessment of their likely effectiveness. These site-specific guidelines should include appropriate recommendations to ensure that any structures conform to the surrounding environment through the appropriate use of architectural style, layout, building materials and scale; and

- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.5.12 Wetland Delineation and Assessment

Undertake the required field work and desktop analysis in order to compile a report that considers the following aspects:

- A broad description of the wetland ecology of the study area and surrounding areas – this must include water abstraction sites;
- Delineation of possible wetlands and associated riparian habitat occurring within the study area and determining of appropriate buffer zones. Wetland delineation must be conducted in accordance with the Department of Water Affairs' approved methodology;
- Identification and description of biodiversity patterns at community and ecosystem level (plant and animal communities in vicinity and threatened/vulnerable ecosystem species) species level (Red Data Book species, presence of alien species) and in terms of significant landscape features that is likely to be impacted by the proposed CSP plant and associated infrastructure;
- To assess the ecological importance and sensitivity of wetland associated ecosystems in the vicinity of the site in terms of construction, operations and water abstractions; and the classification of habitat;
- Identification of potential direct, indirect and cumulative impacts and recommendations to prevent or mitigate these in both the construction, operational and decommissioning phases;
- To describe and map the freshwater ecosystems in the vicinity of the proposed site and the conservation status;
- To determine the impact that the proposed development will have on the conservation status and functioning of freshwater ecosystem on site;
- To propose management and mitigation measures for impacts on freshwater ecosystems; and

- Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
- Discuss and evaluate the findings of each of the various specialist studies;
- Integrate findings to identify workable solutions;
- Recommend appropriate mitigation measures, where required;
- Formulate final recommendations; and
- Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.

9.6 Approach to Undertaking the Project

In order to obtain the required Record of Decision for the Environmental Scoping Study and Plan of Study for EIA from DEA for the project, the following activities will be undertaken:

9.6.1 Authority Consultation

Consultation with all relevant authorities initiated during the Scoping Phase will continue throughout the duration of the project. The representatives from the relevant Departments will be requested to formally provide input into the EIA Process. The authorities to be consulted include:

- National and Provincial Government Representatives:
  - Department of Environmental Affairs (DEA);
  - Department of Water Affairs (DWA);
  - Department of Agriculture, Forestry and Fisheries (DAFF);
  - South African Heritage Resources Agency (SAHRA); and
- Relevant Northern Cape Provincial Authorities (ex. Environment & Conservation, Agriculture).
- Relevant Local and District Municipalities:
  - Siyanda District Municipality;
  - Tsantsabane Local Municipality; and
  - Kgatelopele Local Municipality.

9.7 Environmental Impact Assessment

The EIA will aim to achieve the following:

- To provide an overall assessment of the social and biophysical environments of the area affected by the proposed establishment of a CSP Plant and associated infrastructure;
- To undertake a detailed assessment of the portion of the Farm 469, the Hay (Humansrus) considered for the CSP Plant development, in terms of environmental criteria and impacts (direct, indirect and cumulative), and recommend a preferred location for the proposed plant (based on environmental sensitivity);
- To identify any cumulative impacts associated with the simultaneous development and operation of the SolarReserve SA (Pty) Ltd and Intikon renewable energy developments on the Farm Humansrus; and
- To identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- To undertake a fully inclusive PP Process to ensure that I&AP issues and concerns are recorded.

9.7.1 Public Participation Process for the EIA Phase

9.7.1.1 On-going Consultation with all I&APs

On-going consultation with key stakeholders (e.g. local authorities, relevant government departments, local business), and other identified I&APs will ensure that I&APs are kept informed regarding the EIA findings and proposed mitigation measures. Networking with I&APs will effectively continue throughout the duration of the project until the closure of the EIA phase. Where required, key stakeholders and I&APs will be engaged on an individual basis. The database and issues trail will be continually updated throughout the process.

9.7.1.2 Public Involvement

Public Meetings will be held to provide the general public with feedback regarding the findings of the EIA, and to provide detail regarding mitigation measures proposed. In accordance with the requirements of the EIA Regulations, the public meetings will be advertised **10 days prior** to the event. I&APs registered on the project database will be notified of this public meeting by letter. In addition, key stakeholders will be personally invited to attend separate Focus Group Meetings. Formal minutes of the Public and Focus Group Meetings will be compiled and distributed to the attendees. These proceedings will also be included in the final EIA Report.

9.7.1.3 Social Issues Trail

Issues and concerns raised during the public participation process of the EIA Phase will be compiled into an Issues Trail. Proceedings of meetings and comments received will also form part of the document. This record of issues will provide a consolidated list in order to ensure that all issues and concerns raised by I&APs are considered within the EIA Process.

9.8 Compilation of the Environmental Impact Report

The EIA Report will include and address the following:

- A project description (including a description of the proposed activity, plans illustrating the study area and proposed site, and detailed technical details regarding the proposed project);
- A description of the pre-construction environment;
- A description of the public participation process, including the identification of I&APs, a record of the procedures followed, and the perceptions and views of the I&APs regarding the activity;
- A description of environmental (biophysical and social) issues identified and potential impacts of the proposed project on these aspects (i.e. how the environment may be affected as a result of the proposed activity)
- Assessment of impacts identified in the Scoping Study which were determined to be significant. These impacts will be assessed in terms of the nature, extent, duration, intensity, severity and probability of the impact occurring; and
- Conclusions and recommendations regarding the presence of any environmental fatal flaws and recommendations (including a preferred site and mitigation and management measures) regarding the proposed project.

Furthermore, the EIA Report will comply with Regulation 31(2) of Government NoticeR543 and other applicable regulations/guidelines insofar as content and issues addressed are concerned. The integration of the specialist studies into a consolidated report will allow for easy assessment of the potential environmental aspects. In order to evaluate the significance of the identified impacts, the following characteristics of each potential impact will be identified:

- The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected;
- The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional;
- The duration, wherein it will be indicated whether the lifetime of the impact will be of a short duration (0–5 years), medium-term (5–15 years), long term (> 15 years) or permanent;
- The probability, which shall describe the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely), or definite (impact will occur regardless of any preventative measures);
- The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- The status, which will be described as either positive, negative or neutral.

SolarReserve SA (Pty) Ltd has the responsibility to avoid or minimise impacts and plan for their management (in terms of the 2010 EIA Regulations), the mitigation of significant impacts will be discussed and conclusions and recommendations regarding the preferred corridor.

9.9 Review of Environmental Impact Report

9.9.1 Public Review of the Draft Environmental Impact Assessment Report

The draft EIA Report will be made available at public places for public review and comment, in accordance with the EIA Regulations. A **60-calendar** day period will be allowed for this review process.

An advert indicating the availability of this report and the information regarding the public meeting will be placed in the local newspaper. In addition, all I&APs registered on the project database will be notified of the Public and/or Focus Group Meetings and the availability of this report by either post, e-mail, facsimile or telephonically.

Furthermore copies of the draft EIA Report will be submitted to the DEA prior to the commencement of the public review period.

9.9.2 Authority Review of the Final Environmental Impact Assessment Report

The Environmental Impact Report will be submitted to DEA and Northern Cape Department of Environmental Affairs for review and commenting purposes. All I&AP comments received during the **45-calendar** day public review period will be incorporated into the final EIA Report. This final report will be submitted to the Authorities for their review and consideration.

9.10 Environmental Authorisation

On receipt of the Environmental Authorisation for the project, the I&APs registered on the project database will be informed of this Environmental Authorisation and its associated terms and conditions in writing via either post, e-mail, facsimile. In addition the availability of the Environmental Authorisation will be advertised in relevant the local newspapers.

9.11 Work Programme

The programme for the EIA Phase and the key dates relevant to the project are outlined in the table below:

Table 39: Work Programme

Item	Activity	Timeframe
1.	Obtain written approval of Scoping Report and POS for EIA from DEA	20 November 2011
2.	Specialist studies	20 November 2011
3.	Consultation with I&APs	18 August – 17 October 2011
4.	Compile a draft EIA Report	20 November 2011
5.	Make a draft EIA Report available for public comment	20 November 2011
6.	Public review period	(60 days) 20 November 2011 – 31 January 2012
7.	Finalise EIA Report	08 February 2012
8.	Submit Final EIA Report to DEA and Northern Cape Department of Environmental Affairs and Conservation	08 February 2012
9.	Full Authority review period	(45 days) 08 February 2012 – 25 March 2012
10.	Environmental Authorisation	25 March 2012

10 Recommendation

The Environmental Scoping Study aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project, including the proposed alternatives, for detailed study within the EIA phase. The conclusions and recommendations of this Scoping Study are the result of on-site inspections, the evaluation of impacts identified by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

It is believed that the both beneficial and adverse impacts were thoroughly assessed, the needs and the benefits for this project has been assessed so as to give it a go ahead. Based on the above-mentioned information supplied and the conclusions that were made, it is suggested that the Scoping Report be accepted, that the Plan of Study for EIA be approved and that the applicant be allowed to commence with the EIA Phase of the project. The Scoping process has not revealed any environmental fatal flaws associated with any of the alternatives under consideration.

The purpose of the detailed assessments will be to identify site specific environmental -opportunities and constraints” in order to nominate/select preferred project alternatives.

Furthermore, to ensure that the required mitigation measures are implemented, it is recommended that an EMP be compiled for the project, and attached to the final EIA Report, in order to transfer the findings of the environmental studies into practical measures. This EMP should form part of the contract for the construction and operation of the proposed CSP plant.

The completed EIA must, amongst others, include the following information/comply with the following documents:

- The approved Plan of Study for EIA;
- The specialist reports listed by EIA team in this Scoping Report;
- The specialist inputs as listed in the Plan of Study for EIA; and
- Additional specialist inputs and other relevant information listed by the relevant authorities.

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Appendix A

EIA Application and DEA Confirmation of Receipt

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447 · PRETORIA · 0001 · Fedsure Building · 315 Pretorius Street · PRETORIA
Tel (+ 27 12) 310 3911 · Fax (+ 2712) 322 2682

Reference: 12/12/20/2316
Enquiries: Nyiko Ngoveni
Tel: 012 395 1694 **Fax:** 012 320 7539 **E-mail:** nngoveni@environment.gov.za

Ms Leanna Rautenbach
WorleyParsons RSA Resources and Energy
PO Box 36155
MENLO PARK
0102

Fax: 012 460 1336

PER FACSIMILE / MAIL

Dear Ms Rautenbach

APPLICATION FOR INTEGRATED ENVIRONMENTAL AUTHORISATION AND WASTE MANAGEMENT LICENCE: PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT ON THE FARM 469, HAY RD IN THE NORTHERN CAPE

The Department confirms having received the Integrated Application Form submitted by you on 8 June 2011 for environmental authorisation and waste management licence for the abovementioned project. You have submitted this document to comply with the Environmental Impact Assessment Regulations, 2010 and Government Notice 718 of 2009.

The Department also confirms having received, on 15 June 2011 the original signed Specialist Declarations of Interest for Geohydrological Assessment and Noise Impact Assessment. The Application is accepted.

Yours sincerely

Mr Dumisani Mthembu
Acting Chief Director: Environmental Impact Management
Department of Environmental Affairs
Letter signed by: Ms Nyiko Ngoveni
Designation: PEO: Environmental Impact Evaluation
Date: 21/06/2011

Rautenbach, Leanna (Pretoria)

From:	Franz Scheepers [FScheepers@environment.gov.za]
Sent:	10 May 2011 11:18 AM
To:	Sandile Vilakazi
Cc:	george; Div; Gerry.Pienaar@deaet.ecape.gov.za; Robert Stegman; Herman Grové; Werner Boing; m khosana; Amanda Britz; Coenrad Agenbach; Chantal Matthys; Dumisane Mthembu; Danie Smit; Grant Walters; Johan Benadé; John Geeringh; Mark Jardine; Neo NKotsoe; Percy Ngidi; Pierre Retief; Susara Burger; Sibusisiwe Hlela; Simon Moganetsi; Surprise Zwane; Vusi Skosana; Wynand Fourie; Wayne Hector; Abimbola.Olowa@gauteng.gov.za; Amanda frantz; Basani Ndinindani; Boniswa; daniel Motaung; Eksteen van Wyk; loyiso; Mafu; Mandisa; Maryjane; omolayo; Steven; sylvester; tjatja; Sandile Vilakazi; ramahulu; ogaoraelwe@half.ncape.gov.za; smbanjwa@half.ncape.gov.za; Christian Tham; Peter Kuyler; MongweV@ledet.gov.za; gbatchelor@mpg.gov.za; robyn; shlatshwayo; cwessels@nwpg.gov.za; gethebe; Denga; Mohlalisi; Nemutandani; mnkosi@nwpg.gov.za; smukhola; Ntloko; tshepo@nwpg.gov.za; Boshoff; Ayub Mohamed; Anbarnes@pgwc.gov.za; paul hardcastle; ztoefy@pgwc.gov.za
Subject:	IQ/11/0265: Consideration of separate activities on same footprint

Sandile

Based on the information provided, the following:

1. Nothing prevents another applicant to apply for a similar activity on the same site.

2. Nothing prevents another applicant to apply for a different activity on the same site.

What DEA ultimately wants to see in this regard [after authorization(s) is or are issued], is full compliance with the relevant environmental authorsaition. The relevant one being the one ultimately

The issue around who will ultimately be allowed on the site is an issue to be dealt with between the proponents and the landowner. We cannot and will not entertain any "battles" or "disagreements" in this regard. What we ultimately want to see is 100% compliance with the relevant EA.

Franz Scheepers
Deputy Director: Extension Services EIM: Capacity and Support Tel (012) 310 3459
Cell: 082 332 3367
Fax (012) 310 3688

>>> Sandile Vilakazi 5/10/2011 8:58 AM >>>
Dear Franz,

Enquiry:

Can two EA's be issued by the Department for the same footprint area on one farm portion, if two separate proponents have applied for different activities on that site, with the layout plans clearly indicating that the two activities applied for will overlap.

Regards,

Sandile F. Vilakazi (Ms)
Department of Environmental Affairs
Environmental Impact Management (Parastatals)
Tel No: (012) 310 3891
Fax No: (012) 320 7539
e-mail: SVilakazi@environment.gov.za

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and
(2) National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718 of 2009.

PROJECT TITLE

Environmental Impact Assessment and Waste License for the Humansrus Solar Thermal Energy Power Plant on the Farm 469, Hay RD in the Northern Cape.

PART A: INFORMATION AND APPLICATION PROCESS

1. DEFINITIONS

Definitions in this form are as per the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), the Environmental Impact Assessment ("EIA") Regulations, 2010, the National Environmental Management: Waste Act, 1998 (Act No. 59 of 2008) ("NEMWA") and the Schedule contained in Government Notice 718, published on 3 July 2009 in terms of section 19 of NEMWA.

2. APPLICABILITY OF INTEGRATED ENVIRONMENTAL AUTHORISATION PROCESS

The integrated environmental authorisation process only apply in instances where the **Minister** is both the-

(a) competent authority for the environmental authorisation applied for in terms of NEMA and the EIA Regulations, 2010; and
(b) the licencing authority for the waste management licence in terms of NEMWA.

Kindly refer to paragraph 3.2 of this part of the application to determine in which instances the Minister would be the competent authority in terms of NEMA and the licencing authority in terms of NEMWA.

3. APPLICATION PROCESS EXPLAINED:

3.1 Integrated environmental authorisation process:

3.1.1 The environmental authorisation process prescribed for listed activities under Listing Notices 1, 2 and 3 published in Government *Gazette* Numbers R544, R545 and R546 respectively and the waste licensing process for listed activities contained in the Schedule in Government Notice 718, 2009 published in terms of section 19 of NEMWA are as defined in the Environmental Impact Assessment (EIA) Regulations made under section 24(5) of the National Environmental Management Act, 2008 (Act No. 107 of 1998) ("NEMA").

3.1.2 This integrated application form is the official form in terms of regulation 12(2)(a) of the EIA Regulations, 2010 and must accompany every integrated environmental authorization application pertaining to-
- listed activities in terms of NEMA; and
- waste activities in terms of NEMWA.

3.2 Competent Authority (Where to submit applications)

3.2.1 The Minister of Water and Environmental Affairs is the-

- competent authority in respect of the activities listed in Listing Notices 1, 2 and 3, published in Government *Gazette* numbers R544, R545, and R546 respectively, in terms of NEMA if the activity-
  (a) has implications for international environmental commitments or relations;
  (b) will take place within an area protected by means of an international environmental instrument, other than-
    (i) any area falling within the sea-shore or within 150 meters seawards from the high-water mark, whichever is the greater;
    (ii) a conservancy;
    (iii) a protected natural environment;
    (iv) a proclaimed private nature reserve;
    (v) a natural heritage site; and
    (vi) the buffer zone or transitional area of a world heritage site;
  (c) has a development footprint that falls within the boundaries of more than one province or traverses international boundaries;
  (d) Is undertaken, or is to be undertaken by-
    (i) A national department;
    (ii) A provincial department responsible for environmental affairs or any other organ of state performing a regulatory function and reporting to the MEC; or
    (iii) A statutory body, excluding any municipality, performing an exclusive competence of the national sphere of government; or
  (e) Will take place within a national proclaimed protected area or other conservation area under control of a national authority.
- licencing authority in respect of all activities listed in both categories of the Schedule contained in Government Notice 718, 2009 published in terms of section 19 of NEMWA where –
  (a) Unless otherwise indicated by the Minister by notice in the *Gazette*, the waste management activity involves the establishment, operation, cessation or

decommissioning of a facility at which hazardous waste has been or is to be stored, treated or disposed of;

(b) The waste management activity involves obligations in terms of an international obligation, including the importation or exportation of hazardous waste;

(c) The waste management activity is to be undertaken by-
   (i) A national department;
   (ii) A provincial department responsible for environmental affairs; or
   (iii) A statutory body, excluding any municipality, performing an exclusive competence of the national sphere of government;

(d) The waste management activity will affect more than one province or traverse international boundaries; or

(e) Two or more waste management activities are to be undertaken at the same facility and the Minister is the licencing authority for any of those activities.

However, despite the above-mentioned legislative provisions, the Minister and an MEC may agree that an application for a waste management activity or an environmental authorisation in respect of the above-mentioned activities, where the Minister is the competent/licencing authority, may be dealt with by the relevant MEC within whose province the activity(ies) will take place. Similarly the Minister and the MEC may agree that an application for an environmental authorisation or a waste management activity where the MEC has been identified as the competent/licencing authority, may be dealt with by the Minister. [Section 24C(3) of NEMA and section 43(3) of NEMWA)]

The integrated application for environmental authorisation must be submitted by lodging an application with the National Department of Environmental Affairs. The application must be marked for the attention of:

The Director: Environmental Impact Evaluation
Private Bag X447
Pretoria 0001
Tel: 012 310 3230

3.3 Making an Application

3.3.1 This application form is current as of 1 September 2010. It is the responsibility of the applicant to ascertain whether subsequent versions of the form have been published or produced by the competent authority. It is the applicant's responsibility to download the current version of the application form from the website of the Department at **http://www.deat.gov.za**.

3.3.2 The application must be typed within the spaces provided in the form. The sizes of the spaces provided are not necessarily indicative of the amount of information to be provided. Spaces are provided in tabular format and will extend automatically when each space is filled with typing.

3.3.3 The applicant must clearly mark confidential sections of the information submitted in the application form and supporting documents. Unless protected by law, all information filled in on this application will become public information on receipt by the competent

authority. Any interested and affected party should be provided with the information contained in this application on request, during any stage of the application process.

3.3.4 The applicant must fill in all relevant sections of this form. Incomplete applications will not be processed. The applicant will be notified of the missing information in the acknowledgement letter that will be sent within 14 days of receipt of the application.

3.3.5 Incomplete applications may be returned to the applicant for revision.

3.3.6 Sections in the form that do not apply to the applicant must be marked "not applicable". However, the use of the phrase "not applicable" in the form must be done with circumspection. Should it be done in respect of material information required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the Regulations.

3.3.7 Where applicable **black out** the boxes that are not applicable in the form.

3.3.8 This application form (together with four hard copies of this application form), must be handed in at the offices of the relevant competent authority as determined by the relevant Acts and Regulations and as indicated in this application form. All application forms must be signed as stipulated in the form. Applications that are not signed or completed accordingly will not be considered.

3.3.9 No faxed or e-mailed applications will be accepted.

3.3.10 There is currently no prescribed fee.

3.4 Appointment of an EAP

- The applicant must appoint an EAP in terms of EIA Regulations, 2010;
- The EAP must comply with general requirements as given in EIA regulations, 2010; and
- The EAP may be disqualified in terms of EIA Regulations, 2010.

3.5 Criteria for determining whether basic assessment or scoping is to be applied to applications

3.5.1 NEMA activities

(a) Basic assessment must be applied to an application if the authorisation applied for is in respect of an activity listed in Listing Notices 1 and/or 3 published in Government *Gazette* Numbers R544 and R546, 2010 respectively and which must follows the process described in sections 21-25 of the EIA Regulations, 2010; and

(b) Scoping and Environmental Impact Reporting Process ("S&EIR") must be applied to an application if the authorisation applied for is in respect of an activity listed in Listing Notice 2 published in Government Gazette Number R545, 2010 and which must follows the process described in sections 26-35 of the EIA Regulations, 2010.

3.5.2 NEMWA activities

(a) Basic assessment, in terms of sections 21-25 of the EIA Regulations, 2010, must be applied to an application if the authorisation applied for is in respect of an activity

listed in Category A of the Schedule contained in Government Notice 718, published on 3 July 2009, in terms of section 19 of NEMWA; and

(b) S&EIR, in terms of sections 26-35 of the EIA Regulations, 2010, must be applied to an application if the authorisation applied for is in respect of an activity Category B of the Schedule contained in Government Notice 718, published on 3 July 2009, in terms of section 19 of NEMWA.

3.5.3 <u>Combination of NEMA and NEMWA activities</u>

Should any of the NEMA or NEMWA activities applied for require the application of the S&EIR process, the S&EIR process will be applied to this application for integrated environmental authorisation.

Queries must be addressed to the contact hereunder:

<u>Departmental Details</u>

Postal address:
Department of Environmental Affairs
Attention: Director: Environmental Impact Evaluation
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Fedsure Forum Building (corner of Pretorius and Van der Walt Streets)
2nd Floor North Tower
315 Pretorius Street
Pretoria
0002

Queries should be directed to the Directorate: Environmental Impact Evaluation at:

Tel: 012-310-3290
Fax: 012-320-7539

PART B: GENERAL

1. DESCRIPTION OF PROJECT

The entire project will entail the following (full detail of the project can also be appended):

The proposed project can be defined as a solar thermal-electric power plant that is embodied in the form of a Concentrated Solar Central Receiver Power (CSP) Plant. This project focuses on the possible establishment of a Concentrating Solar Power (CSP) plant in the Humansrus area, Northern Cape Province. The proposed CSP plant is proposed to consist of a maximum installed capacity of up to 100 MW. The plant requires approximately 8 km^2 of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

The CSP Plant being considered is a molten salt-type, Central Receiver technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

A heliostat is a mirror mounted on a pedestal by which the sun is steadily reflected onto one spot – the receiver. Heliostats are arranged in an elliptical formation around the focal point with the majority of the reflective area weight to the more effective side of the heliostat field (southern side in South Africa).

It is estimated that approximately 14 000 and 17 500 heliostats at 75 m^2 each will be required within the heliostat field in order to obtain a power output of approximately 100 MW, while also enabling approximately 18 hours (base load) of energy storage.

The central receiver is situated on the top of the central tower. This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

Power is generated through a conventional Rankine cycle (steam turbine process). The working fluid is a salt mixture. The cold salt is pumped up the central tower at approximate 300°C and flows through the central receiver where it is heated to approximately 550°C after which it can be stored for use in the conventional power generation process (maintaining 98% thermal efficiency).

Purpose of application:

The intention of Solar Reserve SA is to develop large-scale energy projects to generate electricity and reduce the dependence on non-renewable fossil fuel resources. Emergency load shedding in 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation.

The demand for electricity in South Africa has been growing at approximately 3% per annum. This growing demand can be attributed to increasing economic growth and social development within Southern Africa and places significant pressure on South Africa's existing power generation capacity.

Coupled with the rapid advancement in community development, is also the growing awareness of environmental impact, climate change and the need for sustainable development. Due to the nature of the activities associated with the proposed project it cannot be constructed or operated without the required environmental authorisations in terms of *inter alia* NEMA, NEMWA and NWA.

2. FLOW CHART OF OPERATIONS

Please provide a brief description of the activities and operations at the site. Provide a flow chart of the operation showing all inputs and outputs of the process. Give particulars of the source, location, nature, composition and quantity of emission to the atmosphere, surface water, sewer, and ground-water including noise emissions. Solid waste must be in tons and specify units for liquids and gases.

The CSP plant primarily comprises of four subsystems as follows:

- Solar Field - consists of all services and infrastructure related to the management and operation of the heliostats;
- Molten Salt Circuit - includes the thermal storage tanks for storing liquid salt, a concentration receiver/tower, pipelines and heat exchangers;
- The Power Block – housing the steam turbine.
- Auxiliary facilities and infrastructure - includes condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

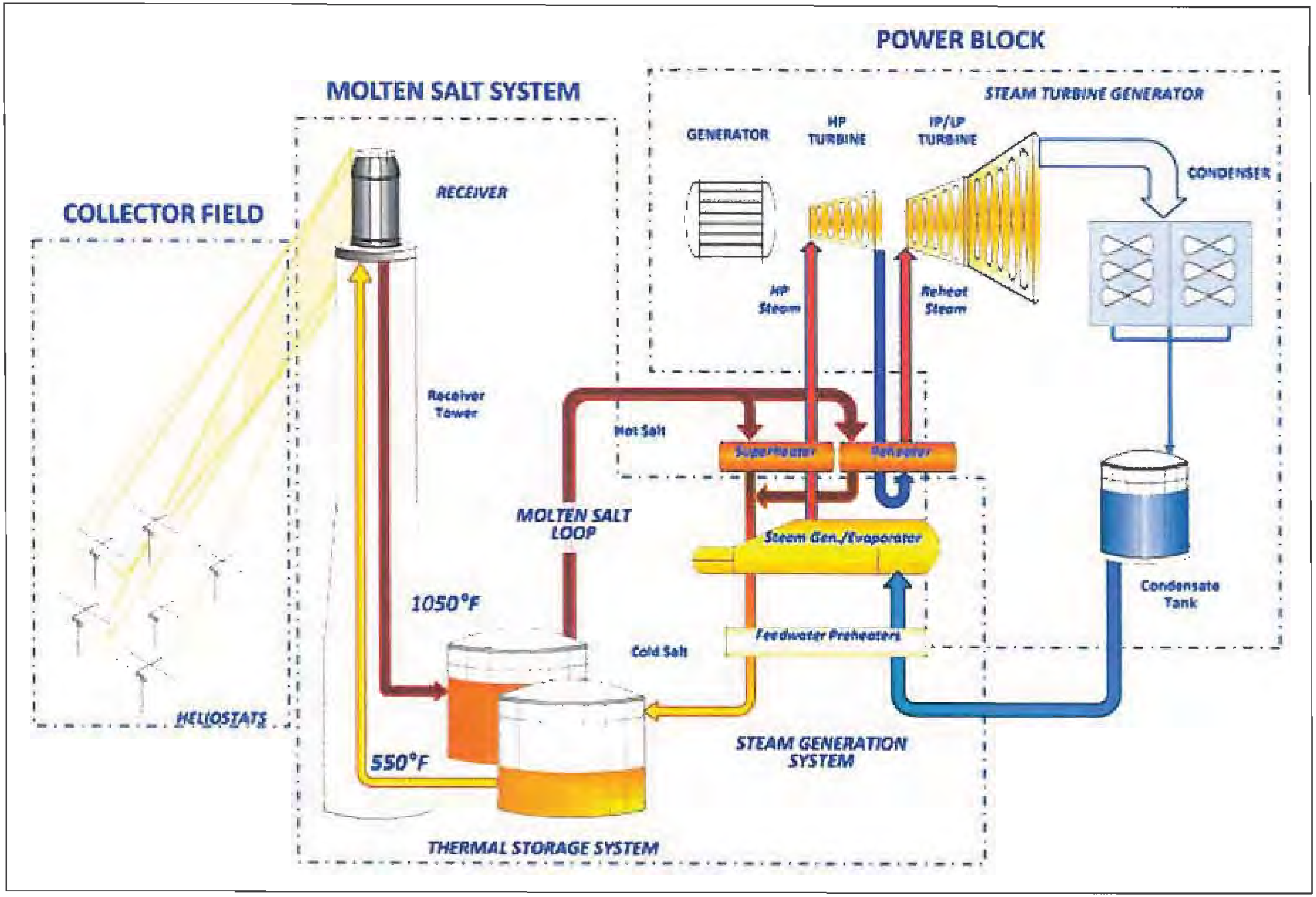
The particulars relating to the source, location, nature, composition and quantity of emission to the atmosphere, surface water, sewer, and ground-water including noise emissions is unknown at this point in time and will be confirmed during the Scoping Phase of the project when more detailed investigations and designs would have been conducted.

The following diagram shows a process flow of the proposed plant. Inputs into the process includes:

- Water;
- Salt;
- Gas or diesel; and
- Sunlight.

Outputs include:

- Electricity;
- Waste water;
- Emissions from the gas or diesel combustion,
- Brine or salt pellets; and
- Salt.


POWER BLOCK
MOLTEN SALT SYSTEM
STEAM TURBINE GENERATOR
GENERATOR
HP TURBINE
IP/LP TURBINE
CONDENSER
RECEIVER
COLLECTOR FIELD
HP Steam
Reheat Steam
Receiver Tower
Hot Salt
Superheater
Reheater
MOLTEN SALT LOOP
Steam Gen./Evaporator
1050°F
Condensate Tank
Feedwater Preheaters
Cold Salt
HELIOSTATS
STEAM GENERATION SYSTEM
550°F
THERMAL STORAGE SYSTEM

3. BACKGROUND INFORMATION

Project applicant:	**SolarReserve South Africa (Pty) Ltd.**		
Trading name (if any):	**SolarReserve South Africa (Pty) Ltd.**		
Contact person:	**Terence Govender**		
Physical address:	**Office L6 B-1, 6th Floor, SinoSteel Plaza, 159 Rivonia Rd, Sandton, South Africa**		
Postal address:	**See above**		
Postal code:	**2191**	Cell:	**+2783 4490433**
Telephone:	**Not Available**	Fax:	**Not Available**
E-mail:	**Terence.Govender@solarreserve.com**		

Landowner:	**Frederick Allen Scholtz**		
Contact person:	**Frederick Allen Scholtz**		
Postal address:	**PO Box 162 Postmansburg 8420**		
Postal code:	**8420**	Cell:	**+2782 821 2729**
Telephone:	**Not Available**	Fax:	**Not Available**
E-mail:	**allanscholtz@gmail.com**		

In instances where there is more than one landowner, please attach a list of landowners with their contact details to this application.

Ownership of the property (mark only one with an X)

Property owned by applicant (100% Share value)		Property leased by applicant	X
Property owned by applicant (Share value less than 100%)		The property is communal land	

Local authority in whose jurisdiction the proposed activity will fall:	**Tsantsabane Local Municipality – Primary Affected LM** *(Primary affected Municipality, however due to the nature of the project and the proximity of the site to the Kgatelopele Local Municipality boundary, this LM was also included.*		
Nearest town or districts:	**Postmansburg, Danielskuil and Kimberley**		
Contact person:	**Mr. Solazi Henge**		
Postal address:	**Tsantsabane Local Municipality** **Postal Address:** **PO Box 5, Postmasburg, 84210** **Physical Address:** **13 Springbok Street, Postmasburg**		
Postal code:	**84210**	Cell:	**+2783 634 1382**
Telephone:	**+2753 313 7300**	Fax:	**+2753 313 1602**
E-mail:	**Solanzi.henge@gmail.com**		

In instances where there is more than one local authority involved, please attach a list of local authorities with their contact details to this application.

Kgatelopele Local Municipality
Mr. Gustav von Mollendorf
Technical Services
Postal Address: PO Box 43
Danielskuil
8405
Physical Address: 222 Barker Street,
Danielskuil
Contact Details: Tel: +27(0)53 384 8600
Fax: +27(0)53 384 0326
Cell: NA
Email: NA

Siyanda District Municipality
Mr. F Rupping
Technical Services
Postal Address: Private Bag X 5875
Upington
8800
Physical Address: cnr Hill and Le Roux Street,
Upington
Contact Details Tel: +27(0)54 337 2939
Cell: +27(0)78 885 3647
Email: lr@siyanda.gov.za

Please note that a complete list of all organs or state and or any other applicable authority with their contact details must be appended to this application.

Property description/physical address: **Farm 469, Hay RD (Humansrus)**

(Farm name, portion etc.) Where a large number of properties are involved (e.g. linear activities), please attach a full list to this application.

Postmasburg, Daniëlskuil

In instances where there is more than one town or district involved, please attach a list of towns or districts to this application.

Current land-use where the site is situated:

Industrial		Recreation	
Agriculture	X	Commercial	
Residential		Mining & quarrying	
Forestry		Wilderness areas	
Wetlands		Nature area	
Open spaces			

Other current land-use
Not applicable

Current land-use zoning: **Agriculture**

In instances where there is more than one current land-use zoning, please attach a list of current land use zonings that also indicate which portions each use pertains to , to this application.

Is a change of land-use or a consent use application required? YES X [redacted]

Must a building plan be submitted to the local authority? YES X

Locality map: An A3 locality map must be attached to the back of this document, as Appendix A. The scale of the locality map must be relevant to the size of the development (at least 1:50 000. For linear activities of more than 25 kilometres, a smaller scale e.g. 1:250 000 can be used. The scale must be indicated on the map.) The map must indicate the following:

- an accurate indication of the project site position as well as the positions of the alternative sites, if any;
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites; and
- a north arrow;
- a legend; and
- locality GPS co-ordinates (Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection).

4. SITE IDENTIFICATION AND LINKAGE, LOCATION AND LANDUSE

4.1 Please indicate all the Surveyor-general 21 digit site (erf/farm/portion) reference numbers for all sites (including portions of sites) that are part of the application.

C	0	3	1	0	0	0	0	0	0	0	0	0	4	6	9	0	0	0	0	0
1		2				3							4						5	

LEGEND:
1. Refers to the Surveyor's-General Office
2. Major Code (Registration Division)
3. Minor code
4. Property No (i.e. Farm No./Erf No./Holding Area No./Sheme No.)
5. Portion Number

(if there are more that 6, please attach a list with the rest of the numbers)
(These numbers will be used to link various different applications, authorisations, permits etc. that may be connected to a specific site)

4.2 If the property type is not surveyed, complete the following:

Not applicable

Full name of leader of village, community or tribal authority [redacted]

Local Authority Magisterial District Tribal Authority/Council	[redacted]

PART C: LISTED ACTIVITIES APPLIED FOR IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE ENVIRONMENTAL IMPACT REGULATIONS, 2010

1. ACTIVITIES APPLIED FOR TO BE AUTHORISED

For an application for authorisation that involves more than one listed or specified activity that, together, make up one development proposal, all the listed activities pertaining to this application must be indicated.

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
GNR. 544, 18 June 2010	(9)	The construction of facilities or infrastructure exceeding 1 000 meters in length for the bulk transportation of water, sewage or stormwater – (i) with an internal diameter of 0,36 meters or more; or (ii) with a peak throughput of 120 litres per second or more.
	(10)	The construction of facilities or infrastructure for the transmission or distribution of electricity – (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.
	(11)	The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
	(12)	The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010;
	(13)	The construction of facilities or infrastructure for the storage, or for the storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic meters;
	(22)	Construction of a road, outside urban areas; (i) where no reserve exists where the road is wider than 8 meters.
GNR. 545, 18 June 2010	(1)	The construction of facilities for the generation of electricity where the electricity output is 20 megawatts or more.
	(3)	Construction of facilities or infrastructure for the storage, or storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic meters;
	(15)	Physical alteration of undeveloped, vacant or derelict land for residential, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.
	(26)	Commencing of an activity, which requires an atmospheric emission license in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), except where such commencement requires basic assessment in terms of Notice of No. R544 of 2010.
GNR. 546, 18 June 2010	(2)	The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres. (a) In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces (i) Outside urban areas, in: *(bb) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;*
	(4)	The construction of a road wider than 4 metres with a reserve less than 13,5 metres. (ii) Outside urban areas, in: *(cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;*

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
		(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.
	(10)	The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. (a) In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces (ii) Outside urban areas in; *(cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*
	(12)	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (b) Within critical biodiversity areas indentified in bioregional plans;
	(13)	The clearance of an area of 1hectare or more of vegetation where 75% or more of the vegetative cover constitutes vegetation, except where such removal of vegetation is required for: (1) The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act no 59 of 2008) in which case the activity is regarded to be excluded from this list. (a) Critical biodiversity areas and ecological support areas as identified in the systematic biodiversity plans adopted by the competent authority. (c) In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces ii. Outside urban areas, in: *cc) Sensitive areas as identified in an environmental management framework as*

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
		contemplated in Chapter 5 of the Act and as adopted by the competent authority;
	(14)	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for : (2) The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act no 59 of 2008) in which case the activity is regarded to be excluded from this list; (a) In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces *(i) All areas outside urban area*
	(16)	The construction of: (i) jetties exceeding 10 square metres in size; (ii) slipways exceeding 10 square metres in size; (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga and Northern Cape Provinces (ii) Outside urban areas in; *cc) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority;* *(ff) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*

Please note that any authorisation that may result from this application will only cover activities specifically applied for.

Please note:
The applicability of GNR 546 is based on the findings of the Siyanda District Municipality Environmental Management Framework. Sensitivity maps are not very clear with regards to Environmental Control Zones and sensitive biodiversity areas, thus these listed activities were included to ensure that no potential activities or impacts are excluded from the proposed EIA process.

2. TYPE OF APPLICATION REQUIRED FOR ABOVE-MENTIONED ACTIVITIES

2.1 Application for Basic Assessment

Is this an application for conducting a basic assessment (as defined in the Regulations)?

[redacted]	NO
	X

Please indicate when the basic assessment report will be submitted:

NOT APPLICABLE

2.2 Application for Scoping and Environmental Impact Reporting (S&EIR) assessment

Is this an application for S&EIR (as defined in the Regulations)?

YES	[redacted]
X	

Please indicate when the S&EIR Report (including the Plan of Study for EIA) will be submitted:

SCOPING REPORT – JUNE/JULYT 2011 **ENVIRONMENTAL IMPACT ASSESSMENT REPORT – DECEMBER 2011**

The S&EIR report will be submitted

after consultation with the competent authority:

YES	[redacted]
X	

PART D: ACTIVITIES APPLIED FOR IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008 AND THE ENVIRONMENTAL IMPACT REGULATIONS, 2010

SECTION 1: TYPE OF APPLICATION AND FACILITY:

1.1 Indicate the type of facility/operation and fill in the required sections only

TYPE OF ACTIVITY	MARK	SECTIONS OF THE FORM TO BE FILLED IN
Recycling and/or recovery Facility	[redacted]	All except Section 5
Storage and or transfer Facility	X	All except Section 5
Treatment facility	X	All except Section 5
Disposal facility	[redacted]	All

1.2 Activities applied for:

An application may be made for more than one listed or specified activity that, together, make up one development proposal. All the listed activities that make up this application must be listed.

INDICATE THE NO. & DATE OF THE RELEVANT NOTICE:	ACTIVITY NUMBERS (AS LISTED IN THE WASTE MANAGEMENT ACTIVITY LIST) :	DESCRIBE EACH LISTED ACTIVITY (and not as per the wording of the relevant Government Notice):
GNR. 718, 03 July 2009	Category B (1)	The storage including the temporary storage of hazardous waste in lagoons.
	Category B (5)	The treatment of hazardous waste using any form of treatment regardless of the size or capacity of such a facility to treat such waste.
	Category B (11)	The construction of facilities for activities listed in Category B

NB: Authorisation issued will only cover activities applied for and listed above. Activities added in the middle or after the processing of this authorisation may mean a totally new application.

1.3 TYPE OF APPLICATION REQUIRED FOR ABOVE-MENTIONED ACTIVITIES

1.3.1 Application for Basic Assessment

Is this an application for conducting a basic assessment (as defined in the Regulations)?

	NO
	X

Please indicate when the basic assessment report will be submitted:

NOT APPLICABLE

1.3.2 Application for Scoping and Environmental Impact Reporting (S&EIR) assessment

Is this an application for S&EIR (as defined in the EIA Regulations, 2010) reporting?

YES	
X	

Please indicate when the S&EIR Report (including the Plan of Study for EIA) will be submitted:

SCOPING REPORT – JUNE/JULYT 2011 ENVIRONMENTAL IMPACT ASSESSMENT REPORT – DECEMBER 2011

The scoping report will be submitted after consultation with the competent authority:

YES	
X	

1.4 Size of Site and Classification

Size of facility for a waste management activity	To be confirmed during the Scoping Phase
Area where the waste management activity takes place	Farm 469 Hay RD (also known as the farm Humansrus), approximately 30 km east of Postmasburg, within the Thantsabane Local Municipality and the Siyanda District Municipality in the Northern Cape.
Classification of facility in terms of climatic water balance	To be confirmed during Scoping Phase
Classification of Facility in terms of the type and the quantity of waste received	To be confirmed during Scoping Phase

1.5 Operational times

PERIOD	FROM	UNTIL
Weekdays	24hrs	
Saturdays	24hrs	
Sunday	24hrs	
Public holidays	24hrs	

SECTION 2: WASTE QUANTITIES

2.1 Indicate or specify types of waste and list the estimated quantities expected to be managed daily (should you need more columns, you are advised to add more)

Hazardous waste	Non hazardous waste	Total waste handled (tonnes per day)
To be confirmed during Scoping Phase	To be confirmed during Scoping Phase	To be confirmed during Scoping Phase

Source of information supplied in the table above Mark with an "X"

Determined from volumes	TBC
Determined with weighbridge/scale	TBC
Estimated	TBC

2.2 Recovery, Reuse, Recycling, treatment and disposal quantities:

Indicate the applicable waste types and quantities expected to be disposed of and salvaged annually:

TYPES OF WASTE	MAIN SOURCE (NAME OF COMPANY)	QUANTITIES		ON-SITE RECOVERY REUSE RECYCLING TREATMENT OR DISPOSAL	OFFSITE RECOVERY REUSE RECYCLING TREATMENT OR DISPOSAL	OFFSITE DISPOSAL
		TONS/MONTH	M³/MONTH	method & location	method location and contractor details	
Salt	SolarReserve (Pty) Ltd	To be confirmed during Scoping Phase	To be confirmed during Scoping Phase	Reverse osmosis and evaporation in a lagoon	To be confirmed during Scoping Phase	To be confirmed during Scoping Phase

SECTION 3: GENERAL

3.1 Prevailing wind direction (e.g. NWW)

November – April	To be confirmed during Scoping Phase
May - October	To be confirmed during Scoping Phase

3.2 The size of population to be served by the facility

To be confirmed during Scoping Phase

	Mark with "X"	Comment
0-499		To be confirmed during Scoping Phase
500-9,999		To be confirmed during Scoping Phase
10,000-199,999		To be confirmed during Scoping Phase
200,000 upwards		To be confirmed during Scoping Phase

3.3 The geological formations underlying the site:

To be confirmed during Scoping Phase

Granite		Quartzite	
Shale		Dolomite	
Sandstone		Dolerite	

Other:

SECTION 4: COMPETENCE TO OPERATE SITE

It is imperative that the holder of the waste management licence is a fit person in terms of section 59 of the NEMWA (59 of 2008). To assess the holder's competence to operate the site, please disclose the following:

4.1 Legal compliance

	YES/NO	DETAILS
Has the applicant ever been found guilty or issued with a non compliance notice in terms of any national environmental management legislation?	No	
Has the applicant's licence in terms of the Waste Act 2008 ever been revoked?	No	
Has the applicant ever been issued with a non compliance notice or letter in terms of any South African Law?	No	

__NB__: Details required above include any information that the applicant wants the Department to take into consideration in determining whether they are a "fit person" and this includes reasons why the offence happened and measures in place to prevent recurrence

4.2 Technical competence

What technical skills are required to operate the site?	To be confirmed during Scoping Phase
How will the applicant ensure and maintain technical competency in the operation of the site?	To be confirmed during Scoping Phase

4.3 Details of applicant's experience and qualification along with that of relevant employees must be summarised as shown in the table below:

NAME	POSITION	DUTIES AND RESPONSIBILITIES	QUALIFICATIONS AND EXPERIENCE
To be confirmed during Scoping Phase	To be confirmed during Scoping Phase	To be confirmed during Scoping Phase	To be confirmed during Scoping Phase

4.4 Financial Provisions

Provide a plan of estimated expenditure for the following:

	ATTACHED/NOT ATTACHED	SECTION OF THE REPORT WHERE IT IS ATTACHED
Environmental Monitoring	To be confirmed during Scoping Phase	
Provision and replacement of infrastructure	To be confirmed during Scoping Phase	
Restoration and aftercare	To be confirmed during Scoping Phase	

SECTION 5: LANDFILL PARAMETERS

Please Note:
The proposed activity does not involve the construction or operation of a landfill and hence this Section of the application is not applicable.

5.1 The method of disposal of waste:

Land-building ☐ Land-filling ☐ Both ☐

The dimensions of the disposal site in metres

	At commencement	After rehabilitation
Height/Depth		
Length		
Breadth		

5.2 The total volume available for the disposal of waste on the site:

Volume Available	Mark with "X"	Source of information (Determined by surveyor/ Estimated)
Up to 99		
100-34 999		
35 000- 3,5		

Volume Available	Mark with "X"	Source of information (Determined by surveyor/ Estimated)
million		
>3,5 million		

5.3 The total volume already used for waste disposal:

(a) Will the waste body be covered daily	YES	NO
(b) Is sufficient cover material available	YES	NO
(c) Will waste be compacted daily	YES	NO

If the answers (a) and/or (b) are No, what measures will be employed to prevent the problems of burning or smouldering of waste and the generation of nuisance?

5.4 The Salvage method

Mark with an "X" the method to be used.

At source	
Recycling installation	
Formal salvaging	
Contractor	
No salvaging planned	

5.5 Fatal Flaws for the site:

Indicate which of the following apply to the facility for a waste management activity:

Within a 3000m radius of the end of an airport landing strip	YES	NO
Within the 1 in 50 year flood line of any watercourse	YES	NO
Within an unstable area(fault zone, seismic zone, dolomitic area, sinkholes)	YES	NO

Within the drainage area or within 5 km of water source	YES	NO
Within an area with shallow and/or visible water table	YES	NO
Within an area adjacent to or above an aquifer	YES	NO
Within an area with shallow bedrock and limited available cover material	YES	NO
Within 100 m of the source of surface water	YES	NO
Within 1km from the wetland	YES	NO
Indicate the distance to the boundary of the nearest residential area	________metres	
Indicate the distance to the boundary of the industrial area	________metres	

5.6 Wettest six months of the year

November- April	
May -October	

5.7 For the wettest six month period indicated above, indicate the following for the preceding 30 years

	Total rainfall for 6 months	Total A-pan evaporation for 6 months	Climatic water balance
For the 1st wettest year			
For the 2nd wettest year			
For the 3rd wettest year			
For the 4th wettest year			
For the 5th wettest year			

	Total rainfall for 6 months	Total A-pan evaporation for 6 months	Climatic water balance
For the 6th wettest year			
For the 7th wettest year			
For the 8th wettest year			
For the 9th wettest year			
For the 10th wettest year			

5.8 Location and depth of ground water monitoring boreholes:

Codes of boreholes	Borehole locality	Depth (m)	Latitude			Longitude		
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"
....	....		°	'	"	°	'	"

5.9 Location and depth of landfill gas monitoring test pit:

Codes of boreholes	Borehole locality	Latitude			Longitude		
....	....	°	'	"	°	'	"
....	....	°	'	"	°	'	"

Codes of boreholes	Borehole locality	Latitude			Longitude		
....	....	°	'	"	°	'	"
....	....	°	'	"	°	'	"
....	....	°	'	"	°	'	"
....	....	°	'	"	°	'	"
....	....	°	'	"	°	'	"

PART E: DECLARATION BY THE APPLICANT

1. The Applicant

I, Terrence Govender , declare that I -

- am, or represent[1], the applicant in this application;
- have appointed / will appoint (delete that which is not applicable) an environmental assessment practitioner to act as the independent environmental assessment practitioner for this application / will obtain exemption from the requirement to obtain an environmental assessment practitioner[2];
- will provide the environmental assessment practitioner and the competent authority with access to all information at my disposal that is relevant to the application;
- will be responsible for the costs incurred in complying with the Environmental Impact Assessment Regulations, 2010, including but not limited to –
    - costs incurred in connection with the appointment of the environmental assessment practitioner or any person contracted by the environmental assessment practitioner;
    - costs incurred in respect of the undertaking of any process required in terms of the Regulations;
    - costs in respect of any fee prescribed by the Minister or MEC in respect of the Regulations;
    - costs in respect of specialist reviews, if the competent authority decides to recover costs; and
    - the provision of security to ensure compliance with conditions attached to an environmental authorisation, should it be required by the competent authority;
- will ensure that the environmental assessment practitioner is competent to comply with the requirements of these Regulations and will take reasonable steps to verify whether the EAP complies with the Regulations;
- will inform all registered interested and affected parties of any suspension of the application as well as of any decisions taken by the competent authority in this regard;

[1] If this is signed on behalf of the applicant, proof of such authority from the applicant must be attached.

[2] If exemption is obtained from appointing an EAP, the responsibilities of an EAP will automatically apply to the person conducting the environmental impact assessment in terms of the Regulations.

- am responsible for complying with the conditions of any environmental authorisation issued by the competent authority;
- hereby indemnify the Government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of the content of any report, any procedure or any action which the applicant or environmental assessment practitioner is responsible for in terms of these Regulations;
- will not hold the competent authority responsible for any costs that may be incurred by the applicant in proceeding with an activity prior to obtaining an environmental authorisation or prior to an appeal being decided in terms of these Regulations;
- will perform all other obligations as expected from an applicant in terms of the Regulations;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

____

Signature of the applicant[4]/ Signature on behalf of the applicant:

Solar Reserve South Africa

____

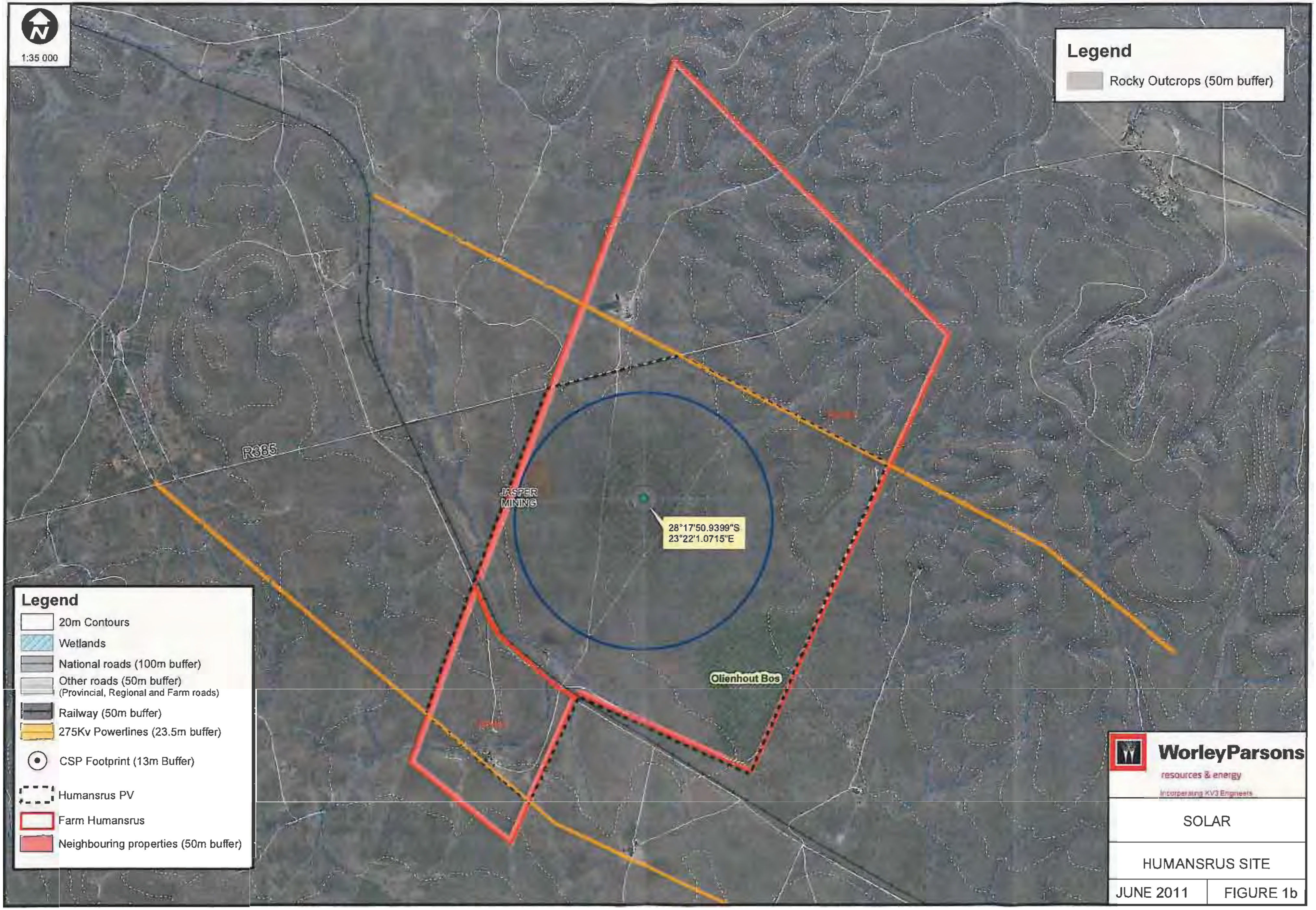
Name of company (if applicable):

04/05/2011

____

Date:

[4] If the applicant is a juristic person, a signature on behalf of the applicant is required as well as proof of such authority. An EAP may not sign on behalf of an applicant.



1:35 000
Legend
Rocky Outcrops (50m buffer)
R385
JASPER MINING
28°17'50.9399"S
23°22'1.0715"E
Olienhout Bos
Legend
20m Contours
Wetlands
National roads (100m buffer)
Other roads (50m buffer)
(Provincial, Regional and Farm roads)
Railway (50m buffer)
275Kv Powerlines (23.5m buffer)
CSP Footprint (13m Buffer)
Humansrus PV
Farm Humansrus
Neighbouring properties (50m buffer)
WorleyParsons
resources & energy
incorporating KV3 Engineers
SOLAR
HUMANSRUS SITE
JUNE 2011
FIGURE 1b

WorleyParsons

resources & energy

WorleyParsons RSA
V3 Forum, 160 Garsfontein Road
Ashlea Gardens 0081 PO Box 36155, Menlo Park 0102
South Africa
Telephone: +27 (0)12 425 0300
Facsimile: +27 (0)12 460 1336
www.worleyparsons.com

25 March 2011

Ref: 257000PWE
File: 257000PWE-03

Allan Scholtz
PO Box 162
Posmansburg
8420

Email: allanscholtz@gmail.com

Attention Allan Stoltz

Dear Sir

NOTIFICATION OF ENVIRONMENTAL IMPACT ASSESSEMENT (EIA) - SOLARRESERVE CONCENTRATED SOLAR POWER PLANT, HUMANSRUS, NOTHERN CAPE

Worley Parsons RSA (Pty) Ltd has been appointed to undertake an Environmental Impact Assessment (EIA) for the proposed Concentrated Solar Power (CSP) Plant to be constructed by Solar Reserve LLC. The proposed CSP Plant and associated activities require an Environmental Authorisation (EA) in terms of Section 24 of the National Environmental Management Act (NEMA), Act 107 of 1998.

Section 15 of the NEMA, Act 107 of 1998 requires that all owners or persons in control of land on which the activity is proposed to take place be notified in writing of the activity proposed. The property identified for the proposed development of the CSP Plant, is the farm Humansrus, situated in the Northern Cape Province. A notification of the proposed development is herewith served to Mr. A Scholtz (680908 5050 084), the owner of the property mentioned with regards to the proposed CSP Plant development.

1. Property Description

Worley Parsons SA would hereby like to extend a formal notification of the proposed EIA process and proposed development to be initiated on the property as defined below:

Farm Name:	Farm ~~468~~ 469 (remaining portion) also known as the Farm Humansrus
Registration Division:	Hay RD
Locality:	Siyanda District Municipality and the Tsantsabane Local Municipality
Province:	Northern Cape

2. Project Summary

The proposed development will entail the construction of a central receiver (solar tower), approximately 200 meters high which is to be surrounded by a circular heliostat (mirror) field (approximately 2.7 kilometres in diameter). The solar radiation is reflected of the heliostats onto the central receiver, the thermal energy concentrated the molten salt complex heated. The heated molten salt complex is then circulated through the CSP Plant. Once the molten salt reaches the generator, steam is produced which in turn activates the turbine to generate power. The proposed CSP Plant will aim to generate an estimated 80 - 100 MW of power to be fed directly into the national grid.

We trust that you find the above in order. Please contact us should you require any additional information.

Yours sincerely
WorleyParsons

L RAUTENBACH
Environmental Scientist

Allan Scholtz
Land Owner
ID Number: 680908 5050 084

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF EAP AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the proposed Humansrus Solar Thermal Energy Power Plant on the Farm 469, the Hay Rd in the Northern Cape.

Environmental Assessment Practitioner (EAP):	WorleyParsons RSA Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155 Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	0122 4256300	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		
Professional affiliation(s) (if any)	IAIA SA member		

Project Consultant:	WorleyParsons RSA Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155 Menlo Park		
Postal code:	0102	Cell:	079 503 1323

Telephone:	0122 4256300	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The Environmental Assessment Practitioner

I, Leanna Rautenbach , declare that –

General declaration:

- I act as the independent environmental practitioner in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation **8** of the Regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;

Signature of the environmental assessment practitioner:

WorleyParsons RSA

Name of company:

06/06/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF EAP AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the proposed Humansrus Solar Thermal Energy Power Plant on the Farm 469, the Hay Rd in the Northern Cape.

Environmental Assessment Practitioner (EAP):	BEAL Environmental Consulting		
Contact person:	Jeanne-Louise Liebenberg		
Postal address:	PO Box 71527 The Willows		
Postal code:	0041	Cell:	073 163 6409
Telephone:	012 807 5347	Fax:	086 537 5828
E-mail:	jl@beal.co.za		
Professional affiliation(s) (if any)			

Project Consultant:	WorleyParsons RSA Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155 Menlo Park		
Postal code:	0102	Cell:	079 503 1323

4.2 The Environmental Assessment Practitioner

I, **Jeanne-Louise Liebenberg** , declare that –

General declaration:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;

- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

____

____

____

____

____
Signature of the environmental assessment practitioner:

BEAL Environmental Consulting
Name of company:

3 June 2011
Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Tourism Impact Assessment		
Contact person:	Paul de Cruz (SiVest)		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	084 224 0088
Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	pauld@sivest.co.za		
Professional affiliation(s) (if any)	International Association for Impact Assessors (IAIA)		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Derek Cosijn, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist: Cosijn

Jongens Keet Associates

Date: 25 May 2011

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Noise Impact Assessment		
Contact person:	Derek Cosijn (Jongens Keet & Associates)		
Postal address:	PO Box 2756, Brooklyn		
Postal code:	0075	Cell:	082 600 6347
Telephone:	012 460 4481	Fax:	086 593 0944
E-mail:	dcosijn@gmail.co.za		
Professional affiliation(s) (if any)	Pr Eng, BSc (Civil Eng), EAPSA (Certified), FSAICE, MSAAI		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Derek Cosijn, declare that –

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Jongens Keet Associates

Date: 25 May 2011

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Air Quality Assessment		
Contact person:	Stuart Thompson (SSI Environmental)		
Postal address:	PO Box 867, Gallo Manor		
Postal code:	2052	Cell:	083 361 5479
Telephone:	011 798 6447	Fax:	011 798 6010
E-mail:	stuartt@ssi.co.za		
Professional affiliation(s) (if any)			

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Stuart Thompson** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SSI Environmental

Name of company (if applicable):

30/05/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Land Capability Assessment		
Contact person:	Garry Paterson (ARC – Institute for Soil, Climate and Water)		
Postal address:	Private Bag X79, Pretoria		
Postal code:	0001	Cell:	083 556 2458
Telephone:	012 310 2601	Fax:	012 323 1157
E-mail:	garry@arc.agric.za		
Professional affiliation(s) (if any)			

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, D G Paterson, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

ARC-Institute for Soil, Climate and Water

Name of company (if applicable):

5th May 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Avi-fauna Impact Assessment		
Contact person:	Jon Smallie (Endangered Wildlife Trust)		
Postal address:	Private Bag X11, Parkview		
Postal code:	2122	Cell:	082 444 8919
Telephone:	011 486 1102	Fax:	011 486 1506
E-mail:	jons@ewt.org.za		
Professional affiliation(s) (if any)	SACNASP		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Jon Smallie** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SSI Environmental - ENDANGERED WILDLIFE TRUST

Name of company (if applicable):

29-05-2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment and Waste License Application for the proposed Humansrus Solar Thermal Energy Power Plant on the Farm 469, the Hay Rd in the Northern Cape.

Specialist:	WorleyParsons RSA Energy and Resources – Waste Division		
Contact person:	Robert Relou		
Postal address:	PO Box 36155 Menlo Park		
Postal code:	0102	Cell:	082 829 5735
Telephone:	0122 4256300	Fax:	012 460 9978
E-mail:	rrelou@kv3.co.za		
Professional affiliation(s) (if any)	Professional Engineering Technician: Engineering Council of SA (200830160 – 05/08/2008)		

Project Consultant:	WorleyParsons RSA Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155 Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	0122 4256300	Fax:	012 460 9978

E-mail: lrautenbach@kv3.co.za

4.2 The specialist appointed in terms of the Regulations_

I, **Robert Relou** , declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Worley Parsons RSA

Name of company (if applicable):

6 June 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Biodiversity Assessment		
Contact person:	Riaan Robbeson (Bathusi Environmental Consulting)		
Postal address:	PO Box 77448, Eldoglen		
Postal code:	0171	Cell:	082 376 5933
Telephone:	012 658 5579	Fax:	086 636 5455
E-mail:	riaan@bathusi.org		
Professional affiliation(s) (if any)	South African Council of Natural Scientific Professions (Reg no: 400005/03, Botanical, Ecological Science) Grassland Society of Southern Africa (Reg no: 667.08/08		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Riaan A. J. Robbeson (Pr.Sci.Nat.) , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Bathusi Environmental Consulting cc
Name of company (if applicable):

4th May 2011
Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Heritage Impact Assessment		
Contact person:	Wouter Fourie (PGS Heritage and Grave Relocation Consultants)		
Postal address:	PO Box 32542, Totiusdal		
Postal code:	0134	Cell:	082 851 3575
Telephone:	012 332 5305	Fax:	0186 658 0199
E-mail:	wouter@gravesolutions.co.za		
Professional affiliation(s) (if any)	Accredited Professional Archaeologists – Association of southern Africa Professional Archaeologists		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Wouter Fourie** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

PGS Heritage and Grave Relocation Consultants

Name of company (if applicable):

26 May 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Hydrology Assessment		
Contact person:	Arthur Chapman (OneWorld Sustainable Investments)		
Postal address:	PO Box 1777, Cape Town		
Postal code:	8000	Cell:	083 290 7066
Telephone:	021 818 2900	Fax:	
E-mail:	Arthur@oneworldgroup.co.za		
Professional affiliation(s) (if any)			

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, ARTHUR CHAPMAN, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

ONEWORLD SUSTAINABLE INVESTMENTS

Name of company (if applicable):

5/5/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Socio-Economic Assessment		
Contact person:	Elana Broughton (Urban-Econ)		
Postal address:	PO Box 13554, Hatfield		
Postal code:	0028	Cell:	082 463 2325
Telephone:	012 342 8686	Fax:	012 342 8688
E-mail:	Elena@urban-econ.com		
Professional affiliation(s) (if any)			

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Elena Konstantinovna Broughton**, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Urban-Econ Development Economists

Name of company (if applicable):

4 May 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Tourism Impact Assessment		
Contact person:	Faith Kalibbala (SiVest)		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	076 175 6698
Telephone:	011 798 0677	Fax:	011 803 7272
E-mail:	faithk@sivest.co.za		
Professional affiliation(s) (if any)	International Association for Impact Assessors (IAIA)		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Faith Kalibbala, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

FKalibbala

Signature of the specialist:

SiVEST

Name of company (if applicable):

09 May 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Tourism Impact Assessment		
Contact person:	Paul de Cruz (SiVest)		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	084 224 0088
Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	pauld@sivest.co.za		
Professional affiliation(s) (if any)	International Association for Impact Assessors (IAIA)		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Paul da Cruz , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SiVEST

Name of company (if applicable):

09 May 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Visual Impact Assessment		
Contact person:	Graham Young (Newtown Landscape Architects)		
Postal address:	PO Box 331, Groenkloof		
Postal code:	0027	Cell:	082 462 1491
Telephone:	011 462 6967	Fax:	011 462 9284
E-mail:	graham@newla.co.za		
Professional affiliation(s) (if any)	South African Council for the Landscape Architectural Profession		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Graham Young. , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

NEWTOWN LANDSCAPE ARCHITECTS CC

Name of company (if applicable):

05 MAY 2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	06/06/2011

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

SOLAR POWER FARMS AT SOUTDRIFT (BLOEMFONTEIN) AND HUMANSRUS (NORTHERN CAPE)

Specialist:	GEOTECHNICAL: MOORE SPENCE JONES		
Contact person:	NINO WELLAND		
Postal address:	PO BOX 4593 RANDBURG		
Postal code:	2194	Cell:	082 567 1561
Telephone:	011 326 2558	Fax:	011 326 2568
E-mail:	msjjhb@iafrica.com		
Professional affiliation(s) (if any)	SAICE SAIEG		

Project Consultant:	WorleyParsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 / 6421	Fax:	012 460 9978
E-mail:	lrautenbach@ku3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, A-M. WELLAND, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

MOORE SPENCE JONES

Name of company (if applicable):

06/06/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Geohydrological Assessment		
Contact person:	Dr. Johanita Kotze (ERM)		
Postal address:	Postnet Suite 624, Private Bag X29, Gallo Manor		
Postal code:	2052	Cell:	082 658 4082
Telephone:	011 798 4300	Fax:	011 804 2289
E-mail:	Johanita.kotze@erm.co.za		
Professional affiliation(s) (if any)	South African Council for Natural Scientific Professions		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Johanita Kotze, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

ERM

Name of company (if applicable):

10/5/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Environmental Assessment Practitioner		
Contact person:	Frank Benedek (SSI Engineers and Environmental Consultants)		
Postal address:	PO Box 867, Gallo Manor		
Postal code:	2052	Cell:	084 619 7703
Telephone:	011 798 6430	Fax:	011 798 6010
E-mail:	frankb@ssi.co.za		
Professional affiliation(s) (if any)			

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Frank George Benedek, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SSI Engineers and Environmental Consultants

Name of company (if applicable):

07/06/2011

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Environmental Impact Assessment for the Humansrus Solar Thermal Energy Plant on the Farm 469, Hay RD in the Northern Cape.

Specialist:	Geohydrological Assessment		
Contact person:	Desmond Visser		
Postal address:	Postnet Suite #206, Private Bag X18, Rondebosch		
Postal code:	7701	Cell:	083 261 8474
Telephone:	021 659 3060	Fax:	021 685 7105
E-mail:	dvisser@srk.co.za		
Professional affiliation(s) (if any)	Pr. Sci. Nat. (Reg. No. 400106/94)		

Project Consultant:	Worley Parsons Resources and Energy		
Contact person:	Leanna Rautenbach		
Postal address:	PO Box 36155, Menlo Park		
Postal code:	0102	Cell:	079 503 1323
Telephone:	012 425 6300 ext. 6421	Fax:	012 460 9978
E-mail:	lrautenbach@kv3.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Desmond Visser , declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SRK Consulting South Africa (Pty) Ltd

Name of company (if applicable):

30 June 2011

Date:

Appendix B

Background Information Document

Background Information Document

Proposed Humansrus Solar Thermal EnergyPower Plant near Postmasburg, Northern Cape Province

DEA Reference: 12/12/20/2316

June 2011

SOLARRESERVE®

SSI
A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS

WorleyParsons
resources & energy

INTRODUCTION

The ever increasing and growing demand for energy as well the need to find more sustainable and environmentally friendly energy resources have prompted developers to explore new energy generation options.

In an effort to utilise renewable energy resources, SolarReserve SA (Pty) LTD is proposing to construct a 100 MegaWatt (MW) Concentrating Solar Thermal Energy Power Plant on the Farm 469 Hay RD (also known as the farm Humansrus), located approximately 30 km east of Postmasburg, Northern Cape Province (refer to Figure 1). The development site is located within the institutional boundaries of the Tsantsabane Local and Siyanda District Municipalities.

In terms of the Environmental Impact Assessment ("EIA") Regulations (April 2006) promulgated under Sections 24 and 24D of the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and the National Environmental Management: Waste Act (Act No. 107 of 1998) [NEM: WA], various aspects of the intended development are considered listed activities which may have an impact on the environment, therefore requiringauthorisation from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

SolarReserve SA (Pty) LTD(the applicant) has appointed Worley Parsons RSA and SSI Engineers and Environmental Consultants (known as the Worley Parsons SSI Environmental Partnership or "WPSEP")as independent Environmental Assessment Practitionersto the project in fulfillment of legislative requirements in support of an application for *Environmental Authorisation* and a *Waste Management License*.

The following primary listed activities have been applied for:

- *NEMAEIA Regulations (2010):*

GN.R545 (2010)	
Activity 1	The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more.

- *NEM: WA: List of Waste Management Activities:*

GN.R718 (2009) (Category B)	
Activity 1	The storage including the temporary storage of hazardous waste in lagoons.
Activity 5	The treatment of hazardous waste using any form of treatment regardless of the size or capacity of such a facility to treat such waste.
Activity 11	The construction of facilities for activities listed in Category B

In terms of the NEMAEIA Regulations (2010) and NEWM: WA the undertaking of an*Environmental Impact Assessment (EIA) Process* to identify and assess the potential environmental impacts associated with the proposed development activities will be required.

NEED AND DESIRABILITY OF PROJECT

The intention of SolarReserve SA (Pty) LTD is to develop numerous large-scale commercial renewable energy projects to diversify the local energy generation 'mix' and reduce South Africa's dependency on non-renewable fossil fuel resources (i.e. coal). Emergency load shedding imposed by Eskom (national electricity utility) in 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation and supply.

The following is the project locality map:

Figure1: Project Locality Map

PURPOSE OF THE DOCUMENT

This document aims to provide you, as an interested and/or affected party (I&AP), with background information regarding the proposed project and information regarding the Environmental Impact Assessment (EIA) Process to be undertaken. Furthermore, the document advises how you can receive information and/or raise issues, which may concern and/or be of interest to you. The sharing of information forms the basis of the public participation process and offers you the opportunity to become actively involved in the project from the outset. Public participation plays an important role in the undertaking of the EIA Process, as input from I&APs ensure that all potential issues are identified and considered during the study.

All stakeholders are therefore invited to register as an Interested and Affected Party (I&AP) and to assist WPSEP in identifying potential impacts associated with the proposed development on the environment and further make suggestions regarding possible mitigation of identified impacts and/or feasible project alternatives.

Please complete the enclosed reply sheet and forward it to the project consultants (details provided below):

Ms Leanna Rautenbach
WorleyParsonsRSA (Pty) Ltd
PO Box 93155
Menlopark
0102
South Africa
☎:012 425 6300/ 🖷:012 460 9978
🖂: leanna.rautenbach@worleyparsons.com

Mr Frank Benedek
SSI Engineers and Environmental Consultants
PO Box 867
Gallo Manor
2052
☎:011 789 6430/ 🖷:011 789 6010
🖂:frankb@ssi.co.za

The demand for electricity in South Africa has been growing at approximately 3% per annum. This growing demand can be attributed to rapid economic growth and social development within South Africa and Southern Africa, which places significant pressure on South Africa's existing power generation capacity and supply capability.

Coupled with the rapid advancement in community development, is also the growing awareness of environmental impacts, climate change and the need for sustainable development.

PROJECT DESCRIPTION

The CSP plant being considered is a molten salt-type, Central Receiver (tower) technology and will primarily comprise of the following four components (Figure 2):

a) **Solar Field** - consists of all services and infrastructure related to the management and operation of the heliostats (reflective mirrors);

b) **Molten Salt Circuit** - includes the thermal storage tanks for storing liquid salt, a concentration receiver/tower, pipelines and heat exchangers;

c) **The Power Block** – housing the steam turbine.

d) **Auxiliary facilities and infrastructure** - includes a condenser-cooling system, electricity transmission lines to allow for grid connection, access routes, water treatment and supply amenities and a CSP plant start-up energy supply unit (gas or diesel generators).

This technology utilizes thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located at a predetermined height above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

Figure 2: An example of a power plant using central receiver (tower) technology. This is a 10MW demonstration plant built in the United States – image courtesy of NREL.

The heliostats are mounted on pedastals and arranged in an elliptical formation around the focal point.(Figure 2)).

It is estimated that approximately 17 000 heliostats with an area of approximately 65 m^2 each will be required for the solar field in order to obtain a power output of approximately 100 MW, while also enabling approximately 12-18 hours (base load) of energy storage.

The central receiver is situated on the top of the central tower. This receiver is in essence a heat exchanger (Figure 4) which absorbs the concentrated beam radiation, converts it to heat. The heat is then transferred to a working fluid (i.e. molten salt mixture and then used to generate steam for conventional power generation.

Power is generated through a conventional Rankine cycle (steam turbine process). The cold salt (approximate temperature: 260°C) is pumped through the central tower to the central receiver where it is heated to approximately 550°C after which the thermal energy of the salt is stored for use in the conventional power generation process (maintaining 98% thermal efficiency) – refer to Figure 5 for a diagrammatic illustration of the power generation process.

Figure 3: Single heliostat – image courtesy NREL

Figure 4: Centralreceiver heat exchange panels – image courtesy: NREL

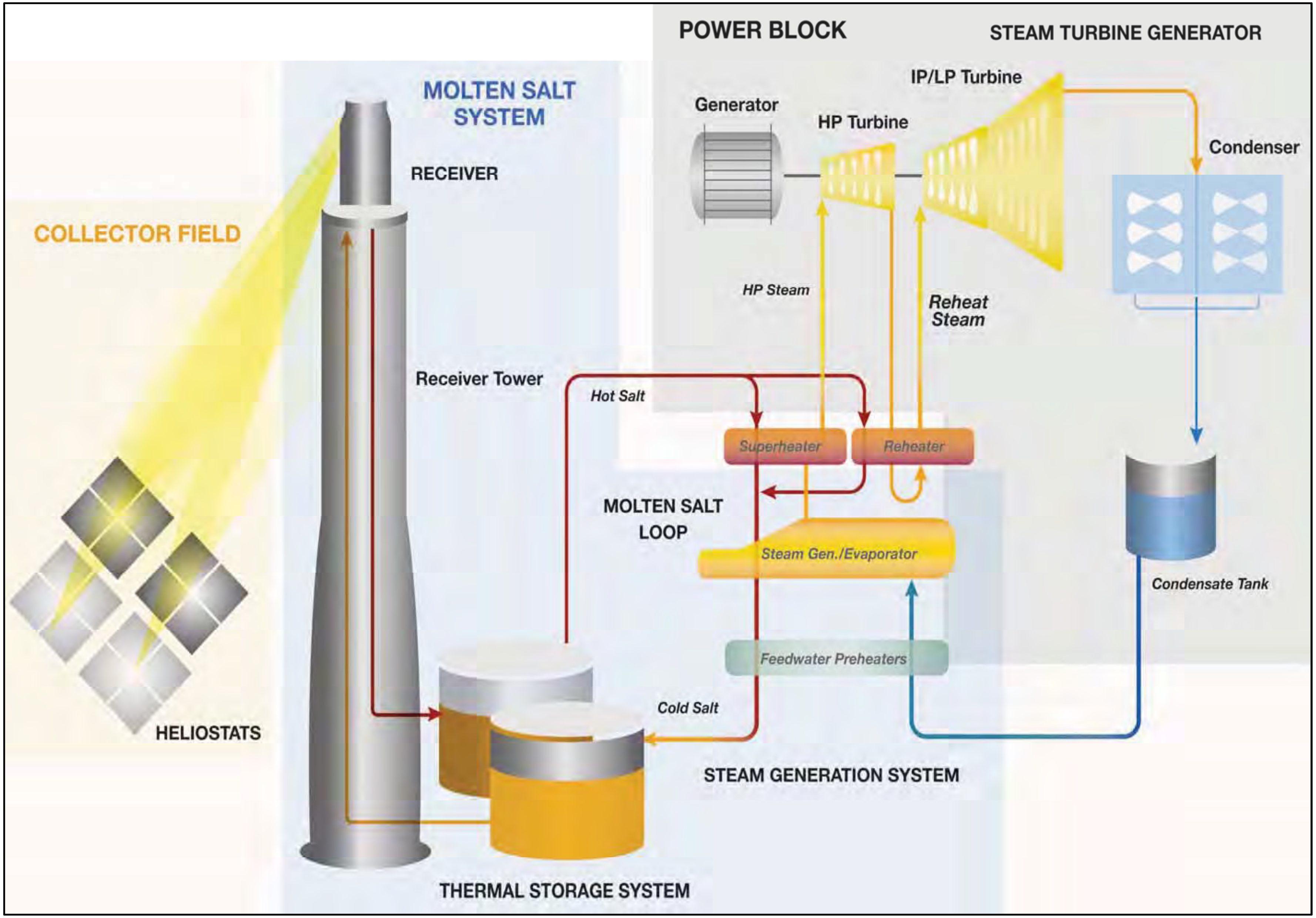


Figure 5: Flow diagram showing the power generation process in a CSP plant.

The plant requires approximately 6km^2 of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

ALTERNATIVES

In terms of the NEMAEIA Regulations, feasible alternatives are required to be considereddduring the EIA Process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The following alternatives will be considered for the project:

- Site Location Alternatives;
- Site Layout Alternatives;
- Technology Alternatives; and
- No-go Alternative.

POTENTIAL ENVIRONMENTAL IMPACTS

A number of potential environmental impacts associated with the project have been identified. As part of the Scoping Phase of the project, desk-top specialist studies will identify potential issues which will require further investigation during the EIA Phase. The following specialist studies will be commissioned:

- Air quality assessment;
- Agricultural potential;
- Avi-fauna (birds);
- Biodiversity (fauna and flora);
- Geohydrology (groundwater);
- Heritage impact assessment;
- Hydrology (surface water);
- Noise impact assessment;
- Socio-economic assessment;
- Tourism assessment.
- Visual impact assessment; and
- Wetland delineation.
- CAA
- Waste study

OVERVIEW OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

An EIA is a planning and decision-making tool undertaken to identify, predict and assess all the potential impacts –positive or negative – for any proposed activity or development which requires authorisation in terms of national legislation. The EIA process consists of the following phases:

- Scoping Phase: Scoping Report and Plan of Study for EIA is submitted to the competent environmental authority [in this instance the National Department of Environmental Affairs,"DEA"] for review and approval; and
- EIA Phase: Environmental Impact Assessment Report (EIAR) which includes an Environmental Management Programme (EMPr) is submitted to the DEA for review and decision-making.

SCOPING PHASE AND SCOPING REPORT

During the Scoping Phase, the existing status of the proposed site and surrounding environments are investigated. This includes aspects such as the biophysical, social and economic environment and provides a baseline assessment which informs and guides any further studies and investigations that may be required during the EIA phase. These potential impacts will also then be considered in the planning of the proposed activity.

EIA PHASE AND EIA REPORT

The EIA Report primarily consists of findings of the specialist studies and addresses the aspects identified through the Scoping Phase and issues identified by stakeholders.

This includes the assessment of the pre-developing environment, identification of potential impacts and appropriate mitigation measures for each anticipated impact in order to minimise or avoid negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.

The objective of the EIA Report is to provide decision makers with sufficient, relevant and objective environmental information to assist them in determining whether to grant or deny the applicant environmental authorisation.

IMPORTANCE OF THE PUBLIC PARTICIPATION PROCESS

Public Participation forms an important part of the EIA process and takes place throughout the duration of the EIA in both the Scoping and EIA phases.

The National Environmental Management Act (Act 107 of 1998) (NEMA) governs environmental impact assessments, including public participation. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment.

Effective public involvement is a vital component of the EIA process, and effective community involvement empowers communities to play an active role in the authorisation process. The public participation process is designed to provide sufficient and accessible information to Interested and Affected parties (I&APs) in an objective manner to assist them to:

- Raise issues of concern and suggestions for enhanced benefits;
- Verify that their issues have been captured;
- Verify that their issues have been considered by the technical investigations; and
- Comment on the findings of the EIA.

WHO ARE INTERESTED AND AFFECTED PARTIES (I&APS)?

Any person, company, authority or other entities that might be directly or indirectly affected by the proposed activity can register as an Interested or Affected Party (I&AP). This includes, but is not limited to landowners, tenants, municipal and provincial authorities, interest groups, Non-Government Organisations and conservation groups. The stakeholder database is compiled through networking and advertising.

I&APs are invited to participate in the consultation process by sharing inputs, comments and/or suggestions throughout the process. Please note that the process is structured according to timeframes and it is kindly request that adherence to the timeframes, which will be communicated to registered I&APs throughout the process, be kept. Input received will be included in an Issues & Response Register as part of the EIA Report to be submitted to the DEA.

Please note that only registered I&APs will receive follow-up information as the application process continues. Stakeholders can at any time throughout the EIA register as an Interested & Affected Party, taking note of certain activities and engagement opportunities that might have lapsed as a result of the fixed process and timeframes.

All I&APs are also encouraged to identify and nominate any other parties deemed to be notified regarding this proposed activity or to share this information document with them. These parties will be registered and contacted directly once nominated or identified.

How can you be involved?

The purpose of an EIA is to provide the authorities with information that will allow them to make a decision on whether to give environmental clearance for the proposed project or not and, if approved, outline the conditions of approval. The contributions of stakeholders from all sectors of society assists informed decision-making. All stakeholders are encouraged to participate and to submit any comments or information about the proposals, alternatives and impacts to consider that are deemed to be useful to the EIA process. If you wish to register or comment, please complete the attached registration/comment sheet, write a letter (by post or fax) or email the contact person.

Environmental Impact Assessment Proposed Humansrus Solar Thermal EnergyPlant (DEA Ref: 12/12/20/2316) REGISTRATION AND COMMENT SHEET	
CONTACT DETAILS: **SSI Engineers and Environmental Consultants** Attention: Mr. Frank Benedek PO BOX 867 Gallo Manor 2052 Tel: 011 789 6430 / Fax: 011 789 6010 Email: frankb@ssi.co.za	**CONTACT DETAILS:** **WorleyParsonsRSA (Pty) Ltd** Attention: Leanna Rautenbach PO Box 36155 Menlopark 0102 Tel: 012 425 6300 / Fax 012 460 9978 Email: leanna.rautenbach@worleyparsons.com

Please complete and return to Ms Leanna Rautenbach (details top right)

TITLE		**FIRST NAME**	
INITIALS		**SURNAME**	
ORGANISATION		**EMAIL**	
POSTAL ADDRESS			
		CODE	
TEL NR		**FAX NR**	

Please **formally register me as an interested and affected party** so that I may receive further information and notifications during the EIA process. **(Please circle applicable box)**	**YES**	**NO**
I would like my notifications by **(Please circle applicable box)**	Letter (mail)	
	Email	
	Fax	

COMMENTS (please use a separate sheet if required)

I suggest that the following issues of concern be investigated in the EIA:

I suggest the following for the EIA process and / or the public participation process:

Any other comments:

Please ask the following of my colleagues/friends to register as an Interested and Affected Party for this EIA:

NAME	ORGANISATION	CONTACT DETAILS

Signature

Date

THANK YOU FOR YOUR CONTRIBUTION

Appendix C

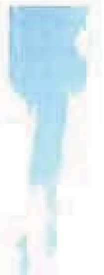
Site Photographs











































4.42
STOP








Appendix D

Issues and Response Report

Jc Pretorius

From: Lizelle Stroh [StrohL@caa.co.za]
Sent: Wednesday, July 27, 2011 1:31 PM
To: Benedek, Frank
Subject: RE: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant
Attachments: Windfarm Powerline Spreadsheet.xls

Please provide the WGS 84 co-ordinates towards the proposed farm, boundaries turning points, on attached spread sheet.

Thanks

Lizell Stroh
Obstacle Specialist
Procedure design and Cartography
For SA Civil Aviation Authority
Tel: 011 545 1232 | **Fax: 011 5451451** **Cell:** 083 461 6660 | **Email:** strohl@caa.co.za |
www.caa.co.za

From: Benedek, Frank [mailto:frankb@ssi.co.za]
Sent: 20 July 2011 06:10 PM
To: Lizelle Stroh
Subject: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

DEA Reference: 12/12/20/2316

Dear Me Stroh

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) of SolarReserve SA (Pty) LTD intent to construct a Concentrating Solar Thermal Energy Power Plant and associated infrastructure on a portion of the Farm 456, the Hay RD, located approximately 30 kilometers east of Postmasburg in the Siyanda District (Northern Cape Province).

In terms of the Environmental Impact Assessment ("EIA") Regulations (April 2006) promulgated under Sections 24 and 24D of the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and the National Environmental Management: Waste Act (Act No. 107 of 1998) [NEM: WA], various aspects of the intended development are considered listed activities which may have an impact on the environment, therefore requiring authorization from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

SolarReserve SA (Pty) LTD (the applicant) has appointed WorleyParsons RSA and SSI Engineers and Environmental Consultants (known as the WorleyParsons SSI Environmental Partnership or "WPSEP") as independent Environmental Assessment Practitioners to undertake the Environmental Impact Assessment (EIA) Process and the associated Public Participation Process in support of an application for Environmental Authorization and a Waste Management License.

Please find herewith attached the project Background Information Document which provides you with more information regarding the proposed project, the EIA Process and the Public Participation Process to be undertaken for this project. Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

By completing and submitting the accompanying Registration and Comment Sheet, you would automatically be registered as an I&AP on the project database. WPSEP would like to thank you, in advance, for becoming part of the process and is looking forward to receiving your valuable comments pertaining to project.

Kind regards

Ms Leanna Rautenbach
WorleyParsonsRSA (Pty) Ltd
PO Box 93155
Menlopark

Mr Frank Benedek
SSI Engineers and Environmental Consultants
PO Box 867
Gallo Manor

0102

☎: 012 425 6300 / 🖷: 012 460 9978
✉: leanna.rautenbach@worleyparsons.com

2052

☎: 011 789 6430 / 🖷: 011 789 6010
✉: frankb@ssi.co.za

Jc Pretorius

From: AnnelizaC [AnnelizaC@nda.agric.za]
Sent: Friday, July 22, 2011 10:37 AM
To: Benedek, Frank
Subject: RE: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

Hello

Pls note that the national Department of Agriculture (DAFF) should be supplied with a copy of all documents derived as DAFF is the custodian of all activities occurring on agricultural land.

This is not only relevant in terms of the acts that this Department is managing e.g. Act 70 of 1970 , Act 43 of 1983 etc but as well as being a commenting authority in terms of NEMA, land use ordinances etc.

Kind regards
Anneliza Collett

Mrs. Anneliza Collett
Directorate: Land Use & Soil Management
Department of Agriculture, Forestry & Fisheries
Tel: 012 - 319 7508
Fax: 012 - 329 5938
e-mail: AnnelizaC@nda.agric.za
www.agis.agric.za

From: Benedek, Frank [mailto:frankb@ssi.co.za]
Sent: 21 July 2011 06:46 PM
To: AnnelizaC
Subject: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

DEA Reference: 12/12/20/2316

Dear Mrs Collette (DAFF – Directorate: Land Use and Soil Management)

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) of SolarReserve SA (Pty) LTD intent to construct a Concentrating Solar Thermal Energy Power Plant and associated infrastructure on a portion of the Farm 456, the Hay RD, located approximately 30 kilometers east of Postmasburg in the Siyanda District (Northern Cape Province).

In terms of the Environmental Impact Assessment ("EIA") Regulations (April 2006) promulgated under Sections 24 and 24D of the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and the National Environmental Management: Waste Act (Act No. 107 of 1998) [NEM: WA], various aspects of the intended development are considered listed activities which may have an impact on the environment, therefore requiring authorization from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

SolarReserve SA (Pty) LTD (the applicant) has appointed WorleyParsons RSA and SSI Engineers and Environmental Consultants (known as the WorleyParsons SSI Environmental Partnership or "WPSEP") as independent Environmental Assessment Practitioners to undertake the Environmental Impact Assessment (EIA) Process and the associated Public Participation Process in support of an application for Environmental Authorization and a Waste Management License.

Please find herewith attached the project Background Information Document which provides you with more information regarding the proposed project, the EIA Process and the Public Participation Process to be undertaken for this project. Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

By completing and submitting the accompanying Registration and Comment Sheet, you would automatically be registered as an I&AP on the project database. WPSEP would like to thank you, in advance, for becoming part of the process and is looking forward to receiving your valuable comments pertaining to project.

Kind regards

Ms Leanna Rautenbach
WorleyParsonsRSA (Pty) Ltd
PO Box 93155
Menlopark

Mr Frank Benedek
SSI Engineers and Environmental Consultants
PO Box 867
Gallo Manor

0102 2052

☎: 012 425 6300 / 🖶: 012 460 9978 ☎: 011 789 6430 / 🖶: 011 789 6010
✉: leanna.rautenbach@worleyparsons.com ✉: frankb@ssi.co.za

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INFOMAIL	800	120.00
Type of Item		
Brochure		
Delivery Option		
Local		
SUBTOTAL		R120.00
VAT TOTAL @ 14 %		R14.74
TRANSACTION TOTAL		R120.00
CASH	(1)	R150.00
CHANGE	(1)	-R30.00
CHANGE		**R30.00**
VAT TOTAL @ 14 %		R14.74

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Contact Phone : 0846197703

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INFOMAIL	1141	114.10
Type of Item		
Pamphlet		
Delivery Option		
Local		
SUBTOTAL		R114.10
VAT TOTAL @ 14 %		R14.01
TRANSACTION TOTAL		R114.10
CASH	(1)	R120.00
CHANGE	(1)	-R5.90
CHANGE		**R5.90**
VAT TOTAL @ 14 %		R14.01

CUSTOMER DETAILS

Name : SOLAR RESERVE
Customer No : POSTCASH
Permit No : .
Contact Name : LENNA
Contact Phone : 0124256300

We deliver
whatever it takes!

Jc Pretorius

From: Thys Horak [ThysH@atns.co.za]
Sent: Friday, July 22, 2011 12:41 PM
To: Rautenbach, Leanna (Pretoria); Benedek, Frank
Subject: ADDITIONAL INFORMASTION REQUIRED

Dear Sir/Madam

This e- mail serves as an acknowledgement of receipt of your E-mail dated 20 July 2011

In order for ATNS to evaluate your request and to provide you with our position as to the Proposed Humansrus Solar Thermal Energy Power plant we require the following information please.

- The height in feet/meters of the Top of the Central receiver
- The dimensions of each Heliostat - length, width and height above ground level
- The geographical coordinates of the parcel of land on which this facility will be located. Coordinates of each corner of the land in Degrees, Minutes and Seconds to 2 decimals of a second in WGS-84 format e.g. S261615.23 E0231723.76
- The Elevation of the site – lowest and highest in meters or feet above mean sea level (AMSL)
- The location and dimensions of any structure in support of the Plant .

Once ATNS is in possession of the aforementioned the evaluation process will commence.

Kind regards

Matthys C Horak
ATM Specialist
ATNS, ATM Planning Department
Tel: 011 961 0307
Cel: 079 879 3654
E-mail: thysh@atns.co.za

Environmental Impact Assessment Proposed Humansrus Solar Thermal Energy Plant (DEA Ref: 12/12/20/2316) **REGISTRATION AND COMMENT SHEET**	
CONTACT DETAILS: **SSI Engineers and Environmental Consultants** Attention: Mr. Frank Benedek PO Box 867 Gallo Manor 2052 Tel: 011 789 6430 / Fax: 011 789 6010 Email: frankb@ssi.co.za	**CONTACT DETAILS:** **WorleyParsonsRSA (Pty) Ltd** Attention: Leanna Rautenbach PO Box 36155 Menlopark 0102 Tel: 012 425 6300 / Fax 012 460 9978 Email: leanna.rautenbach@worleyparsons.com

Please complete and return to Ms Leanna Rautenbach (details top right)

TITLE	MR	FIRST NAME	MATTHYS
INITIALS	M C	SURNAME	HORAK
ORGANISATION	ATNS	EMAIL	thysh@atns.co.za
POSTAL ADDRESS			
		CODE	
TEL NR	011 961 0307	FAX NR	011 961 0447

Please **formally register me as an interested and affected party** so that I may receive further information and notifications during the EIA process. **(Please circle applicable box)**	YES	NO
I would like my notifications by **(Please circle applicable box)**	Letter (mail) Email Fax	

COMMENTS (please use a separate sheet if required)

I suggest that the following issues of concern be investigated in the EIA:

I suggest the following for the EIA process and / or the public participation process:

Any other comments:

A FORMAL ATNS POSITION WILL BE DOCUMENTED ONCE WE HAVE CONCLUDED OUR EVALUATION

Please ask the following of my colleagues/friends to register as an Interested and Affected Party for this EIA:

NAME	ORGANISATION	CONTACT DETAILS

[signature]
Signature

21 June 2011
Date

THANK YOU FOR YOUR CONTRIBUTION

Jc Pretorius

From: Thys Horak [ThysH@atns.co.za]
Sent: Friday, July 22, 2011 9:39 AM
To: Benedek, Frank; Rautenbach, Leanna (Pretoria)
Subject: Proposed Humansrus Solar Energy Plant
Attachments: 20110721142138923.pdf

Dear Frank and Leanna

Herewith completed Registration as Interested/Affected party to the
proposed Humansrus Solar Energy Plant.

Kind regards

Matthys C Horak
ATM Spacialist
ATNS, ATM Planning Department
Tel: 011 961 0307
Cel:079 879 3654
E-mail : thysh@atns.co.za

Jc Pretorius

From: Rautenbach, Leanna (Pretoria)
Sent: Tuesday, July 26, 2011 12:40 PM
To: Tshiping WUA
Cc: Benedek, Frank
Subject: RE: Inligting

Hi Albertus

Dankie vir die belang.

Frank, van SSI sal die publieke kontak handhaaf – maar voel vry om my te kontak as jy iets benodig.

Mbt die projeckte – ons fasiliteer slegs die Humansrus CSP Projek.

Groete

Leanna Rautenbach
Environmental Scientist

WorleyParsons
resources & energy

Incorporating KV3 ENGINEERS

From: Tshiping WUA [mailto:info@tshiping.co.za]
Sent: 26 July 2011 10:07 AM
To: Rautenbach, Leanna (Pretoria)
Subject: Inligting

Hier is my inligting vir die Groenwater & Humansrus projekte.

Albertus Viljoen
CEO - Tshiping WUA

Sel : 083 649 5452
Tel : 053 313 0595
Fax : 053 313 0595
eFax : 086 589 3482
info@tshiping.co.za
PO Box 434, Postmasburg, 8420

Appendix E

Site notice Photographs

KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGSPROSES

Kennis word hiermee gegee kragtens die Omgewingsimpakbepaling (OIB) Regulasies wat verskyn in Regeringskennisgewings Nr. R543 tot 546 (2010), afgekondig ingevolge Artikel 24(5) van die Wet op Nasionale Omgewingsbestuur (Wet Nr. 107 van 1998) en die Wet op Nasionale Omgewingsbestuur: Afval (Wet Nr. 107 van 1998), dat SolarServe SA (Edms) BPK van voorneme is om gelyste aktiwiteite te onderneem wat 'n Omgewingsmagtiging en 'n Afvallisensie van die Nasionale Departement van Omgewingsake (DOS) vereis.

HUMANSRUS SONTERMIESE-ENERGIEKRAGAANLEG

DOS-VERW: 12/12/20/2316

PROJEKBESKRYWING

SolarReserve SA (Edms) BPK stel die konstruksie en bedryf van 'n 100 Megawatt Konsentrerende Sontermiese-Energiekragaanleg (STEK-aanleg) en gepaardgaande infrastruktuur voor. Die Omvang van die projek: Die voorgestelde STEK-aanlegterrein is ongeveer 6 km^2 in omvang. Die STEK-aanleg bestaan primêr uit die volgende vier substelsels:

- Sonveld wat bestaan uit alle dienste en infrastruktuur wat verband hou met die bestuur en bedryf van 2-as son-volgende heliostate;
- Gesmelte sout-baan wat die termiese bergingstenks vir die berging van die vloeibare sout, 'n konsentrasie-toring/ontvanger, pyplyne en hittewisselaars insluit;
- Die Kragblok wat die stoomturbine/opwekker huisves;
- Hulpfasiliteite en –infrastruktuur wat die kondensatorverkoelingstelsel, elektrisiteit-transmissielyne vir netwerkverbinding, toegangsroetes, watervoorsiening en –fasiliteite en aansitenergie-aanleg (gas of diesel) opwekkers insluit.

AANSOEKPROSES

'n Aansoek om 'n geïntegreerde permit (d.w.s. 'n omgewingsmagtiging en afvalbestuurlisensie) is by die bevoegde owerheid, die DOS, ingedien. Die volgende projekverwysingsnommer is uitgereik – **12/12/20/2316**. Hierdie verwysingsnommer moet in alle korrespondensie aan die Omgewingsimpakpraktisyne en die DOS aangehaal word.

AANSOEKER

SolarReserve SA (Edms) BPK

PROJEKLIGGING

Die Plaas 469, die Hay RD, in die Siyanda-distrik munisipale area, Noord-Kaap.

Die voorgestelde terrein is naby die R358 geleë, ongeveer 30 km oos van Postmasburg, Noord-Kaap.

HOE OM TE REGISTREER

Partye of persone wat as 'n belangstellende en geraakte party (B&GP) wil geregistreer ten einde bykomende inligting rakende hierdie aansoek te ontvang, word versoek om hulle kontakbesonderhede en kommentaar en/of kwessies in verband met die projek aan WorleyParsons RSA of SSI Environmental te stuur – besonderhede van die kontakpersone word hieronder verstrek. Let asseblief daarop dat kommentaar/navrae binne ***60 dae*** van die publikasie aan die omgewingskonsultant voorgelê moet word. 'n Agtergrondinligtingsdokument is op versoek beskikbaar.

Geliewe kennis te neem dat B&GPs in kennis gestel sal word van die besonderhede van beplande openbare / fokusgroepvergaderings en die beskikbaarheid van die konsep Omvangbepalingsverslag vir openbare hersiening.

DATUM VAN KENNISGEWING

14 Julie 2011

OMGEWINGSIMPAKPRAKTISYNE

WorleyParsons RSA
Me. Leanna Rautenbach

Posbus 36155
Menlopark
0102
☎: 012 425 6300
🖷: 012 460 9978
✉: leanna.rautenbach@worleyparsons.co.za

SSI Environmental
Mnr. Frank Benedek

Posbus 867
Gallo Manor
2052
☎: 011 789 6430
🖷: 011 789 6010
✉: frankb@ssi.co.za

SOLARRESERVE®

WorleyParsons
resources & energy

SSI
A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) that SolarReserve SA (Pty) LTD intends to carry out listed activities requiring both an Environmental Authorisation and a Waste Management License from the National Department of Environmental Affairs (DEA):

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

DEA REF: 12/12/20/2316

PROJECT DESCRIPTION

SolarReserve SA (Pty) LTD proposes the construction and operation of a 100 MegaWatt Concentrating Solar Thermal Energy Power (CSP) plant and associated infrastructure. Extent of the project: The proposed CSP plant site is approximately 6 km^2 in extent. The CSP plant comprises primarily of the following four subsystems:

- Solar Field that consists of all services and infrastructure related to the management and operation of the 2-axis sun tracking heliostats;
- Molten Salt Circuit which includes the thermal storage tanks for storing the liquid salt, a concentration tower/receiver, pipelines and heat exchangers;
- The Power Block housing the steam turbine/generator;
- Auxiliary facilities and infrastructure which includes the condenser-cooling system, electricity transmission lines for grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

APPLICATION PROCESS

An application for an integrated permit (i.e. environmental authorisation and waste management license) has been submitted to the competent authority, the DEA. The following project reference number has been issued – **12/12/20/2316**. This number is to be referenced on all correspondence to the Environmental Assessment Practitioners and the DEA.

APPLICANT

SolarReserve SA (Pty) LTD

PROJECT LOCATION

The Farm 469, the Hay RD, in the Siyanda District Municipal area, Northern Cape.

ENVIRONMENTAL ASSESSMENT PRACTITIONERS

WorleyParsons RSA
Ms. Leanna Rautenbach

PO BOX 36155
Menlopark
0102
☎: 012 425 6300
🖷: 012 460 9978
🖂: leanna.rautenbach@worleyparsons.co.za

SSI Environmental
Mr. Frank Benedek

PO BOX 867
Gallo Manor
2052
☎: 011 789 6430
🖷: 011 789 6010
🖂: frankb@ssi.co.za

The proposed site is situated just off the R358, approximately 30 km east of Postmasburg, Northern Cape.

HOW TO REGISTER

Parties or persons wishing to register as an interested and affected party (I&AP) in order to obtain additional information regarding this application are requested to forward their contact details and comments/or concerns in relation to the project to WorleyParsons RSA or SSI Environmental – details of the contact persons are provided below. Please note that comments/queries are to be submitted to the environmental consulting within ***60 days*** of publication of this notice. A background information document is available upon request.

Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

DATE OF NOTICE

14 July 2011

SOLARRESERVE®

WorleyParsons
resources & energy

SSI
A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS

KITSISO YA TSAMAISO YA TLHATLHOBO YA SEKGATLHA MO TIKOLOGONG

Kitsiso e neetswe malebana le Molao ya Tlhatlhobo ya Sekgatlha sa Tikologo (EIA), e e gatisitsweng mo Dikitsisong tsa Puso Nr. R543 go ya go 546 (2010), e e diranang le Karolo 24(5) ya Molao wa Bosetšhaba ya Botsamaisi ba Tikologo (Molao 107 wa 1998) le Botsamaisi ba Bosetšhaba ba Tikologo: Molao wa Matlakala (Molao 59 wa 2008) gore SolarReserve SA (Pty) LTD e e ikaeletseng go tsaya ditirwana tse kwetsweng di tlhoka laesense ya Tetlelelo ya Tikologo le ya Botsamaisi ba Matlakala go tswa mo Lefapheng la Bosetšhaba la Merero ya Tikologo (DEA):

POLANTE YA THEMALE YA MATLA YA KWA HUMANSRUS

DEA REF: 12/12/20/2316

TLHALOSO YA POROJEKE

SolarReserve SA (Pty) LTD e tshitsinya kago le tiragatso ya Polante ya Solara ya Themale ya Matla ya Mekhawate di le 100 le dikago tse di tsamaelanang (CSP). Bogolo ba porojeke: Saete e e tshitsinntsweng ya polante ke 6 km^2 ka bogolo. Polante ya CSP e na le dithusatsamaiso tse di latelang:

- Lebala la Solara le le nang le ditirelo tsotlhe le dikago tse di amanang le botsamaisi le tiragatso ya heliosetate ya letsatsi la ekesisi 2-;
- Sekete ya Molten Salt e e nang le ditanka tsa polokelo tse di bothito go boloka letswai le le mtsi, seamogedi/tora, dipeipi le ditsamaisa molelo;
- Jenereitara/Thebine ya Boloko ba Matla a tsa Matlo;
- Didiriswa tsa tlaleletso le kago tse di tsenyeletsang tsamaiso ya go gatsetsa, mela ya go tsamaisa motlakase go gokaganya keriti, ditsela tsa phitlhelelo, neelano ya metsi le sediriswa sa polante go simolola matla (dijenereitara tsa gase kgotsa tsa disele).

TSAMAISO YA TIRISO

Kopo ya tetlelelo e e lomaganeng (sk.laesense ya tetla ya tikologo le botsamaisi ba matlakala) e neilwe bobusi jo bo nang le bokgoni, e leng DEA. Nomoro ya kaelo ya porojeke e e latelang e neetswe – **12/12/20/2316**. Nomoro e e tshwanetse go tlhagelela mo dikgolaganong tsotlhe go ya go Badiredi ba Tlhatlhobo ya Tikologo le DEA.

MOKOPI

SolarReserve SA (Pty) LTD

LEFELO LA POROJEKE

Polase 469, HayRD mo Lefelong la Mmasepala wa Sedika sa Siyanda, Kapa Bokone. Saete e e tshitsinntsweng e mo tseleng ya R358, e ka nna 30 km botlhaba ba Postmasburg, Kapa Bokone.

O IKWADISA JANG

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LETLHA LA KITSISO

14 Phukwi, mo ngwageng wa kete pedi, some le bongwe.

BADIREDI BA TLHATLHOBO YA TIKOLOGO

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Ms. Leanna Rautenbach

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Appendix F

Newspaper Advertisements

KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGPROSES

Kennis word hiermee gegee kragtens die Omgewingsimpakbepaling (OIB) regulasies wat verskyn in Regeringskennisgewings Nr. R543 tot 546 (2010), afgekondig ingevolge Artikel 24(5) van die Wet op Nasionale Omgewingsbestuur (Wet Nr. 107 van 1998) en die Wet op Nasionale Omgewingsbestuur: Afval (Wet Nr. 107 van 1998), dat SolarServe SA (Edms) BPK van voorneme is om gelyste aktiwiteite te onderneem wat 'n Omgewingsmagtiging en 'n Afvalbestuurslisensie van die Nasionale Departement van Omgewingsake (DOS) vereis.

HUMANSRUS KONSENTREERENDE SONTERMIESE ENERGIEKRAGAANLEG

DOS-VERW: 12/12/20/2316

PROJEKBESKRYWING

SolarReserve SA (Edms) BPK stel die konstruksie en ontwikkeling van 'n 100-Megawatt-sontermiese-energiekragaanleg (STEK-aanleg) en gepaardgaande infrastruktuur voor. Die voorgestelde STEK-aanlegterrein is ongeveer 6 km2 in omvang. Die STEK-aanleg bestaan primêr uit die volgende vier substelsels:

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AANSOEKER

SolarReserve SA (Edms) BPK

PROJEKLIGGING

Die Plaas 469, die Hay RD, in die Siyanda-distrik munisipale area, Noord-Kaap. Die voorgestelde terrein is naby die R358 geleë, ongeveer 30 km oos van Postmasburg, Noord-Kaap.

HOE OM TE REGISTREER

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Geliewe kennis te neem dat B&GPs in kennis gestel sal word van die besonderhede van beplande openbare / fokusgroepvergaderings en die beskikbaarheid van die konsep-omvangbepalingsverslag vir openbare hersiening.

DATUM VAN KENNISGEWING

14 Julie 2011

OMGEWINGSIMPAKPRAKTISYNE

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KITSISO YA TSAMAISO YA TLHATLHOBO YA SEKGATLHA MO TIKOLOGONG

Kitsiso e neetswe malebana le Molao ya Tlhatlhobo ya Sekgatlha sa Tikologo (EIA), e e gatisitsweng mo Dikitsisong tsa Puso Nr. R543 go ya go 546 (2010), e e diranang le Karolo 24(5) ya Molao wa Bosetšhaba ya Botsamaisi ba Tikologo (Molao 107 wa 1998) le Botsamaisi ba Bosetšhaba ba Tikologo: Molao wa Matlakala (Molao 59 wa 2008) gore SolarReserve SA (Pty) LTD e e ikaeletseng go tsaya ditirwana tse kwetsweng di tlhoka laesense ya Tetlelelo ya Tikologo le ya Botsamaisi ba Matlakala go tswa mo Lefapheng la Bosetšhaba la Merero ya Tikologo (DEA):

POLANTE YA THEMALE YA MATLA YA KWA HUMANSRUS
DEA REF: 12/12/20/2316

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SolarReserve SA (Pty) LTD e tshitsinya kago le tiragatso ya Polante ya Solara ya Themale ya Matla ya Mekhawate di le 100 le dikago tse di tsamaelanang (CSP). Bogolo ba porojeke: Saete e e tshitsinntsweng ya polante ke 6 km2 ka bogolo. Polante ya CSP e na le dithusatsamaiso di ken ne tse di latelang:

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MOKOPI

SolarReserve SA (Pty) LTD

LEFELO

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DOS-VERW: 12/12/20/2316

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NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) that SolarReserve SA (Pty) LTD intends to carry out listed activities requiring both an Environmental Authorisation and a Waste Management License from the National Department of Environmental Affairs (DEA):

HUMANSRUS CONCENTRATING SOLAR THERMAL ENERGY POWER PLANT

DEA REF: 12/12/20/2316

PROJECT DESCRIPTION

SolarReserve SA (Pty) LTD proposes the construction and operation of a 100 MegaWatt Concentrating Solar Thermal Energy Power (CSP) plant and associated infrastructure. The proposed CSP plant site is approximately 6 km^2 in extent. The CSP plant comprises primarily of the following four subsystems:

- Solar Field that consists of all services and infrastructure related to the management and operation of the 2-axis sun tracking heliostats;
- Molten Salt Circuit which includes the thermal storage tanks for storing the liquid salt, a concentration tower/receiver, pipelines and heat exchangers;
- The Power Block housing the steam turbine/generator;
- Auxiliary facilities and infrastructure which includes the condenser-cooling system, electricity transmission lines for grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

APPLICATION PROCESS

An application for an integrated permit (i.e. environmental authorisation and waste management license) has been submitted to the competent authority, the DEA. The following project reference number has been issued – **12/12/20/2316**. This number is to be referenced on all correspondence to the Environmental Assessment Practitioners and the DEA.

APPLICANT

SolarReserve SA (Pty) LTD

PROJECT LOCATION

The Farm 469, the Hay RD, in the Siyanda District Municipal area, Northern Cape. The proposed site is situated just off the R358, approximately 30 km east of Postmasburg, Northern Cape.

HOW TO REGISTER

Parties or persons wishing to register as an interested and affected party (I&AP) in order to obtain additional information regarding this application are requested to forward their contact details and comments/or concerns in relation to the project to WorleyParsons RSA or SSI Environmental – details of the contact persons are provided below. Please note that comments/queries are to be submitted to the environmental consulting within ***60 days*** of publication of this notice. A background information document is available upon request.

Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

DATE OF NOTICE

14 July 2011

ENVIRONMENTAL ASSESSMENT PRACTITIONERS

WorleyParsons RSA
Ms. Leanna Rautenbach

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SolarReserve SA (Pty) LTD

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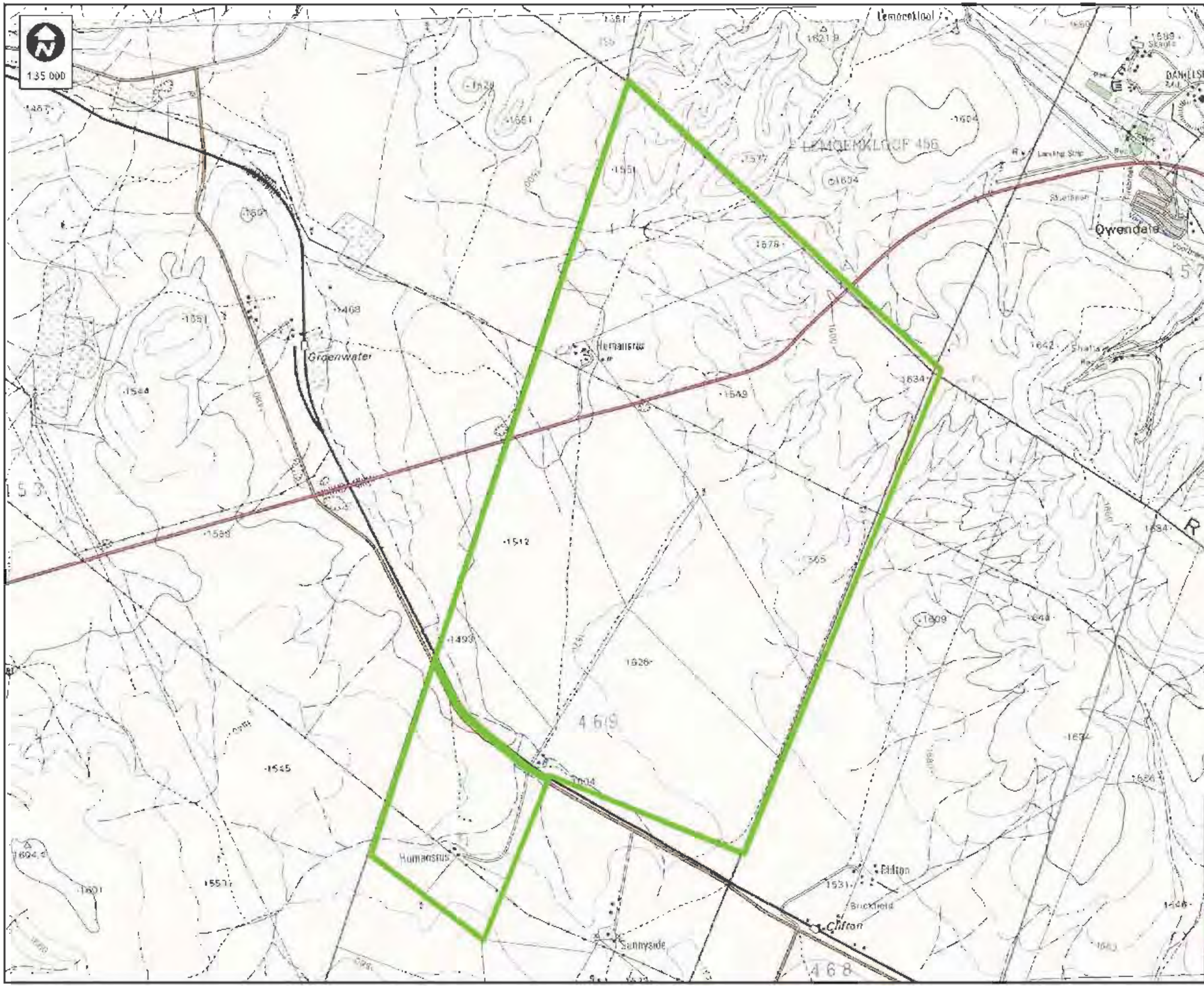
Appendix G

Locality and Layout Plans

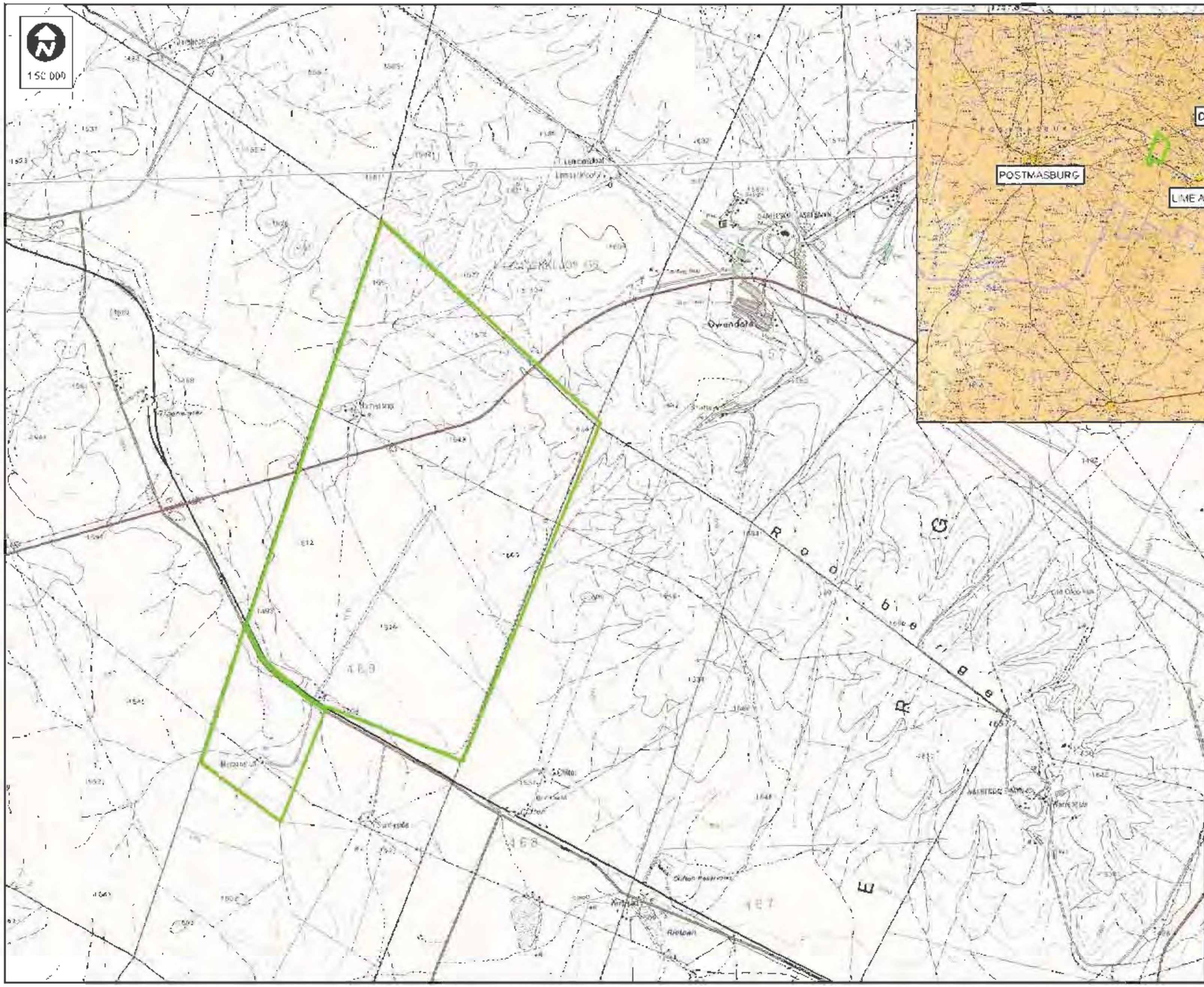


HUMANSRUS SOLAR

LOCALITY

JUNE 2011 | FIGURE 1a

WorleyParsons resources & energy

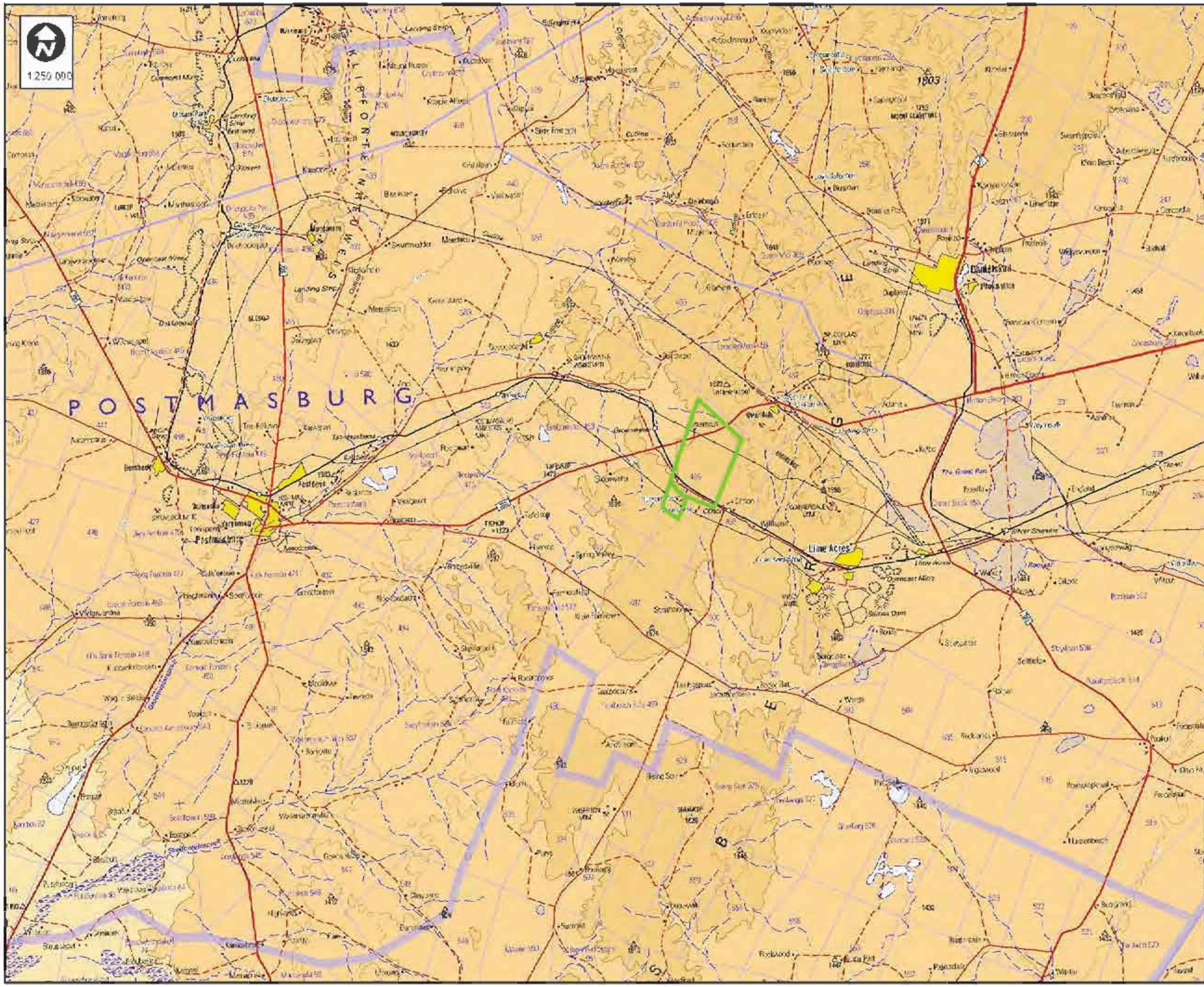


HUMANSRUS SOLAR

LOCALITY

JUNE 2011 | FIGURE 1

WorleyParsons
resources & energy
incorporating KV3 ENGINEERS



HUMANSRUS SOLAR

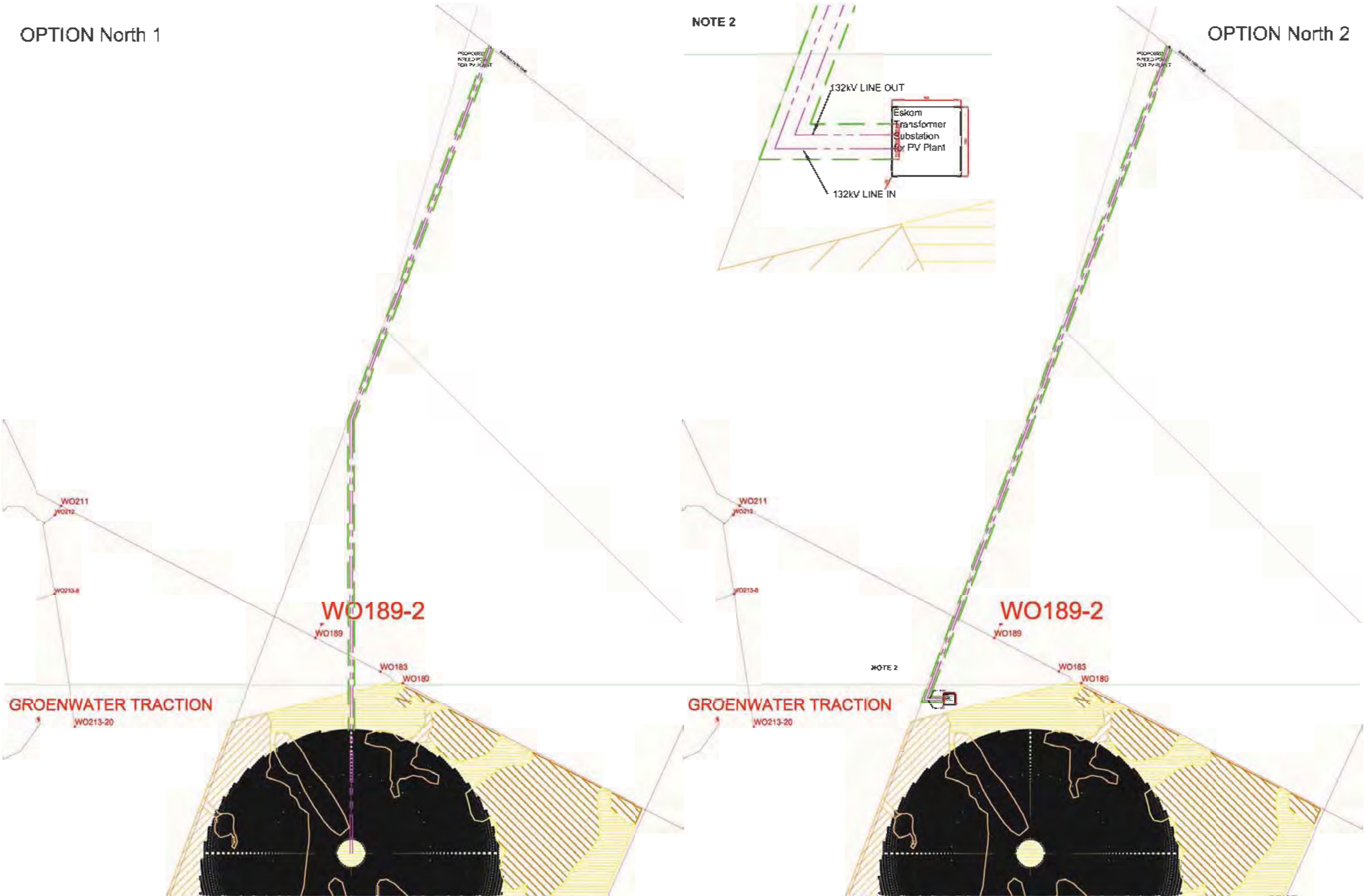
LOCALITY

JUNE 2011 | FIGURE 1b

WorleyParsons
resources & energy
incorporating KV3 ENGINEERS

Appendix H

Network integration Designs



FOR APPROVAL

WorleyParsons

Incorporating KV3 ENGINEERS

DESIGNED
DRAWN
CHECKED

CONSULTING ENGINEER
DATE
CLIENT
DATE

SOLARRESERVE SOUTH AFRICA

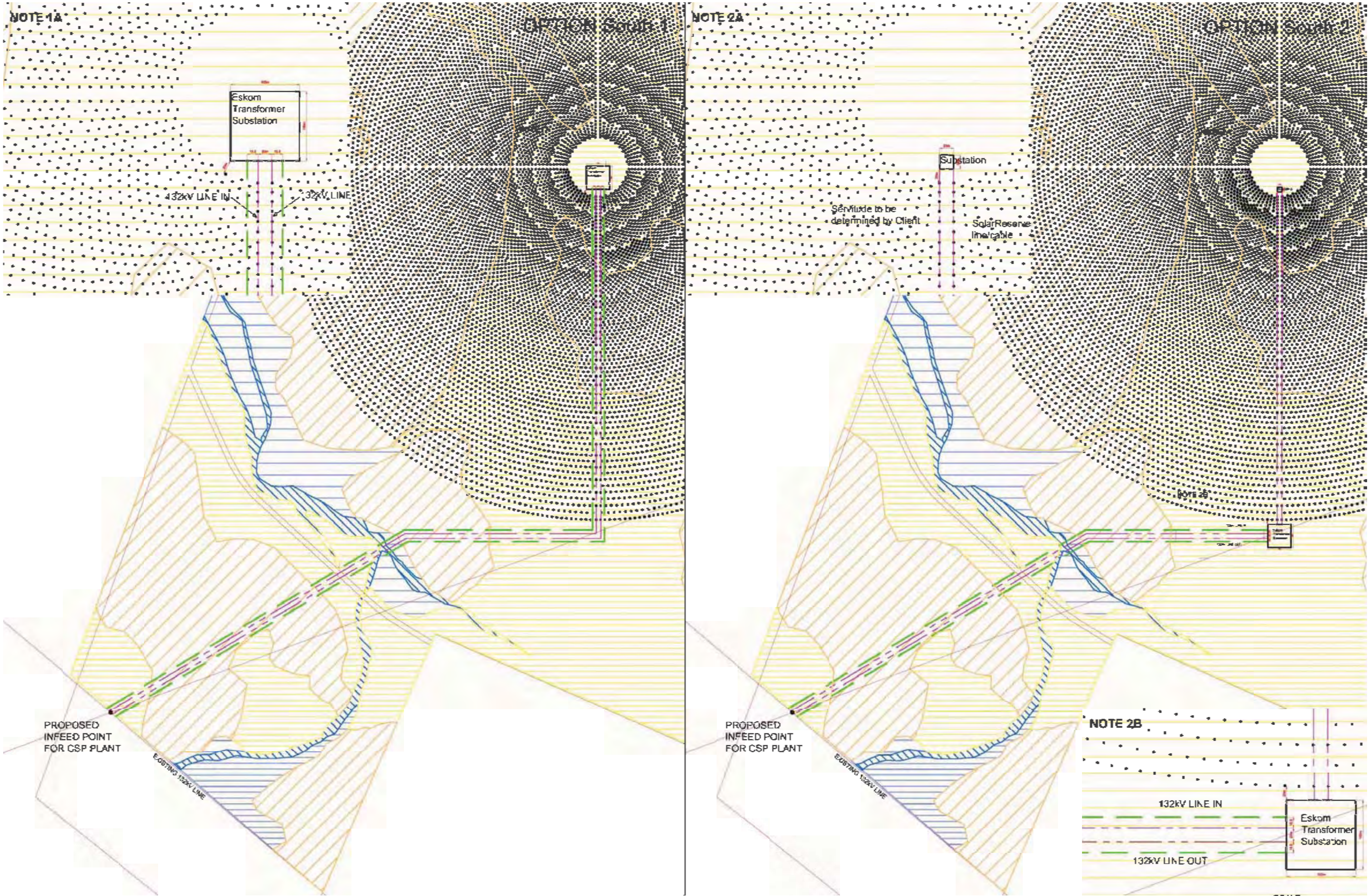
CSP HUMANSRUS

132kV LINE SERVITUDES
& SUBSTATION POSITIONS
NORTH 1 & 2

SCALE 1:7500

DATE 19 JULY 2011

DRAWING NUMBER
257000PE0\02-Rev1



FOR APPROVAL

WorleyParsons

DATE

DATE

SOLARRESERVE SOUTH AFRICA

CSP HUMANSRUS

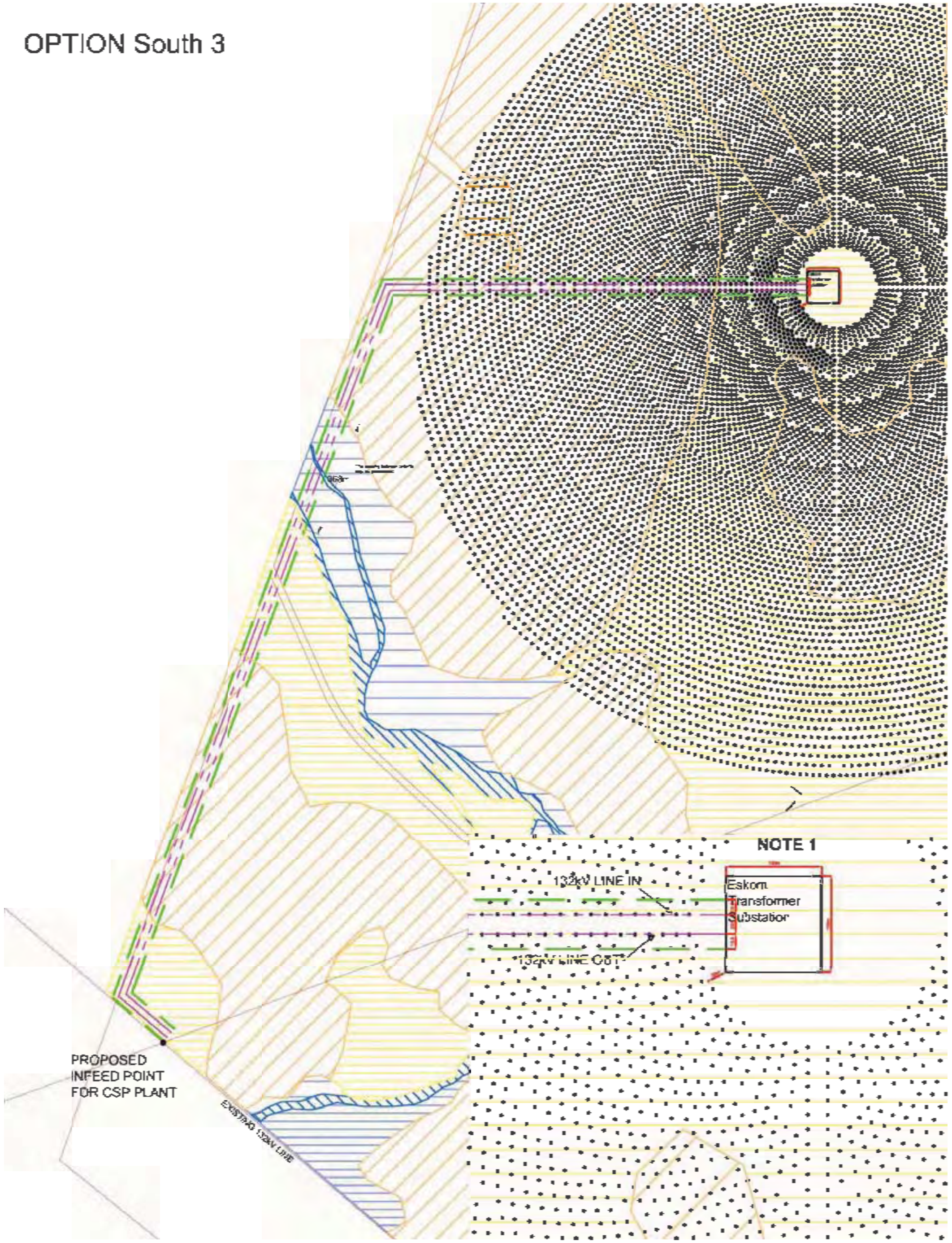
132kV LINE SERVITUDES
& SUBSTATION POSITIONS
OPTION SOUTH 1 & 2

SCALE 1:7500

DATE 19 JULY 2011

DRAWING NUMBER
257005PE0/01-Rev1

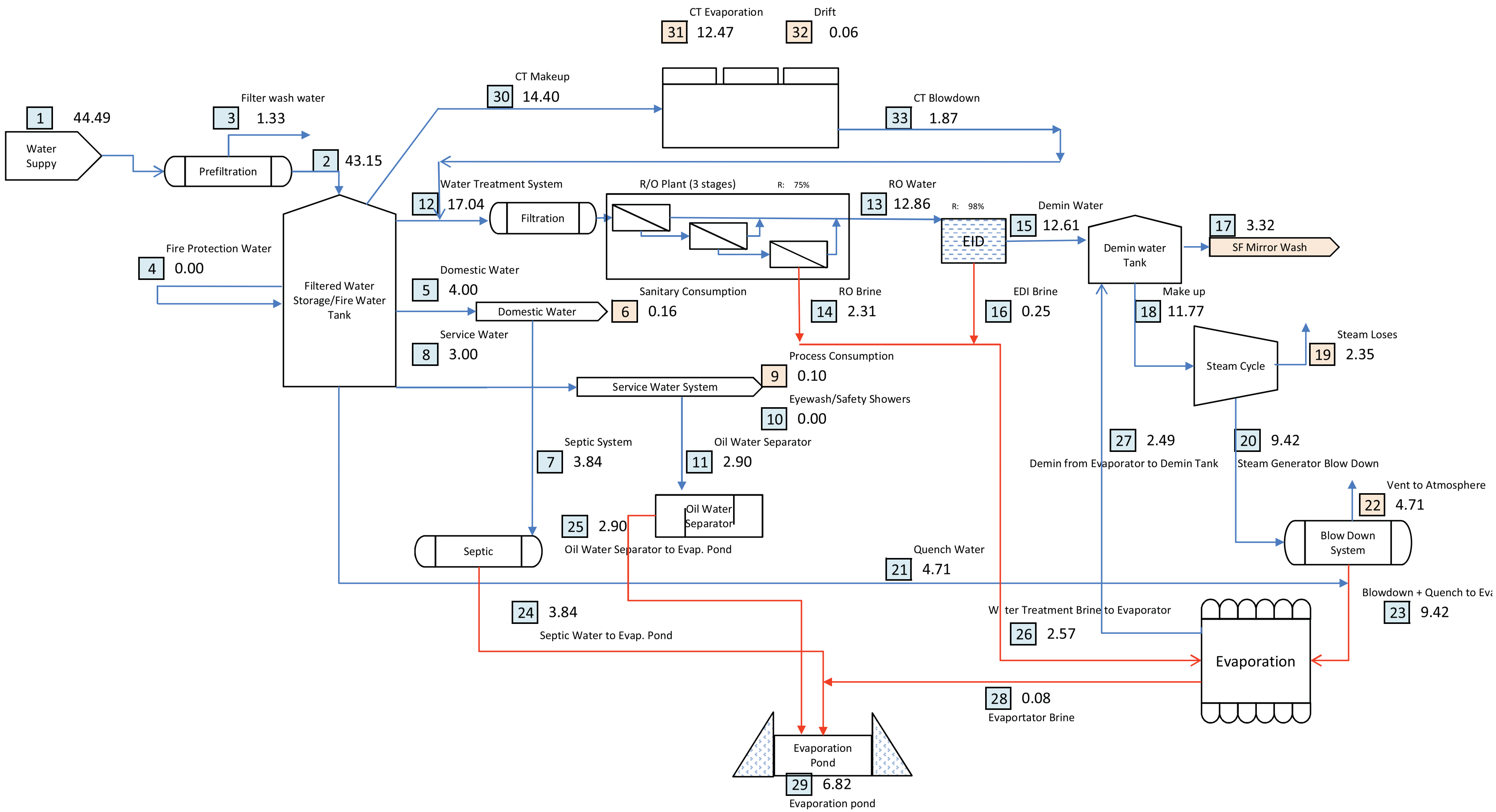
OPTION South 3



AMENDMENT	FOR APPROVAL	WorleyParsons	CLIENT	PROJECT	DRAWING DESCRIPTION	SCALE 1:7500
		DESIGNED / DRAWN / CHECKED	SOLARRESERVE SOUTH AFRICA	CSP HUMANSRUS	132kV LINE SERVITUDES & SUBSTATION POSITIONS OPTION SOUTH 3	DATE 19 JULY 2011
		CONSULTING ENGINEER DATE / CLIENT DATE				DRAWING NUMBER 257000PE0002-Rev1

Appendix I

Water Balance


1 44.49
Water Suppy
Prefiltration
3 1.33
Filter wash water
2 43.15
Filtered Water Storage/Fire Water Tank
4 0.00
Fire Protection Water
30 14.40
CT Makeup
31 12.47
CT Evaporation
32 0.06
Drift
33 1.87
CT Blowdown
12 17.04
Water Treatment System
Filtration
R/O Plant (3 stages)
R: 75%
13 12.86
RO Water
14 2.31
RO Brine
EID
R: 98%
15 12.61
Demin Water
16 0.25
EDI Brine
Demin water Tank
17 3.32
SF Mirror Wash
18 11.77
Make up
Steam Cycle
19 2.35
Steam Loses
20 9.42
Steam Generator Blow Down
Blow Down System
22 4.71
Vent to Atmosphere
23 9.42
Blowdown + Quench to Eva
5 4.00
Domestic Water
Domestic Water
6 0.16
Sanitary Consumption
8 3.00
Service Water
Service Water System
9 0.10
Process Consumption
10 0.00
Eyewash/Safety Showers
11 2.90
Oil Water Separator
Oil Water Separator
7 3.84
Septic System
Septic
25 2.90
Oil Water Separator to Evap. Pond
24 3.84
Septic Water to Evap. Pond
21 4.71
Quench Water
27 2.49
Demin from Evaporator to Demin Tank
26 2.57
W ter Treatment Brine to Evaporator
Evaporation
28 0.08
Evaportator Brine
Evaporation Pond
29 6.82
Evaporation pond

Appendix J

Title Deeds

HERTOG, MOOLY, HORN, KRIEL & KIE,
PROKUREURS, NOTARISSE & AKTEBESORGERS,
N.B.S. GEBOU, JONESSTRAAT,
KIMBERLEY.

1988 -06- 13

AKTE VAN TRANSPORT

T 880 /19 88

ten gunste van

JOHANNA MAGDALENA ALBERTA SCHOLTZ

BC 003407 - 2008

GEK... ...EER

CAN...

REGISTRATEUR...

16 OCT 2008

Opgestel deur my,

TRANSPORTBESORGER.

KRIEL N.H.

Van en Voorletters.

Landbank

VERBIND MORTGAGED

VIR FOR R 500 000-00

II

B 00659 / 2003

06 MAY 2003

REGISTRATEUR/REGISTRAR

10/120

DIE IDENTITEITSNOMMER VAN DIE	THE IDENTITY NUMBER OF THE
T Inkomster	
IS VERANDER NA	HAS BEEN CHANGED TO
310712 0058 086	
06 MAY 2003	REGISTRATEUR/REGISTRAR

III

Transportakte

Hierby word bekendgemaak:

T 880 /19 88

DAT NOëL HENRY KRIEL

voor my, Registrateur van Aktes , KIMBERLEY,

verskyn het te KIMBERLEY

hy, die genoemde komparant synde behoorlik daartoe gemagtig deur 'n volmag aan hom verleen deur

die Eksekuteur in die

BOEDEL VAN WYLE FREDERICK ALLEN SCHOLTZ

(Nr. 7/88)

- BLANKE GROEP -

gedateer die 24ste dag van FEBRUARIE 1988 en geteken

te KIMBERLEY;

VIR ENDOSSEMENTE KYK BLADSY 6
FOR ENDORSEMENTS SEE PAGE

En genoemde Komparant het verklaar dat aangesien kragtens die gesamentlike Testament gedateer te Postmasburg op die 7de dag van November 1974 van wyle FREDERICK ALLEN SCHOLTZ wie op 20 Desember 1987 te Postmasburg oorlede is, en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ, egteliede met mekaar in gemeenskap van goedere getroud gewees, die langslewende eggenote geregtig is op een-helfte (½) van die hiernavermelde eiendom onderworpe aan die bepalings van die gemelde Testament, hierinlater uiteengesit, en ook kragtens die huwelik in gemeenskap van goedere geregtig is op die ander helfte (½) van gemelde eiendom,

en dat hy in sy voornoemde hoedanigheid hierby in volkome en vrye eiendom sedeer en transporteer namens die gesamentlike boedel, aan en ten gunste van

JOHANNA MAGDALENA ALBERTA SCHOLTZ
(Identiteitsnommer 310712 0058 00 3)
- Weduwee -
- BLANKE GROEP -

haar erfgename, eksekuteurs, administrateurs of regverkrygendes -

SEKERE Restant van Plaas Nr. 469

GELEë in die Afdeling Hay

GROOT as sulks TWEEDUISEND TWEEHONDERD DRIE EN DERTIG KOMMA NUL SES NUL DRIE (2233,0603) Hektaar

AANVANKLIK OORGEDRA kragtens Akte van Toekenning (GRIEKWALAND WES ERFPAGTE BOEKDEEL 18, FOLIO 25) met kaart wat daarop betrekking het en gehou kragtens Transportakte Nr. 783/1960 en Transportakte Nr. 1490/1973

- 3 - / .....

A. <u>SPESIAAL ONDERHEWIG</u> aan die voorwaardes soos geskep in Akte van Toekenning (GRIEKWALAND-WES ERFPAGTE BOEKDEEL 18, FOLIO 25), wat lui as volg :

1. That all roads and thoroughfares now existing on the said land shall remain free and uninterrupted and that the Government reserves the right to make, or cause to be made on or across the said land for the public benefit such Roads, Railroads, Railway Stations, Paths, Aqueducts, Dams, Drains, Reservoirs, Watercourses or other Public works as may be required as also to conduct Telegraphs over the said land and to establish convenient Outspans for the use of Travellers.

2. That the Government reserves also the right, at all times to enter upon the said land, and to take, excavate, dig or quarry all stones, earth, gravel or other materials as shall or may be required for any such public works as in the preceding condition specified, without compensation to the proprietor, and that all Public Officers employed by Government as Surveyors, Engineers or the like, shall have the right to travel over and remain upon the said Land, with their Servants, Horses, Cattle and Equipages.

3. That the Government reserves the rights to all precious stones gold or silver found on or under the surface of the said land.

4. And lastly that the said land shall be subject to all such duties, rules and regulations as either now are or hereafter may be in force with regard to land granted on similar tenure.

- 4 - / .....

B. 'n Gedeelte van binnegemelde eiendom groot 11,1847 Hektaar is onteien kragtens Artikel 130 Ordonnansie 15/1952 deur die Provinsiale Administratuer. Sien Onteieningskennisgewing Nr. R/017/539 gedateer 3 Oktober 1966 soos geëndosseer kragtens Artikel 31 van Wet 47 van 1937 op 13 Junie 1967 op Akte van Transport Nr. 783/1960.

C. ONDERWORPE aan 'n ewigdurende reg om elektrisiteit te gelei oor die binnegemelde eiendom ten gunste van die Elektrisiteits Voorsieningskommissie kragtens Notariële Akte van Serwituut Nr. 23 /1970S.

D. VERDER ONDERWORPE aan 'n permanente serwituut van waterleiding wat strek oor 'n strook grond ongeveer 165 meter lank en 10 meter breed ten gunste van die Republiek van Suid-Afrika, kragtens Notariële Sessie van Serwituut Nr. K 20/78 S.

E. VERDER ONDERWORPE aan die voorwaarde opgelê in die voormelde gesamentlike Testament, gedateer te Postmasburg op die 7 dag van November 1974 van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ insoverre dit die een-helfte (½) van die eiendom aanbetref, naamlik :

"4. Enige vroulike persoon wat kragtens hierdie ons Testament erf sal haar erfenis ontvang as haar vrye en uitsluitlike eiendom, vry van die skulde, beheer en maritale reg van, en uitgesluit van enige gemeenskap van goedere met, enige eggenoot met wie sy in die huwelik getree het of nog mag tree en haar kwitansie alleen sal 'n voldoende kwytskelding wees vir enige betaling aan haar."

- 5 - / .....

B

Weshalwe die Komparant afstand doen van al die regte en titel wat die genoemde gesamentlike boedel van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ voorheen op genoemde eiendom gehad het en gevolglik ook erken dat die gesamentlike boedel van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ geheel en al van die besit daarvan onthef en nie meer daartoe geregtig is nie en dat, kragtesn hierdie akte, bogenoemde

JOHANNA MAGDALENA ALBERTA SCHOLTZ
(Identiteitsnommer 310712 0058 00 3)
- Weduwee -

haar Erfgename, Eksekuteurs, Administrateurs of Regverkrygendes tans en voortaan daartoe geregtig is, ooreenkomstig plaaslike gebruik, behoudens die regte van die Staat en ten slotte erken hy dat die eiendom gewaardeer is vir Boedelbelastingdoeleindes in die som van DRIEHONDERD DRIE EN VEERTIGDUISEND DRIEHONDERD RAND (R343 300,00);

Ten bewyse waarvan ek, genoemde Registrateur van Aktes tesame met die Komparant hierdie Akte onderteken en dit met die ampseël bekragtig het.

Aldus gedoen en verly op die kantoor van die Registrateur van Aktes te KIMBERLEY op 20

q.q.

In my teenwoordigheid,

REGISTRATEUR VAN AKTES
KIMBERLEY.

Hereregte : Vrygestel
Belasting Uitklaring Sertifikaat uitgereik deur die Afd elingsraad van Hay.
NAGESIEN: 1. 2.

Contact Information

windeed

VERMEULEN, GERT JOHANNES

GENERAL INFORMATION

Date Requested	2011/07/28 07:51:44
Reference	

PERSON INFORMATION

Surname	VERMEULEN
Forename(s)	GERT JOHANNES
Date of Birth	1959/05/02
ID Number(s)	5905025049086

CONTACT INFORMATION

Phone (home)	0533840398 (Last updated: 2008/06/30)
Phone (work)	0533840598 (Last updated: 2007/03/10)
Mobile Number	Not available
Residential Address	402 KRANSKLOOF, DANIELSKUIL DISTRICT, DANIELSKUIL, DANIELSKUIL, 8405 (Last updated: 2009/04/13)
Postal Address	P O BOX 459, DANIELSKUIL, 8405 (Last updated: 2009/01/01)

DISCLAIMER

Printed: 2011/03/31 08:30:44

Deeds Office Property

windeed

PLAAS 469, 469, 0 (REMAINING EXTENT) (Kimberley)

GENERAL INFORMATION

Deeds Office	Kimberley
Date Requested	2011/03/31 08:30:34
Information Source	Deeds Office
Reference	

PROPERTY INFORMATION

Property Type	Farm
Farm Name	PLAAS 469
Farm Number	469
Portion	0 (REMAINING EXTENT)
Local Authority	NOT AVAILABLE
Registration Division	HAY RD
Province	NORTHERN CAPE
Diagram Deed	GWQ18/25
Extent	2229.4651H
Previous Description	

OWNER INFORMATION

Owner 1 of 1

Person Type	Individual
Name	SCHOLTZ JOHANNA MAGDALENA ALBERTA
ID Number	3107120058003
Title Deed	T880/1988
Registration Date	1988/06/20
Purchase Price	
Purchase Date	-
Share	
Microfilm Reference	
Multiple Properties	False
Multiple Owners	False

ENDORSEMENTS (5)

#	Document	Description	Institution	Amount	Microfilm
1	B1988/2008	BOND	FIRSTRAND BANK LTD	R300000.00	
2	K20/1978S	CONTRACT SERVITUDES/MINERALS/LEASES/PC		Unknown	
3	K23/1970S	CONTRACT SERVITUDES/MINERALS/LEASES/PC		Unknown	
4	OD113/1993			Unknown	
5	ONTEIENINGS KENNISGEWIN G R/017/		539	Unknown	

HISTORIC DOCUMENTS (1)

#	Document	Description	Owner	Amount	Microfilm
1	B659/2003	BOND		Unknown	

DISCLAIMER

Appendix K

Specialist Assessments

REPORT

On contract research for

SSI ENVIRONMENTAL / WORLEYPARSONS RSA

and SolarReserve SA (Pty) Ltd

ARC • LNR

SOIL INFORMATION
FOR THE PROPOSED
HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, NEAR POSTMASBURG, NORTHERN CAPE

By

D.G. Paterson (Pr. Sci. Nat. 400463/04)

May 2011

Report No. GW/A/2011/42

ARC-Institute for Soil, Climate and Water,
Private Bag X79, Pretoria 0001, South Africa

Tel (012) 310 2500 Fax (012) 323 1157

DECLARATION

I hereby declare that I am qualified to compile this report as a registered Natural Scientist and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

D G Paterson
May 2011

CONTENTS

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SSI Environmental / WorleyParsons RSA to undertake a soil investigation on a site near Postmasburg, in the Northern Cape Province. The purpose of the investigation is to contribute to the Environmental Impact Assessment (EIA) process for a proposed concentrated solar power (CSP) facility on behalf of SolarReserve SA (Pty) Ltd.

The objectives of this study, which is a desk-top investigation that forms part of the scoping phase assessment, are:

- To obtain all existing soil information and to produce a soil map of the specified area as well as

- To assess broad agricultural potential.

2. SITE CHARACTERISTICS

2.1 Location

An area was investigated lying approximately 25 km to the east of the town of Postmasburg between 28^{o} 17’ and 28^{o} 20’ S and between 23^{o} 20’ and 23^{o} 24’ E.

The area lies immediately to the south of the R385 Posmasburg-Danielskuil tar road. The position of the site is shown on the map in Figure 1.

2.2 Terrain

The site is generally flat to gently sloping and lies at a height of approximately 1500 metres above sea level (although small areas of slightly steeper topography occur close to the north-eastern boundary). No permanent drainage ways occur in the study area, with only one small seasonal stream running through the south-western portion.

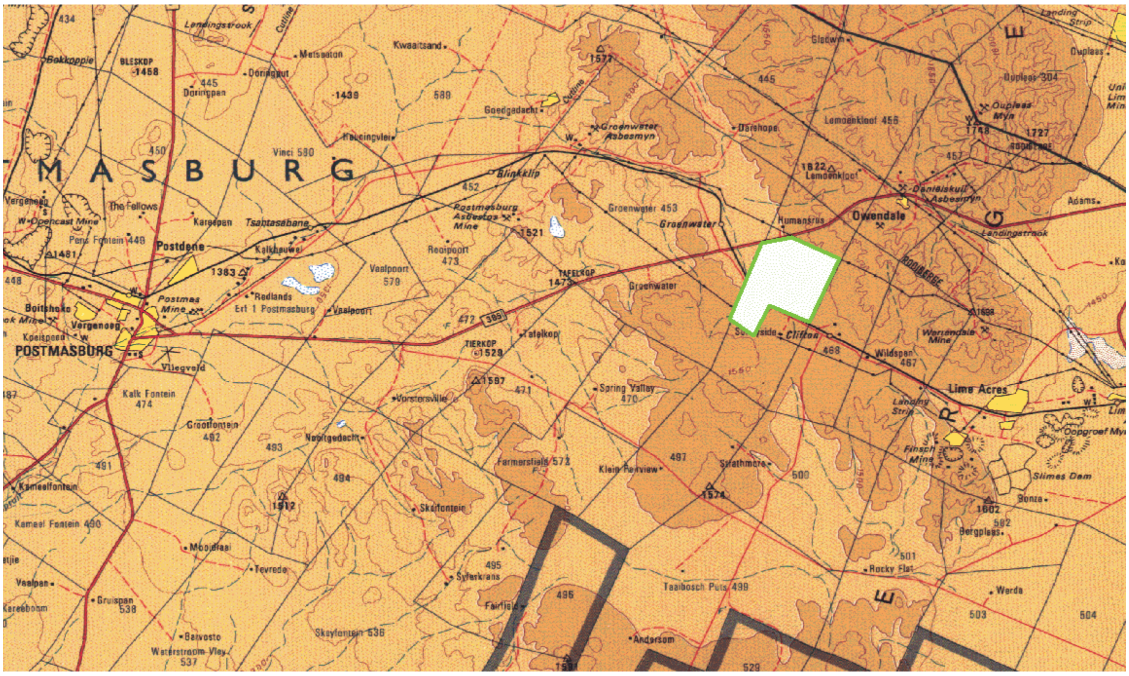


Figure 1 Locality map

2.3 Climate

The climate of the area can be regarded as typical of the northern Karoo interior, with a low, generally summer rainfall distribution, warm to hot summers and cold to very cold winters (Koch & Kotze, 1986). The main climatic indicators are given in Table 1 below.

Table 1 Climate Data

Month	Rainfall (mm)	Min. Temp (^oC)	Max. Temp (^oC)
Jan	62.6	17.1	33.2
Feb	71.9	16.5	31.5
Mar	84.3	14.5	29.0
Apr	45.3	9.3	26.0
May	19.1	4.7	22.8
Jun	7.8	1.0	19.3
Jul	3.1	0.6	19.8
Aug	7.2	3.0	22.4
Sep	7.5	7.1	26.3
Oct	20.0	11.2	28.9
Nov	29.1	13.7	30.7
Dec	50.1	15.6	32.0
Year	407.9 mm	18.2^oC (Average)	

Very warm temperatures (>42^oC) may be experienced in summer, while frost in winter (end of March to early September) is not uncommon, and may be severe on occasion.

2.4 Parent Material

The geology of the area comprises rocks of the Griqualand west Sequence (Geological Survey, 1977). In the west, lava of the Ongeluk formation occurs, while in the east, jaspelite, crocodilite and shale of the Danielskuil Formation is present. Much of the central area is covered by wind-blown Quaternary sand deposits.

3. METHODOLOGY

Existing information was obtained from the map sheet 2822 Postmasburg (Eloff *et al.*, 1986) from the national Land Type Survey, published at a 1:250 000 scale. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The area under investigation is covered by a total of three land types, as shown on the map in the Appendix, namely:

- Ae214, Ae215 (Red structureless soils, high base status)
- Ib237 (Rocky areas with shallow soil)

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur. The site was not visited during the course of this study, and so the detailed composition of the specific land types has not been ground-truthed.

A summary of the dominant soil characteristics of each land type is given in Table 2 below (the colours correspond to those used in the map in the Appendix).

The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in bold type.

4. SOILS

A summary of the dominant soil characteristics is given in Table 2 below.

It should be noted that the Agricultural Potential referred to in column 6 is *soil potential only* and does not take prevailing climatic conditions into account.

Table 2 Land types occurring (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Potential (%)
Ae214	Hutton 36	300-1200	31%	Red, sandy loam to sandy clay loam soils on hard rock	High:7.0 Mod: 41.3 Low: 51.7
	Hutton 33/36	100-300	30%	Red, loamy sand to sandy clay loam soils on hard rock	
Ae215	Hutton 33	450-1200	81%	Red, sandy soils on hard rock and calcrete	High:0.0 Mod: 92.5 Low: 7.5
	Hutton 30	450-1200	8%	Red, very sandy soils on hard rock and calcrete	
Ib237	Rock	-	61%		High:0.0 Mod: 14.0 Low: 86.0
	Hutton 30/33	50-300	25%	Red, sandy topsoils on rock	

5. AGRICULTURAL POTENTIAL

Much of the central part of the area (land type Ae215) comprises moderately deep to deep soils (300-1200+ mm deep) onto rock, while the remainder has more shallow soils (land type Ae214) or rock (land type Ib237). However, the low rainfall in the area (Table 1) means that the only means of cultivation would be by irrigation and the Google Earth image (Figure 2) of the area shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation.

Figure 2 Google Earth image of study area

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 15-20 ha/large stock unit (ARC-ISCW, 2004).

6. IMPACTS

The project as envisaged will comprise infrastructure as follows:

1. Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
2. Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
3. The Power Block; and
4. Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

The major impact on the natural resources of the study area would be the loss of arable land due to the construction of the various types of infrastructure. However, this impact would in all probability be of limited significance (due to the low potential soils and the fact that construction of the infrastructure will not involve deep excavations or large-scale topsoil removal) and would be local in extent. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state, with little impact, especially given the low prevailing agricultural potential.

The impact can be summarized as follows:

Table 3 Impact significance

Nature of impact	Loss of agricultural land	Land that is no longer able to be utilized due to construction of infrastructure
Status of impact	Neutral (N)	No cost or benefit to receiving environment
Spatial Scale of impact	Low (1)	Confined to site boundary
Time Scale of impact	High (3)	Lifespan of project
Probability of impact	Probable (2)	Likely to materialise
Severity of impact	Average (2)	Mitigation & rehabilitation will be possible
Significance of impact	Medium (8)	
Mitigation factors	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs.	

It does not appear, from a soils aspect, that there are any especially sensitive areas (“fatal flaws”) within the site that should be avoided.

In conclusion, due mainly to the low potential soils and prevailing climatic limitations for agriculture, it is extremely unlikely that any sort of detailed soil investigation will be necessary.

REFERENCES

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Koch, F.G.L. & Kotze, A.V., 1986 Climate data. In: Land types of the maps SE27/20 Witdraai, 2720 Noenieput, 2722 Kuruman, 2724 Christiana, 2820 Upington & 2822 Postmasburg. *Mem. Nat. Agric. Res. S. Afr.* No. 3. ARC-Institute for Soil, Climate and Water, Pretoria.

Eloff, J.F, Idema, S.W.J. & Bennie, A.T.P., 1986. 1:250 000 land type map 2822 Postmasburg. ARC-Institute for Soil, Climate and Water, Pretoria.

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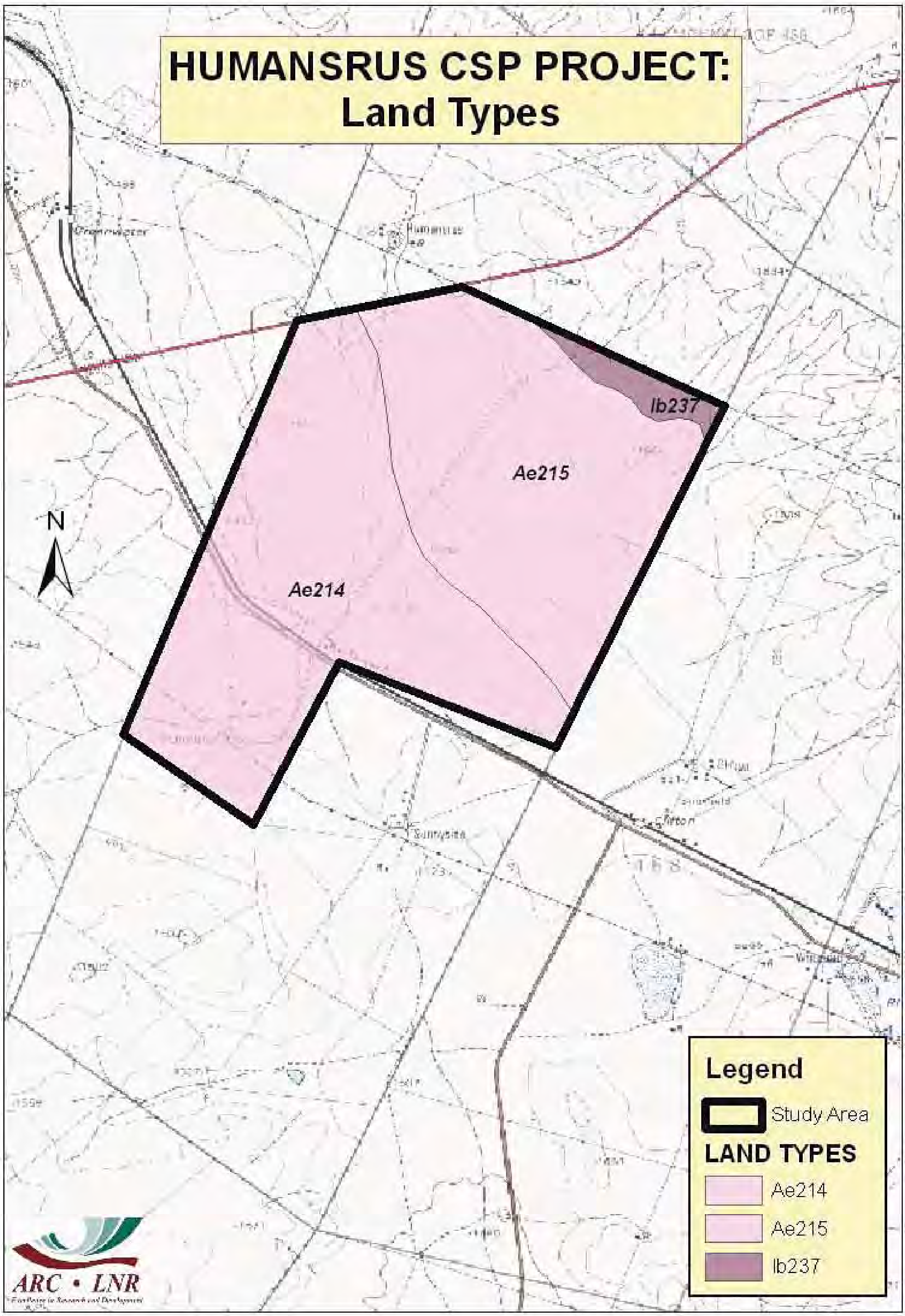
MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., 1977. Soil classification. A binomial system for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

APPENDIX

MAP OF LAND TYPES


HUMANSRUS CSP PROJECT:
Land Types
Ib237
Ae215
Ae214
N
Legend
Study Area
LAND TYPES
Ae214
Ae215
Ib237
ARC • LNR

Air Quality Assessment - Scoping Report: Proposed Humansrus Solar Thermal Energy Power Plant near Postmasburg (Northern Cape Province)

30 June 2011

A Report for: SolarReserve SA (Pty) Ltd

SSI
A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS
Linking People. Promoting Growth.

Tel: +27 11 798 6447

Email: stuartt@ssi.co.za

Building No 5, Country Club Estate, 21 Woodlands Drive, Woodmead, 2191

DOCUMENT DESCRIPTION

Client:
SolarReserve SA (Pty) Ltd

Project Name:
Air Quality Assessment - Scoping Report: Proposed Humansrus Solar Thermal Energy Power Plant near Postmasburg (Northern Cape Province)

SSI Environmental Reference Number:
E02.JNB.000956

Authority Reference:
NA

Compiled by:
Stuart Thompson

Date:
30 June 2011

Location:
Postmasburg, Northern Cape

Reviewer: Nicola Walton

Signature

Approval: Raylene Watson

Signature

TABLE OF CONTENTS

List of Figures

List of Tables

1 INTRODUCTION

1.1 Background

SSI Environmental was requested by SolarReserve SA (Pty) Ltd (hereafter referred to as SolarReserve) to carry out an air quality impact assessment for the development of a proposed Solar Thermal Energy Power Plant, or otherwise commonly known as a Concentrated Solar Power (CSP) Plant, 30 km east of Postmasburg in the Northern Cape Province (Figure 1). The intention of SolarReserve is to develop solar resources to generate electricity and reduce the dependence on non-renewable fossil fuel resources. Emergency load shedding in 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation. This study aims to assist in the development of a scoping study for the site and its potential to utilise the resource in the area.

1.2 Scope of Work

This project aims to identify the potential air quality impacts associated with the construction, operation and eventual decommissioning of the proposed CSP Plant, and associated infrastructure, as well as provide guidance on possible mitigation measures to reduce environmental impacts.

FIGURE 1: LOCALITY MAP SHOWING LOCATION OF THE CSP SITE IN RELATION TO LOCAL TOWNS (SOURCE: GOOGLE EARTH).

1.3 Project Team

Raylene Watson is currently employed as the Air Quality Unit Manager for SSI Environmental in South Africa. Her key responsibilities are to manage the air quality unit and to promote SSI Environmental as a Company within South Africa and the rest of Africa.

She completed her Bachelor of Science Degree (BSc) in 1994 at the Rand Afrikaans University (now called University of Johannesburg), majoring in Botany and Zoology. Her BSc (Honours - Zoology) course was subsequently completed at the same institution (1995). She was awarded an NRF scholarship to undertake her Masters Studies in Ecotoxicology. This Thesis focused on the assessment of heavy metal bioaccumulation in fish, found in the Olifantsriver Catchment area (one of the main river systems in South Africa). Her Masters was completed in 1997, this work was used to supplement further studies, culminating in the completion of a Doctorate in 2000, which focused on the assessment of a Fish Health Assessment Index. Her Doctorate was awarded the Nights Awards by the Parasitological Association of South Africa for its contribution to the Field of Parasitology in 2001.

After completing her studies she worked as an air quality impact assessor at Airshed Planning Professional, where after 5 years of service she moved over to SSI to start up the air quality unit for SSI Environmental. The air quality unit has now been in existence for 4 years, and has developed into a team of 4 individuals. During her work as an air quality specialist she has undertaken over 200 assessments focusing primarily on industrial related source impacts. Key studies undertaken focused on the assessment of impacts related to mining operations, smelters, landfill sites, sewage works, airports, harbour developments, residential developments and the expansion of road networks. Work has been undertaken in South Africa and further afield on the African Continent, including countries like, Angola, Mozambique, Zimbabwe, Zambia, Namibia, Democratic Republic of the Congo, Botswana and Mauritius.

Stuart Thompson is a senior environmental consultant for SSI Engineers and Environmental Consultants, and a specialist in the field of air quality assessments. Qualified as an Applied Environmental Scientist (BSc. Hons) and a Member of the South African Geophysical Association (SAGA) as well as the Society of South African Geographers (SSAG), Stuart has 7 years experience in the environmental field, including 5 years in the field of air quality. He has managed and contributed to a variety of project in South Africa, as well as further afield on the African continent, including Tanzania, Malawi, DRC, Mozambique, Mauritius, Swaziland, Zambia, Sierra Leone and Botswana on assessments ranging from large-scale commercial developments and Power Generation Projects to numerous mining operations. Stuart spent 6 months working with the SSI parent company DHV B.V. based in Amersfoort, Netherlands. During this time he worked on several projects for the European Union, as well as acting as a specialist technical advisor for a large scale environmental project in India.

Nicola Walton is an air quality specialist with over five years of experience in the air quality field. Over this time, she has been involved in numerous air quality management and monitoring projects. Her primary areas of expertise include emissions inventory development, dispersion modelling simulations, air quality impact assessments and air quality management plans.

1.4 Project Description

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a CSP Plant. This project focuses on the possible establishment of a CSP plant in the Northern Cape area. The proposed CSP Plant is proposed to consist of a maximum installed capacity of up to 100 MW. The plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

The CSP Plant being considered is a molten salt-type, Receiver Tower technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

A heliostat is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in a circular formation around the off-centre focal point / Receiver Tower with the majority of the reflective area weight to the more effective side of the heliostat field.

The Central Receiver is situated on the top of the Receiver Tower. This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

2 APPLICABLE LEGISLATION

The information presented in the section which follows, details the local legislation within South Africa, as well as a list of international laws and conventions to which South Africa is a signatory.

2.1 South African Legislative and Standards Frameworks

2.1.1 National Environmental Management: Air Quality Act 39 of 2004

The National Environmental Management: Air Quality Act (39 of 2004) represents a move to an air pollution control strategy that is based on receiving air quality management. It focuses on the adverse impacts of air pollution on the ambient environment and sets standards as the benchmark for air quality management performance. At the same time it sets emission standards to minimize the amount of pollution that enters the environment. The Act regulates the control of noxious and offensive gases emitted by industrial processes, the control of smoke and wind borne dust pollution, and emissions from diesel vehicles.

The promulgation of the National Air Quality Act (2004) resulted in a shift from national air pollution control based on source based controls to decentralised air quality management through an effects-based approach. An effects based approach requires the meeting of ambient air quality standards. These ambient standards are to be set by the Local and District Municipalities which govern air quality management in the area. The Municipality of concern here is the Tsantsabane Local Municipality. If these standards have not been set yet the National Ambient Air Quality Standards will need to be adhered to. Such standards provide the objectives for air quality management.

Multiple levels of standards provide the basis for both ‘continued improvements’ in air quality and for long term planning in air quality management. Although maximum levels of ambient concentrations should be set at a national level, more stringent ambient standards may be implemented by provincial and local authorities.

The control and management of all sources of air pollution relative to their contributions to ambient concentrations is required to ensure that improvements in air quality are secured in the timeliest, even handed and cost-effective way. The need to regulate diverse source types reinforces the need for varied management approaches ranging from command and control methods to voluntary measures.

The objectives of the Air Quality Act as stated in Chapter 1 are as follows:

- Give effect to everyone’s right ‘to an environment that is not harmful to their health and well-being’; and
- Protect the environment by providing reasonable legislative and other measures that (i) prevent pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The National Framework is one of the significant functions detailed in Chapter 2 of the Air Quality Act. The Framework serves as a blueprint for air quality management and aims to achieve the air quality objectives as described in the preamble of the Air Quality Act.

Chapter 3 of the Air Quality Act covers institutional and planning matters, and is summarised as follows:

- The Minister may establish a National Air Quality Advisory Committee as a subcommittee of the National Environmental Advisory Forum established in terms of the National Environmental Management Act (NEMA);
- Air Quality Officers must be appointed at each level of Government (National, Provincial, Municipal);

- Each National Department or Province preparing an Environmental Implementation Plan or Environmental Management Plan in terms of NEMA must include an Air Quality Management Plan (AQMP). Each Municipality preparing an Integrated Development Plan must include an AQMP;
- The contents of the AQMPs are prescribed in detail; and
- Each organ of state is required to report on the implementation of its AQMP in the annual report submitted in terms of NEMA.

In Chapter 4 of the Air Quality Act, air quality management measures are outlined in terms of:

- The declaration of Priority Areas, where ambient air quality standards are being, or may be, exceeded;
- The listing of activities that result in atmospheric emissions and which have or may have a significant detrimental effect on the environment;
- The declaration of Controlled Emitters;
- The declaration of Controlled Fuels;
- Other measures to address substances contributing to air pollution, that may include the implementation of a Pollution Prevention Plan or an Atmospheric Impact Report; and
- The requirements for addressing dust, noise and offensive odours.

Licensing of Listed Activities through an Atmospheric Emission Licence is addressed in Chapter 5 of the Air Quality Act. On 31 March 2010, the Minister of Water and Environmental Affairs published the Listed Activities and Minimum Emission Standards. International air quality management is outlined in Chapter 6 and offences and penalties in Chapter 7.

2.1.2 National Ambient Air Quality Standards

The Air Quality Act makes provision for the setting and formulation of National ambient air quality standards for substances or mixtures of substances which present a threat to health, well-being or the environment. On 24 December 2009, the Minister of Water and Environmental Affairs established National ambient air quality standards (Table 2-1). These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area. If the air quality standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

TABLE 1: NATIONAL STANDARDS (µG/M3) WITH ALLOWABLE FREQUENCIES OF EXCEEDANCE FOR IMMEDIATE COMPLIANCE. THE VALUES INDICATED IN BLUE ARE EXPRESSED IN PPB.

Pollutant	Averaging Period	Concentration	Frequency of Exceedance
Sulphur dioxide SO_2	10-min average	500 (191)	526
	1-hr average	350 (134)	88
	24-hr average	125 (48)	4
	Annual average	50 (19)	0
Nitrogen dioxide	1-hr average	200 (106)	88

Pollutant	Averaging Period	Concentration	Frequency of Exceedance
NO_2	Annual average	40 (21)	0
Carbon monoxide CO	1-hr average	30 000 (26 000)	88
	8-hourly running average	10 000 (8 700)	11
Ozone O_3	8-hourly running average	120 (61)	11
Particulate Matter PM10	24-hr average	120 75 (from 2015)	4
	Annual average	50 40 (from 2015)	0
Lead Pb	Annual average	0.5	0
Benzene C_6H_6	Annual average	10 (3.2) 5 (from 2015)	0

2.2 International Guidelines and Standards

2.2.1 United Nations Framework Convention on Climate Change (UNFCCC[1])

The Convention entered into force on 21 March 1994. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 192 countries having ratified including South Africa.

Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change

2.2.2 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the UNFCCC. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. This amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The Kyoto Protocol is generally seen as an important first step towards a truly global emission reduction regime that will stabilize GHG emissions, and provides the essential architecture for any future international agreement on climate change. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 180 nations including South Africa have ratified the treaty to date. Under the treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms.

The Kyoto mechanisms are:

[1]www.UNFCCC.org

- Emissions trading – known as “the carbon market";
- The clean development mechanism (CDM); and
- Joint implementation (JI).

These mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.

2.2.3 The Vienna Convention for the Protection of the Ozone Layer

The ultimate objective of the Convention is to protect human health and the environment against adverse effects resulting from human activities which modify or are likely to modify the ozone layer and urges the Parties to take appropriate measures in accordance with the provisions in the Convention and its Protocols which are in force for that party. To achieve the aforementioned objectives, the Parties, within their capabilities, are expected to: cooperate to better understand and assess the effects of human activities on the ozone layer and the effects of the modification of the ozone layer; adopt appropriate measures and cooperate in harmonizing appropriate policies to control the activities that are causing the modification of the ozone layer; cooperate in the formulation of agreed measures for the implementation of this Convention; and cooperate with competent international bodies to implement effectively this Convention and protocols to which they are party.

2.2.4 The Montreal Protocol on Substances that Deplete the Ozone Layer

These protocol controls production of ozone depleting substances: The Montreal Protocol on Substances that Deplete Ozone Layer is a protocol under the Vienna Convention. The Protocol controls the production and consumption of the most commercially and environmentally significant ozone-depleting substances - those listed in the Annexes to the Protocol. One feature of the Montreal Protocol which makes it unique, is Article 6 that requires the control measures to be revised at least every four years (starting 1990), based on the review and assessment of latest available-information on scientific, environmental, technical and economic aspects of the depletion of the ozone layer. Based on reports of assessment panels appointed by the Parties and taking into consideration the needs and situation of the developing countries, the Protocol has already been adjusted and amended twice.

At present, 191 nations have become party to the Montreal Protocol. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was opened for signature on September 16, 1987 and entered into force on January 1, 1989 followed by a first meeting in Helsinki, May 1989. Since then, it has undergone seven revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

2.2.5 The Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention is an international legally binding agreement on persistent organic pollutants (POPs). In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs, which it defined as “chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment”.

Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme for Chemical Safety (IPCS) prepared an assessment of the 12 worst offenders. Known as the Dirty Dozen, this list includes eight organo-chlorine pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene; two industrial chemicals: hexachlorobenzene (HCB) and the polychlorinated biphenyl (PCB) group; and two groups of industrial by-products: dioxins and furans.

The negotiations for the Stockholm Convention on Persistent Organic Pollutants were completed on May 23rd 2001 in Stockholm, Sweden. The convention entered into force on May 17th, 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agreed to outlaw nine of the "dirty dozen" chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans. Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans-boundary threat. Several other substances are being considered for inclusion in the Convention. These are: hexabromobiphenyl, octaBDE, pentaBDE, pentachlorobenzene, short-chained chlorinated paraffin's, lindane, α- and β-hexachlorocyclohexane, dicofol, endosulfan, chlordecone and PFOS.

The Convention sets out several objectives including:

- The elimination from commerce of identified POPs and others that may be identified in the future;
- Encouraging the transition in commerce to safer alternatives;
- Identifying additional POPs;
- The clean-up of old stockpiles and equipment containing POPs; and
- Encouraging all stakeholders to work towards a POP-free environment.

2.2.6 International Concerns Around Mercury

There are international initiatives to address mercury but to date no international policy has been developed. A recent programme backed by the United Nations (UN) that aims to reduce the health and environmental impacts of mercury includes a two-year period of voluntary action to reduce emissions and an evaluation to determine whether an international treaty is necessary. It aims to develop partnerships between government, industry and other key groups to reduce emissions.

2.2.7 Equator Principles

The Environmental Assessment report required needs to addresses baseline environmental and social conditions, requirements under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health, cultural properties, and biodiversity, including endangered species and sensitive ecosystems, use of dangerous substances, major hazards, occupational health and safety, fire prevention and life safety, socio-economic impacts, land acquisition and land use, involuntary resettlement, impacts on indigenous peoples and communities, cumulative impacts of existing projects, the proposed project, and anticipated future projects, participation of affected parties in the design, review and implementation of the project, consideration of feasible environmentally and socially preferable alternatives, efficient production, delivery and use of energy, pollution prevention and waste minimization, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.

2.2.8 International Finance Corporation

The International Finance Corporation (IFC) recommends the following in regards to air pollution. "Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislation standards, or in their absence, the current World Health Organization (WHO) Air Quality Guidelines (AQGs0 or other internationally recognized sources). As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed." However also includes that the "25 percent increment rule itself is too strict to be applied universally on all guidelines, to be noted that the emission figures vary greatly between different guidelines and therefore a universal increment rule will lead in most cases to big unnecessary problems without enhancing the environment".

3 BASELINE ENVIRONMENT

3.1 Description of Environment

3.1.1 Regional and Local Climate and Atmospheric Dispersion Potential

The nature of the local climate will determine what will happen to pollution when it is released into the atmosphere (Tyson & Preston-Whyte, 2000). Pollution levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion of pollution.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson & Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air lies directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth's surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson & Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth's surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth's surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson & Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversions is most common over Southern Africa (Tyson & Preston-Whyte, 2000).

The climate in the Northern Cape is essentially a continental one - the weather provides hot wet summers (December to February) and mild dry winters (June to August). The infrequent summer rains tend to take the form of occasional severe thunderstorms rather than prolonged soft showers. It is not unusual for winter night-time temperatures to drop below freezing (Available at URL: http://www.bdb.co.za/kimberley/climate.htm).

Figure 2 provides an indication where various meteorological measurements have taken place within the immediate vicinity of the plant site in the past. All sites with the exception of the Kimberley sites have however been discontinued since the early nineties so no recent data is available for presentation within the region. All the sites with the exception of Kimberley are agricultural stations and recorded measurements for temperature, humidity, rainfall as well as incidents of thunderstorms, hail and fog. A summary of this historical data collected is presented in the subsections which follow. Kimberley represents the South African Weather Services weather office, where over and above the variables listed above wind data is also recorded. Due to the data availability for Kimberley, this site has been used to determine the general meteorological conditions for the area. However as the site is approximately 140km from Kimberley microclimatic conditions will vary, therefore site specific meteorological data will be used for all modelling purposes and for the Environmental Impact Report.

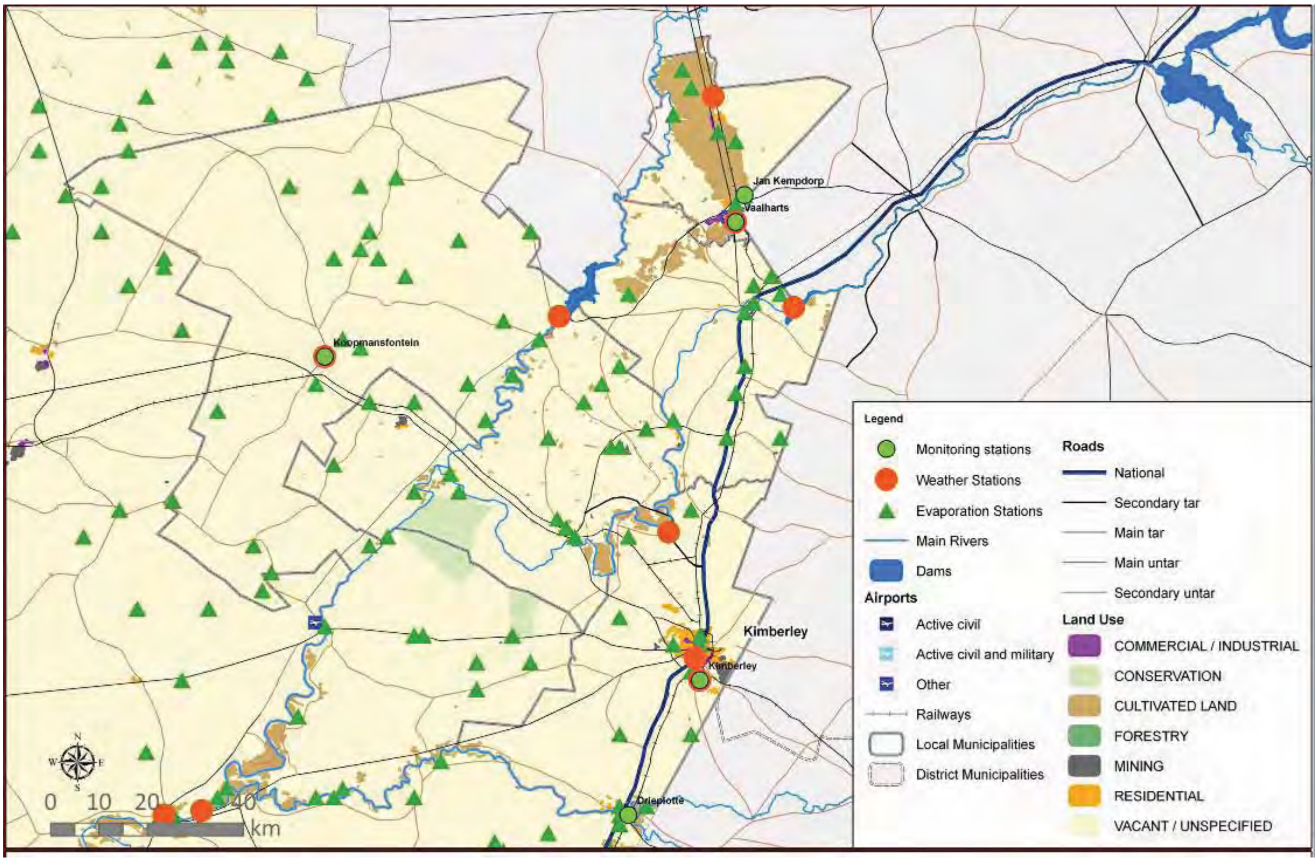


FIGURE 2: LOCATION OF METEOROLOGICAL SAMPLING POINTS WITHIN THE REGION.

3.1.2 Temperature

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella and Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity.

Temperature also provides an indication of the rate of development and dissipation of the mixing layer. This is the zone within the upper atmosphere where air movement takes place and where pollutants released can more easily be diluted by mixing with surrounding air before it reaches ground level.

Daily summer temperatures within the region range between ~18.5 °C and ~25.4 °C with an average of ~21.3 °C. Winter temperatures range between ~8.7 °C and ~17.5 °C with an average of ~12.4 °C as is indicated in Figure 3.

Of the five sites assessed, the temperature profile differs very slightly. With marginally lower temperatures recorded at the Kimberley and Diepplotte sites (Figure 3).

The highest maximums recorded in the District range from 39.9 °C to 41.2 °C respectively. With the lowest recorded temperature recorded at -10.6 °C at the Koopmansfontein site (Table 2:).

3.1.3 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella and Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Total monthly rainfall figures for the five sites assessed are depicted in Figure 2-4. The area under investigation lies in the summer rainfall region of South Africa, receiving an average total annual rainfall of ~484 mm.

Of the data collected for the various site within the region, no real variation in rainfall patterns could be observed (Figure 4). The number of rain days does however vary with more rain days noted at the Kimberley site to the southeast and at the Koopmansfontein site to the west, indicating that even though the same amount of rainfall fell in these areas this rainfall is distributed over a longer period (Table 3).

3.1.4 Relative Humidity

When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

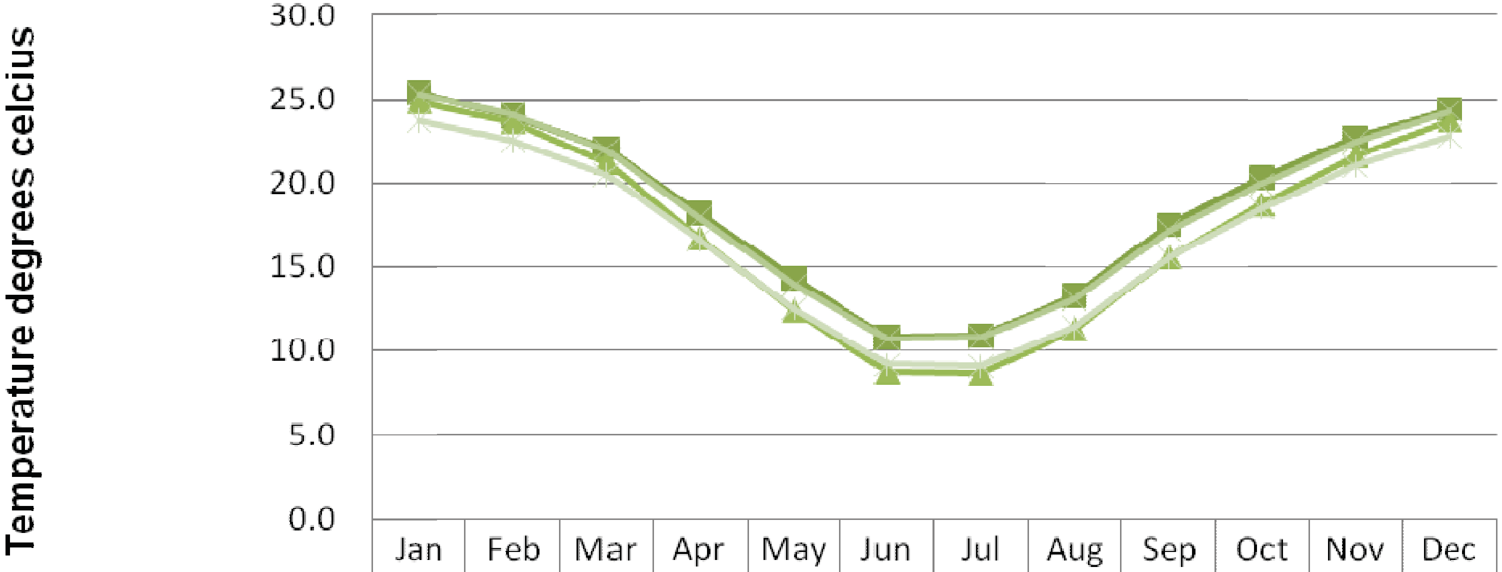
Within the region being assessed incidence of humidity above 70% occur quite often. This is illustrated in Figure 5, with a slightly lower level of maximum humidity recorded at Jan Kempdorp. Figure 6 similarly presents the lowest humidity figures recorded at these sites over the periods sampled, of significance is the marked difference in humidity between Jan Kempdorp and Vaalharts which are situated geographically quite closely to each other (Table 3, Figure 3).

3.1.5 Thunderstorms, Hail and Fog

The analysis of the occurrence of certain meteorological variables such as the development of thunderstorms, hail and fog, provides an indication of the severity and variability of climatic conditions in the area being investigated.

Incidents of thunderstorms, hail and fog were reported at four of the five sites. Thunderstorms were noted to occur more often at Kimberley with a total average of 55 days per year expected, this compared to only 25 days for Vaalharts, 47 days for Diepplotte and 39 days for Koopmansfontein. It appears that the southern and eastern portions of the region experience more thunderstorms than the north and west (Table 4:).

A similar profile is presented with the comparison of hail and fog occurrences in the District. Both these phenomena however occur infrequently (Table 4:).



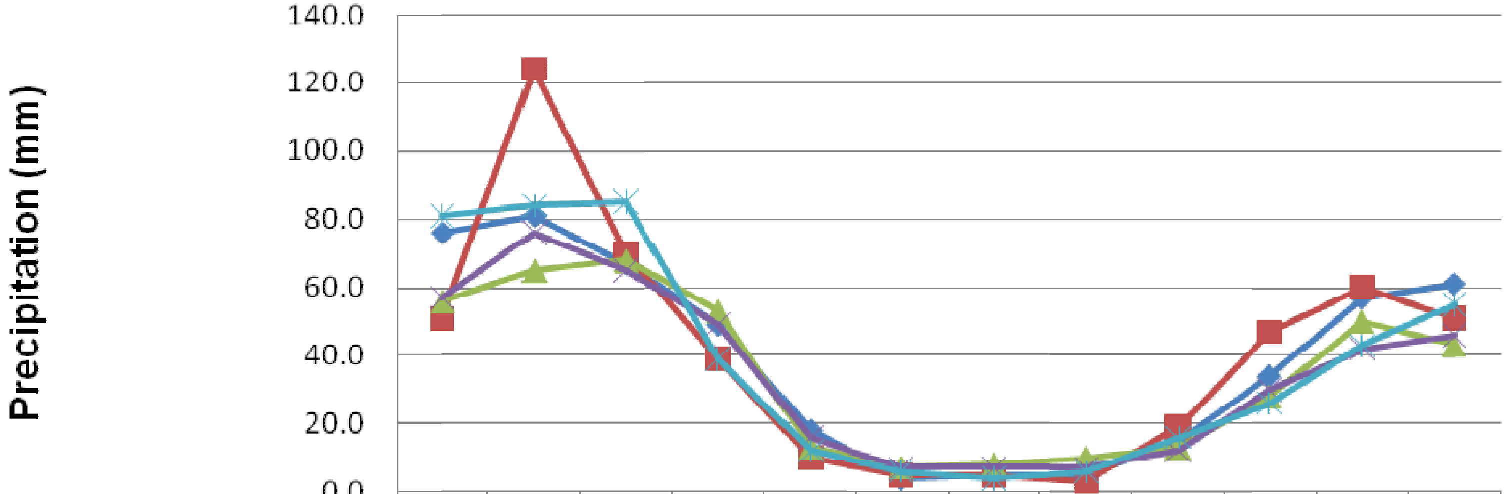
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan Kempdorp	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Vaalharts	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Diepplotte	24.8	23.6	21.2	16.7	12.4	8.8	8.7	11.3	15.6	18.7	21.6	23.7
Kimberley	25.3	24.1	22.0	17.9	13.9	10.7	10.8	13.1	17.2	19.9	22.4	24.3
Koopmansfontein	23.7	22.5	20.5	16.6	12.5	9.2	9.1	11.4	15.6	18.5	21.0	22.8

FIGURE 3: MEAN TEMPERATURE PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

TABLE 2: TEMPERATURE PROFILE FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Temperature - Agricultural Station (ºC)					Temperature - Agricultural Station (ºC)					Temperature - Agricultural Station (ºC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.7	33.0	25.4	41.2	8.5	16.9	32.7	24.8	40.5	10.0	16.4	33.2	24.8	41.0	6.3
February	17.0	30.9	24.0	38.7	6.1	16.6	30.8	23.8	38.0	4.5	15.8	31.5	23.6	40.5	3.3
March	15.0	29.1	22.1	37.1	1.5	14.2	29.2	21.8	37.0	3.0	13.4	29.0	21.2	38.0	1.0
April	10.7	25.7	18.2	35.0	0.1	10.0	26.3	18.1	34.5	-0.5	8.7	24.8	16.7	36.0	-2.5
May	6.0	22.5	14.3	31.6	-3.7	4.8	23.1	13.9	30.5	-3.4	3.1	21.7	12.4	33.0	-6.5
June	2.3	19.2	10.8	27.1	-6.4	0.8	19.4	10.1	26.5	-7.5	-0.8	18.2	8.8	27.5	-9.3
July	2.1	19.8	10.9	26.6	-7.2	0.1	19.7	9.9	26.0	-8.0	-1.5	18.8	8.7	27.1	-9.8
August	4.2	22.4	13.3	32.6	-6.8	3.1	22.8	12.9	30.5	-5.5	1.1	21.5	11.3	31.0	-9.3
September	8.5	26.4	17.5	35.5	-4.0	7.0	25.6	16.3	34.5	-3.5	5.6	25.6	15.6	36.0	-6.2
October	11.9	28.7	20.3	38.2	-2.0	11.2	27.9	19.6	36.5	-1.0	9.3	28.1	18.7	37.2	-2.7
November	14.5	30.8	22.7	39.0	4.0	13.8	30.3	22.0	37.3	5.1	12.6	30.5	21.6	38.5	3.8
December	16.5	32.3	24.4	39.9	4.5	15.7	31.8	23.7	39.0	3.5	14.9	32.5	23.7	40.6	4.6
Annual Avg	10.5	26.7	18.6	41.2	-7.2	9.5	26.6	18.1	40.5	-8.0	8.2	26.3	17.3	41.0	-9.8

Month	Kimberley (1961-1990)					Koopmansfontein (1961-1990)				
	Temperature - Weather Office (ºC)					Temperature - Agricultural Station (ºC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.9	32.8	25.3	40.4	7.1	15.7	31.6	23.7	39.9	5.6
February	17.3	31.0	24.1	39.9	5.6	15.1	30.0	22.5	39.0	3.4
March	15.2	28.8	22.0	36.2	2.0	13.1	27.9	20.5	36.1	-1.0
April	10.9	24.8	17.9	34.9	0.0	8.8	24.5	16.6	35.5	-3.0
May	6.5	21.4	13.9	31.1	-5.7	3.8	21.3	12.5	30.9	-6.8
June	3.2	18.2	10.7	26.6	-6.7	0.3	18.1	9.2	29.1	-9.5
July	2.8	18.8	10.8	26.8	-7.9	-0.3	18.6	9.1	26.0	-10.1
August	4.9	21.3	13.1	30.5	-6.7	1.7	21.1	11.4	29.9	-10.6
September	8.9	25.5	17.2	35.5	-5.5	6.0	25.2	15.6	34.9	-7.2
October	11.9	27.8	19.9	37.6	-0.5	9.4	27.6	18.5	36.4	-2.6
November	14.6	30.2	22.4	39.2	3.3	12.2	29.8	21.0	39.5	-1.5
December	16.6	32.1	24.3	39.7	4.8	14.2	31.4	22.8	39.3	3.6
Annual Avg	10.9	26.0	18.5	40.4	-7.9	8.3	25.6	16.9	39.9	-10.6



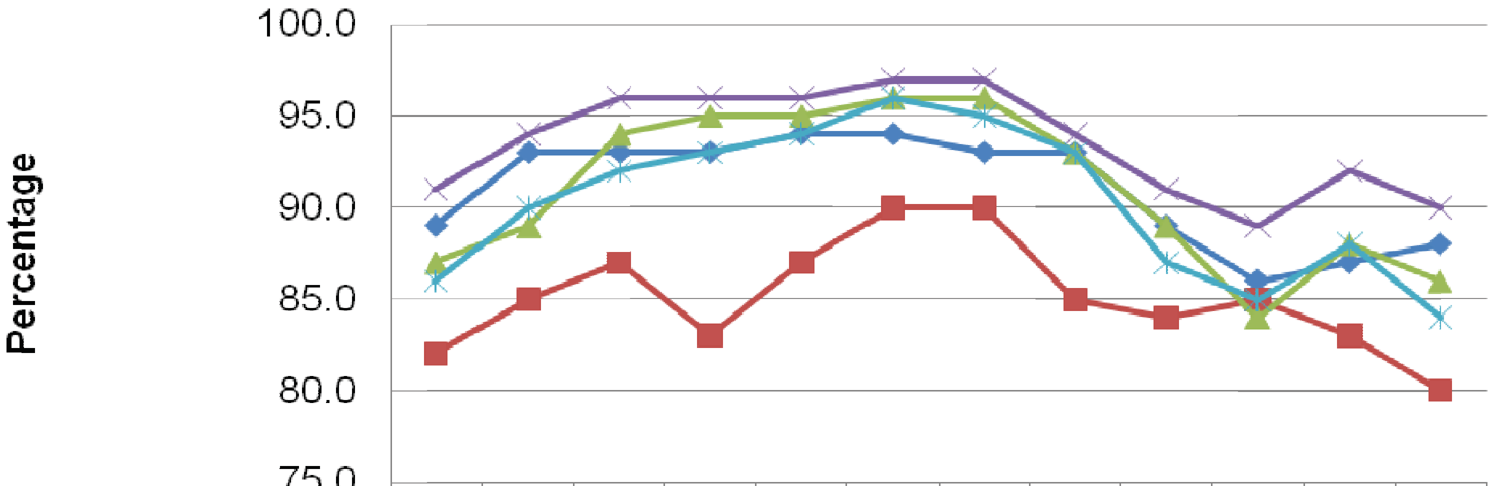
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	76.0	81.0	67.0	49.0	18.0	4.0	5.0	5.0	15.0	34.0	57.0	61.0
Jan Kempdorp	51.0	124.0	70.0	39.0	10.0	5.0	5.0	3.0	19.0	47.0	60.0	51.0
Diepplotte	56.0	65.0	68.0	53.0	13.0	7.0	8.0	10.0	13.0	28.0	50.0	43.0
Kimberley	57.0	76.0	65.0	49.0	16.0	7.0	7.0	7.0	12.0	30.0	42.0	46.0
Koopmansfontein	81.0	84.0	85.0	39.0	12.0	6.0	4.0	6.0	16.0	26.0	43.0	55.0

FIGURE 4: AVERAGE MONTHLY RAINFALL PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

TABLE 3: RAINFALL PROFILE FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

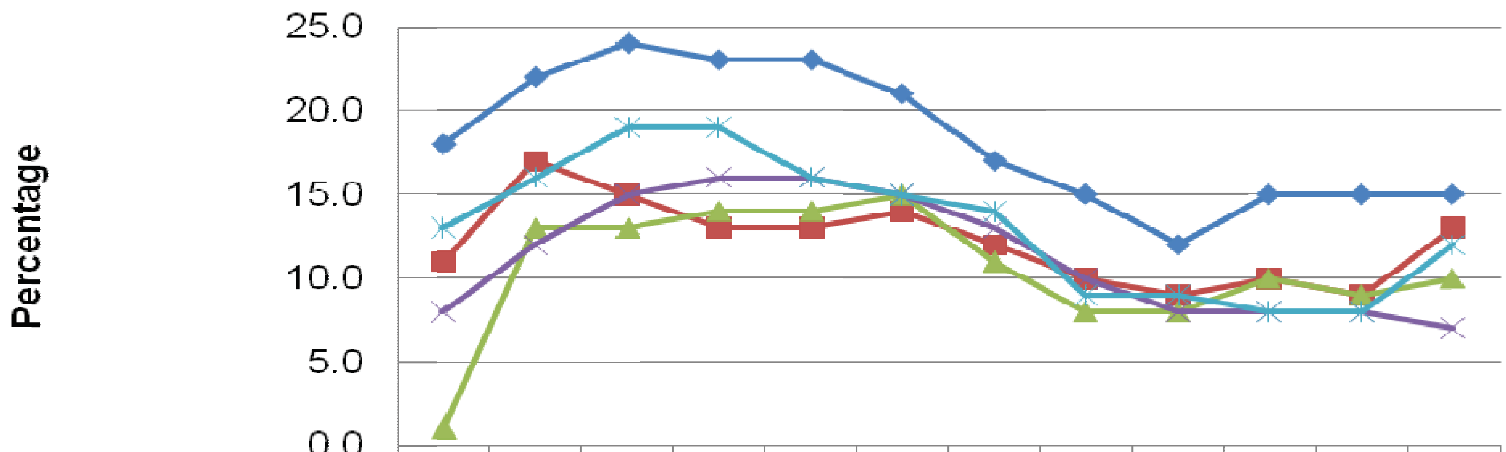
Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Precipitation - Agricultural Station (mm)					Precipitation - Agricultural Station (mm)					Precipitation - Agricultural Station (mm)				
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm
January	76.0	84.0	8.5	17.0	3.0	51.0	29.0	6.3	9.0	3.0	56.0	82.0	7.4	20.0	1.0
February	81.0	169.0	8.5	16.0	2.0	124.0	157.0	8.9	16.0	2.0	65.0	61.0	8.3	16.0	1.0
March	67.0	55.0	8.5	17.0	3.0	70.0	30.0	7.4	12.0	6.0	68.0	95.0	8.0	16.0	4.0
April	49.0	59.0	6.1	12.0	0.0	39.0	44.0	5.0	12.0	0.0	53.0	77.0	6.6	12.0	3.0
May	18.0	53.0	2.2	6.0	0.0	10.0	32.0	1.5	4.0	0.0	13.0	43.0	2.4	7.0	0.0
June	4.0	14.0	1.2	5.0	0.0	5.0	11.0	1.1	3.0	0.0	7.0	19.0	2.0	6.0	0.0
July	5.0	40.0	0.9	4.0	0.0	5.0	33.0	0.2	1.0	0.0	8.0	24.0	1.3	5.0	0.0
August	5.0	23.0	1.2	5.0	0.0	3.0	15.0	0.6	1.0	0.0	10.0	35.0	2.0	8.0	0.0
September	15.0	31.0	2.4	9.0	0.0	19.0	21.0	2.6	9.0	0.0	13.0	28.0	2.5	11.0	0.0
October	34.0	40.0	4.7	12.0	0.0	47.0	34.0	5.1	10.0	0.0	28.0	34.0	5.2	15.0	0.0
November	57.0	75.0	7.1	13.0	2.0	60.0	83.0	5.2	8.0	2.0	50.0	51.0	6.7	13.0	2.0
December	61.0	52.0	7.3	14.0	2.0	51.0	33.0	6.0	12.0	0.0	43.0	37.0	6.1	13.0	2.0
Annual Avg	472.0	169.0	59.0	76.0	46.0	484.0	157.0	50.0	64.0	37.0	414.0	95.0	58.0	89.0	40.0

Month	Kimberley (1961-1990)					Koopmansfontein (1961-1990)				
	Precipitation - Weather Office (mm)					Precipitation - Agricultural Station (mm)				
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm
January	57.0	45.0	9.8	21.0	2.0	81.0	109.0	9.5	21.0	2.0
February	76.0	88.0	9.8	19.0	2.0	84.0	77.0	10.3	21.0	3.0
March	65.0	54.0	10.2	16.0	3.0	85.0	90.0	10.4	17.0	4.0
April	49.0	51.0	7.6	14.0	3.0	39.0	48.0	7.0	12.0	3.0
May	16.0	55.0	3.3	8.0	0.0	12.0	41.0	2.6	7.0	0.0
June	7.0	18.0	2.5	7.0	0.0	6.0	23.0	1.3	5.0	0.0
July	7.0	22.0	1.5	5.0	0.0	4.0	28.0	0.9	4.0	0.0
August	7.0	26.0	1.8	8.0	0.0	6.0	32.0	1.4	7.0	0.0
September	12.0	44.0	3.1	12.0	0.0	16.0	57.0	2.0	9.0	0.0
October	30.0	35.0	6.1	13.0	0.0	26.0	25.0	5.4	12.0	1.0
November	42.0	60.0	7.7	16.0	3.0	43.0	98.0	7.0	16.0	2.0
December	46.0	60.0	7.9	13.0	3.0	55.0	51.0	8.4	16.0	1.0
Annual Avg	414.0	88.0	71.0	98.0	49.0	457.0	109.0	66.0	88.0	50.0



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	89.0	93.0	93.0	93.0	94.0	94.0	93.0	93.0	89.0	86.0	87.0	88.0
Jan Kempdorp	82.0	85.0	87.0	83.0	87.0	90.0	90.0	85.0	84.0	85.0	83.0	80.0
Diepplotte	87.0	89.0	94.0	95.0	95.0	96.0	96.0	93.0	89.0	84.0	88.0	86.0
Kimberley	91.0	94.0	96.0	96.0	96.0	97.0	97.0	94.0	91.0	89.0	92.0	90.0
Koopmansfontein	86.0	90.0	92.0	93.0	94.0	96.0	95.0	93.0	87.0	85.0	88.0	84.0

FIGURE 5: MAXIMUM MONTHLY HUMIDITY PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	18.0	22.0	24.0	23.0	23.0	21.0	17.0	15.0	12.0	15.0	15.0	15.0
Jan Kempdorp	11.0	17.0	15.0	13.0	13.0	14.0	12.0	10.0	9.0	10.0	9.0	13.0
Diepplotte	1.0	13.0	13.0	14.0	14.0	15.0	11.0	8.0	8.0	10.0	9.0	10.0
Kimberley	8.0	12.0	15.0	16.0	16.0	15.0	13.0	10.0	8.0	8.0	8.0	7.0
Koopmansfontein	13.0	16.0	19.0	19.0	16.0	15.0	14.0	9.0	9.0	8.0	8.0	12.0

FIGURE 6: MINIMUM MONTHLY HUMIDITY PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

TABLE 4: THUNDER-STORMS, HAIL, FOG AND HUMIDITY FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES).

Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Other - Agricultural Station					Other - Agricultural Station					Other - Agricultural Station				
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %
January	3.7	0.2	0.0	89.0	18.0				82.0	11.0	7.9	0.1	0.1	87.0	1.0
February	4.0	0.1	0.0	93.0	22.0				85.0	17.0	5.8	0.0	0.1	89.0	13.0
March	2.9	0.0	0.0	93.0	24.0				87.0	15.0	6.2	0.1	0.2	94.0	13.0
April	1.7	0.2	0.0	93.0	23.0				83.0	13.0	4.4	0.2	0.3	95.0	14.0
May	0.6	0.2	0.0	94.0	23.0				87.0	13.0	1.6	0.0	0.2	95.0	14.0
June	0.2	0.0	0.2	94.0	21.0				90.0	14.0	1.2	0.0	0.6	96.0	15.0
July	0.3	0.1	0.1	93.0	17.0				90.0	12.0	1.2	0.0	0.5	96.0	11.0
August	0.3	0.0	0.1	93.0	15.0				85.0	10.0	1.5	0.0	0.2	93.0	8.0
September	1.5	0.1	0.1	89.0	12.0				84.0	9.0	1.9	0.0	0.1	89.0	8.0
October	2.7	0.1	0.0	86.0	15.0				85.0	10.0	4.6	0.2	0.0	84.0	10.0
November	3.6	0.4	0.0	87.0	15.0				83.0	9.0	5.9	0.3	0.0	88.0	9.0
December	3.5	0.1	0.0	88.0	15.0				80.0	13.0	5.3	0.2	0.0	86.0	10.0
Annual Avg	25.0	2.0	1.0	98.0	10.0				93.0	5.0	47.0	1.0	2.0	98.0	5.0

Month	Kimberley (1961-1990)					Koopmansfontein (1961-1990)				
	Other - Weather Office					Other - Agricultural Station				
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %
January	8.4	0.3	0.0	91.0	8.0	8.1	0.0	0.0	86.0	13.0
February	7.7	0.4	0.3	94.0	12.0	6.4	0.2	0.3	90.0	16.0
March	6.7	0.3	0.3	96.0	15.0	6.1	0.2	0.3	92.0	19.0
April	4.8	0.2	0.7	96.0	16.0	3.7	0.2	0.1	93.0	19.0
May	1.7	0.0	0.4	96.0	16.0	1.0	0.1	0.1	94.0	16.0
June	0.7	0.1	0.4	97.0	15.0	0.2	0.1	0.0	96.0	15.0
July	0.8	0.1	0.7	97.0	13.0	0.4	0.0	0.0	95.0	14.0
August	1.3	0.1	0.5	94.0	10.0	0.5	0.0	0.0	93.0	9.0
September	2.5	0.1	0.2	91.0	8.0	1.4	0.1	0.0	87.0	9.0
October	5.7	0.3	0.1	89.0	8.0	2.9	0.2	0.0	85.0	8.0
November	6.4	0.5	0.0	92.0	8.0	3.8	0.1	0.0	88.0	8.0
December	8.0	0.3	0.1	90.0	7.0	4.6	0.4	0.1	84.0	12.0
Annual Avg	55.0	3.0	4.0	98.0	5.0	39.0	2.0	1.0	97.0	6.0

3.1.6 Wind Field

Wind is important in that it cleans by diluting and dispersing pollutants but it can also transport pollutants over large distances. Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Period, day-time and night-time average wind roses for the South African Weather Service's Kimberley Airport station are depicted in **Error! Reference source not found.** a), b) and c) for the period January 2001 to December 2001 respectively. Similarly, period, day-time and night-time average wind speed frequency distribution graphs are presented in

(c)

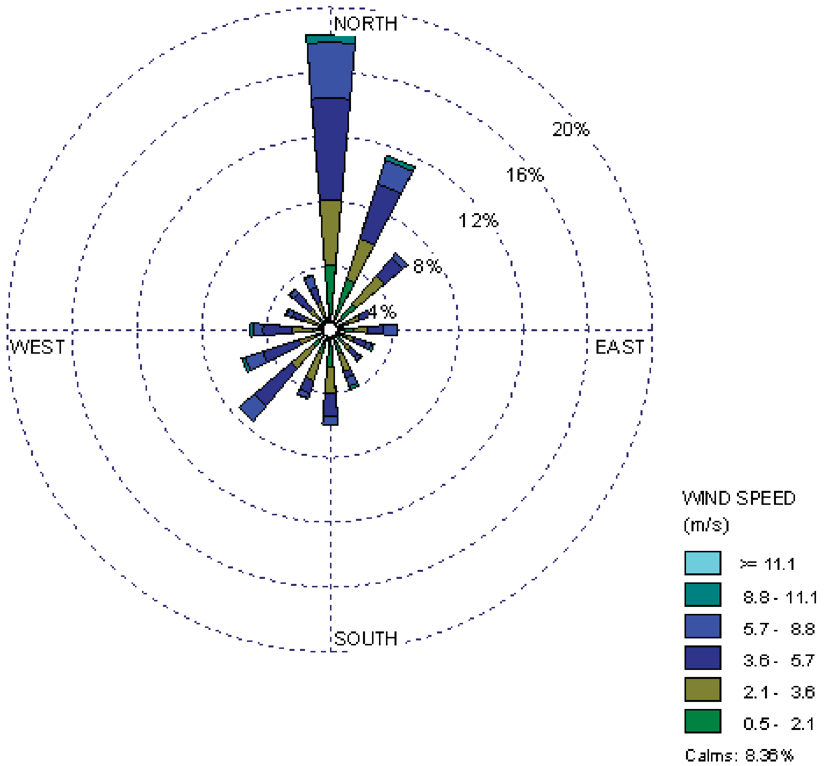


Figure 7 a), b) and c).

From the period wind rose (**Error! Reference source not found.**a) it is note that winds predominate from the north for 23% of the time. Wind speeds in the range of 3.6 - 5.7 m/s occurred for 29.1% of the time, with higher wind speeds in the range of 5.7 – 8.8 m/s and from 8.8 - 11.1 m/s noted to occur for 16.8% and 3.1% of the time respectively (

(c)

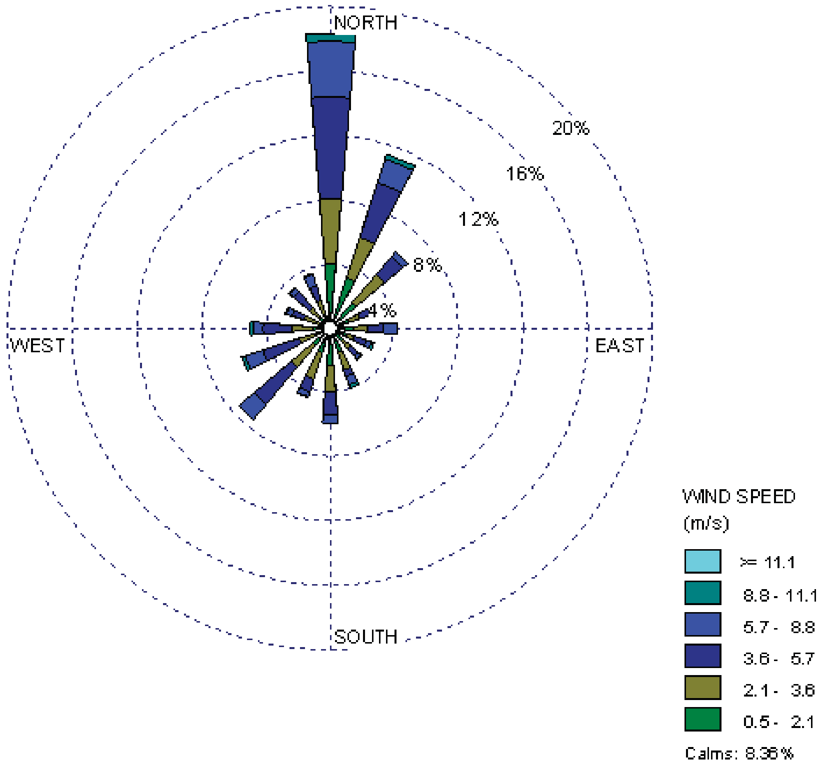
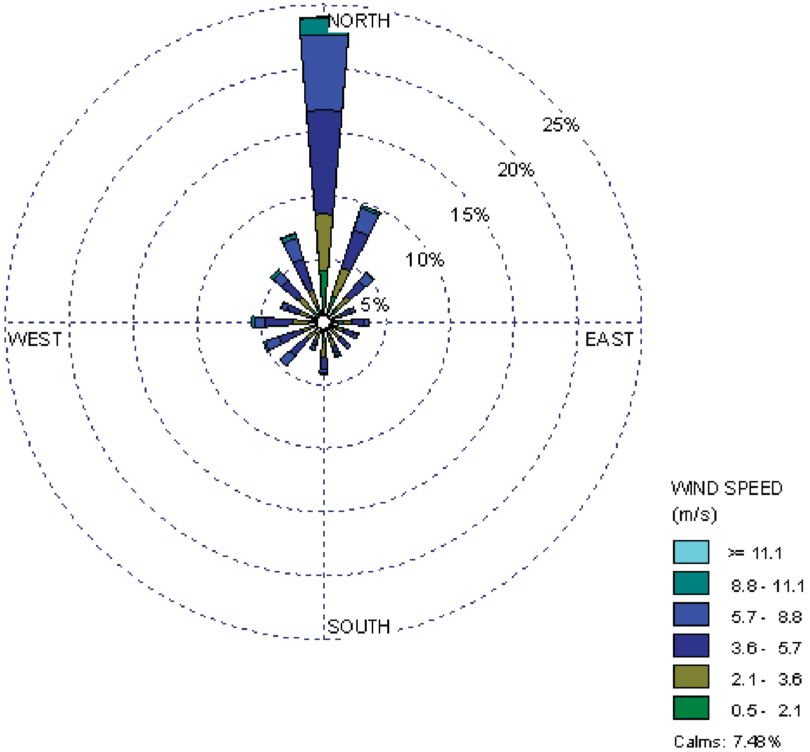


Figure 7a). These higher wind speeds are noted to occur from the north.

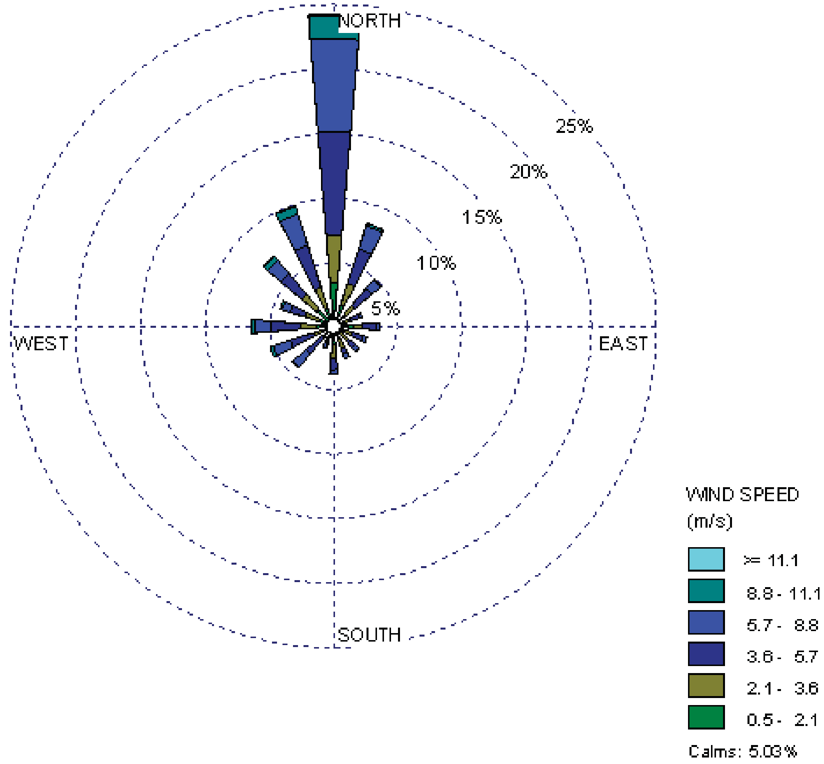
When comparing day-time and night-time wind profiles a higher incidence of southwesterly winds are noted during night-times (**Error! Reference source not found.**c). Southwesterly winds increase in frequency from 5% to 7% of the time when comparing day-time and night-time conditions. North-northeasterly and southerly winds also increase in frequency during night-time from 8-11 % and 4-6 % respectively. As is to be expected during night-time wind speeds are noted to be lower when compared to day-time conditions, predominating in the range of 0.5 – 5.7 m/s.

From this wind profile it is noted that sources impacting on air quality would most likely impact more significantly on sensitive areas to the south of these activities. With wind speeds in the calm (0.5 – 5.7) to moderate (5.7 – 8.8) range predominating indicates that the dispersion potential for the area can be considered to be poor to moderately good.

(a)


NORTH
SOUTH
EAST
WEST
5%
10%
15%
20%
25%
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 7.48%

(b)


NORTH
SOUTH
EAST
WEST
5%
10%
15%
20%
25%
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 5.03%

(c)

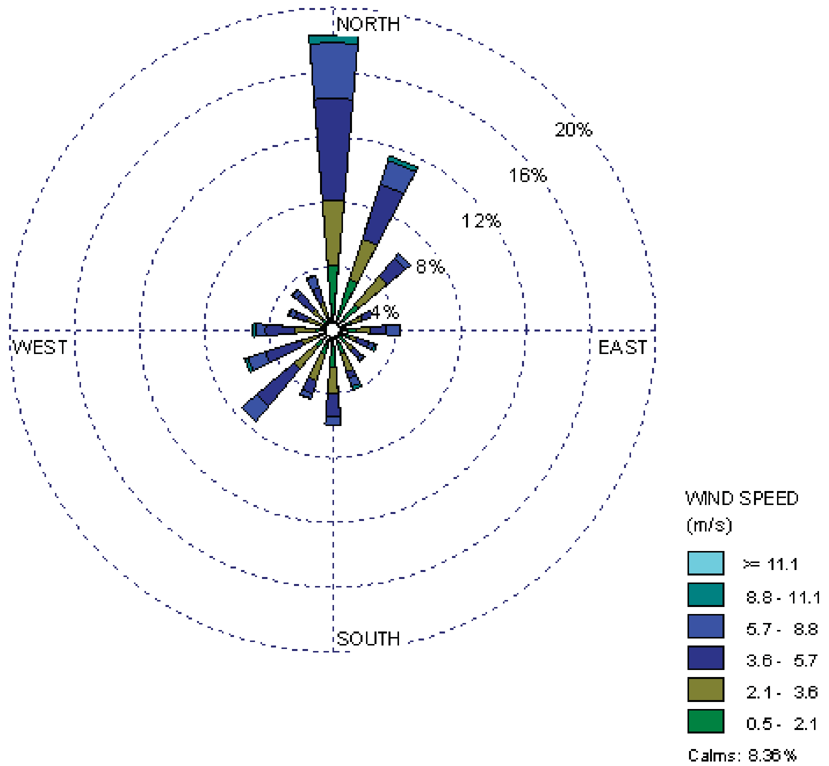


FIGURE 7: KIMBERLEY WIND CLASS FREQUENCY DISTRIBUTION (A) PERIOD (B) DAYTIME (C) NIGHTTIME.

3.1.7 Atmospheric Stability

Atmospheric stability (indication of the amount of mixing and movement of air possible in an area) is commonly categorised into one of six stability classes. These are briefly described in Table 5.

The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Figure 8 depicts the estimated atmospheric stability for the Kimberley area in the form of a rose. The rose indicates how the atmospheric stability differs from different wind directions. It can be noted however that there is not a marked difference in the variability of stability class types with wind direction. Figure 9: indicating that a neutral stability class occurs for 24.3% of the time, stable atmospheric conditions can be expected to occur for 18.2% of the time with very stable conditions noted for 22.5 % of the time. The predominance of atmospheric stability for the region in the neutral to very stable range, suggests that very little movement and potential for mixing of pollutants and the consequent dilution of a pollution plume exists. Thus when pollutants are released they will tend not to dissipate quickly from source.

TABLE 5: STABILITY CLASS.

A	Very unstable	Calm wind, clear skies, hot daytime conditions
B	Moderately unstable	Clear skies, daytime conditions
C	Unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

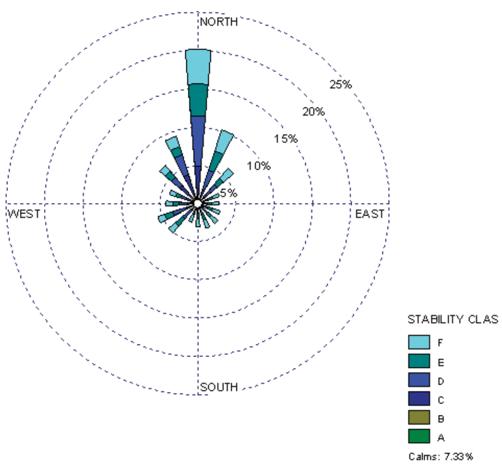


FIGURE 8: KIMBERLEY STABILITY CLASS FREQUENCY DISTRIBUTION BY WIND DIRECTION.

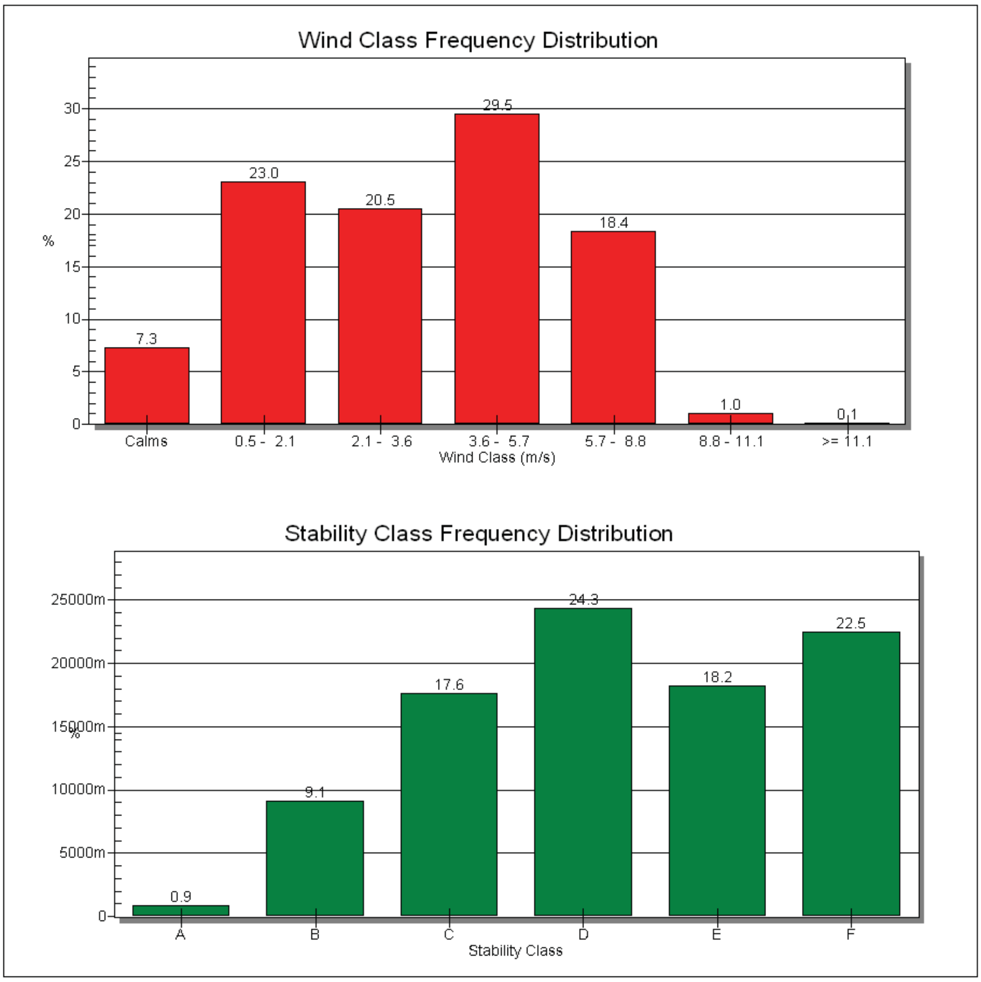


FIGURE 9: KIMBERLEY STABILITY CLASS FREQUENCY DISTRIBUTION BY WIND SPEED.

3.2 Other Polluting Sources in the Area

A detailed emissions inventory for the Groenwater area is not available. Based on site visits and 1:50 000 topographical maps; the following sources of air pollution have however been identified. These are important to consider in terms of assessing the cumulative impact potential on air quality in the region:

- Agricultural activities;
- Vehicle entrainment and exhaust gas emissions;
- Mining activities
- Veld Fires; and
- Domestic Fuel Burning.

A qualitative discussion on each of these source types is provided in the subsections which follow.

3.2.1 Agriculture

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. Mixed farming is practised in the area. The farming includes maize, wheat, grain sorghum, sunflower seed, drybeans and soybeans. Vegetables are produced under irrigation. The types of livestock assessed included pigs, sheep, goats, chickens and cattle. Emissions assessed include ammonia and hydrogen sulphide (USEPA, 1996).

3.2.2 Vehicles

The force of the wheels of vehicles travelling on unpaved roadways causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic (USEPA, 1996). Due to the nature of both mining and agricultural activity, road networks can often be of a temporary nature, and are thus unpaved. An extensive unpaved road network exists in the area.

Due to the high degree of transport of product from the site expected during mining operations, exhaust tailpipe emissions from vehicles is a significant source of particulate emissions. Exhaust fumes contain nitrogen, oxygen, carbon monoxide, water vapour, sulphur dioxide, nitrogen oxide, volatile hydrocarbons and polyaromatic hydrocarbons (PAHs) and their derivatives, acetylaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

3.2.3 Mining

Mining results in significant sources of fugitive dust emissions which primarily occur due to wind erosion of extensive poorly controlled tailings impoundments. Such sources are frequently associated with localised nuisance dust that contributes to the concentration of fine particulate matter in the atmosphere. Whereas high dust fallout rates have been measured to occur in close proximity to poorly controlled tailings impoundments, the contribution of such impoundments to airborne fine particulate concentrations is lower. Other emissions generated due to mining operations are generally associated with surface mining activity. Dust fallout and inhalable particulate emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing, screening and milling of ore and ore products). Subsurface mining operations result in small quantities of particulate, sulphur dioxide (SO2), nitrogen dioxide (NO2) and carbon monoxide (CO2) being released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground

3.2.4 Veld Fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amounts of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads. The factors that affect the rate of spread are (1) weather (wind velocity, ambient temperature, relative humidity); (2) fuels (fuel type, fuel bed array, moisture content, fuel size); and (3) topography (slope and profile). However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier et al, 1995).

3.2.5 Domestic Fuel Burning

It is anticipated that low income households in the area surrounding the site are likely to use coal and wood for space heating and/ or cooking purpose. The problems facing Metsimatala around the impact of air pollution generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002).

Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest Mozambique Air Quality Objectives, for instance, required the monthly average concentration of PM10 (particulate matter < 10 µm in diameter) to be < 200 µg/m3 (annual average < 100 µg/m3). In contrast, a typical 24-hr average concentration of PM10 in homes using biofuels may range from 200 to 5000 µg/m3 or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥ 50000 µg/m3 in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global

exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

3.3 Standards and Guidelines

The main pollutant of concern which may poses a health risk to surrounding sensitive receptors and possible communities during the current investigation is particulate matter. Particulate matter is a collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface. Particulate matter includes dust, smoke, soot, pollen and soil particles (Kemp, 1998). An overview is provided of the available local regulations and standards (SANS), and then for comparison, international guidelines and standards prescribed for inhalable particulate and nuisance dust exposure, these include the World Bank (WB), European Union (EU), United Kingdom (UK), World Heath Organisation (WHO), and the United States Environmental Protection Agency (USEPA).

3.3.1 Inhalable Particulates

Particulate matter (PM) has been linked to a range of serious respiratory and cardiovascular health problems. The key effects associated with exposure to ambient particulate matter include: premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, decreased lung function, and increased risk of myocardial infarction (USEPA, 1996).

PM represents a broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behaviour and method of measurement. The concentration of particles in the air varies across space and time, and is related to the source of the particles and the transformations that occur in the atmosphere (USEPA, 1996).

PM can be principally characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions (USEPA, 1996):

- PM_{10} (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are not generally deposited in the lung);
- $PM_{2.5}$, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less);
- $PM_{10-2.5}$, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and
- Ultra fine particles generally defined as those less than 0.1 microns.

Fine and coarse particles are distinct in terms of the emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters. Fine particles are directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulphur dioxide, nitrogen oxides, or organic compounds. Fine particles are generally composed of sulphate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometres, while most coarse particles typically deposit to the earth within minutes to hours and within tens of kilometres from the emission source. Some scientists have postulated that ultra fine particles, by virtue of their small size and large surface area to mass ratio

may be especially toxic. There are studies which suggest that these particles may leave the lung and travel through the blood to other organs, including the heart.

Coarse particles are typically mechanically generated by crushing or grinding and are often dominated by resuspended dusts and crustal material from paved or unpaved roads or from construction, farming, and mining activities (USEPA, 1996).

Table 6: outlines the local and international health risk criteria used for the assessment of inhalable particulate matter (PM_{10}). Guidelines and standards are provided for a 24-hour exposure and annual average exposure period respectively.

TABLE 6: AVAILABLE LOCAL AND INTERNATIONAL STANDARDS USED FOR THE EVALUATION OF INHALABLE PARTICULATE MATTER (PM10).

Origin	24-Hour Exposure (µg/m³)	Annual Average Exposure (µg/m³)	Number of Exceedances Allowed per year
RSA(1)	120(1)	50(1)	4 daily exceedances
RSA(2)	75(2)	40(2)	0 daily exceedances
Australia	50		5 daily exceedances
World Bank(3)	500	100	NA
EU(4)	50	20	7 daily exceedances
US-EPA(5)	150	50(6)	1 daily exceedance
UK(7)	50	40	35 daily exceedances
WHO(8) (9) (10)	50	20	NA

Notes: (1) Standard laid out in the National Environment Management: Air Quality Act. No. 39 of 2004:

(2) Compliance by 1 January 2015

(3) World Bank Air Quality Standards summary obtainable at URL http://www.worldbank.org/html/fpd/em/power/standards/airqstd.stm#paq.

(4) European Union Air Quality Standards summary obtainable at URL http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Directive&an_doc=1999&nu_doc=30.

(5) United States Environmental Protection Agencies National Air quality Standards obtainable at URL http://www.epa.gov/air/criteria.html

(6) To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 µg/m^3.

(7) United Kingdom Air Quality Standards and objectives obtainable at URL http://www.airquality.co.uk/archive/standards.php

(8) WHO = World Health Organisation

(9) Guidance on the concentrations at which increasing, and specified mortality responses due to PM are expected based on current scientific insights (WHO, 2005).

(10) Air quality guideline

3.3.2 Nuisance Dust

Nuisance dust is known to result in the soiling of materials and has the potential to reduce visibility. Atmospheric particulates change the spectral transmission, thus diminishing visibility by scattering light. The scattering efficiency of such particulates is dependent upon the mass concentration and size distribution of the particulates.

Various costs are associated with the loss of visibility, including: the need for artificial illumination and heating; delays, disruption and accidents involving traffic; vegetation growth reduction associated with reduced photosynthesis; and commercial losses associated with aesthetics. The soiling of building and materials due to dust frequently gives rise to damages and costs related to the increased need for washing, cleaning and repainting. Dustfall may also impact negatively on sensitive industries, e.g. bakeries or textile industries. Certain elements in dust may damage materials. For instance it was found that sulphur and chlorine if present in dust may cause damage to copper (Maeda et al., 2001).

The physical smothering of the leaf surface of plants by dust particles causes reduced light transmission, affecting photosynthetic processes resulting in growth reduction (Thompson et al., 1984; Pyatt and Haywood, 1989; Farmer, 1993).

Increases in the temperature of particle-covered leaves result in a positive impact on respiration and a negative impact on photosynthesis and productivity (Eller, 1977). The physical obstruction of the stomata has been observed to reduce stomatal resistance, resulting in the potential for higher uptake of pollutant gases, and it may also affect the exchange of water vapour (CEPA/FPAC Working Group, 1999). Particle accumulation on leaf surfaces may cause plants to become more susceptible to other stresses such as disease (CEPA/FPAC Working Group, 1999). A review of the effects of cement dust on trees showed that the dust caused physical damage to the leaves, reduced fruit setting and generally reduced growth (Farmer, 1993). Several studies in Europe and the United States have indicated that a decline in species diversity may be linked to declining air quality around urban and industrial areas (Gunnarsson, 1988; Hallingbäck, 1992; Váňa, 1992; Van Zanten, 1992; Finizio et al., 1998; Jones & Paine, 2006; Motiejūnaitė, in press; Otnyukova, in press).

Air pollution is a recognized health hazard for man and domestic animals (Newman et al., 1979). Air pollutants have had a worldwide effect on both wild birds and wild mammals, often causing marked decreases in local animal populations (Newman et al., 1979). The major effects of industrial air pollution on wildlife include direct mortality, debilitating industrial-related injury and disease, physiological stress, anaemia, and bioaccumulation. Some air pollutants have caused a change in the distribution of certain wildlife species.

South Africa is one of the only countries who have issued guideline limits for the evaluation of nuisance dust levels. A four banding system has traditionally been used which describes the dust deposition as resulting in a slight, moderate, heavy or very heavy nuisance impact. These criteria are summarised as follows:

Slight	: < 250 mg/m²/day
Moderate	: > 250 mg/m²/day < 500 mg/m²/day
Heavy	: > 500 mg/m²/day < 1200 mg/m²/day
Very Heavy	: > 1200 mg/m²/day

The South African Department of Minerals and Energy (DME) use the 1 200 mg/m²/day threshold level as an action level. In the event that on-site dustfall exceeds this threshold, the specific causes of high dustfall should be investigated and remedial steps taken.

"Slight" dustfall is barely visible to the naked eye. "Heavy" dustfall indicates a fine layer of dust on a surface, with "very heavy" dustfall being easily visible should a surface not be cleaned for a few days. Dustfall levels of > 2000 mg/m²/day constitute a layer of dust thick enough to allow a person to "write" words in the dust with their fingers.

Local experience, gained from the assessment of impacts due to dust from mine tailings dams in Gauteng, has shown that complaints from the public will be activated by repeated dustfall in excess of ~2000 mg/m²/day. Dustfall in excess of 5000 mg/m²/day impacting on residential or industrial areas generally provoke prompt and angry complaints.

The main limitation in using this type of classification system is that it is purely descriptive and does not provide and indication as to what action needs to be taken to remediate the problem. The South African Bureau of Standards in their SANS 1929:2005 publication, "Ambient air quality – limits for common pollutants", provides additional criteria which can be used for the evaluation of fallout dust deposition. A four banded scale has been provided, with target, action and alert thresholds indicated. Permissible margins of tolerances are outlined with possible exceptions noted. Table 7: and Table 8 detail these evaluation criteria.

TABLE 7: FOUR BAND SCALE EVALUATION CRITERIA FOR DUST DEPOSITION (SANS, 2005).

Band Number	Band Description	Dustfall rate, D (mg/m²/day, 30-day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of the dustfall rate being exceeded. Incidence reported to be submitted to the relevant authority.

TABLE 8: TARGET, ACTION AND ALERT THRESHOLDS FOR DUST DEPOSITION (SANS, 2005).

Level	Dustfall rate, D (mg/m²/day, 30-day average)	Averaging Period	Permitted Frequency of Exceeding dustfall rate
Target	300	Annual	
Action residential	600	30 days	Three within any year no two sequential months
Action industrial	1200	30 days	Three within any year not sequential months
Alert threshold	2400	30 days	None. First incidence of dust fall rate being exceeded requires remediation and compulsory report to the relevant authorities.

An enterprise may submit a request to the authorities to operate within band 3 (action band), as specified in Table 7: , for a limited period, provided that this is essential in terms of the practical operation of the enterprise and provided that and appropriate control technology is applied for the duration. No margin of tolerance will be granted for operations that result in dustfall rates which fall within band 4 (alert band) as specified in Table 8 (SANS, 2005).

Dustfalls that exceed the specified rates but that can be shown to be the result of some extreme weather or geological event shall be discounted for the purpose of enforcement and control. Such an event might typically result in excessive dustfall rates across an entire metropolitan region, and not be localised to a particular operation. Natural seasonal variations, for example, the naturally windy months each year, will not be considered extreme events for this definition (SANS, 2005).

3.4 Sensitive Receptors

The residential, educational and recreational land uses are considered to be sensitive receptors. For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible. The following 1:50 000 topographical cadastral maps were used:

- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989; and.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982.

The proposed plant is located to the east of Postmasburg (Figure 1:). A number of small villages such as Groenwater, and the Lime Acres Mining Area are located in close proximity to the proposed site. Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust settling on the leaves of plants can result in damage to plants and inhalation of dust may result in sickness and associated lung diseases for wildlife and humans which will be present in the vicinity of the proposed plant. A more detailed inventory of settlements and sensitive receptors will be obtained on site visits and with assistance of the public participation specialists working on the project.

4 ASSESSMENT OF ENVIRONMENT LIKELY TO BE AFFECTED

The impact assessment phase of this investigation assesses the impact the construction and operational phase of the proposed plant will have on the surrounding areas.

This Section of the report outlines the predicted increase in impacts with the introduction of the plant and operations. To clearly detail the predicted impacts in ambient inhalable particulate ground level concentrations, only operational emissions will be included in this evaluation. The construction and decommissioning phases of the operation can only qualitatively be addressed due to the variability and unpredictable nature of the construction operations on site.

4.1 Methodology

Dispersion modelling will be undertaken using the US-EPA approved Aermod Dispersion Model. This model is based on the Gaussian plume equation and is capable of providing ground level concentration estimates of various averaging times, for any number of meteorological and emission source configurations (point, area and volume sources for gaseous or particulate emissions).

The AERMOD View model is used extensively to assess pollution concentrations and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows 2000/XP and NT4 (Service Pack 6).

The AERMOD (dispersion model used during the current investigation, is a steady state Gaussian plume model which can be used to assess pollutant concentrations and /or deposition fluxes from a wide variety of sources associated with an industrial source complex. Some of the modelling capabilities are summarised as follows:

- AERMOD may be used to model primary pollutants and continuous releases of toxic hazardous waste pollutants;
- AERMOD model can handle multiple sources, including point, volume, area and open pit source types. Line sources may also be modelled as a string of volume sources or as elongated area sources;
- Source emission rates can be treated as constant or may be varied by month, season, hour of day, or other periods of variation, for a single source or for a group of sources;
- The model can account for the effects aerodynamic downwash due to nearby buildings on point source emissions;
- The model contains algorithms for modelling the effects of settling and removal (through dry deposition) of large particulates and for modelling the effects of precipitation scavenging from gases or particulates;
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system;
- AERMOD incorporates the COMPLEX1 screen model dispersion algorithms for receptors in complex terrain;
- The model uses real-time meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impact on the modelling area; and
- Output results are provided for concentration, total deposition, dry deposition, and/or wet deposition flux.

Input data to the AERMOD model includes: source and receptor data, meteorological parameters, and terrain data. The meteorological data includes: wind velocity and direction, ambient temperature, mixing height and stability class.

The uncertainty of the AERMOD model predictions is considered to be equal to 2, thus it is possible for the results to be over predicting by double or under predicting by half, it is therefore recommended that monitoring be carried out at the proposed more during operation to confirm the modelled results, to ensure legal standards are maintained.

4.2 Input parameters

The emissions inventory will need to be developed to determine the emissions generated from each source. This is likely to be undertaken using the US-EPA AP42 emission factors. These emission factors are calculated based on standard operating conditions for various industries, and activities, and are used as an accepted alternative if no site specific or monitored data is available. The inventory will be developed based on the plant operations and will require information relating to processes used.

4.3 Potential Impacts

4.3.1 Construction Phase

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access roads, and the plant area. These predicted impacts cannot be quantified, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities. Instead a qualitative description of the impacts will be provided. This will involve the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

1. Product Transport
   - Scraping;
   - Debris handling;
   - Debris stockpiles; and
   - Truck transport and dumping of debris.
2. Power Plant
   - Clearing of area for infrastructure;
   - Debris handling;
   - Debris stockpiles; and
   - Truck transport and dumping of debris.

4.3.1.1 Creation and Grading of Access Roads

Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

The periodic watering of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases.

4.3.1.2 Preparation of areas identified for the construction of the plant and supporting infrastructure.

Removal of material usually takes place with a bulldozer, extracted material is then stored in piles for later use during rehabilitation procedures. Fugitive dust is generated during the extraction and removal of overlying material, as well as from wind blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the extracted material, usually by truck, to the stock

piles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

To avoid the generation of unnecessary dust, material drop height should be reduced and material storage piles should be protected from wind erosion. This can take the form of wind breaks, water sprays or vegetation of piles. All stockpiles should be damped down, especially during dry weather.

It should be noted that emissions generated by wind are also dependent on the frequency of disturbance of the erodable surface. Each time material is added to or removed from a storage pile or surface, the potential for erosion by wind is restored. Any crusting of the surface binds the erodable material (USEPA, 1996). Dust created during the transportation can be limited by watering the road sections that are being used and by either wetting the material being transported or covering the back of the trucks, to limit the wind blown dust from the load.

The removed topsoil will have to be transported to a designated collection point from where it can be recovered later during site rehabilitation. The removal of this material for storage should be done along designated roads which are properly maintained (watering), to reduce the amount of vehicle entrained dust which can be kicked up during these activities. In addition to the use of dedicated, treated roads, the material transported can be wet or covered to limit the wind blown dust being released from the load.

4.3.1.3 Overview of potential Impacts

The following components of the environment may be impacted upon during the construction phase:

- Ambient air quality;
- Local residents and neighbouring communities;
- Employees;
- The aesthetic environment; and
- Possibly fauna and flora.

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

Sensitive receptors were identified in Section 3.4. Given the short duration and low level of activity expected during construction, but bearing in mind that no quantitative emission figures exist, no long adverse impacts are anticipated on these receptors. Impact of fugitive dust emissions on employees on site could however be significant during the construction phase, but will vary between phases, with level of activity and meteorological conditions.

4.3.2 Operational Phase

This section aims to deal with the predicted air quality impacts which result due to the proposed operations. Details regarding the source characteristics will be obtained from site layout plans and process specific information provided and a questionnaire filled in by the client. The sources to be included in this assessment can be categorised as follows:

- Material handling;
- Plant Installation; and
- Equipment Transport.

Once all site layouts and final geotechnical works are complete, information will then be sufficient for dispersion modelling and will be included in the Environmental Impacts Report.

4.3.3 Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and tailings impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.4 Proposed Mitigation

4.4.1 Construction Phase

Due to the lack of quantitative dust emissions data for the site, it is recommended that the precautionary principle be followed and dust control measures be implemented. Recommendations for the control of fugitive dust emissions are given in Table 9: . Wet suppression with water is the least expensive of the possible control measures but is temporary in nature.

TABLE 9: RECOMMENDATIONS FOR THE CONTROL OF FUGITIVE DUST EMISSIONS DURING THE CONSTRUCTION PHASE (USEPA, 1996).

4.5 Emission Source	4.6 Recommended Control Methods
Debris handling and debris piles	Wind speed reduction
	Wet suppression [(1)]
Truck transport [(2)]	Wet suppression
	Paving
	Chemical stabilisation [(3)]
Bulldozers	Wet suppression
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression
	Paving
	Chemical stabilisation
General construction	Wind speed reduction
	Wet suppression
	Early paving of permanent roads

Note: [(1)] Dust control plans should contain precautions against watering programs that confound trackout problems.

[(2)] Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.

[(3)] Chemical stabilisation is usually cost-effective for relatively long-term or semi-permanent unpaved roads.

Water may be combined with a surfactant as wetting agent. Surfactants increase the surface tension of water, reducing the quantity of water required. Chemical stabilisation is of longer duration but is not cost effective for small-scale operations. Dust-A-Side (DAS) represents an example of a chemical product, which is commercially available and widely used by mines and quarries. The DAS product binds with the aggregate used to build on-site roads. It should be noted however, that the treatment with chemical stabilisers can have adverse effects on plant and animal life and can contaminate the treated material (USEPA, 1996).

Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. Facilities for the washing of vehicles could be provided at the entry and exit points. A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas or near stockpiles. Traffic over exposed areas should be kept to a minimum (USEPA, 1996).

All stockpiles should be maintained for as short a time as possible and should be enclosed by wind breaking enclosures of similar height to the stockpile. Stockpiles should be situated away from the site boundary, water courses and nearby receptors and should take into account the predominant wind direction.

During the transfer of material to piles, drop heights should be minimised to control the dispersion of materials being transferred (USEPA, 1996).

Additional preventative techniques include the reduction of the dust source extent and adjusting work processes to reduce the amount of dust generation (USEPA, 1996).

4.6.1 Operational Phase

In order to provide a better indication of the extent of the impacts expected from the proposed construction and operational phases of this development, dispersion simulations will need to be undertaken. This will however only be able to take place once more detail is available regarding the nature of each source type and their respective emission rates.

Once these impacts have been quantified, appropriate management measures can be suggested to best mitigate the predicted impacts. These modelled results will similarly allow for the assessment of compliance to current South African and International Standards.

4.6.2 Decommissioning Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.6.3 Post-Closure Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

Proposed Humansrus Solar Thermal Energy Power Plant

SPECIALIST AVIFAUNAL IMPACT ASSESMENT

SCOPING REPORT
May 2011

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This avifaunal specialist study and report was undertaken and compiled by Jon Smallie and Andrew Pearson in their capacities as avifaunal specialists for the Endangered Wildlife Trust (EWT).

Declaration of Independence

Specialist Investigator

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith."

"Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

Investigator:	Jon Smallie (Pri.Sci.Nat)
Qualification:	BSc (hons) Wildlife Science
Affiliation:	South African Council for Natural Scientific Professions
Registration number:	400020/06
Fields of Expertise:	Ecological Science
Registration:	Professional Member

Declaration of Independence

All specialist investigators specified above declare that:

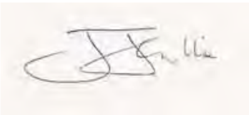
- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.

Terms and Liabilities

- This report is based on a short term investigation using the available information and data related to the site to be affected. No long term investigation or monitoring was conducted.
- The Precautionary Principle has been applied throughout this investigation.
- The specialist investigator, and the Endangered Wildlife Trust, for whom he/she works, does not accept any responsibility for the conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from these assessments or requests made to them for the purposes of this assessment.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator withholds the right to amend this report, recommendations and conclusions at any stage should additional information become available.

- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report and all of the information contained herein remain the intellectual property of the Endangered Wildlife Trust.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Signed on the 26th May by Jon Smallie in his capacity as specialist investigator for the Endangered Wildlife Trust's Wildlife and Energy Programme.



Executive Summary

Solar Reserve SA (Pty) Ltd is planning a 100 MW Solar Thermal Energy Power Plant (or otherwise known as a Concentrated Solar Power (CSP) plant) on the Farm 469, Hay RD (Humansrus), approximately 30 km east of Postmasburg, in the Northern Cape. Very few CSP plants have been constructed worldwide to date, and knowledge on the associated avifaunal impacts remains limited. The site consist mainly of uniform, arid vegetation types sites. Few permanent water bodies are on site. The proposed site falls within the Quarter Degree Grid Square (QDGS), 2823AD, and the South African Bird Atlas Project (SABAP) records 168 bird species of which 11 are Red Listed Species. Various other species relevant to the project were identified and include raptors, doves, pigeons and aerial foragers such as swallows and swifts.

Potential impacts of the project on avifauna may include collision of birds with heliostats, burning of birds in focal points, and habitat destruction and disturbance of bird will be of moderate significance. Further impacts with associated infrastructure may also occur such as, collision and/or electrocution of birds with any new overhead power lines as well as habitat destruction and disturbance of birds during the construction of new roads and/or pipelines. The presence of open water ponds close to the CSP plant could drastically increase the potential for avifaunal impacts, especially when one considers the proximity of the site to already established water bird populations at the three CWAC sites.

Introduction

Solar Reserve SA (Pty) Ltd is planning a Solar Thermal Energy Power Plant (or otherwise known as a Concentrated Solar Power (CSP) plant). SSI was appointed as independent environmental consultants to conduct the Environmental Impact Assessment (EIA) process for the proposed development, and the Endangered Wildlife Trust (EWT) was subsequently appointed to conduct an avifaunal specialist study. The proposed CSP plant is located on the Farm 469, Hay RD (Humansrus), approximately 4 km southeast of Groenwater and 30 km east of Postmasburg, in the Northern Cape (see Fig. 1). Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW which will require approximately 3 square kilometers of terrain. To the authors knowledge only two plants have been constructed to date, i.e. Solar One - an experimental 10 MW plant built in 1979 in Barstow, California and Solar Two – an improvement on Solar One at the same site. A 40 MW plant is also under development in Spain (Spain Solar Tres). The proposed site falls within the Quarter Degree Grid Square (QDGS), 2823AD, and the South African Bird Atlas Project (SABAP) records 168 bird species of which 11 are Red Listed Species (Harrison *et al*, 1997). In addition, three Coordinated Waterbird Count (CWAC) areas, which are regarded as sites important for water birds either by virtue of the species present or the numbers in which they are represented, are within close proximity to the study area.

Figure 1: Google Earth image showing the relative position of the proposed CSP plant at Humansrus, depicted on the map with by the yellow star, as well as Postmasburg to the West and Kimberley to the South East.

Terms of Reference

The following terms of reference for the EWT avifaunal study were adopted:

- Identification of sensitive sites: The bird sensitive sections of the study area will be identified.
- Describe affected environment and determine status quo: The existing environment will be described and the bird communities most likely to be impacted will be identified. Different bird micro-habitats will be described as well as the species associated with those habitats.
- Describe focal species: Threatened bird species (as per red data book status), will be identified, and species most likely to be impacted upon will be identified.
- Identification of impacts: The potential impact on the birds will be identified.
- Propose and explain mitigation measures: Practical mitigation measures will be recommended and discussed.

Methodology

The following section describes the process and criteria used to assess the site during the scoping phase in terms of avifaunal impact.

- The study was initially conducted from a desk top level. Using various GIS layers, 1:50 000 topographical maps and Google earth images, key features within the study area were identified and a map of the site and surrounding area was created using ARCGIS 9.3.
- The various data sets discussed below under "sources of information" were collected.
- This data was examined to determine presence of sensitive Red Data species in the study area.
- Abundance of the species most sensitive to this project (not necessarily red listed species) was determined.
- A thorough site visit was conducted.
- Bird micro-habitats were then identified and described.
- Proximity of the site to water was assessed, as was the presence of small water features (e.g. dams or water troughs) within the site boundary.
- The impacts of the proposed project on birds were then predicted.

Sources of Information

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison et al, 1997) obtained from the Avian Demography Unit (ADU) of the University of Cape Town, as a means to ascertain which species occur within the study area. A data set was obtained for these quarter degree square (Table 1).
- The SABAP 2 data for the relevant Pentads was also consulted.
- Data from the Co-ordinated Avifaunal Road count project (CAR – Young, Harrison, Navarro, Anderson & Colahan, 1997) for the "Mpumalanga Precinct".
- Data from the Co-ordinated Waterbird Count (CWAC) project was also consulted to determine whether any CWAC sites exist in the study area (Taylor, Navarro, Wren- Sargent, Harrison & Kieswetter, 1999).
- The Important Bird Areas of southern Africa (IBA) project data (Barnes 1998) was consulted to determine its relevance to this project.
- The conservation status of all bird species occurring in the aforementioned quarter degree square was determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes, 2000).
- Electronic 1:50 000 maps were obtained from the Surveyor General.

High resolution satellite imagery from Google Earth was used to aid in the identification of micro-habitats

Scope, Limitations and Assumptions

This study forms part of the scoping phase and aims to evaluate the alternative sites identified during the pre-screening exercise. This study made the assumption that the above sources of information are reliable. The following factors may potentially detract from the accuracy of the predicted results:

- In assessing the impacts of the associated infrastructure such as a new power line – the EWT is hugely experienced. However, with regard to the impacts of the CSP plant itself, this is largely new territory – quite possibly the case for all consultants on this project. With the exception of the one paper already cited, very little information on avifaunal impacts at existing solar plants could be found. The level of confidence with which the various impacts are discussed is therefore relatively low. However it must also be stated that many of the impacts of the CSP plant itself cannot readily be mitigated for in any case. For example if birds mistake the heliostats for water sources and are burnt in the focal points, mitigation for this would be very difficult.

- Unfortunately the Southern African Bird Atlas Project (Harrison et al 1997) data is now relatively outdated. This results in a low confidence in the report rates of the various species in the study area. Furthermore, updated data for the second bird atlas project (SABAP2), revealed a low number of counts for the relevant pentad.
- The site visit was conducted in May, over which time various species may not have been present in the study area.
- The SABAP data covers the period 1986-1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate.
- The exact position and nature of the associated infrastructure such as pipelines, power lines and roads was not available during the site visit. From personal conversation with the farmer it appears likely that there will be a new power line built from the plant to a new substation connecting to an existing High Voltage line which runs on the south west border of the study area (see Fig. 2.). The impacts therefore of associated infrastructure will therefore only be assessed fully in the final EIA phase of the study.

General comment: Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behavior can never be entirely reduced to formulas that will hold true under all circumstances.

Review of potential avifaunal issues

Extensive review of the available literature on the internet relating to avifaunal interactions at solar energy power plants revealed very little, particularly in comparison to the literature available on avifaunal interactions with other forms of power generation. Possible reasons for this include the following:

- Little knowledge on these impacts exists since so few solar plants have been constructed to date.
- The two plants previously constructed were experimental sites, not commercial. All information related to the experiments would therefore have been private and not released into the public domain.
- The impacts of solar power plants of this type on avifauna are in fact relatively minor.

One paper entitled “Avian mortality at a solar energy power plant” (McCrary, McKernan, Schreiber, Wagner & Sciarrotta 1986) was discovered. This paper describes the results of their weekly monitoring over a two year period at Solar One. The main results of this study are summarized below:

- Forty visits (one week apart) to the facility over a two year period revealed 70 bird carcasses involving 26 species. It was estimated that between 10 and 30% of carcasses were removed by scavengers in between visits, so the actual number of mortalities may have been slightly higher. It is important to note that extensive agricultural lands and evaporation ponds (53 ha) were situated adjacent to the facility, which probably resulted in a higher abundance of many bird species than would otherwise have been the case.
- Fifty seven (81%) of the birds died through collision with infrastructure, mostly (>75%) colliding with the heliostats. Species killed in this manner included water birds, small raptors, gulls, doves, sparrows and warblers.
- Thirteen (19%) of the birds died through burning in the standby points. Species killed in this manner were mostly swallows and swifts.

Briefly, some of the anticipated avifaunal issues involved with the Humansrus Solar Thermal Energy project are now described below.

Issues relating to the CSP plant itself:

- Collision with the heliostats (mirrors):
  Reflective surfaces are particularly prone to collisions in the same way as household windows. The CSP plant will consist of hundreds or thousands of heliostat mirrors and can be expected to result in some collisions.
- Collision with the central receiver tower:
  Almost any infrastructure that stands proud in the landscape will result in a certain number of collisions by birds. In this case, the central receiver tower will stand approximately 200 m tall, a significant height, particularly in this landscape. A mitigating factor is that it will be a solid concrete tower and should be relatively visible to birds.
- Roosting on the central receiver tower:
  Birds could potentially use the top of the tower as a roosting site at night. It is likely that they would only come in to roost after the plant has been shut down in the evenings, and would leave the roost before the plant starts up in the morning.
- Burning when in vicinity of the central receiver:
  The central receiver will glow white hot when the plant is operational which might potentially result in birds in the vicinity being burnt.
- Burning when entering the “standby focal points”:
  During testing, maintenance and daily start up procedures, the heliostats are focused in groups onto focal or standby points in the sky, usually at roughly the same height as the

central receiver (approximately 200 m). In the case of the CSP plant, there will be numerous standby points. McCrary et al found that 19% of the birds that were found dead at Solar One were burned in standby points. Avian foragers such as swifts and swallows accounted for 46% of these mortalities. The more time a bird spends in the air the more chance there is of it flying into a standby point. The height at which species fly is also critical, species likely to fly at this height include the swifts, swallows, and martins.

- Loss of habitat:
  The CSP plant will take up an area of approximately 3 km squared. This would obviously be habitat previously available to the birds in the area.
- Disturbance:
  Resident bird species may be disturbed by construction, operational and maintenance activities associated with the CSP plant, particularly whilst breeding.
- Nesting of Sociable Weavers and other species on the plant infrastructure:
  Experience in this arid region has shown that Sociable Weavers are quick to nest on any manmade infrastructure and they may utilize infrastructure at the CSP site.

It is important to stress that most of the above impacts – and certainly the first five listed impacts – will probably only become significant when large numbers of birds are in the vicinity of the CSP plant. For example one swallow being burnt in a focal point would hardly be considered a significant impact. However, if a large flock of swallows congregated – perhaps due to a nearby roost site – a large number of birds could be burnt and the significance would be greatly amplified. For this reason, the more sensitive species in terms of the above impacts are likely to be the gregarious, flocking species.

Issues relating to the associated infrastructure:

The EWT believes that the impacts of the associated infrastructure such as overhead power lines on birds may in fact outweigh the impacts of the CSP plant itself, depending on the length of new infrastructure that needs to be constructed. The proximity of site to the existing power line and road infrastructure is therefore very important. The closer the final site is to existing infrastructure, the less new infrastructure will need to be built. Briefly, the impacts of the associated infrastructure are as follows:

New power line:

- Collision with associated power line infrastructure.
- Electrocution on associated power line infrastructure.
- Nesting on associated power line infrastructure.

- Disturbance through construction and maintenance activities of new power line.
- Habitat destruction through construction activities of new line.

New road/s:

- Disturbance of avifauna through construction and maintenance activities.
- Habitat destruction through construction activities.

New pipe line/s:

- Disturbance of avifauna through construction and maintenance activities.
- Habitat destruction through construction activities.

Issues or factors that may attract birds to the vicinity of the CSP plant thereby amplifying the above interactions/impacts:

In this arid, relatively uniform landscape, large congregations of birds are unlikely unless a strong attractant exists, such as water.

- Birds attracted to open water evaporation ponds:
  In this landscape, any source of water is hugely important for all animals - including birds. If the CSP plant involves any open water sources such as evaporation ponds, this will attract more birds into the immediate area thus heightening the risk of the above impacts occurring. McCrary *et al* (1986) found a number of water birds (teal, grebes, coots) that had collided with heliostats at Solar One and this is almost certainly related to the presence of large (53 ha) evaporation ponds nearby. This is supported by the fact that 45% of all species recorded in 150 ha around Solar One, were only recorded at the ponds. The importance of the evaporation ponds at Solar One to birds is further illustrated by the fact that 107 bird species were recorded in the vicinity of Solar One, whilst the avian community in similar habitat elsewhere is usually less than 20 species. It is clear then that the presence of open water ponds close to the CSP plant would drastically increase the potential for avifaunal impacts.

- Birds mistakenly attracted to heliostats:
  In these arid regions the daily activity schedule of many animals and birds revolves around securing their required daily intake of water. For example, Namaqua Sandgrouse (medium report rate in the study area) fly in flocks to water sources during mid to late morning. There is a possibility that birds such as these may mistake the heliostats for water sources when flying high above and descend to investigate. In the case of the Sandgrouse, they would typically circle several times once they have located a water source, before

descending. If the heliostats are mistaken for water, these birds would most likely circle through one or more focal points and may well be burnt to death.

Regional Overview

The Northern Cape region is one of the most arid in southern Africa. In examining the region as a whole in terms of avifauna, it is important to relate the avifauna to the biomes and vegetation types present in the area. Harrison *et al* (1997) in "The Atlas of Southern African Birds" provide an excellent description of the various biomes represented in the region and the associated bird species. It is widely accepted within the ornithological community that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (in Harrison *et al* 1997). Therefore, this vegetation description focuses on factors which are relevant to bird distribution and is not a complete account of plant species. Of more relevance is the description of micro-habitat, given in following sections of this report

Nama karoo biome: This biome comprises mainly low shrubs and grasses, trees such as *Acacia karoo* and exotic species such as *Prosopis glandulosa* are restricted to watercourses. Compared to "succulent karoo", "nama karoo" has a much higher proportion of grass and tree cover. The "karoo" used loosely to mean both "nama" and "succulent karoo", supports a particularly high diversity of species endemic to southern Africa. Avifauna characteristically comprises ground dwelling species of open habitats. The tree lined watercourses allow penetration of several species typical of arid woodland such as the Kori Bustard and Karoo Korhaan. Several species are almost entirely confined to the "Nama karoo" such as the Red Lark and Sclaters Lark. Because rainfall in the "nama karoo" is in summer and the neighboring "succulent karoo" has winter rainfall, there is opportunity for species to migrate seasonally between the two. Two species suspected to do so (on the basis of atlas data) are the Ludwig's Bustard and Larklike Bunting.

Woodland biome: Woodland covers much of the northern and eastern parts of the country and is defined as having a distinct grassy under story and a woody upper story of trees and shrubs. Tree cover can range from sparse such as in the southern Kalahari, to almost closed. The more arid woodland types such as the Kalahari vegetation types are typically fine leaved and dominated by acacias and typically occur on nutrient rich, often alluvial soils in the western regions.

Central Kalahari is characterized by sparse to dense shrubland on deep Kalahari soils, grass cover is variable and dependant on rainfall. Southern Kalahari consists of open shrubland on deep Kalahari sands and again, grass cover is variable and dependant on rainfall. Avifauna of the

Kalahari vegetation types is characteristic, with many species that occur in the moister woodlands avoiding the Kalahari, probably due to the absence of surface water. At the same time there are no species truly endemic to the Kalahari, most of them also spread to other woodland types. Two species which have their ranges centered on the Kalahari however, are the Fawn-colored Lark and Kalahari Robin, representing possibly the closest to endemic species of the Kalahari.

A more site specific vegetation descriptions can be obtained from Mucina & Rutherford 2006, and the vegetation types occurring on site are identified in Figure 2 below. Six vegetation types are present in the surrounding areas of the site, namely Ghaap Plateau Vaalbosveld, Kuruman Mountain Bushveld, Kuruman Thornveld, Olifantshoek Plains Thornveld, Southern Kalahari Mekgacha, and Southern Kalahari Salt Pans. Two vegetation types Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld are present within the site itself, with the former representing the majority of the area.

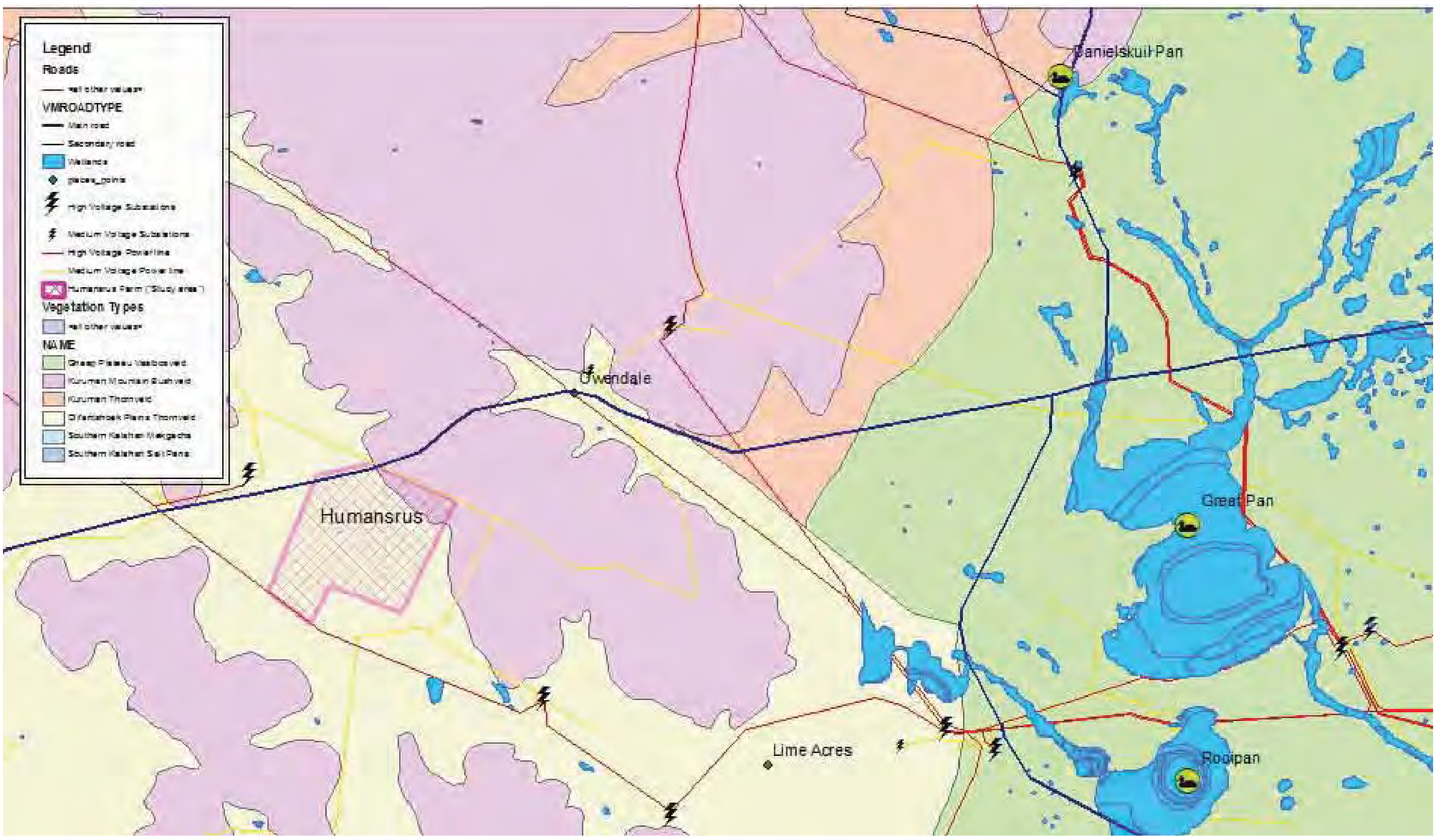


Figure 2: Vegetation Map of the site and surrounding areas, also showing CWAC sites, existing power lines, substations, roads, wetlands and places of human settlement.

Presence of Red Data bird species

Table 1 below shows report rates for the Red Data species in the study area (Harrison *et al* 1997). Report rates are an expression of the number of times a species is counted in a particular square expressed as a percentage of the number of times that square was counted. A total of 168 species have been recorded for the QDGS, which had been relatively well counted with 77 cards submitted. Eleven species recorded are listed in the red data book (Barnes, 2000)

Table 1: Red Data species recorded in the quarter degree square (2823AD) covering the study area (Harrison *et al* 1997).

Total species		168
# cards submitted		77
Species	Cons. status	Report Rate (%)
Tawny Eagle	VU	1
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
Kori Bustard	VU	1
White-backed Vulture	VU	17
Black Harrier	NT	1
Black Stork	NT	5
Secretarybird	NT	9
Greater Painted-snipe	NT	1
Greater Flamingo	NT	5

CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened.

An evaluation of CAR data revealed that there were no Co-ordinated Avifaunal Road-count routes through or near to the site. The site does not fall within an Important Bird Area (IBA) and there were no IBA’s within close proximity to the site.

An evaluation of the SABAP 2 data revealed that of the four pentads in the study area, pentad number 2820_2325, was the only one that had been sufficiently counted. This is likely due to the

fact that the settlement of Lime Acres falls within this pentad. The data for this pentad did not reveal any additional information to that obtained from the SABAP 1 data.

Three CWAC sites were identified to the east of the study area, namely Danielskuil Pan, Great Pan, and Rooipan, and are shown in Figure 2.

Bird Micro-habitats

An examination of the micro habitats available to birds within the study site was conducted. These are generally evident at a much smaller spatial scale than vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. The following micro-habitats were identified on site:

Drainage Lines and Wetlands

Figure 3: An example of a drainage line, with evidence of erosion, observed in the general study area.

Few wetland areas were observed on site. There is a "vlei" area situated parallel to the rail line at the south west of the site which appears to flow toward a small dam (see section below). The desktop study revealed the presence of Salt Pans and CWAC sites in the surrounding area (discussed above). Drainage lines and wetlands are an important form of habitat to numerous species. Drainage lines are often surrounded by natural grasslands, which may provide habitat for species such korhaans, cranes, larks and pipits. Various waterfowl, such as ducks and geese, may make use of these areas

Man-made Dams

Figure 4: A small dam observed, close to the western boundary of the farm.

Artificially constructed dams have become important attractants to various bird species in the South African landscape. Various waterfowl frequent these areas and crane species often use dams to roost in communally. Birds such as flamingos and African Spoonbills may make use of these areas. Therefore dams are a key element of this study, and should be classed as no-go areas for this project.

Grassland

Figure 5: Grassland observed on site

Grassy areas make up the majority of the site and fall within the areas classified as Olifantshoek Plains Thornveld. Grasslands represent a significant feeding area for many bird species such as Blue Crane, Secretarybird, Kori Bustard and Northern Black Korhaan. The grassland patches are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl, as well as small mammals such as Suricates (see Fig. 6). This in turn may attract large raptors because of both the presence and accessibility of prey.

Figure 6: A group of Suricates observed at their burrows, in grassland, near to the site.

Bushveld, Woodland and Thicket patches

Figure: 7: A woodland and Thicket patch observed on site

Small patches of Acacia thickets and bushes were observed, usually close to disturbed areas such as homesteads and kraals. As one moves to the periphery of the site, away from the flat grassy

areas, the elevation rises and small trees and bushveld appear (depicted as "Kuruman Mountain Bushveld" discussed above). These areas attract smaller passerine species such as Robins and Shrikes. Weavers and Sparrow-weavers use the tree as structures for nesting and Raptors such the Southern Pale Chanting Goshawk may use these areas for perching.

Figure 8: A photograph taken from an elevated point, east of the site, looking west towards the site, showing grassy areas of Olifantshoek Plains Thornveld at lower elevation, and Kuruman Mountain Bushveld at a higher elevation. The majority of the site is to be built in the flat lower lying area.

<u>Water-trough points</u>

Figure 9: A central water point for cattle on site. Note the short grazed grassy areas.

Through overgrazing and the clearance of vegetation by cattle at these feeding and watering points, a microhabitat favoured by certain species has been created. Small species such as robins and wagtails are attracted to the water trough itself to drink, while the open, short grassy areas are favoured by terrestrial species such as coursers and lapwings. Francolins and korhaans were also observed foraging in these areas during the site visit

Table 2 below shows the micro habitats that each Red Data bird typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis below represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where impacts on those species will be most significant.

Table 2: Preferred Micro-habitats and likelihood of occurrence on site of Red Data species recorded in the relevant QDGS.

Species	Preferred Micro-habitat	Likelihood of occurrence on site
Tawny Eagle	Woodland and Bushveld	Unlikely
Martial Eagle	Woodland, savannah and Shrublands	Possible
Lesser Kestrel	Arable lands and Grasslands	Likely
Blue Crane	Farm Dams, cultivated lands and grassland	Likely
Kori Bustard	Grasslands and Bushveld	Unlikely
White-backed Vulture	Savannah Woodlands and Bushveld	Possible
Black Harrier	Cultivated lands and Grasslands	Unlikely
Black Stork	Rivers and Kloofs	Unlikely
Secretarybird	Cultivated lands and Grasslands	Possible
Greater Painted-snipe	Dams and Wetlands	Unlikely
Greater Flamingo	Dams and wetlands	Possible

Focal species

After determining the red data species that are likely or may possibly be found on site, as well as identifying the microhabitats, the focal species for the study were identified. Table 3 below shows the report rates for selected species that have been recorded in the quarter degree squares covering the study area (Harrison *et al* 1997). Focal Red Data species have been included, as well

as a selection of non Red Data species which are considered to have particular relevance to this study such as raptors, doves, pigeons and aerial foragers such as swallows and swifts. Those species observed during the site visit are also indicated.

Table 3: Report rates for selected Focal Red Data species and a selection of other species that are considered particularly relevant to the study (Harrison *et al* 1997)

Species	Cons Status	Report Rate (2823AD)
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
White-backed Vulture	VU	17
Secretarybird	NT	9
Greater Flamingo	NT	5
Grey Heron*		56
Cape Teal		57
Verreaux's Eagle		55
Booted Eagle		4
Black-shouldered Kite*		69
Jackal Buzzard		0
Pale Chanting Goshawk		39
Rock Kestrel		79
Greater Kestrel		12
Helmeted Guineafowl*		55
Red-crested Korhaan		1
Black Korhaan* (pre-split)		34
Crowned Lapwing*		90
Blacksmith Lapwing*		91
Pied Avocet		25
Black-winged Stilt		56
Spotted Dikkop*		3
Double-banded Courser*		8
Namaqua Sandgrouse		36

Rock (Speckled) Pigeon		65
Red-eyed Dove*		29
Cape Turtle Dove*		44
Laughing Dove*		96
Namaqua Dove		79
Barn Owl*		4
Spotted Eagle Owl		1
White-rumped Swift		57
Little Swift		58
European Swallow (Barn)		32
White-throated Swallow		10
Greater Striped Swallow		70
Rock Martin		79
Brown-throated Martin		9
Pied Crow*		56
Mountain Chat		81
Familiar Chat*		78
Ant-eating Chat*		86
Karoo Scrub-Robin		55
Kalahari Scrub-Robin*		55
Black-chested Prinia*		66
Cape Wagtail*		95
Common Fiscal*l		94
White-browed Sparrow-weaver*		84
Sociable Weaver		1
House Sparrow*		83
Scaly-feathered Finch*		12
Red-billed Quelea*		34
Yellow Canary*		92

CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened, * = recorded during site visit.

Evaluation of avifaunal impacts

Issues relating to the CSP plant itself:

Collision with the heliostats (mirrors):

This is likely to impact on birds, but the extent to which it will occur is unknown at this stage. The impact on bird populations worldwide through them colliding with windows of buildings has been well documented (see www.flap.org). At Solar One, 81% of bird mortalities were through collision with structures, with >75% of these collisions having occurred with the heliostat mirrors themselves (McCrary *et al* 1986).

Collision with the central receiver tower:

Bird collisions with tall infrastructure have also been well documented world wide. However, this typically occurs with migratory species in flocking behavior and has usually involved low visibility conditions such as fog. There are unlikely to be sufficient numbers of any particular bird species at the site of the CSP plant to constitute flocking behavior thereby resulting in this risk. It is however likely that the occasional bird will collide with the tower.

Roosting on the central receiver tower:

The tower will be a prominent structure in the landscape and may be an attractive roost for certain bird species. Although it will be too hot during operation, as it cools down during the evenings it may be a very attractive (particularly during winter) if it retains some warmth (although the temperature it retains remains to be seen). If it is well lit at night, this may attract insects, thereby attracting birds. If birds do roost on the tower, this is likely to simply be a nuisance for plant staff, as bird pollution will build up on any available surfaces.

Burning when in vicinity of the central receiver:

It seems unlikely to be a significant impact as birds would presumably be repelled by the heat before they get within burning range. Certain particularly fast flying species may be impacted on, such as the doves, swifts, martins and swallows identified in table 3. Research at Solar One did not detect any mortalities through this mechanism (McCrary *et al* 1986).

Burning when entering the "standby focal points":

This impact is likely to occur at the CSP plant. The significance of the impact will depend on a number of factors which are unclear at this stage, for example: exactly how many focal points will exist; what size will they be; how long will they be in operation for each day. At

this stage it is safe to say that some birds will in all likelihood be killed in the focal points. The significance of the impact will depend on just how many birds, and what species are killed. Furthermore, it seems unlikely that any mitigation for this impact will be possible. Monitoring at Solar One recorded that 19% of all bird mortalities were through burning in standby or focal points – mostly swifts and swallows (McCrary *et al* 1986).

Loss of habitat:

Approximately three square kilometres will be taken up by the CSP plant in total. The vegetation in this area will should not be fully cleared automatically. Rather, only the areas where infrastructure has to be constructed should be cleared. Obviously construction activities on site will flatten and impact on certain areas of vegetation even if it is not cleared. Similar habitat is abundant in the greater area and it is anticipated that the bird species will move to surrounding areas.

Disturbance:

Construction activities will no doubt disturb the birds in the area, particularly breeding birds – however due to the uniformity of the broader area, these birds can quite easily move off and find similar habitat nearby.

Nesting of Sociable Weavers and other species on the plant infrastructure:

The extent to which this occurs will need to be monitored closely. This is an impact of the birds on the plant rather than the plant on the birds. It is hoped that the constant moving and cleaning of the heliostats will make them unattractive nesting substrate for the birds. No nests were observed within the site boundaries, however, some nests (such as the one shown in Fig. 9 below) were observed in the surrounding areas.

Figure 9: A sociable weaver nest on a manmade structure observed in the surrounding area.

Issues relating to associated infrastructure:

New power lines:

Collision of large terrestrial birds with overhead power lines is likely to occur and is anticipated to be the most significant threat posed by associated infrastructure. Species most likely to be affected are korhaans and other large terrestrial species. The significance of this impact depends on the length of new line to be built. In this case it appears that new line will be required from the CSP plant to a substation connecting with the High Voltage Line running to the South West of the site. The exact routing of this new line was not available at the time of the site visit, and the impact therefore can not be fully assessed at this stage.

Electrocution of birds on pylons will depend entirely upon the exact pylon structure that for the new line – detail of which was not available at the time of this study. Electrocution risk is determined by the phase-phase and phase-earth clearances on a pole structure which differ greatly between different structures. Again, if the structure used is dangerous to birds, the significance of this impact will vary with the length of the line.

Nesting of birds on pylons is in fact a positive impact on avifauna, but may impact negatively on the quality of electrical supply by causing electrical faults. In the case of Sociable Weaver nests, the nest material may pose problems to the pylons structural integrity through added weight, and there is an increased fire risk due to the fuel load of these massive nests.

Disturbance of avifauna through construction and maintenance activities associated with the power line is not likely to be significant.

Habitat destruction by construction activities is likely to occur, but not likely to be significant.

New roads:

Disturbance of avifauna is likely to occur to some extent, but not likely to be too significant as there is already a gravel district road (along the rail line to the west of the site) as well as various tracks through the farm and it is unlikely that extensive new roads would be, again depending on the exact layout of the CSP plant within the farm.

Habitat destruction caused by road construction will have some impact on avifauna, but as discussed elsewhere the habitat in this landscape is relatively uniform and so this impact is unlikely to be too significant.

New pipe lines:

This infrastructure is likely to have very similar impacts to the roads discussed above, except on a smaller scale. Should new pipelines be required for water supply to the CSP plant impacts of this on avifauna will be minor habitat destruction and minor disturbance.

Conclusions

The site is in the arid Kalahari and Nama Karoo Biomes of the Northern Cape, with uniform vegetation of only two types (Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld) found on the study site. The uniformity of the site resulted in few microhabitats available for birds. There were no major water bodies or wetlands on site, with only one small dam and a narrow “vlei” area to the south west of the site. The presence of three CWAC sites to the East of the study area,

means that it is possible for waterfowl and other bird species associated with water, may be attracted to additional water sources (e.g. evaporation ponds) created by the CSP project. A prediction of the impacts of the proposed CSP plant on avifauna at Humansrus revealed the following key findings:

Impacts associated with CSP plant:

- Collision of birds with heliostats is likely to be of moderate significance. It is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Burning of birds in focal points will be of moderate significance. Again, it is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Habitat destruction and disturbance of bird will be of moderate significance. This can be mitigated by ensuring that the construction Environmental Management Plan incorporates guidelines as to how best to minimize this impact.

Impacts associated with new power lines:

- Collision of birds with overhead power lines is likely to be of moderate significance. This will be mitigated for by marking the relevant sections of line with appropriate marking devices. These sections of line will be identified as part of the Environmental Management Programme (EMP) phase.

Impacts associated with new roads, pipe lines.

- Habitat destruction and disturbance of birds will be of moderate to low significance. This will be mitigated by ensuring that the construction EMP incorporates guidelines as to how best to minimize this impact.

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Project code: SSI – HSP - 2011/17

Terrestrial Biodiversity Scoping Assessment for the proposed Humansrus Solar Thermal Energy Power Plant on the Farm Humansrus 469, Northern Cape Province

compiled by

Bathusi Environmental Consulting

May 2011

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I PROJECT DETAILS

Client:	Worley Parsons RSA PTY (LTD) & SSI Engineers & Environmental Consultants
Report name:	Strategic Biodiversity Scoping Assessment for the proposed Concentrated Solar Plant (CSP) on Farm Humansrus 469, Northern Cape Province.
Report type:	Terrestrial Biodiversity Scoping Assessment Report
BEC Project number:	SSI - HSP – 2011/17
Authority Reference:	N/A
Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.)

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III SPECIALIST INVESTIGATORS

The Natural Scientific Professions Act of 2003 aims to '*provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith*'.

Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

Floristic Investigator:	Riaan Robbeson (Pr.Sci.Nat.)
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
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Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	*667.08/08*
Investigator:	**Dewald Kamffer (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*

IV DECLARATION OF INDEPENDENCE

All specialist investigators, project investigators and members of companies employed for the purpose of conducting this biodiversity investigation declare that:

- BEC act as independent consultants compiling this report;
- BEC is not a subsidiary, legally or financially, of the proponent;
- Specialists employed for the purpose of this assessment are bound to the rules and ethics of the South African Council for Natural Scientific Professions;
- At the time of completing this report, BEC did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than financial compensation for work performed in a professional capacity in terms of the Environmental Impacts Assessment Regulations, 2005;
- BEC will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the general public;
- BEC do not have any influence over decisions made by the governing authorities;
- BEC undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2005;
- BEC will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not;
- BEC do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience; and
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.

Signature of principal ecologist:

Bathusi Environmental Consulting cc (CK1999/052182/23)

Name of company:

17th May 2011

Date:

V SURVEY DETAILS

No site investigations were conducted for this phase of the project and the report is based on a desk-top analysis of available data. Suitable field surveys will be conducted during the EIA phase of the project.

VI LEGISLATION

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

- (a) Details of (i) The person who prepared the report, and
  (ii) The expertise of that person to carry our the specialist study or specialised process;
- (b) A declaration that the person is independent in a form as may be specified by the competent authority;
- (c) An indication of the scope of, and the purpose for which, the report was prepared;
- (d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
- (e) A description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- (g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
- (h) A summary and copies of any comments that were received during any consultation process;
- (i) Any other information requested by the competent authority.

Compliance with provincial, national and international legislative aspects is strongly advised during the planning, assessment, authorisation and execution of this particular project. Legislative aspects taken cognisance of during the compilation of this report included the following, but may not necessarily be limited to the following:

Table 1: Legislative guidance for this project	
Biodiversity Act (No. 10 of 2004)	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
Conservation of Agricultural Resources Act 43 of 1983	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
Convention on International Trade in Endangered Species of Wild Life and Fauna	International agreement between governments, drafted as a result of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Environmental Conservation Act (No. 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
National Environmental Management Act (No. 107 of 1998)	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated and positive aspects enhanced.
National Environmental Management Act (No 10 of 2004)	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
National Forest Act, 1998 (No 84 of 1998)	Cutting, disturbing, damaging or destroying any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of the subsection published by the Minister in the Gazette. The sections include protected tree species, a particular tree, a group of trees or particular woodland to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire of dispose of any protected tree, except under a licence granted by the Minister.
National Spatial Biodiversity Assessment	The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on its biophysical characteristics, which are ranked according to priority levels.

Table 1: Legislative guidance for this project	
Protected Areas Act (No. 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
Protected Species – Provincial Authorities	Provincial ordinances were developed to protect particular plant species within specific provinces. The protection of these species is enforced through permitting requirements associated with provincial lists of protected species. Permits are administered by the provincial departments responsible for environmental affairs.

VII CONTENTS

VIII LIST OF TABLES

IX LIST OF FIGURES

1 EXECUTIVE SUMMARY

Objectives of this Biodiversity Scoping Assessment are firstly to assess regional and local biodiversity sensitivities, secondly to identify macro habitat characteristics of the proposed project alternatives and lastly to present a preliminary opinion on the proposed site in terms of suitability for the project by means of identifying likely/ potential impacts.

Non-perennial streams are present in the south western part of the study area. In addition, it would appear as if wider floodplains are associated with some of the streams. The region is generally classified as relative dry and the ecological functionality of these areas would therefore be important on a local and regional scale on a temporary basis. No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

Land cover of the region of the study comprises extensive untransformed habitat with limited areas characterised by development, agriculture, mining and other forms of habitat transformation. The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprises variable habitat in terms of relief and spatial heterogeneity. No declared area of conservation is present within the general surrounds of the study area. The study area however does fall within the Griqualand West Centre of Endemism.

Although it is not in the scope of this report to present a detailed description of the soil types of the area, the Ae214/215 and Ib237 land types are present within the study area.

The study area is situated within the Savanna Biome, comprising two VEGMAP vegetation types, namely Kuruman Mountain Bushveld and Olifantshoek Plains Thornveld. Both are ascribed a Least Threatened conservation status. The SANBI database indicates the known presence of only 165 plant species within this particular ¼ degree grid (2823AD). This relative low diversity is the result of poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity. The SANBI database indicates the following protected tree species as being present in this ¼ degree grid:

- *Acacia haematoxylon;* and
- *Boscia albitrunca.*

Although not captured in the database, it is also likely that *Acacia erioloba* (Camel Thorn) will be present within the area. In addition it has been indicated that *Olea europaea* subsp. *europaea* of exceptional size is present in the study area. These individuals, although not a protected species of this province, might qualify as remarkable trees and special mitigation measures might be needed to protect the individuals.

No Red Data plants are known to occur in the study area, or the immediate surrounds. However, the regional floristic diversity indicates a relative poor knowledge of the

vegetation of the area. It is therefore likely that Red Data flora species might be present, but yet undiscovered.

A total of 56 Red Data animals (excluding avifauna) are known to occur in the Northern Cape Province. Of these species, 13 are listed as Data Deficient (DD), 21 are listed as Near Threatened (NT), 12 are listed as Vulnerable (VU), 5 are listed as Endangered (EN) and 5 species are listed as Critically Endangered (CR). It is estimated that approximately 79% of these species have a low probability of occurring in the immediate region of the study area, 11 species are estimated to have a moderate probability of occurring and one a high probability of occurrence in the immediate region of the study area.

Macro habitat types (with estimated preliminary sensitivities) identified from aerial images includes the following:

- Floodplains (Medium-high sensitivity);
- Localised Rocky Outcrops (Medium-high sensitivity);
- Mountain Woodland (High sensitivity);
- Non-perennial streams (High sensitivity);
- Shrubveld Plains (Medium-low sensitivity); and
- Woodland Plains & Hills (Medium sensitivity).

The development of a CSP in an area such as this will result in a severe impact on the ecological status of the area since it is largely a destructive activity. The study area comprises natural and (assumed) relative pristine woodland/ savanna as well as mountainous terrain. On a local scale the impact is therefore expected to be severe and significant. However, the VEGMAP database indicates that much of the Olifantshoek Plains Thornveld remains untransformed on a regional scale (app. 99%) and the loss of this area (app. 900ha) is regarded insignificant on a regional scale. The contribution of this proposed development in terms of local and regional fragmentation and habitat isolation will similarly be extremely low since little of the region comprises transformed habitat. However, a major development such as this in a largely undeveloped region is frequently viewed as the 'thin end of the wedge', allowing the opportunity, start and means for future development in the area, effectively meaning the start habitat transformation on a larger scale.

The EIA phase will therefore be used to assess the sensitivity of the receiving environment on a local and regional scale. Questions that need to be answered in the EIA phase include:

- Are there any biological or biophysical attributes of conservation importance present on the property that that will ultimately be affected severely and significantly by the proposed development;
- Are there any biological or biophysical attributes present within the proposed development boundary that sets it apart from neighbouring properties and surrounding areas in terms of uniqueness and conservation potential;
- Does the property, or any part thereof, represent an area of importance in terms of regional, provincial or national conservation strategies;

- Will the relocation of the proposed development to a nearby (assumed technically and financially feasible) area result in lower impact on the biological environment/ does this property represent the optimal location in terms of biodiversity attributes on a local and regional scale;
- Can impacts resulting from the proposed development be mitigated to an acceptable level;
- Will the loss of this area imply a severe and significant impact on the biological environment in terms of ecological functionality and attributes such as migration patterns, local and regional habitat fragmentation and isolation characteristics, etc. on the short and/ or long term?

Potential impacts on the ecological environment were placed in three categories, namely:

- Direct impacts:
  - Destruction of threatened and protected flora species;
  - Direct impacts on threatened fauna species;
  - Destruction of sensitive/ pristine habitat types;
  - Direct impacts on common fauna species;
- Indirect Impacts:
  - Floristic species changes subsequent to development;
  - Faunal interactions with structures, servitudes and personnel;
  - Impacts on surrounding habitat/ species;
- Cumulative Impacts:
  - Impacts on SA's conservation obligations & targets (VEGMAP vegetation types);
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation.

The nature and extent of these impacts will be assessed during the EIA phase of the project, and potential and suitable mitigation measures will be recommended in order to attempt the mitigation of impacts.

2 TERMS OF REFERENCE

Objectives of this Biodiversity Scoping Assessment are firstly to assess regional and local biodiversity sensitivities, secondly to identify macro habitat characteristics of the proposed project alternatives and lastly to present a preliminary opinion on the proposed site in terms of suitability for the project by means of identifying likely/ potential impacts.

The Terms of Reference for this scoping assessment are as follows:

- Incorporate available data of the study area into the assessment, including existing scientific reports, regional conservation information and databases;
- Conduct a high level photo analysis of the proposed area in order to identify preliminary habitat variations;
- Provide broad descriptions of the terrestrial environment (ecological habitat types) of the proposed site as perceived from aerial images;
- Compile a preliminary sensitivity assessment of identified habitat types;
- Provide a description of ecological attributes present within the proposed site that are regarded as important on a local and/ or regional scale;
- Provide a basic description of impacts (direct, indirect and cumulative impacts) on the terrestrial environment that may result from the proposed project and activities associated with the project;
- Provide a statement regarding the potential significance of the identified impacts and issues as it relates to the proposed site;
- Map all relevant aspects;
- Identify gaps of information as perceived during this process;
- Provide recommendations regarding the methodology to be adopted in the EIA phase in assessing potentially significant impacts; and
- Present all results in a suitable format.

3 INTRODUCTION

Destructive activities in a natural environment require vigilance to ensure that the biological and cultural heritage of future generations is not adversely affected by activities of today. Concern is growing about the consequences of biodiversity losses, for ecosystem functioning, for the provision of ecosystem services and for human well being.

Why is Biodiversity Conservation Important? Biodiversity sustains life on earth. An estimated 40 percent of the global economy is based on biological products and processes. Biodiversity has allowed massive increases in the production of food and other natural materials, which in turn have fed the (uncontrolled) growth and development of human societies. Biodiversity is also the basis of innumerable environmental services that keep us and the natural environment alive, from the provision of clean water and watershed services to the recycling of nutrients and pollination.

Current pressures on and losses of biodiversity are unfortunately threatening to undermine the functionality of natural ecological processes and adaptive responses of the environment. The last few decades have witnessed brutal increases in the rate at which biodiversity is being altered by humanity. With uncontrolled growth of human population, consumption needs have increased exponentially as well as the drive to extract more economically valuable resources at ever faster rates. Natural habitats that harbour some of the world's most valuable biodiversity are being lost at increasingly faster and over progressively wider areas, while managed lands are undergoing increasing simplification. Adopting 'biodiversity friendly' practices remains challenging within the entire developmental sphere, especially for smaller companies and peripheral players. This is partly because governments, while perhaps committed on paper to biodiversity, have found it difficult to create the right incentives and apply the necessary regulations in a way that could encourage all players to conserve biodiversity.

Humanity faces the challenge of supporting the needs of growing populations from a rapidly shrinking natural resource base. Achieving a balance while doing this will require a better understanding and recognition of conservation and development imperatives and this is only a step towards more strategic and integrated approach to land use planning and management that helps societies make better-informed decisions. Evidence illustrate how management tools, rehabilitation and restoration processes, together with improved scientific knowledge, can help conserve biodiversity; also highlighting that mutual benefits can result from stronger collaboration between the development and conservation sectors. Good practice, collaboration and innovative thinking can advance biodiversity conservation worldwide while ensuring that the minerals and products that society needs are produced responsibly.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. The enactment of the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

4 LIMITATIONS & LIABILITIES

Although care was taken during this assessment to present a document of adequate detail, the presentation of a detailed biological and biophysical data pertaining to the proposed site and surrounds is not an objective of this particular phase of the study. Results presented in this report are ultimately based on a desktop assessment of available data and not on the detailed long-term investigation of all environmental attributes and the varying degrees of biological diversity that may be present in the study area. No concrete conclusions may therefore be drawn with regards to biological diversity or conservation strategies as far as this study area is concerned. Results of this assessment therefore represent only a preliminary investigation; the study area will ultimately be subjected to more detailed biodiversity investigations during the EIA phase.

It is emphasised that information, as presented in this document, only have bearing on the site as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

Lastly, additional information may come to light during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

5 PROJECT BACKGROUND

Solar energy use currently contributes a very small portion of the total energy supply in the Northern Cape Province. Approximately 0.2% of households use it for cooking, and 0.15% uses it for heating, but the Northern Cape has the highest solar energy use for lighting (1%) when compared to other provinces. In particular, the area of the Northern Cape bordering Namibia has the highest solar radiation intensity in southern Africa, and there is a national drive to increase the use of solar energy technologies (SoER, 2004).

SolarReserve SA (Pty) Ltd is planning a Concentrated Solar Power (CSP) plant on the Farm 469, Hay RD (Humansrus), situated approximately 4 km southeast of Groenwater and 30 km east of Postmasburg, in the Northern Cape, Tsantsabane Local Municipality. Beal Environmental Consulting was appointed as independent environmental consultants to conduct the Environmental Impact Assessment (EIA) process for the proposed development. WPRSA / SSI were appointed as independent consultant to carry out the Public Participation process.

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, SolarReserve SA (Pty) Ltd is assessing the feasibility of constructing a CSP plant with a

maximum capacity of 100 MW in the Northern Cape. This CSP plant will comprise of four main subsystems, namely:

- Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- The Power Block; and
- Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Bathusi Environmental Consulting cc was appointed to conduct the relevant terrestrial biodiversity investigations. Riaan A. J. Robbeson conducted the floristic assessment while Dewald Kamffer (Ecocheck cc) assessed the faunal components.

6 APPROACH TO THIS SCOPING ASSESSMENT

In order to present an objective opinion of the terrestrial biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of any area within the proposed site in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects:

- A desk-top assessment of all available biological and biophysical data;
- Specialist interpretation of available data, or known sensitivities of certain regional attributes; and
- A GIS based sensitivity analysis.

6.1 Background Information

This biodiversity scoping assessment will establish a reference point for the biophysical and biological sensitivities of the study area by means of the Ecosystem Approach or Landscape Ecology. The Ecosystem Approach is advocated by the Convention on Biological Diversity, recognizing that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

For the purpose of this particular study a local / regional scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. In laymen's terms it implies that if sensitive habitat types/ ecosystems (frequently associated with biodiversity elements of high sensitivity or conservation importance) are protected, species that are sensitive to changes in the environment will ultimately be protected. Species conservation is therefore largely replaced by the concept of habitat conservation. This approach is regarded effective since the protection of sensitive ecosystems will ultimately filter down to species level.

It is inevitable that the Landscape Ecology Approach will not function effectively in all cases since extremely localised and small areas will inevitably occur scattered in an area, which can not always be captured on available databases. In addition to the compilation of basic species lists and the identification and description of localised ecological habitat it is also regarded important to identify areas of sensitivity on a local scale and, where possible, communities or species that are considered sensitive in terms of impacts that are likely to result from the proposed development.

7 BIOPHYSICAL ATTRIBUTES

The regional setting of the proposed site is indicated in Figure 1, with georeferenced Google Earth images presented in Figure 2, downloaded from the Google Earth website and georeferenced using Arcview 3.2.

7.1 SURFACE WATER

Areas of surface water contribute significantly towards the local and regional biodiversity of an area due to the atypical habitat that is available within the ecotonal areas. These ecotones (areas or zones of transition between different habitat types) are frequently occupied by species that occur in both of the bordering habitats, and is therefore generally rich in species due to the confluence of habitats. In addition to daily visitors that utilise water sources on a frequent basis, some flora and fauna species are specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas, exhibiting extremely narrow habitat variation tolerance levels. Ecotonal interface areas form narrow bands around areas of surface water and they constitute extremely small portions when calculated on a purely mathematical basis. However, taking the high species richness into consideration these areas are extremely important on a local and regional scale. Rivers also represent important linear migration routes for a number of fauna species as well as a distribution method for plant seeds.

The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the south western part of the study area; evident from the Google Earth images. In addition to the presence of these non-perennial streams, it would appear as if wider floodplains are associated with the streams. The region is generally classified as relative dry and the ecological functionality of these areas would therefore be important on a local and regional scale on a temporary basis. The northern part of the study area is characterised by mountainous terrain and seasonal flow from these areas created floodplains at the foothills of the mountains. These areas are mostly characterised by wide, flat and sandy beds. Due to the rapid nature of the drainage, the habitat is normally not characterised by riparian or wetland related species.

No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

Figure 1: Regional setting of the study area

Figure 2: Google Earth image of Site 1

7.2 Land Cover and Land use

Since land use often determines land cover, it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land. Most of the Province is dominated by vast open areas of natural vegetation; 69.7% of the total area is covered by shrubland and low fynbos. A further 14.2% of the Northern Cape is dominated by thicket vegetation and bushland. A total of 0.7% of the Province is classified as degraded whilst 0.2% has dongas and sheet erosion. Urbanisation in the Province is relatively low at 0.1% (SoER, 2004).

Land cover categories of the general region are presented in Figure 3. For the purpose of this assessment, land cover are loosely categorised into classes that represent natural habitat and land cover categories that resulted from habitat degradation and transformation on a local or regional scale. Areas that are characterised by high levels of transformation and habitat degradation is generally accepted as being suitable for development purposes as it is unlikely that biodiversity attributes of importance will be present or affected by development. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes.

The region of the study comprises extensive untransformed habitat with limited areas characterised by development, agriculture, mining and other forms of habitat transformation. One of the shortfalls of the ENPAT database is that it does not reflect the current status of natural habitat within the study area. At this stage of the process it is therefore assumed that all areas indicated as natural habitat is representative of the regional vegetation types and are in a good condition. While this assumption is unlikely to hold true throughout the region, an assessment of the actual ecological status of vegetation types within the study area is beyond the scope of this report and will only be addressed during the EIA phase.

7.3 Topography, Relief and Slopes

The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprising the Ib land type, is likely to be variable in relief and spatial heterogeneity. The presence of these habitat types is important in terms of habitat variability and ultimately biodiversity attributes that characterise these parts. Hills and ridges have generally been shown to have a rich biodiversity consisting of an important habitat for sensitive species as well as high plant diversity.

Topographical categories are presented in Figure 4.

Figure 3: Land Cover of the general region

Figure 4: Topographical categories of the general region

7.4 Declared Areas of Conservation

No declared area of conservation is present within the general surrounds of the study area. The study area however does fall within the Griqualand West Centre of Endemism.

7.5 Land Types

Although it is not in the scope of this report to present a detailed description of the soil types of the area, a basic description will suffice for this assessment as a strong association between habitat types and land types are typically known to occur. The following land type units are encountered in the study area:

- Ae214/215 - A- land types generally represent flat or slightly undulating landscapes, on granite, shale and Karoo sediments which mostly give rise to deep, freely drained soils. Yellow & red soils without a water table predominate, belonging in one or more of the Inanda, Kranskop, Magwa, Hutton, Griffon or Clovelly soil forms. The land does not qualify as a plinthic catena and one of the above soil forms occupy at least 40% of the area (red, high base status, >300mm deep, no dunes); and
- Ib237 - This land type is characteristic of the very rocky quartzite hills and ridges, with very little, shallow soil. These ridges have grassland on cooler, exposed sites and bush on warmer sheltered sites [land types with exposed rock (exposed country rock, stones or boulders) covering more than 80% of the area. The rocky portion may be underlain by soils which would have qualified the unit for inclusion in another broad soil pattern was it not for the surface rockiness].

Land types of the region are illustrated in Figure 5.

7.6 Regional Ecology

7.6.1 Background

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. The term savanna is widely used to describe a vegetation type with a well-developed grassy layer and an upper layer of woody plants. The distribution of variations and smaller communities are correlated with many environmental factors, including geology, landform, climate, soil types, fire and a very specific faunal composition. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity. A major factor delimiting the biome is the lack of sufficient rainfall which prevents the upper layer from dominating. This, coupled with fires and grazing, keeps the grass layer dominant.

Conservation of savanna is good in principle, mainly due to the presence of the Kruger and Kalahari Gemsbok National Parks within the biome. Similarly, in neighbouring countries, large reserves occur, such as Etosha, Gemsbok, Chobe and Hwange National Parks and the Central Kalahari Game Reserve. However, this high area conserved in South Africa, belies the fact that half of savanna vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game-farming and can thus be considered effectively preserved, provided that sustainable stocking levels are maintained. The importance of tourism and big game hunting in the conservation of the area must not be underestimated.

African savannas are inhabited by 13,000 plant species, of which 8,000 are savanna endemics. Dry savannas, specifically, have more than 3,300 endemic species. This plant biodiversity equals that of the South African grasslands, and is only exceeded by the Fynbos biome. In respect of animal biodiversity, the savannas are without peer. Dry South African savannas have more recorded species of amphibians (52 species), reptiles (177 species), birds (519 species) and mammals (171 species) than any other biome.

The Kalahari savanna is a sandy, arid region in the western interior. Within the Kalahari savanna system, seven major vegetation types have been described. Two of these vegetation types are present within the study area, namely the Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld) and Kalahari Mountain Bushveld (Kuruman Mountain Bushveld).

Flagship fauna species for the Savanna Biome include:
- Starbust Horned Baboon Spider (*Ceratogyrus bechuanicus*);
- Ground Hornbill (*Bucorvus leadbeateri*);
- Cape Griffon (*Gyps coprotheres*);
- Wild Dog (*Lycaon pictus*);
- Short-eared Trident Bat (*Cloeorotis percivali*); and
- White Rhinoceros (*Ceratotherium simum*).

The study area comprises two VEGMAP vegetation types (Figure 6), namely:
- Kuruman Mountain Bushveld; and
- Olifantshoek Plains Thornveld.

7.6.2 Kuruman Mountain Bushveld

This vegetation is characterised by rolling hills with gentle to moderate slopes and hill pediment areas with an open shrubveld with *Lebeckia macrantha* prominent in places with a well developed grass layer. The conservation status of this unit is set at Least Threatened, but none of this vegetation type is formally conserved in statutory conservation areas. The transformation status is low, but some parts are heavily utilised for grazing purposes.

Species of conservation importance that are present in this vegetation type include the Griqualand West Endemics *Lebeckia macrantha*, *Justicia puberula*, *Tarchonanthus obovata*, *Euphorbia wilmaniae*, *Digitaria polyphylla*, *Sutera griquensis* and the Endemic *Euphorbia planiceps.*

7.6.3 Olifantshoek Plains Thornveld

This vegetation type comprises the pediment areas of the major mountains in the region as well as some of the ridges to the west. The vegetation comprises very wide and diverse units on plains with usually open tree and shrub layers with *Acacia luederitzii*, *Boscia albitrunca* and *Searsia tenuinervis*. The grass layer is typically poorly developed and sparse. Red aeolian sands characterise the substrate.

The conservation status of this vegetation type is set at Least Threatened, with only 0.3% statutorily conserved in the Witsand Nature Reserve. Only about 1% of the area has been transformed and erosion is low.

Species of conservation importance that are present in this vegetation type include the Kalahari and Griqualand West Endemics *Acacia luederitzii* var. *luederitzii*, *Lebeckia macrantha*, *Hermannia burchelli*, *Justicia puberula*, *Putterlickia saxatilis*, *Tarchonanthus obovata*, *Anthephora argentea*, *Sutera griquensis* and the Endemic *Amphiglossa tecta.*

Figure 5: Land Types of the general region

Figure 6: VEGMAP vegetation types of the region

7.7 Regional Floristic Diversity

The SANBI database indicates the known presence of only 165 plant species within this particular ¼ degree grid (2823AD). This relative low diversity is the result of poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity.

The following plant species are known to occur in the region of the study area (SANBI Database):

Table 2: PRECIS data for 2823AD	
Species	Family
Acacia haematoxylon	Fabaceae
Acacia hebeclada subsp. *hebeclada*	Fabaceae
Acacia tortilis subsp. *heteracantha*	Fabaceae
Anthephora pubescens	Poaceae
Antizoma angustifolia	Menispermaceae
Aristida adscensionis	Poaceae
Aristida congesta subsp. *congesta*	Poaceae
Aristida meridionalis	Poaceae
Aristida stipitata subsp. *spicata*	Poaceae
Aristida vestita var. *vestita*	Poaceae
Asparagus suaveolens	Asparagaceae
Atriplex semibaccata var. *appendiculata*	Chenopodiaceae
Barleria bechuanensis	Acanthaceae
Boscia albitrunca	Capparaceae
Brachiaria marlothii	Poaceae
Caesalpinia gilliesii	Fabaceae
Calobota cuspidosa	Fabaceae
Chascanum pinnatifidum var. *pinnatifidum*	Verbenaceae
Chenopodium hederiforme var. *dentatum*	Chenopodiaceae
Chloris virgata	Poaceae
Cirsium vulgare	Asteraceae
Cleome angustifolia subsp. *diandra*	Capparaceae
Coccinia sessilifolia	Cucurbitaceae
Convolvulus boedeckerianus	Convolvulaceae
Convolvulus ocellatus	Convolvulaceae
Cucumis heptadactylus	Cucurbitaceae
Cynodon dactylon	Poaceae
Cyperus difformis	Cyperaceae
Datura inoxia	Solanaceae
Deverra burchellii	Apiaceae
Digitaria eriantha	Poaceae
Diospyros austro-africana var. *microphylla*	Ebenaceae
Ehretia alba	Boraginaceae
Enneapogon desvauxii	Poaceae
Enneapogon scoparius	Poaceae
Eragrostis bicolor	Poaceae

Table 2: PRECIS data for 2823AD	
Species	Family
Eragrostis echinochloidea	Poaceae
Eragrostis homomalla	Poaceae
Eragrostis lehmanniana var. *lehmanniana*	Poaceae
Eragrostis mexicana subsp. *virescens*	Poaceae
Eragrostis pallens	Poaceae
Eragrostis pilgeriana	Poaceae
Eragrostis porosa	Poaceae
Eragrostis procumbens	Poaceae
Eragrostis sp.	Poaceae
Eragrostis trichophora	Poaceae
Eragrostis truncata	Poaceae
Eriocephalus ericoides subsp. *griquensis*	Asteraceae
Erucastrum austroafricanum	Brassicaceae
Erucastrum strigosum	Brassicaceae
Eucalyptus camaldulensis	Myrtaceae
Eucalyptus sp.	Myrtaceae
Euclea crispa subsp. *ovata*	Ebenaceae
Euphorbia duseimata	Euphorbiaceae
Euphorbia mauritanica var. *mauritanica*	Euphorbiaceae
Galenia pubescens	Aizoaceae
Gazania sp.	Asteraceae
Geigeria filifolia	Asteraceae
Glossochilus burchellii	Acanthaceae
Gnidia polycephala	Thymelaeaceae
Gymnosporia buxifolia	Celastraceae
Gymnosporia sp.	Celastraceae
Helichrysum cerastioides var. *cerastioides*	Asteraceae
Helichrysum zeyheri	Asteraceae
Heliophila suavissima	Brassicaceae
Heliotropium ciliatum	Boraginaceae
Hereroa carinans	Aizoaceae
Hermannia comosa	Malvaceae
Hermannia eenii	Malvaceae
Hermannia erodioides	Malvaceae
Hermannia jacobeifolia	Malvaceae
Hermbstaedtia fleckii	Amaranthaceae
Hermbstaedtia odorata var. *aurantiaca*	Amaranthaceae
Hertia ciliata	Asteraceae
Heteropogon contortus	Poaceae
Hyparrhenia hirta	Poaceae
Hypertelis salsoloides var. *salsoloides*	Molluginaceae
Indigofera alternans var. *alternans*	Fabaceae
Indigofera denudata	Fabaceae
Indigofera sp.	Fabaceae
Ipomoea oenotheroides	Convolvulaceae
Jamesbrittenia atropurpurea subsp. *atropurpurea*	Scrophulariaceae

Table 2: PRECIS data for 2823AD	
Species	Family
Jamesbrittenia aurantiaca	Scrophulariaceae
Jamesbrittenia tysonii	Scrophulariaceae
Juncus rigidus	Juncaceae
Justicia puberula	Acanthaceae
Kedrostis foetidissima	Cucurbitaceae
Kohautia cynanchica	Rubiaceae
Kyphocarpa angustifolia	Amaranthaceae
Lactuca inermis	Asteraceae
Laggera decurrens	Asteraceae
Lantana rugosa	Verbenaceae
Lessertia affinis	Fabaceae
Leucas capensis	Lamiaceae
Limeum argute-carinatum var. *argute-carinatum*	Molluginaceae
Lithops aucampiae subsp. *aucampiae*	Aizoaceae
Lopholaena cneorifolia	Asteraceae
Lycium horridum	Solanaceae
Melinis repens subsp. repens	Poaceae
Melolobium burchelli	Fabaceae
Melolobium microphyllum	Fabaceae
Menodora africana	Oleaceae
Mirabilis jalapa	Nyctaginaceae
Monechma divaricatum	Acanthaceae
Nemesia lilacina	Scrophulariaceae
Oenothera indecora	Onagraceae
Olea europaea subsp. *africana*	Oleaceae
Ornithoglossum dinteri	Colchicaceae
Osteospermum sp.	Asteraceae
Osteospermum spinescens	Asteraceae
Oxalis depressa	Oxalidaceae
Oxalis lawsonii	Oxalidaceae
Pachypodium succulentum	Apocynaceae
Panicum stapfianum	Poaceae
Parkinsonia aculeata	Fabaceae
Pavonia burchellii	Malvaceae
Pelargonium multicaule subsp. *multicaule*	Geraniaceae
Peliostomum leucorrhizum	Scrophulariaceae
Pentarrhinum insipidum	Apocynaceae
Pentzia quinquefida	Asteraceae
Plantago lanceolata	Plantaginaceae
Platycarphella parvifolia	Asteraceae
Plinthus sericeus	Aizoaceae
Plinthus sericeus	Aizoaceae
Pogonarthria squarrosa	Poaceae
Pollichia campestris	Caryophyllaceae
Polygonum bellardii	Polygonaceae
Pteronia cylindracea	Asteraceae

Table 2: PRECIS data for 2823AD	
Species	Family
Rosenia humilis	Asteraceae
Ruschia semidentata	Aizoaceae
Ruschia sp.	Aizoaceae
Salvia disermas	Lamiaceae
Salvia stenophylla	Lamiaceae
Salvia verbenaca	Lamiaceae
Schmidtia kalahariensis	Poaceae
Searsia ciliata	Anacardiaceae
Searsia lancea	Anacardiaceae
Searsia pendulina	Anacardiaceae
Searsia pyroides var. *pyroides*	Anacardiaceae
Searsia tridactyla	Anacardiaceae
Selago albida	Scrophulariaceae
Selago mixta	Scrophulariaceae
Senecio carnosus	Asteraceae
Sericorema sericea	Amaranthaceae
Sesamum triphyllum var. *triphyllum*	Pedaliaceae
Solanum namaquense	Solanaceae
Sporobolus fimbriatus	Poaceae
Stachys spathulata	Lamiaceae
Stipagrostis ciliata var. *capensis*	Poaceae
Stipagrostis sp.	Poaceae
Stipagrostis uniplumis var. *uniplumis*	Poaceae
Styphnolobium japonicum	Fabaceae
Tarchonanthus camphoratus	Asteraceae
Tecoma stans var. *stans*	Bignoniaceae
Themeda triandra	Poaceae
Thesium lacinulatum	Santalaceae
Tragus racemosus	Poaceae
Triraphis purpurea	Poaceae
Typha capensis	Typhaceae
Viscum rotundifolium	Viscaceae
Wahlenbergia androsacea	Campanulaceae
Withania somnifera	Solanaceae
Zinnia peruviana	Asteraceae
Zygophyllum pubescens	Zygophyllaceae

7.8 Plant Species of Conservation Importance

South Africa is the third most biologically diverse country in the world, yet plant and animal species are over utilised and between 14% and 37% of plant, bird, reptile, amphibian, mammal and butterfly species are listed as threatened in South African Red Data Books. The SANBI database indicates the following protected tree species as being present in this ¼ degree grid:

- *Acacia haematoxylon;* and
- *Boscia albitrunca.*

Although not captured in the database, it is also likely that *Acacia erioloba* (Camel Thorn) will be present within the area. In addition it has been indicated that *Olea europaea* subsp. *europaea* of exceptional size is present in the study area. These individuals, although not a protected species of this province, might qualify as remarkable trees and special mitigation measures might be needed to protect the individuals.

No Red Data plants are known to occur in the study area, or the immediate surrounds. However, the regional floristic diversity indicates a relative poor knowledge of the vegetation of the area. It is therefore likely that Red Data flora species might be present, but yet undiscovered.

7.9 Alien & Invasive Plant Species

Invasive alien species pose the second largest threat to biodiversity after direct habitat destruction. Approximately 1,900 of South Africa's 3,435 Red Data Book species are threatened directly or indirectly affected by alien invasive plants. In the Northern Cape, many invasive alien species are well established and cause substantial damage (SoER, 2004). Invasive species are a threat to indigenous species through the following mechanisms:

- Displacement by direct competition;
- Reduction of structural diversity;
- Disruption of the prevailing vegetation dynamics;
- Impacts on fire regimes due to increases in biomass;
- Alteration of local hydrology; and
- Modification of nutrient cycling (Van Wilgen and Van Wyk, 1999).

The following five alien invasive species are the most widely distributed within the Northern Cape:

- *Atriplex lindleyi* (Sponge-fruit saltbush) (Category 3);
- *nummularia* (Old-man saltbush) (Category 2);
- *Nicotiana glauca* (Wild tobacco) (Category 1);
- *Opuntia ficus-indica* (Sweet prickly pear) (Category 1); and
- *Prosopis glandulosa* var. *torreyana/velutina* (Honey mesquite) (Category 2).

No information is yet available on the presence and extent of alien and invasive plant species within the study area or the immediate region. This aspect will be investigated in more detail during the EIA phase of the project.

8 REGIONAL FAUNAL PROBABILITIES

The following Red Data fauna species (with estimated probabilities for the proposed site) are known to occur in the Northern Cape Province (excluding avifauna):

Table 3: Red Data fauna species for Northern Cape Province			
Biological Name	English Name	STATUS	Probability
	Butterflies		
Athene lindae	Linda's Hairtail	VU	low
	Amphibians		
Cacosternum karooicum	Karoo Caco	DD	low
Pyxicephalus adspersus	Giant Bullfrog	NT	moderate
Strongylopus springbokensis	Namaqua Stream Frog	VU	low
	Reptiles		
Bitis schneideri	Namaqua Dwarf Adder	VU	low
Cordylus cataphractus	Armadillo Girdled Lizard	VU	low
Cordylus lawrenci	Lawrence's Girdled Lizard	NT	low
Dermochelys coriacea	Leatherback Turtle	CR	low
Gerrhosaurus typicus	Namaqua Plated Lizard	NT	low
Goggia microlepidota	Small-scaled Dwarf Leaf-toed Gecko	NT	low
Homopus signatus	Speckled Cape Tortoise	NT	low
Lamprophis fiskii	Fisk's House Snake	VU	low
Phelsuma ocellata	Namaqua Day Gecko	NT	low
Typhlosaurus lomii	Lomi's Blind Legless Skink	VU	low
	Mammals		
Acinonyx jubatus	Cheetah	VU	low
Atelerix frontalis	South African Hedgehog	NT	low
Bathyergus janetta	Namaqua Dune Mole-rat	NT	low
Bunolagus monticularis	Riverine Rabbit	CR	low
Chrysochloris asiatica	Cape Golden Mole	DD	low
Chrysochloris visagiei	Visagie's Golden Mole	CR	low
Cistugo lesueuri	Leseur's Wing-gland Bat	NT	moderate
Cistugo seabrai	Angolan Wing-gland Bat	VU	low
Crocidura cyanea	Reddish-grey Musk Shrew	DD	moderate
Crocidura fuscomurina	Tiny Musk Shrew	DD	low
Crocidura hirta	Lesser Red Musk Shrew	DD	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	DD	low
Crocuta crocuta	Spotted Hyaena	NT	low
Cryptochloris wintoni	De Winton's Golden Mole	CR	low
Damaliscus lunatus lunatus	Tsessebe	EN	low
Diceros bicornis bicornis	Black Rhinoceros - arid ecotype	CR	low
Elephantulus intufi	Bushveld Elephant-shrew	DD	low
Equus zebra hartmannae	Hartmann's Mountain Zebra	EN	low

Table 3: Red Data fauna species for Northern Cape Province

Biological Name	English Name	STATUS	Probability
Erimitalpa granti	Grant's Golden Mole	VU	low
Graphiurus platyops	Rock Dormouse	DD	low
Hippotragus equinus	Roan Antelope	VU	low
Hyaena brunnea	Brown Hyaena	NT	moderate
Lycaon pictus	African Wild Dog	EN	low
Manis temminckii	Pangolin	VU	low
Mellivora capensis	Honey Badger	NT	moderate
Miniopterus schreibersii	Schreiber's Long-fingered Bat	NT	moderate
Mirounga leonina	Southern Elephant Seal	EN	low
Myosorex varius	Forest Shrew	DD	low
Mystromys albicaudatus	White-tailed Rat	EN	low
Otomys slogetti	Sloggett's Rat	DD	low
Panthera leo	Lion	VU	low
Paratomys littledalei	Littledale's Whistling Rat	NT	moderate
Petromys typicus	Dassie Rat	NT	low
Poecilogale albinucha	African Weasel	DD	moderate
Rhinolophus capensis	Cape Horseshoe Bat	NT	low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT	moderate
Rhinolophus darlingi	Darling's Horseshoe Bat	NT	moderate
Rhinolophus denti	Dent's Horseshoe Bat	NT	moderate
Rhinolophus fumigatus	Ruppel's Horseshoe Bat	NT	low
Suncus varilla	Lesser Dwarf Shrew	DD	low
Tatera leucogaster	Bushveld Gerbil	DD	high
Xerus princeps	Mountain Ground Squirrel	NT	low

A total of 56 Red Data animals (excluding avifauna) are known to occur in the Northern Cape Province. Of these species, 13 are listed as Data Deficient (DD), 21 are listed as Near Threatened (NT), 12 are listed as Vulnerable (VU), 5 are listed as Endangered (EN) and 5 species are listed as Critically Endangered (CR).

It is estimated that approximately 79% of these species have a low probability of occurring in the immediate region of the study area, 11 species are estimated to have a moderate probability of occurring and one a high probability of occurrence in the immediate region of the study area (red).

9 PRELIMINARY MACRO HABITAT TYPES

Macro habitat types that were identified from aerial images include the following (Figure 7):

- Floodplains – Grassy habitat associated with the wide, flat levees of the non-perennial streams. Woody species generally absent and soils expected to be sandy and deep;
- Localised Rocky Outcrops – Characterised by small and localised areas where boulders and rocks are present with little substrate and vegetation, also appears to be relative degraded due to the presence of several informal roads;
- Mountain Woodland – Situated in the north-eastern section of the study area, characterised by relative steep slopes, high rockiness and mountainous habitat, comprising relative dense woodland. Expected to be relative pristine as these habitat types are generally not extensively utilised;
- Non-perennial streams – Streambeds of non-perennial streams with relative wide banks and levees, characterised by the absence of a prominent woody layer;
- Shrubveld Plains – Plains habitat where woody species are present mostly as low shrubs or scattered trees, dominated by herbaceous species, mostly on deep, sandy soils; and
- Woodland Plains & Hills – Plains and low hills with a prominent woody layer. The composition of this woody layer is likely to be different to that of the Mountain Woodland habitat type. This unit is also likely to be split upon finer investigation as there will likely be significant variation in the floristic composition of the variations and the rockiness of the terrain based on the prevalence of specific biophysical attributes.

10 MACRO HABITAT SENSITIVITIES

Estimated habitat sensitivities ascribed to the macro habitat types is based on the assumption that the vegetation is representative of the regional vegetation type. An assessment of the status of the habitat types, in relation to the regional vegetation type will form part of the Impact Assessment phase.

- Floodplains – Medium-high sensitivity – due to infrequent inundation following rain periods;
- Localised Rocky Outcrops – Medium-high sensitivity due to the limited availability of this particular habitat type. Evidence from Google Earth images indicate a potentially degraded status;
- Mountain Woodland – High sensitivity, likely to be relative pristine, presence of steep slopes generally associated with important and sensitive floristic species, communities and faunal assemblages;
- Non-perennial streams – High sensitivity due to the association with wetland habitat types;

- Shrubveld Plains – Medium-low sensitivity – generally abundantly present, as well as well utilised; and
- Woodland Plains & Hills – Medium sensitivity – varying sensitivity between plains and hills.

Figure 7: Preliminary Macro Habitat Types of the study area

11 DISCUSSION

In order to present a preliminary opinion on the suitability of the site for the proposed development, the following is taken into account:

- Presence/ absence of natural and sensitive habitat types or communities within the boundaries of the site;
- Areas/ habitat of sensitivity within the immediate surrounds that might also be affected;
- Perceived ecological status;
- Known regional/ local sensitivities; and
- Habitat types that might be affected by infrastructure, pipelines and access roads that will be required for the proposed development.

Firstly it has to be accepted that the development of a CSP in an area such as this will result in a severe impact on the ecological status of the area since it is largely a destructive activity. The study area comprises natural and (assumed) relative pristine woodland/ savanna as well as mountainous terrain. Most of these habitat types will be destroyed in order to make space available for the required infrastructure of the CSP plant. At this stage it is estimated that approximately 3km x 3km will be needed for the proposed project. On a local scale the impact is therefore expected to be severe and significant.

Secondly, the VEGMAP database indicates that much of the Olifantshoek Plains Thornveld remains untransformed on a regional scale; approximately 842,000 still remains untransformed, representing 99% of the original surface area. The loss of this area (app. 900ha) is regarded insignificant on a regional scale. The contribution of this proposed development in terms of local and regional fragmentation and habitat isolation will similarly be extremely low since little of the region comprises transformed habitat. However, a major development such as this in a largely undeveloped region is frequently viewed as the 'thin end of the wedge', allowing the opportunity, start and means for future development in the area, effectively meaning the start habitat transformation on a larger scale.

No definite answer can be presented in terms of the suitability of the site for the proposed development as numerous questions need to be answered in terms of the biodiversity status and sensitivity of the area. The EIA phase will therefore be used to assess the sensitivity of the receiving environment on a local and regional scale. Questions that need to be answered in the EIA phase include:

- Are there any biological or biophysical attributes of conservation importance present on the property that that will ultimately be affected severely and significantly by the proposed development;
- Are there any biological or biophysical attributes present within the proposed development boundary that sets it apart from neighbouring properties and surrounding areas in terms of uniqueness and conservation potential;

- Does the property, or any part thereof, represent an area of importance in terms of regional, provincial or national conservation strategies;
- Will the relocation of the proposed development to a nearby (assumed technically and financially feasible) area result in lower impact on the biological environment/ does this property represent the optimal location in terms of biodiversity attributes on a local and regional scale;
- Can impacts resulting from the proposed development be mitigated to an acceptable level; and
- Will the loss of this area imply a severe and significant impact on the biological environment in terms of ecological functionality and attributes such as migration patterns, local and regional habitat fragmentation and isolation characteristics, etc. on the short and/ or long term?

12 POTENTIAL IMPACTS ON TERRESTRIAL BIODIVERSITY

No impacts were identified that could lead to a beneficial effect on the ecological environment since the proposed development is largely destructive as it involves the decimation of natural habitat.

Impacts resulting from the construction and operation of a CSP plant have permanent and severe physical impacts on biota or the habitat in which they occur. Direct impacts, such as habitat destruction and modifications, are regarded immediate, long-term and of high significance. These impacts are mostly measurable and fairly easy to assess as the effects thereof is immediately visible and can be determined to an acceptable level of certainty. In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. A measure of estimation is therefore necessary in order to evaluate these impacts. Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

Ten impacts were identified that are of relevance to any development in a natural environment. Not all of these impacts might occur, or the extent of impact might be limited; the relevance of these impacts is therefore determined prior to being implemented in the Impact Assessment.

Impacts were placed in three categories, namely:

- Direct impacts:
  - Destruction of threatened and protected flora species;
  - Direct impacts on threatened fauna species;
  - Destruction of sensitive/ pristine habitat types;
  - Direct impacts on common fauna species;
- Indirect Impacts:
  - Floristic species changes subsequent to development;
  - Faunal interactions with structures, servitudes and personnel;
  - Impacts on surrounding habitat/ species;
- Cumulative Impacts:
  - Impacts on SA's conservation obligations & targets (VEGMAP vegetation types);
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation.

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Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

Report Prepared for

SSI Engineers and Environmental Consultants

Report Number SRK 436964/Draft1

Report Prepared by

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Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

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Table of Contents

List of Tables

List of Figures

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by SSI Engineers and Environmental Consultants, the Department of Water Affairs and local property owners in the Humansrus area. SRK has exercised due care in reviewing the supplied information. Whilst SRK has compared the available data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the available data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Glossary of Terms

Aquifer: A water-bearing geological formation capable of supplying economic quantities of groundwater to wells, boreholes and springs.

Aquitard: A saturated geological unit with a relatively low permeability that retards, but does not prevent the movement of water; while it may not readily yield water to boreholes and springs, it may act as a storage unit.

Aquiclude: A geological unit with a very low permeability that severely restricts groundwater movement. GRU boundaries are commonly formed by aquicludes, e.g. dykes.

Contamination: The introduction of any substance into the environment by the action of man.

Fractured-rock Aquifer: Aquifers where groundwater occurs within fractures and fissures in hard-rock formations.

Groundwater: Refers to the water filling the pores and voids in geological formations below the water table.

Groundwater Flow: The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the slope of the water table and the transmissivity of the geological formations.

Groundwater Recharge: Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic Zone).

Groundwater Resource: All groundwater available for beneficial use, including by man, aquatic ecosystems and the greater environment.

Groundwater Resource Units: (GRU's) Represent provisional zones defined for the purposes of assessing and managing the groundwater resources of a region, in terms of large-scale abstraction from relatively shallow (depth < 300m) production boreholes. They represent areas where the broad geohydrological characteristics (i.e. water occurrence and quality, hydraulic properties, flow regime, aquifer boundary conditions etc.) are anticipated to be similar. Sometimes also called Groundwater Resource Units (GRU's).

Intergranular Aquifer: Aquifers where groundwater is contained in original intergranular interstices of sedimentary and weathered formations.

Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing and/or intergranular porosity; may be highly productive and able to support large abstractions for public supply and other purposes; water quality is generally very good.

Minor Aquifer System: Fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability; aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.

Non-Aquifer: A groundwater body that is essentially impermeable, does not readily transmit water and/or has a water quality that renders it unfit for use.

Non-Aquifer Systems: formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities; water quality may also be such that it renders the aquifer unusable; groundwater flow through such rocks does take place and needs to be considered when assessing the risk associated with persistent pollutants.

Permeability: The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as $m^3/m^2 \cdot d$ or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with *hydraulic conductivity*, which relates specifically to the movement of water.

Pollution: The introduction into the environment of any substance by the action of man that is, or results in, significant harmful effects to man or the environment.

Recharge: The addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.

Saline Water: Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids.

Saturated Zone: The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere

Specific Yield: Ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity from that mass.

Storativity (S): The volume of water released from storage per unit of aquifer storage area per unit change in head.

Unconfined Aquifer: An aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.

Unsaturated Zone: That part of the geological stratum above the water table where interstices and voids contain a combination of air and water; synonymous with *zone of aeration* or *vadose zone*.

Water Table: The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

List of Abbreviations

DWA	Department of Water Affairs (previously DWAF)
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity (Salinity of water)
GA	General Authorisation
m	metres
mamsl	Metres above mean sea level
mbgl	Metres below ground level
mS/m	Milli-siemens per metre
m^3/a	Cubic metres per annum
mm	millimetres
m^3/m	Cubic metres per month
SRK	SRK Consulting
mg/ℓ	Milligrams per litre
Ma	Million years
STEP Plant	Solar Thermal Energy Power Plant

1 Introduction

During June 2011 SRK Consulting was requested by Mr. Frank Benedek of SSI Engineers and Environmental Consultants to submit a cost proposal for a detailed groundwater resource assessment and provide specialist input to the Waste Management Licence Application, Environmental Impact Assessment and the Water Use Licence required for a proposed Concentrated Solar Power Plant (STEP Plant) on the farm Humansrus near Postmasburg in the Northern Cape Province.

The development is proposed for the Farm 469, (here after referred to as the Farm Humansrus) the Hay Rd, is located in the Northern Cape Province approximately 30 km east of Postmasburg along the R31 route to Kimberley (**Figure 1**). Farms and small communities in the area are totally dependent on groundwater whilst the larger communities like Postmasburg, Daniëlskuil and Lime Acres use groundwater as well as surface water from the Vaal-Gamagara pipe line, which crosses Humansrus farm.

1.1 Scope of Work

The following scope of work and deliverables were provided:

1. To provide a detailed description of the site topography, geological and geo-hydrological characteristics of the study area;
2. Depiction and characterization of the groundwater regime in a regional geological and geohydrological context indicating the overall characteristics of the geological settings and aquifer parameters, and identification of immediate groundwater users;
3. Data obtained from hydrocensus survey as well as the data obtained from the NGDB to be mapped.
    1) A desktop study to be undertaken for the analysis of data obtained from the National Department of Water Affairs' National Groundwater Database (NGDB);
    2) Site visit for purposes of the hydrocensus; and
    3) Consultation with relevant landowners to obtain additional borehole data, if available.
4. Determination of pre-project groundwater quality by means of baseline groundwater quality monitoring and sampling;
5. Assess the potential impacts (direct, indirect and cumulative) of the proposed development and the significance thereof on groundwater resources and downstream water users in the general area.
6. Description of groundwater management measures related to all project phases;
7. Groundwater monitoring protocols and a report containing groundwater monitoring data and analysis;
8. A groundwater model illustrating the above mentioned analysis will be required.

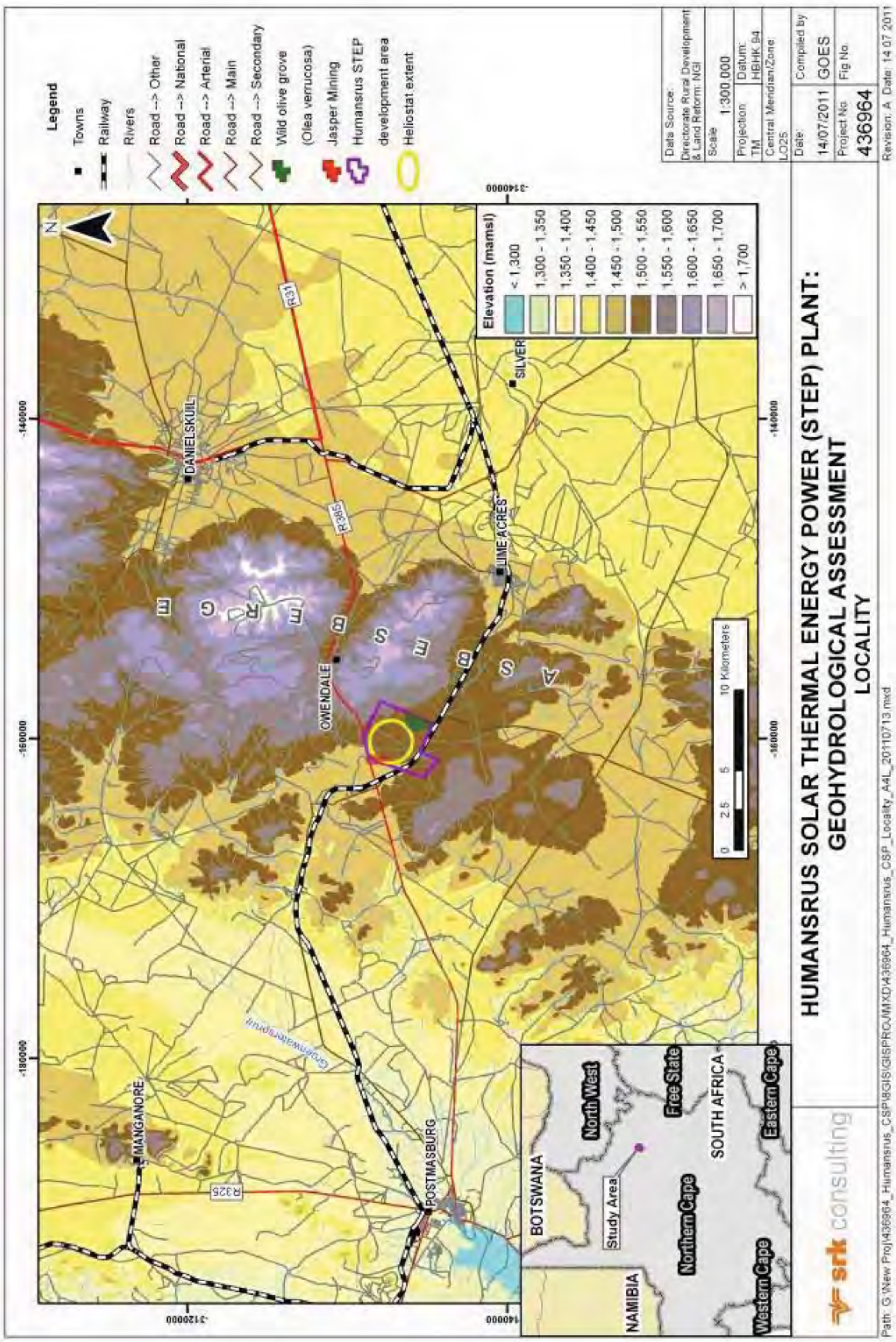


Figure 1: Locality of the Humansrus Solar Energy Thermal Power Plant site

9. Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
   1) Discuss and evaluate the findings of each of the various specialist studies;
   2) Integrate findings to identify workable solutions;
   3) Recommend appropriate mitigation measures, where required, and
   4) Formulate final recommendations.
10. Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.
11. Recommendations on any further studies / additional scope of work that may be required during or after the EIA process.

1.2 Deliverables

Project deliverables:

1. Groundwater resource assessment report;
2. Groundwater Scoping Report (for the EIA/Waste Management Licence); and
3. Groundwater EIA Report (for the EIA/Waste Management Licence).

1.3 Methodology

The methodology employed for the investigation up to scoping level was as follows:

- All existing groundwater related information was collated and reviewed for the property and its surrounds. This included information from existing reports, the Department of Water Affairs' National Groundwater Database (NGDB), Water Authorisation and Registration Management System (WARMS database) and published maps;
- A detailed hydrocensus was carried out on existing boreholes, shallow wells and springs on the property, as well as a representative number of private boreholes, wells and springs that occur on the surrounding properties. During this field survey water levels, current abstraction, type of equipment, water usage, and basic chemistry based on field testing and any other information that was available from the owners/operators were measured and recorded;
- Groundwater management units (GMUs) were delineated for the site and the recharge, exploitation potential, and water balance of the groundwater resources in each GMU were derived. For this purpose the GIS grids generated for the DWA National Groundwater Resource Assessment, Phase 2 was used. The quality of the groundwater resources in each GMU was also assed. All data were captured into an ArcGIS 10 database and the aquifers defined and groundwater flow directions, aquifer boundaries, e.g. structural and lithological were defined;
- The current and anticipated groundwater uses were compared to the exploitation potential of the aquifers in the GMUs;
- Potential groundwater bearing structures and formations were mapped on satellite imagery and aerial photographs using the ArcGIS desktop software. The geological data of the area

were obtained and georeferenced for use in the GIS. The boreholes and other relevant groundwater information were superimposed on GIS generated maps for analysis; and

- The data were analyses and collated for the Scoping Report.

1.4 Work Programme

A hydrocensus of the boreholes on the Farm Humansrus and adjacent farms was conducted on 14 and 15 July 2011. All available geohydrological information (borehole depth, yield, groundwater intersections, groundwater use and estimated abstraction, etc.) was collected from the respective owners during this visit. Boreholes were visited and the relevant geohydrological data (like groundwater levels, quality, equipment, etc.) were measured and recorded. Simultaneously the local geology was noted and red flag areas identified.

2 Project Description

SolarReserve SA (Pty) Ltd (here after referred to SRSA) plans to construct a Solar Thermal Energy Power Plant (here after referred to as a STEP Plant) on the Humansrus farm. The STEP Plant generates power by concentrating the heat from the sun on a receiver where after the salt (heat transfer medium) is heated for the generation of electricity. Unlike wind and photovoltaic technology, the technology implemented by the proposed STEP Plant has the ability to store energy, which means that electricity can be delivered as and when needed dependent solely on demand and not climatic factors.

STEP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) arranged within a circle shaped heliostat field with an estimated land coverage of 3 km^2. The tower is erected slightly off-centre in the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver on top of the tower. The concentrated sunlight within the receiver, heats molten salt to over 550ºC, which then flows into a salt thermal storage tank.

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower;
- The salt complex is pumped from the cold salts thermal storage tank to the central receiver. The salt complex is transported through the central receiver tower by means of extremely thin tubes;
- The molten salt complex is heated up to approximately 566ºC and is circulated in the central receiver tower;
- The molten salt concentration is then transported to the hot salt thermal storage tank;
- Energy is transferred by means of a heat exchanger or steam generator to generate steam for the turbine;
- The highly pressurised steam is then passed through a steam turbine to generate electricity;
- The salt complex cools down to an approximate 288ºC in the steam generator; and

- After this process is completed, the molten salt concentrate is transported to the cold salt thermal storage tank – in order for the electricity generation cycle to commence once more.

The STEP Plant comprises four main subsystems which will be summarised below:

1. Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats;
2. Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
3. The Power Block; and
4. Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Three (3) different plant setups are under investigation for the Humansrus site of which 3 (Hybrid Cooled Zero Discharge System) is the preferred setup. The annual water demands of the different setups are as follow:

1. Dry Cooled Zero Discharge System - 169,200 m^3
2. Dry Cooled Non Zero Discharge System - 211,900 m^3
3. Hybrid Cooled Zero Discharge System - 246,200 m^3

3 Baseline Data

3.1 Physiography and Climate

The Farm Humansrus is located in a north-west – south-east running valley with two semi-parallel ranges of hills occurring on the western and eastern sides of the farm (**Figure 1**). This valley is controlled by faults on the two flanks with the eastern hills formed by hard, weather-resistant banded ironstone and jaspilite. The eastern hills form part of the Asbestos Hills stretching from Kuruman in the north to Prieska in the south.

The elevation of the study area varies between 1 460 mamsl in the far north-west and 1 630 mamsl on the eastern side of Humansrus. Hills on the western side of the valley are more gentle with only a few points where the elevation reaches >1,600 mamsl. The central valley on Humansrus farm is elevated between 1,500 and 1,540 mamsl.

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000 are summarized in **Table 1** below. The data indicate that January is the hottest month with an average maximum daily temperature of 32^{o}C and June the coldest with an average maximum daily temperature of 18^{o}C. During June and July the average minimum daily temperature drops to <3^{o}C.

Table 1: Temperature data for Kimberley (South African Weather Service)

KIMBERLEY CLIMATIC AVERAGES 1960-2000													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP	32.6	31.2	28.9	25	21.5	18.4	18.8	21.4	25.7	28	30.1	32.1	26.2
MIN TEMP	17.7	17.3	15.2	10.7	6.2	2.8	2.5	4.7	8.8	11.9	14.5	16.5	10.7
AVE TEMP	25.2	24.3	22	17.9	13.9	10.6	10.6	13.1	17.3	19.9	22.3	24.3	18.5
KIMBERLEY CLIMATIC ABSOLUTES 1960-2000													
HIGHEST TEMP	40.4	39.9	37.8	34.9	31.3	26.6	26.8	31.2	36.6	37.6	39.2	40.9	40.9
LOWEST TEMP	6.5	5.6	2	-2.8	-5.7	-7.9	-8.1	-7.8	-5.5	-0.5	2.5	3.8	-8.1

The data also indicates that the absolute maximum temperature recorded during the period was 40.9^{o}C and the lowest -8.1^{o}C.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in **Table 2** below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 2: Precipitation statistics for the Humansrus area (Source: South African Rain Atlas)

Average monthly precipitation in mm) at Measuring Station Coordinates: S28^{o}18' E023^{o}22'													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean:	64.7	76.3	77.8	42.5	15	5.2	3.6	5.6	11.2	22.2	31.3	45.9	401.1
Standard Deviation:	46	50.9	49.7	35.2	18.6	10.1	8.2	11.2	17.0	24.1	28.4	36.5	107.9

The data indicate that 84% of the precipitation occurs during the months November to April. This phenomenon is characteristic of a summer rainfall area. March is the wettest month with an average precipitation of ~78 mm, whilst July is the driest with <4 mm.

The rainfall distribution for this area is indicated in **Figure 2** over page. Rainfall generally decreases from the site (Humansrus) to the west, south and south east. The highest precipitation occurs in the mountainous area west and south west of Danëlskuil, where the MAP exceeds 520 mm. The lowest precipitation occurs at two isolated localities south east of Danëlskuil and Lime Acres respectively. These areas have a MAP of less than 360 mm.

3.2 Geology

The geology of the study area, which is located on the eastern flank of the Dimoten Syncline striking in a general north-south direction, is depicted in **Figure 3** on page 9. The geological map indicates that significant parts of the study area are covered by Recent deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersected argillaceous, loose and well weathered material up to 30 mbgl, however this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales and banded ironstone, which were deposited after a period of erosion forming a unconformity in this specific area. The upper part of this Formation consists of a 1–3 m thick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic andesitic lavas of the Ongeluk Formation. This Makganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the STEP Plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus (see **Figure 3**). The area between these faults has apparently been displaced downwards to form a graben structure.

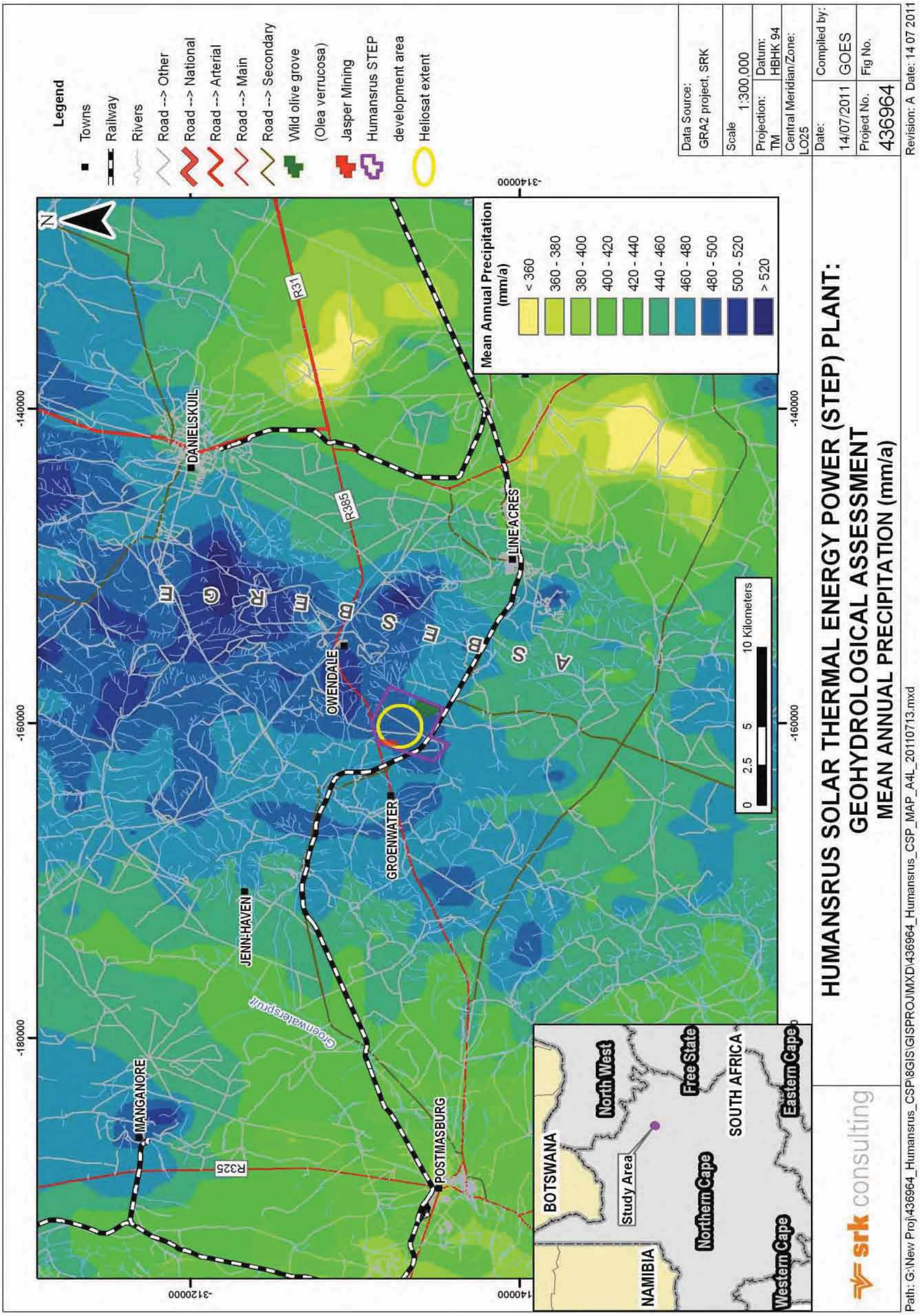


Figure 2: Rainfall distribution in the Humansrus area

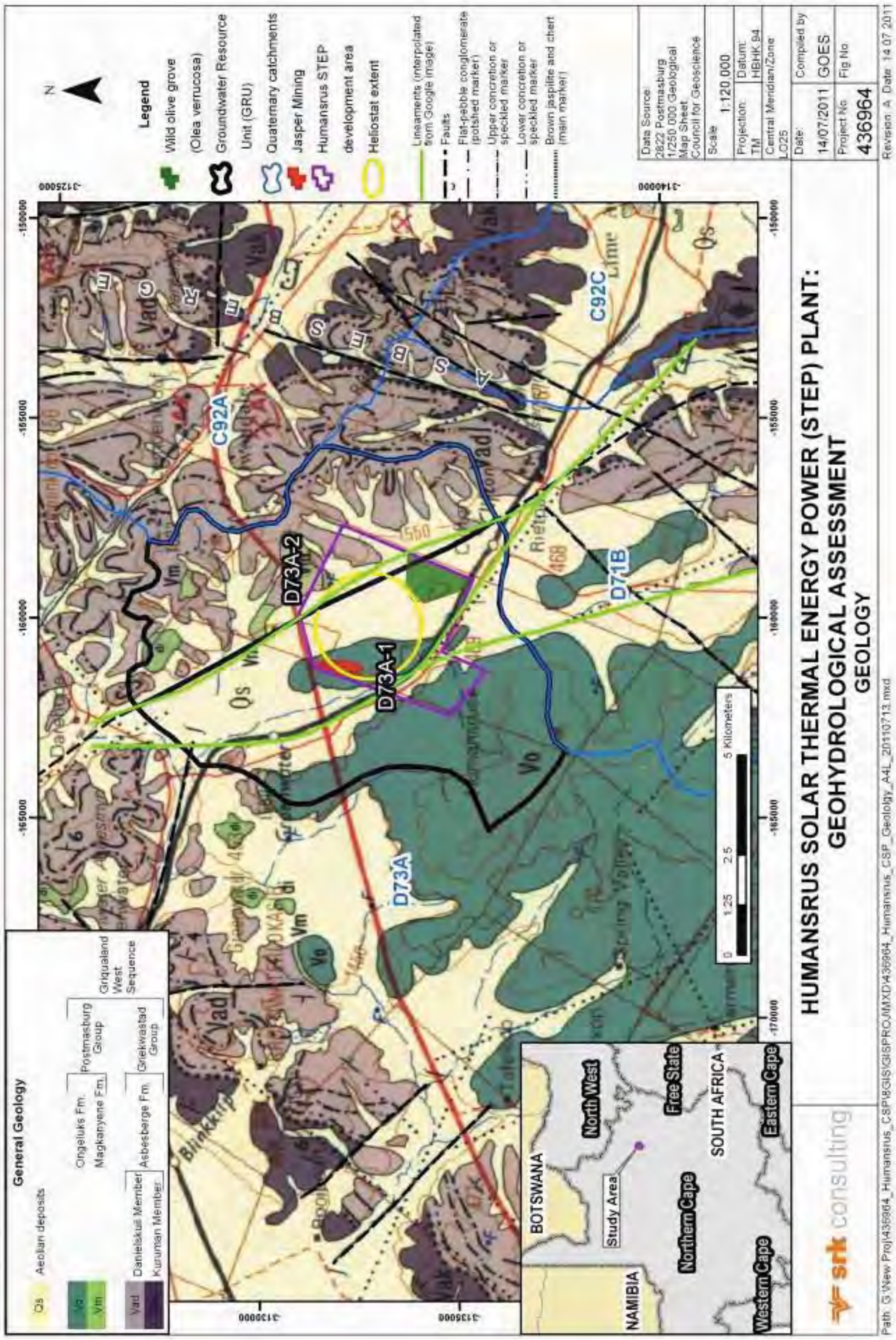


Figure 3: Geology of the Humansrus area (after Council for Geoscience)

3.3 Hydrogeology

3.3.1 Aquifer Type

Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers (**Figure 4**). This type of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operates in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shale and mudstone, which rather deform than fracture under stress.

Some unconfined interganular aquifers (also known as primary aquifers) also occur in and near the main drainage channel of the area at Groenwater station north-west of Humansrus. Here the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. All these result in a poorly developed primary aquifer that is very vulnerable to droughts.

3.3.2 Hydrocensus Results

The hydrocensus results are summarized in **Table 3** (page 12) with the localities of these boreholes indicated in **Figure 5**. Forty-one (41) boreholes and one (1) spring were surveyed on the Farm Humansrus and its surrounds.

Four anomalously high yielding boreholes were located in the area, i.e. boreholes HS2, GR10, GR11 and GR12. These boreholes are located on the two graben-faults in the area with boreholes GR10, GR11 and GR12 on the western fault and borehole HS2 on the eastern fault. Borehole HS2 intersected highly fractured lava and tillite, as evident from drill cuttings around the borehole. It was reportedly yield tested by Mr Scholtz at 40 ℓ/s. However, during removal of the test pump, it got stuck in the borehole at 60 mbgl, probably as a result of the borehole collapsing due to an insufficient length of casing been inserted. This borehole cannot be used and a new borehole needs to be drilled adjacent to it for production purposes, if required. Borehole HS4, which is also located on or close to the eastern fault, has only a maximum immediate yield of 1 ℓ/s. It is believed that this relative shallow borehole (54 m) was not drilled deep enough to intersect the main fault and hence the relative low yield. Borehole GR11 is a replacement borehole drilled for borehole GR10 and is ~5 m from the latter. This borehole and borehole GR12, were previously used to irrigate ~25 ha of lucerne.

The average borehole yield of the surveyed boreholes is 4.6 ℓ/s. This value is skewed by a few extraordinary high yielding boreholes. Therefore the median borehole yield of 1.4 ℓ/s gives a much better indication of the borehole yield that can be expected from a successful borehole drilled in this area. Boreholes drilled to intersect the graben faults could be much higher yielding, possibly 20 ℓ/s to as high as 40 ℓ/s.

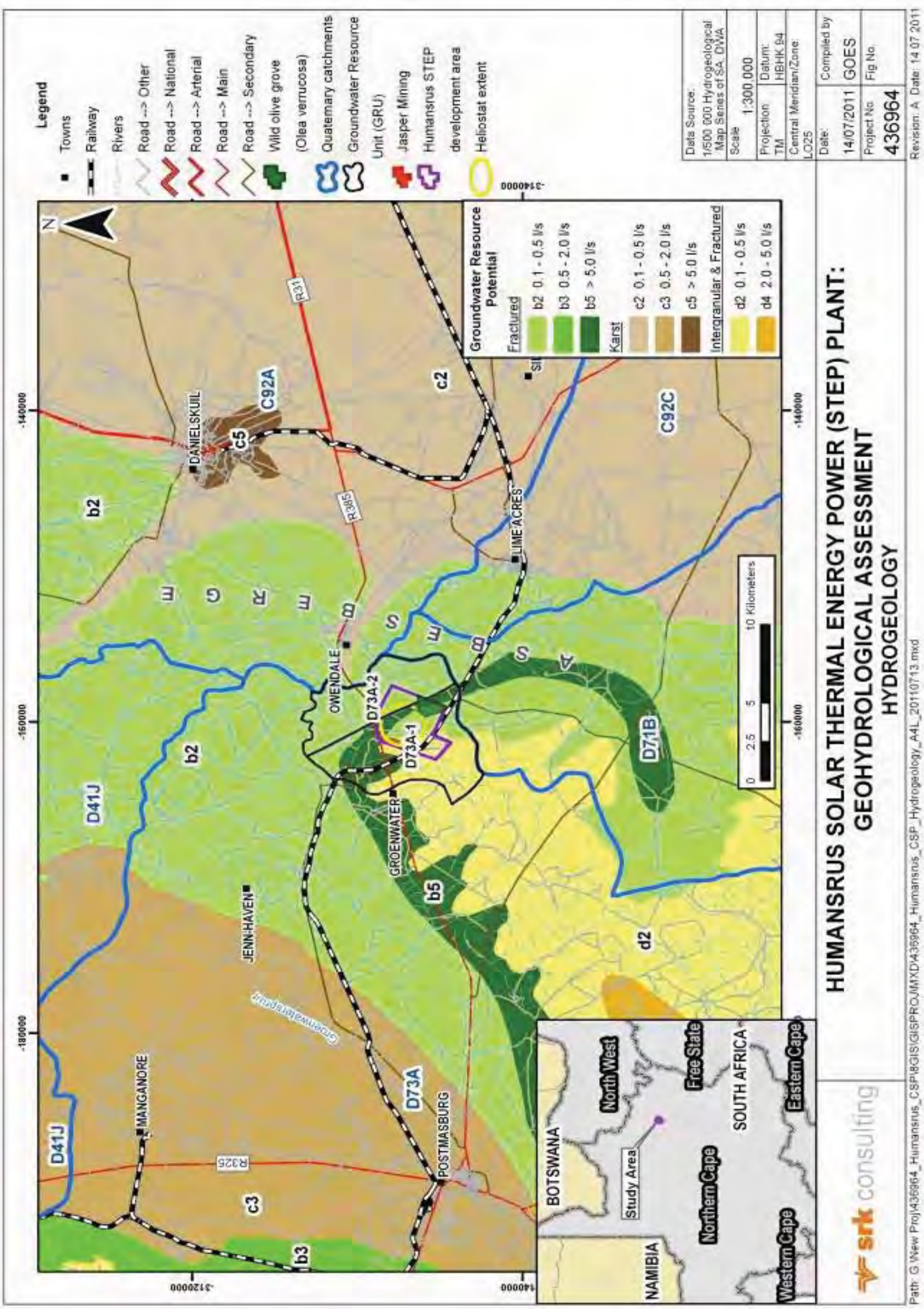


Figure 4: Aquifer type and yield potential in the Humansrus area (after the DWA 1:500 000 scale hydrogeological map series data)

Table 3: Summary of hydrocensus results of the Humansrus area.

Bh Nr	Date	Latitude	Longitude	Eleva-tion (mamsl)	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Pump intake (mbgl)	Use	pH	EC (mS/m)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Land reform												
GR1	15-Jul-11	-28.29228	23.31879	1499	73	4.0	19.00	None		Domestic			G47253, Pump removed
GR10	15-Jul-11	-28.28773	23.34227	1476		20.0	5.87	None					
GR11	15-Jul-11	-28.28773	23.34225	1477	60	20.0	7.05	None					Replacement bh for GR10
GR12	15-Jul-11	-28.27770	23.33874	1467	28	10.0	2.12	None					
GR13	15-Jul-11	-28.25558	23.32697	1458	0		0.00	None		Irrigation	7.22	132	Spring
GR14	15-Jul-11	-28.25672	23.33109	1461	9			WP 100mm cylinder	5	Domestic, Stock	7.70	33	Closed
GR15	15-Jul-11	-28.27567	23.33025	1488	91		19.49	None					
GR16	15-Jul-11	-28.26194	23.35528	1495	73		18.79	WP 75mm cylinder		Stock	7.45	43	
GR17	15-Jul-11	-28.25250	23.35111	1493	52			WP 60mm cylinder		Stock	7.37	61	
GR2	15-Jul-11	-28.29878	23.31550	1496	60			50mm Mono		Domestic			Pump out of order, Closed
GR3	15-Jul-11	-28.28208	23.31056	1485	64	3.5	29.11	40mm Submersible	55	Domestic	7.90	97	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	15-Jul-11	-28.27552	23.31678	1479	32	0.3	27.59	None					Tested by SRK in 2007, Likely partially collapsed
GR5	15-Jul-11	-28.27740	23.30551	1463	50	4.1	17.33	None					Tested by SRK in 2007
GR7	15-Jul-11	-28.27743	23.30550	1464	78	1.4	17.07	None					Drilled by SRK 2008, Blow yield
GR8	15-Jul-11	-28.27703	23.33501	1470	11			Handpump					Closed
GR9	15-Jul-11	-28.27719	23.33510	1471	15		4.00	40mm submersible					Out of order
Farm:	Humansrus - Owner: Mr. Allen Scholtz												
HS1	14-Jul-11	-28.27903	23.36406	1491	50	1.8	27.27	40mm Submersible	45	Domestic, Stock	7.15	52	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	14-Jul-11	-28.27681	23.36466	1467	107	40.0	28.02	None					Water strike at 98 mbgl Fractured lava and tillite
HS3	14-Jul-11	-28.28088	23.36538	1493	36	0.2		None					Roots at 10 mbgl
HS4	14-Jul-11	-28.29156	23.37531	1530	54	1.0		WP 90mm cylinder	42	Stock	7.90	54	Bees in borehole
HS5	14-Jul-11	-28.32079	23.35028	1525	54	1.8	18.27	WP 90mm cylinder	42	Stock			Out of order, Water flows in @ 10 mbgl
HS6	14-Jul-11	-28.28322	23.39720	1627	210	0.5		None					Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk												
SE1	14-Jul-11	-28.32690	23.36535	1519	84	3.6		WP 65mm cylinder	45	Stock			Baseplate closed
SE10	14-Jul-11	-28.32897	23.37159	1515	60	2.5		None					Collapsed at 6.8 mbgl
SE2	14-Jul-11	-28.32920	23.36567	1521	24	0.3		WP 65mm cylinder	24	Stock			Baseplate closed
SE3	14-Jul-11	-28.32963	23.36553	1522	33	0.5	17.00	WP 65mm cylinder	30	Domestic, Stock			
SE4	14-Jul-11	-28.32989	23.36586	1522	35	1.0		40mm Submesible	30	Domestic, Stock	7.23	90	Baseplate closed
SE5	14-Jul-11	-28.32921	23.36266	1516	35	1.9		WP 100mm cylinder	18	Stock			Baseplate closed
SE6	14-Jul-11	-28.33779	23.35252	1567	150	0.3	73.44	WP 65mm cylinder	81	Stock	7.70	70	Water strike at 75 mbgl
SE7	14-Jul-11	-28.32590	23.34681	1534	15	0.1	12.35	Solarpump	14	Stock	7.90	59	Alt Nr GW9
SE8	14-Jul-11	-28.32722	23.34662	1537	30	0.0		None					Dry
SE9	14-Jul-11	-28.32923	23.37240	1516	60	4.2		None					Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk												
CN1	15-Jul-11	-28.32497	23.39030	1506			31.71	WP 60mm cylinder	39	Domestic			
CN2	15-Jul-11	-28.32503	23.38942	1535				50mm Mono	42	Domestic, stock	6.85	32	Closed, Pump yield = 0.9 ℓ/s
CN3	15-Jul-11	-28.32493	23.38938	1535		0.3	29.65	None					
CN4	15-Jul-11	-28.32333	23.38965	1541			32.46	WP 60mm cylinder	36	Stock			
CN5	15-Jul-11	-28.32609	23.38891	1534		0.7	25.79	None					Was equipped with 40mm Subm., Intake @ 45m
CN6	15-Jul-11	-28.32919	23.38791	1528			19.31	None					
CN7	15-Jul-11	-28.32916	23.38609	1523		0.9	12.22	None					Blocked 0.2m below water level
CN8	15-Jul-11	-28.32973	23.38429	1526				None					Blocked at 16.7 mbgl, Dry
CN9	15-Jul-11	-28.33991	23.38789	1517			9.27	WP 60mm cylinder	21	Stock	7.25	51	
CN10	15-Jul-11	-28.34507	23.38803	1514			9.18	WP 60mm cylinder	24	Stock	7.20	59	
					Average	**4.6**					**7.4**	**64.1**	
					Median	**1.4**					**7.4**	**59.0**	

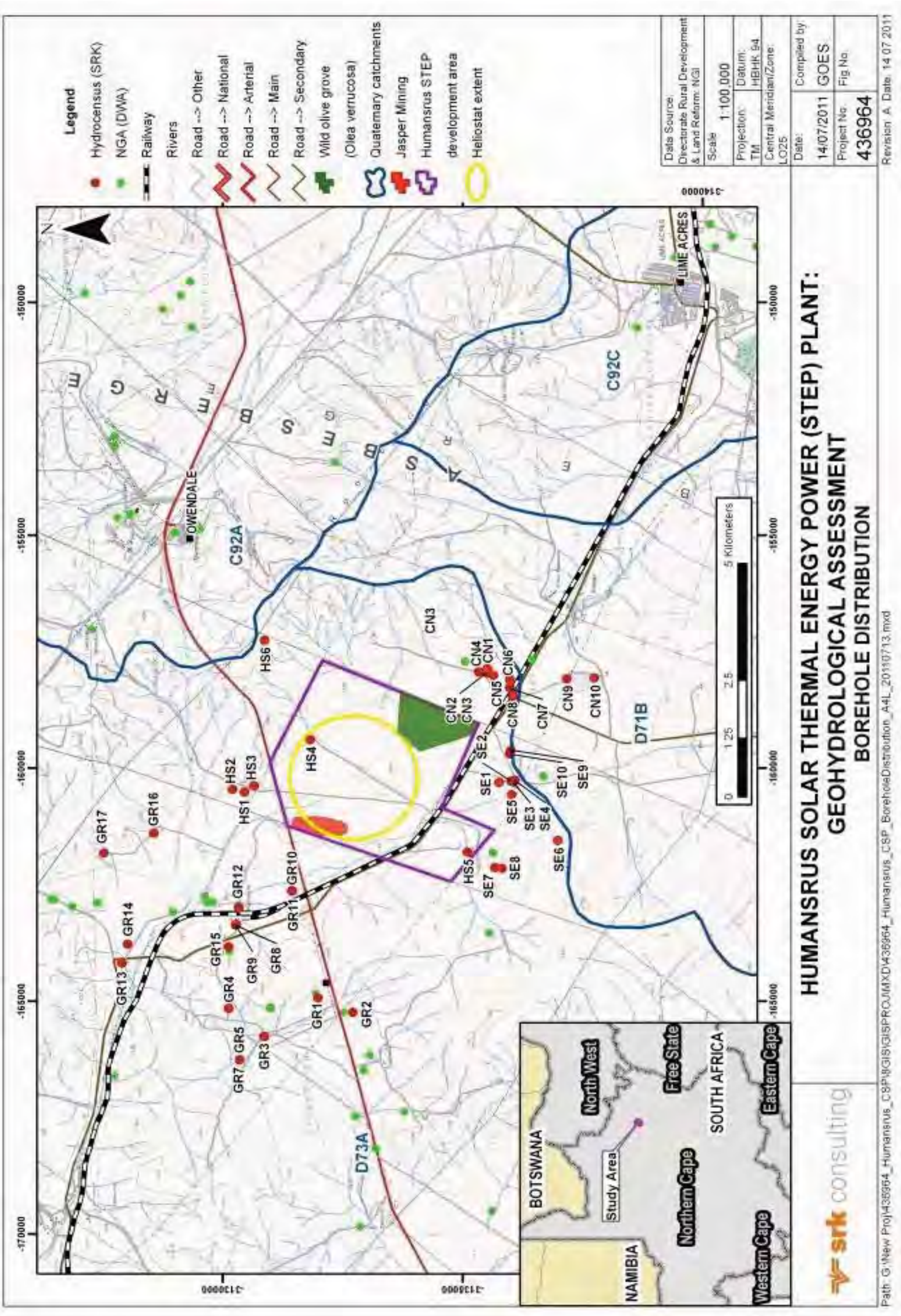


Figure 5: Localities of surveyed boreholes in the Humansrus area

3.3.3 Current Abstraction

The estimated abstraction from the Farm Humansrus and the surrounding areas is summarised in **Table 4** page 15. In the case of electric pumps, the estimates are based on pump yields and daily operating hours as reported by the owners. For windpumps a 24 h/d operation at 12% of the maximum yield was assumed (which is determined by the cylinder size). This assumption is based on the author's personal experience in the Karoo area. Based on these assumptions a total abstraction of approximately 104 000 m^3/a is calculated for the study area. Nearly 66% (~68 000 m^3/a) of this volume is abstracted in the Groenwater rural area, of which ~54% is for domestic use and 46% (31 500 m^3/a) spring flow at GR13.

No large scale irrigation currently takes place in the area and most of the abstracted groundwater is used for stock watering and domestic use. However, groundwater was previously abstracted from boreholes GR11 and GR12 at a rate of ~180 000 m^3/a to irrigate 25 ha of lucerne. This abstraction continued for several years and was only ceased after this portion of Groenwater was bought by the Department of Rural Affairs and Land Reform (pers. Comm. Mr. Scholtz).

3.3.4 Groundwater Resource Potential

The Humansrus area falls within the Quaternary Drainage Region D73A (see **Figure 3** and **Figure** 5) for which the amount of water available under General Authorisation is listed under Zone A of the Groundwater Taking Zones, where no water may be taken from this drainage regions except as set out under Schedule 1[1] and small industrial users[2] (DWAF, 2004). Therefore, if the water demand is to be satisfied from the groundwater resources a Water Use Licence Application will have to be submitted.

Two (2) Groundwater Resource Units (GRU's) were defined for this area. These are based on surface drainage, measured groundwater elevations and lineaments such as faults and dykes. The boundaries of these GRU's are indicated in **Figure 3**. The GRA2 grid datasets (DWAF, 2005) were used to derive the MAP, effective recharge and groundwater resource potential for these GRU's. As boreholes cannot intersect all the available recharge in an area, an exploitability factor (DWAF, 2005) was used to calculate the volume of groundwater that can actually be abstracted through boreholes. Current abstraction based on the hydrocensus data was subtracted from this value to determine the current Groundwater Exploitation Potential. These calculated values are summarised in **Table 5** on page 16.

[1] Not taking more than 10 cubic metres from groundwater on any given day.

[2] •"Small industrial users" mean water users who qualify as work creating enterprises that do not use more than twenty cubic metres per day (i.e. 20 000 litres/day) and identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented, under the following categories:-

a) 1: food processing;
b) 2: prospecting, mining and quarrying;
c) 3: manufacturing;
d) 5: construction

Table 4: Estimated groundwater abstraction in the Humansrus area

Bh Nr	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Use	Estimated Annual Abstraction (m^3)	Comments
Farm:	Groenwater				TOTAL	68,223	
GR1	73	4.0	19.00	None	Domestic	11,000	Pump removed, Abstraction was ~11,000 m^3/a
GR10		20.0	5.87	None			
GR11	60	20.0	7.05	None			Previous abstraction 120,000 m^3/a
GR12	28	10.0	2.12	None			Previous abstraction 60,000 m^3/a
GR13	0		0.00	None	Irrigation	31,500	Spring - rough estimate - difficult to measure flow
GR14	9			WP 100mm cylinder	Domestic, Stock	3,406	Closed
GR15	91		19.49	None			
GR16	73		18.79	WP 75mm cylinder	Stock	1,514	
GR17	52			WP 60mm cylinder	Stock	1,135	
GR2	60			50mm Mono	Domestic	7,900	Pump out of order, Previously pumped at ~7,900 m^3/a
GR3	64	3.5	29.11	40mm Submersible	Domestic	11,038	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	32	0.3	27.59	None			Tested by SRK in 2007, Likely partially collapsed
GR5	50	4.1	17.33	None			Tested by SRK in 2007
GR7	78	1.4	17.07	None			Drilled by SRK 2008, Blow yield
GR8	11			Handpump		730	Closed
GR9	15		4.00	40mm submersible			Out of order - not used anymore
Farm:	Humansrus				TOTAL	17,082	
HS1	50	1.8	27.27	40mm Submersible	Domestic, Stock	10,512	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	107	40.0	28.02	None			Water strike at 98 mbgl Fractured lava and tillite
HS3	36	0.2		None			Roots at 10 mbgl
HS4	54	1.0		WP 90mm cylinder	Stock	6,570	Bees in borehole
HS5	54	1.8	18.27	WP 90mm cylinder	Stock		Out of order, Water flows in @ 10 mbgl
HS6	210	0.5		None			Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside				TOTAL	10,549	
SE1	84	3.6		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE10	60	2.5		None			Collapsed at 6.8 mbgl
SE2	24	0.3		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE3	33	0.5	17.00	WP 65mm cylinder	Domestic, Stock	1,135	
SE4	35	1.0		40mm Submesible	Domestic, Stock	1,971	Baseplate closed
SE5	35	1.9		WP 100mm cylinder	Stock	3,406	Baseplate closed
SE6	150	0.3	73.44	WP 65mm cylinder	Stock	1,135	Water strike at 75 mbgl
SE7	15	0.1	12.35	Solarpump	Stock	631	Alt Nr GW9
SE8	30	0.0		None			Dry
SE9	60	4.2		None			Collapsed at 8 mbgl
Farm:	Clifton				TOTAL	8,089	
CN1			31.71	WP 60mm cylinder	Domestic	1,135	
CN2				50mm Mono	Domestic, stock	3,548	Closed, Pump yield = 0.9 ℓ/s
CN3		0.3	29.65	None			
CN4			32.46	WP 60mm cylinder	Stock	1,135	
CN5		0.7	25.79	None			Was equipped with 40mm Subm., Intake @ 45m
CN6			19.31	None			
CN7		0.9	12.22	None			Blocked 0.2m below water level
CN8				None			Blocked at 16.7 mbgl, Dry
CN9			9.27	WP 60mm cylinder	Stock	1,135	
CN10			9.18	WP 60mm cylinder	Stock	1,135	
					TOTAL FOR STUDY AREA	103,942	

Table 5: Groundwater exploitation potential of the Humansrus area

Groundwater Resource Unit	Area (m^2)	Area (km^2)	No. of cells	MAP (mm/a)	Recharge Factor (%)	Average Mean Annual Recharge (m^3/a)	Average Mean Annual Recharge (mm/a)	Groundwater Exploitation Potential (m^3/a) Wet Season	Groundwater Exploitation Potential (m^3/a) Dry Season	Volume of Water stored in Aquifer (m^3/a)	5m Drawdown Storage Volume (m^3/a)
Quaternary Catchment											
D73A	1,558,947,048	1,558.95	63,737	407	2.10%	23,021,400	8.6	19,554,500	15,472,300	333,785,000	25,459,600
Groundwater Resource Units (GRU's)											
D73A-1	42,490,000	42.49	4,249	476	2.00%	627,462	9.4	437,116	325,853	9,097,502	693,916
D73A-2	27,820,000	27.82	2,782	487	2.00%	410,826	9.9	340,868	268,020	5,956,520	454,336
TOTAL						***1,038,287***		***777,984***	***593,873***	***15,054,022***	***1,148,252***
Humansrus CSP Development Area											
Development Area	13,560,000	13.56	1,356	488	2.10%	200,244	10.1	170,089	134,581	2,903,322	221,452

The GRA2 data indicate that the Humansrus GRU (D73A-1) has an estimated average mean recharge of approximately 627 000 m^3/a, i.e. 2% of the MAP of 476 mm. The mean annual recharge in the Humansrus area is shown in **Figure 6** page 17. The groundwater exploitation potential was calculated to vary from 326 000 m^3/a for dry seasons to 437 000 m^3/a for wet seasons, i.e. a mean of approximately 381 000 m^3/a. The volume of groundwater that is potentially stored in the aquifers of the Humansrus GRU has been calculated as approximately 9.1 million m^3.

Based on information supplied by SSI, the maximum water demand of any of the three types of STEP Plants that is under consideration, is 246 200 m^3/a for the Hybrid Cooled Zero Discharge Plant.

Hourly water demand ranges from 41.5 m^3/h (11.53 ℓ/s) under full load to 8.35 m^3/h (2.32 ℓ/s) during off times. *Note: For this study, as a worst case scenario, this maximum demand figure was used for comparison to the sustainable amount of water available for exploitation*.

Comparing this maximum water demand (worst case scenario) to the exploitation potential of the Humansrus GRU (D73A-1), it is evident that this demand is well within (65%) the long term yield capacity of the aquifers of the GRU.

3.3.5 Depth to Water Table and Inferred Groundwater Flow Directions

Depth to water table at Humansrus varies from 18 to 28 mbgl.

The hydrocensus data and data from the NGDB were used to plot the groundwater elevations on the topgraphical map, from which the groundwater flow directions were inferred (**Figure 7**). The groundwater elevations normally mimics the surface elevation contours and generally flows from higher lying to lower lying areas. The inferred flows are from the surrounding high lying flanks of the valley towards the centre lower lying floor of the valley at Humansrus and then along the valley towards the north-west. These groundwater elevations indicate that the southern part of the surveyed area (i.e. the farm Clifton and part of the farm Sunnyside) falls outside the Humansrus GRU in another drainage region (D71B).

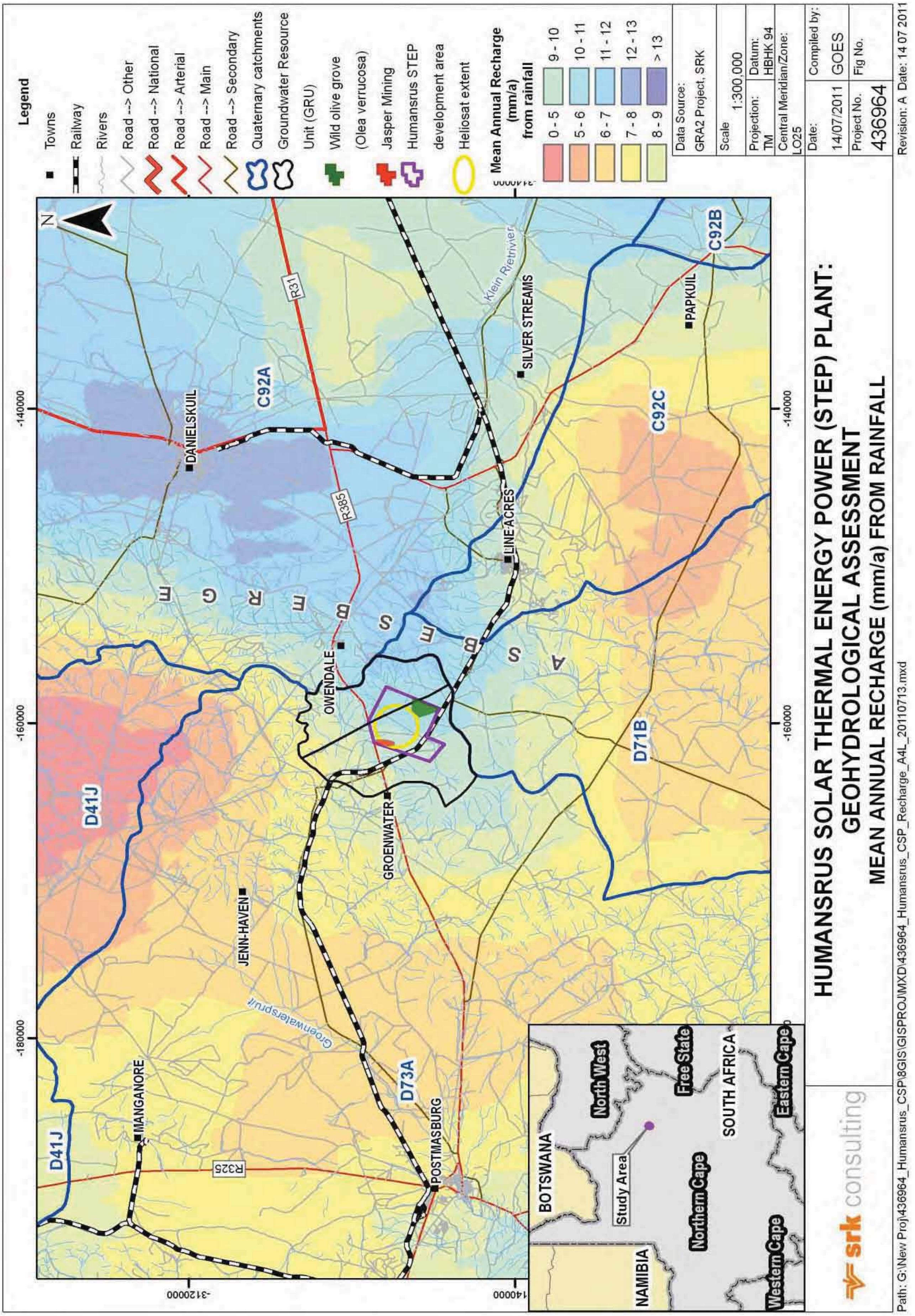


Figure 6: Mean annual recharge in the Humansrus area

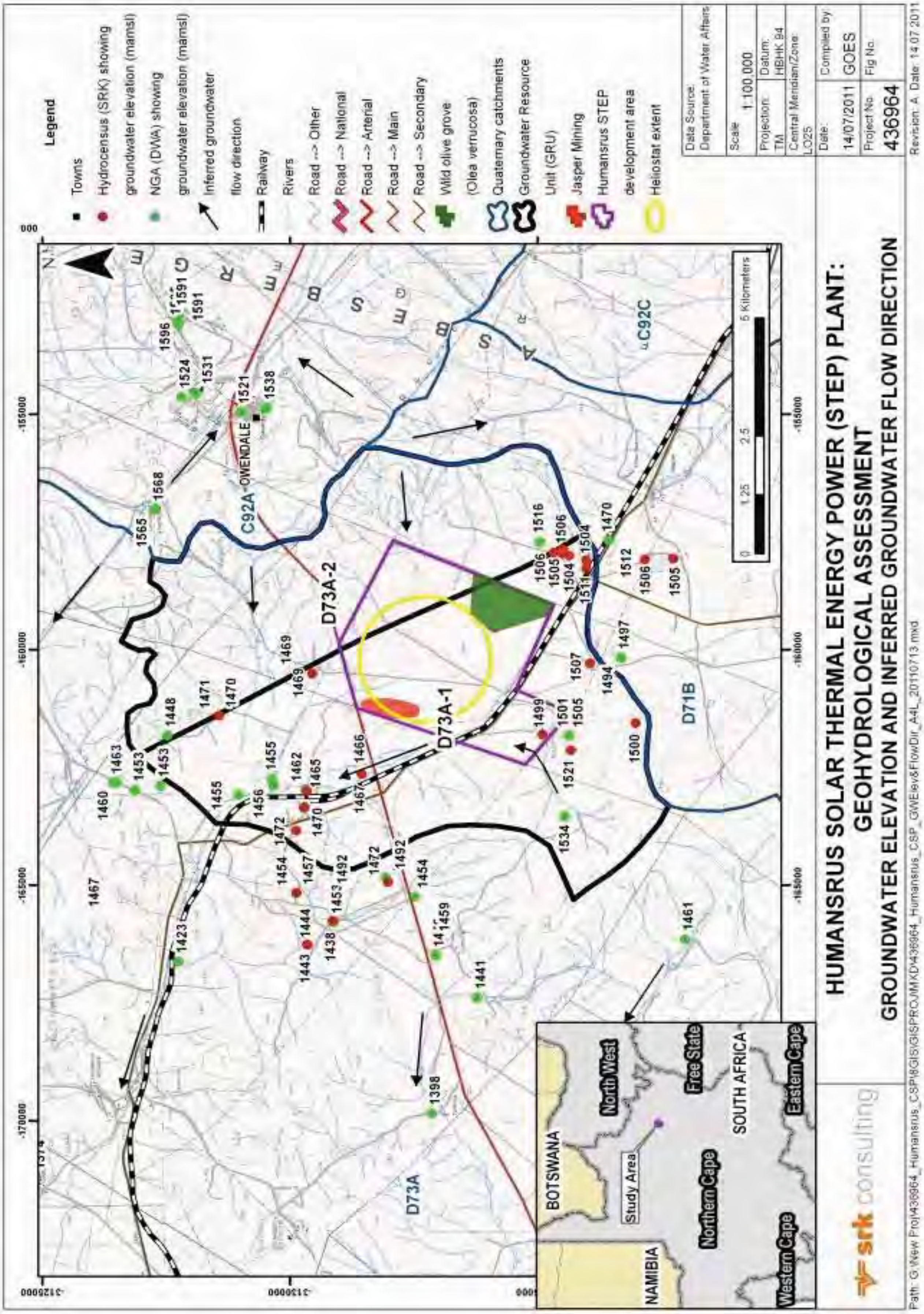


Figure 7: Groundwater elevations and inferred flow directions in the Humansrus area

3.3.6 Groundwater Quality

The groundwater salinity (expressed as Electrical Conductivity in mS/m) of the Humansrus area is shown in **Figure 8** (page 20). The groundwater quality varies throughout the area with the best quality of groundwater occurring in the recharge areas, i.e. the jaspilite and banded ironstone hills in the eastern and northern parts of the study area. However, the groundwater quality throughout the area is generally good and based on the field measured Electrical Conductivity's (EC), which ranged between 32 and 132 mS/m (mean EC = 59 mS/m), suitable for human consumption[3]. Noticeable anomalies in the field measured EC's were recorded near potential pollution sources (e.g. stock pens) in areas with shallow water levels. This indicates that the aquifers are easily polluted by surface pollution sources due to a rapid recharge and relative quick vertical infiltration.

The average EC and pH values of the surveyed boreholes are 66.8 and 7.5 respectively and correlate well with the median values. This means that there are not highly anomalous values for these parameters which skew the average values. Borehole GR14 and the spring GR13 are in the same area with largely different EC values. The relative high EC measured at the spring can likely be attributed to surface pollution from animals drinking at this open water source. Boreholes GR14 and CN2 are drilled in the Daniëlskuil Member (jaspilite) of the Asbestos Hills Formation and yield groundwater with very low EC values. The Asbestos Hills Formation in this area is characterized by a very good groundwater quality.

3.3.7 Aquifer Vulnerability

Figure 9 shows aquifer vulnerability as determined by evaluating seven parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible away from the high risk areas in the north and east. Best position will be in the south-western parts of the farm where the aquifer vulnerability is lowest.

[3] ≤150 mS/m is acceptable for long term human consumption (SABS, 2006)

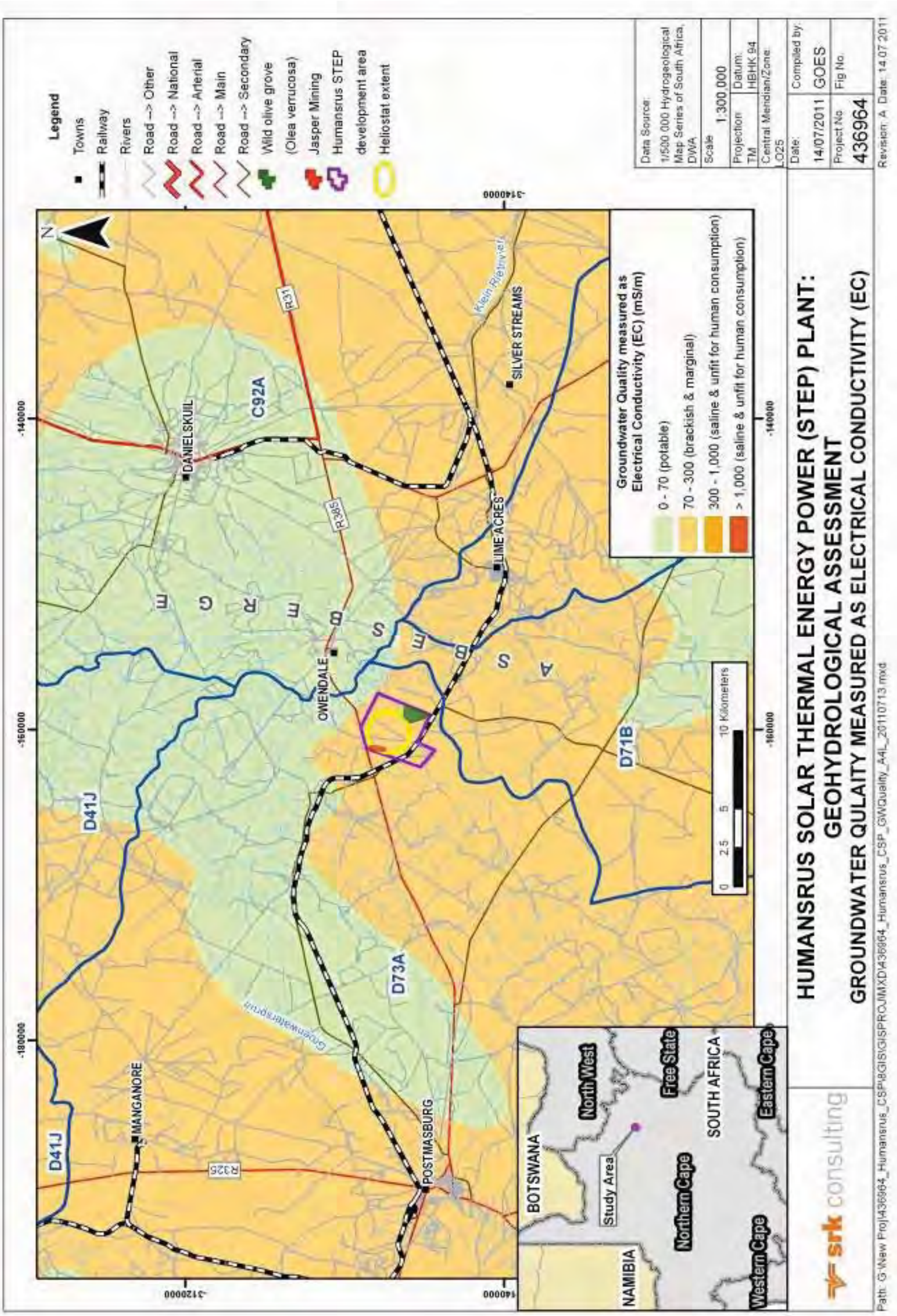


Figure 8: Groundwater salinity in the Humansrus area

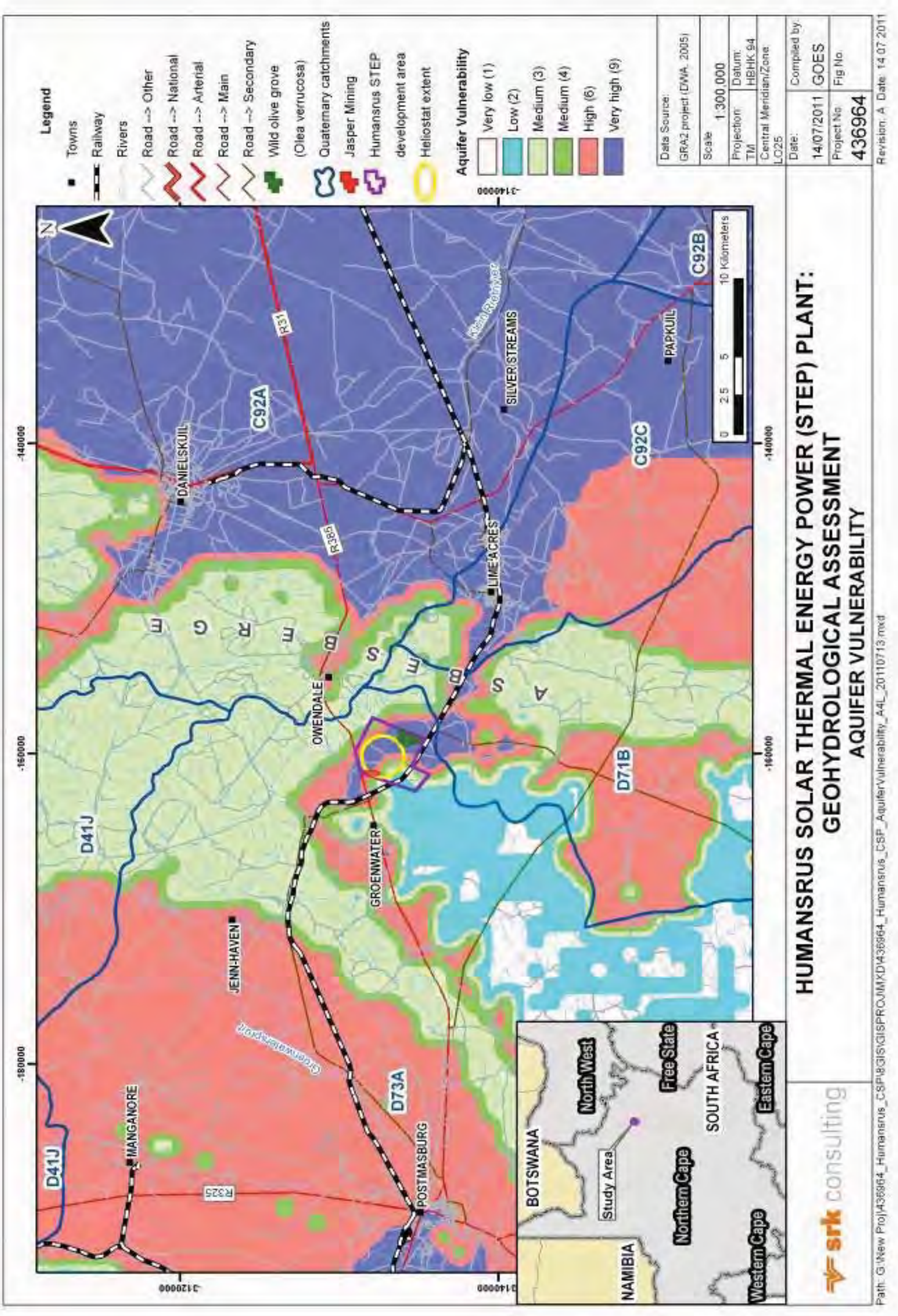


Figure 9: Aquifer vulnerability map of the Humansrus area

4 Conclusions

Based on the information discussed in this report the following can be concluded regarding the groundwater conditions at Humansrus:

- Local geological observations during the hydrocensus and lineament mapping from Google Earth images indicate that the valley at Humansrus farm is a result of graben faulting;
- Maximum immediate yields of boreholes drilled along these two graben faults are very high, but otherwise borehole yields seldom exceed 4 ℓ/s;
- The high yielding borehole HS2 drilled on the eastern graben fault intersected highly fractured lava and tillite in the fault zone and had a reported tested yield of 40 ℓ/s. This borehole is blocked at 60 mbgl by a pump that got stuck and cannot be used;
- Two boreholes (GR11 and GR12) located along the western graben fault at Groenwater were previously utilized for irrigation purposes and groundwater was abstracted at a rate of 180 000 m^3/a without an apparent significant negative impact on the aquifer;
- Relative little groundwater is abstracted from this area and groundwater is mainly used for stock watering and domestic purposes;
- Most of the calculated groundwater abstraction occurs in the Groenwater rural area with the Groenwater spring the main contributor;
- Groundwater quality measured as salinity (EC) in the surveyed area is generally good to very good with a mean EC of 59 mS/m. The EC only deteriorates near pollution sources such as stock pens, pit latrines and soak away pits. The best quality groundwater occurs near the recharge areas of the Asbestos Hills Formation in the eastern parts of the Humansrus valley;
- Groundwater exploitation figures for the area indicate that the expected maximum water demand of 246 200 m^3/a for the STEP Plant is only ~65% of the Exploitation Potential of the Humansrus GRU (D73A-1). Therefore, satisfying the STEP Plant's water demand from the local groundwater resources should not have an unacceptable negative influence on groundwater resources of the area;
- The General Authorisation for taking of groundwater from Drainage Region D73A is zero, except for schedule one and small scale industrial purposes. Therefore, if the water demand is to be satisfied from the groundwater resources, a Water Use Licence Application will have to be submitted to the DWA;
- The best areas for future production boreholes for the STEP Plant are the two graben faults at Humansrus with the eastern fault the prime choice;and
- From aquifer vulnerability point of view the proposed area for the STEP Plant is favourable as long as possible sources of groundwater pollution are kept away from the two graben faults, especially the north-eastern and eastern parts of the farm. Best area for the evaporation pond will be the south-western part of the farm where aquifer vulnerability is low. The groundwater level in this area is ~18 mbgl with argillaceous material expected in the upper part of the geological profile which will give some protection from surface pollution.

5 Recommendations

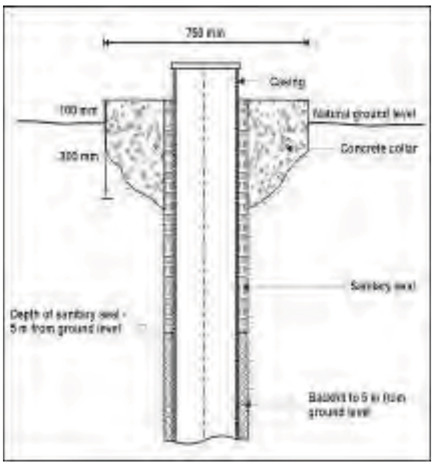
Based on the conclusion of this preliminary report the following is recommended:

1. The Solar Power Tower and evaporation ponds must be placed close to the centre of the valley at Humansrus as far away as possible from the two graben faults;
2. Heliostats can be placed all over the area as these do not pose a groundwater pollution hazard;
3. Future production boreholes must be concentrated on the two graben faults with the eastern fault the primary choice;
4. All existing boreholes must be properly sealed at the surface to prevent surface pollution of the groundwater. This measure will also prevent bees from invading the borehole;
5. A more detailed hydrogeological impact assessment including drilling of test boreholes and test pumping of existing and the test boreholes must be carried out;
6. At least three (3) shallow monitoring boreholes (two downstream and one upstream) must be drilled and pump tested near the evaporation ponds to obtain aquifer parameters for the numerical model and contamination transport model. These boreholes can be used for monitoring purposes in future;
7. The reportedly high yielding borehole HS2, which is unusable due to a pump stuck in it, should be replaced with a new production borehole drilled adjacent to it. The new borehole must be pump tested according to the DWA requirements. This will provide invaluable information regarding aquifer parameters of the fault zone for use in the groundwater numerical model;
8. Existing borehole HS4 must also be yield tested to obtain aquifer parameters in an area with a much lower aquifer potential; and
9. In order to safeguard the groundwater supplies from contamination and equipment from theft and damage, two zones of protection must be established around each production borehole.

Inner protection Zone

The inner protection zone is an area of at least 50 m x 50 m, centred on the actual borehole. The following measures must be applied in this protection zone:

- No pit latrines, VIP's, soak-aways or septic tanks – to prevent effluent from percolating into the aquifer and borehole;
- No storage of fuel, lubricants or other hazardous substances without a leak prove;
- Production boreholes for domestic use must be equipped with a sanitary seal – to prevent contaminated surface water and spilled fuel from percolating down the casing into the borehole;
- The concrete collar around borehole casing must be at least 100 mm higher than the floor or surface level



to prevent spilled fuel, water from leakages, wash water, etc to enter the borehole;

- No ponding of surface water must be allowed, i.e. the area must be sloped for surface water to drain away from this zone;
- Vegetation, other than trees and large bushes, should be maintained in this zone – Note: Roots of bushes and trees growing near boreholes often grows into the borehole where it can cause considerable problems;
- The borehole and pumping equipment must be housed in a lockable pump house. For this purpose a removable cage manufactured out of galvanised steel mesh and corrugated steel sheets is recommended. This cage, rather than a brick building, is recommended as it can be readily removed in case the borehole is damaged or if it needs to be re-developed and cleaned.
- The production boreholes, as well as other monitoring boreholes in the area, must be properly sealed to prevent entry of reptiles, insects, birds and small rodents.
- The entire area should be properly fenced with a lockable gate to prevent unauthorised entry and to exclude animals. The gate must be positioned and of such a type that allows easy vehicle access.
- A signboard must be erected on the gate warning people of the dangers and that unauthorised entry is not allowed.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted hydrogeological and environmental practices.

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Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

Report Prepared for

SSI Engineers and Environmental Consultants

Report Number SRK 436964/Draft1

Report Prepared by

srk consulting

July 2011

Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

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Table of Contents

List of Tables

List of Figures

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by SSI Engineers and Environmental Consultants, the Department of Water Affairs and local property owners in the Humansrus area. SRK has exercised due care in reviewing the supplied information. Whilst SRK has compared the available data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the available data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Glossary of Terms

Aquifer: A water-bearing geological formation capable of supplying economic quantities of groundwater to wells, boreholes and springs.

Aquitard: A saturated geological unit with a relatively low permeability that retards, but does not prevent the movement of water; while it may not readily yield water to boreholes and springs, it may act as a storage unit.

Aquiclude: A geological unit with a very low permeability that severely restricts groundwater movement. GRU boundaries are commonly formed by aquicludes, e.g. dykes.

Contamination: The introduction of any substance into the environment by the action of man.

Fractured-rock Aquifer: Aquifers where groundwater occurs within fractures and fissures in hard-rock formations.

Groundwater: Refers to the water filling the pores and voids in geological formations below the water table.

Groundwater Flow: The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the slope of the water table and the transmissivity of the geological formations.

Groundwater Recharge: Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic Zone).

Groundwater Resource: All groundwater available for beneficial use, including by man, aquatic ecosystems and the greater environment.

Groundwater Resource Units: (GRU's) Represent provisional zones defined for the purposes of assessing and managing the groundwater resources of a region, in terms of large-scale abstraction from relatively shallow (depth < 300m) production boreholes. They represent areas where the broad geohydrological characteristics (i.e. water occurrence and quality, hydraulic properties, flow regime, aquifer boundary conditions etc.) are anticipated to be similar. Sometimes also called Groundwater Resource Units (GRU's).

Intergranular Aquifer: Aquifers where groundwater is contained in original intergranular interstices of sedimentary and weathered formations.

Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing and/or intergranular porosity; may be highly productive and able to support large abstractions for public supply and other purposes; water quality is generally very good.

Minor Aquifer System: Fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability; aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.

Non-Aquifer: A groundwater body that is essentially impermeable, does not readily transmit water and/or has a water quality that renders it unfit for use.

Non-Aquifer Systems: formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities; water quality may also be such that it renders the aquifer unusable; groundwater flow through such rocks does take place and needs to be considered when assessing the risk associated with persistent pollutants.

Permeability: The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as $m^3/m^2 \cdot d$ or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with *hydraulic conductivity*, which relates specifically to the movement of water.

Pollution: The introduction into the environment of any substance by the action of man that is, or results in, significant harmful effects to man or the environment.

Recharge: The addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.

Saline Water: Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids.

Saturated Zone: The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere

Specific Yield: Ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity from that mass.

Storativity (S): The volume of water released from storage per unit of aquifer storage area per unit change in head.

Unconfined Aquifer: An aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.

Unsaturated Zone: That part of the geological stratum above the water table where interstices and voids contain a combination of air and water; synonymous with *zone of aeration* or *vadose zone*.

Water Table: The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

List of Abbreviations

DWA	Department of Water Affairs (previously DWAF)
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity (Salinity of water)
GA	General Authorisation
m	metres
mamsl	Metres above mean sea level
mbgl	Metres below ground level
mS/m	Milli-siemens per metre
m^3/a	Cubic metres per annum
mm	millimetres
m^3/m	Cubic metres per month
SRK	SRK Consulting
mg/ℓ	Milligrams per litre
Ma	Million years
STEP Plant	Solar Thermal Energy Power Plant

1 Introduction

During June 2011 SRK Consulting was requested by Mr. Frank Benedek of SSI Engineers and Environmental Consultants to submit a cost proposal for a detailed groundwater resource assessment and provide specialist input to the Waste Management Licence Application, Environmental Impact Assessment and the Water Use Licence required for a proposed Concentrated Solar Power Plant (STEP Plant) on the farm Humansrus near Postmasburg in the Northern Cape Province.

The development is proposed for the Farm 469, (here after referred to as the Farm Humansrus) the Hay Rd, is located in the Northern Cape Province approximately 30 km east of Postmasburg along the R31 route to Kimberley (**Figure 1**). Farms and small communities in the area are totally dependent on groundwater whilst the larger communities like Postmasburg, Daniëlskuil and Lime Acres use groundwater as well as surface water from the Vaal-Gamagara pipe line, which crosses Humansrus farm.

1.1 Scope of Work

The following scope of work and deliverables were provided:

1. To provide a detailed description of the site topography, geological and geo-hydrological characteristics of the study area;
2. Depiction and characterization of the groundwater regime in a regional geological and geohydrological context indicating the overall characteristics of the geological settings and aquifer parameters, and identification of immediate groundwater users;
3. Data obtained from hydrocensus survey as well as the data obtained from the NGDB to be mapped.
    1) A desktop study to be undertaken for the analysis of data obtained from the National Department of Water Affairs' National Groundwater Database (NGDB);
    2) Site visit for purposes of the hydrocensus; and
    3) Consultation with relevant landowners to obtain additional borehole data, if available.
4. Determination of pre-project groundwater quality by means of baseline groundwater quality monitoring and sampling;
5. Assess the potential impacts (direct, indirect and cumulative) of the proposed development and the significance thereof on groundwater resources and downstream water users in the general area.
6. Description of groundwater management measures related to all project phases;
7. Groundwater monitoring protocols and a report containing groundwater monitoring data and analysis;
8. A groundwater model illustrating the above mentioned analysis will be required.

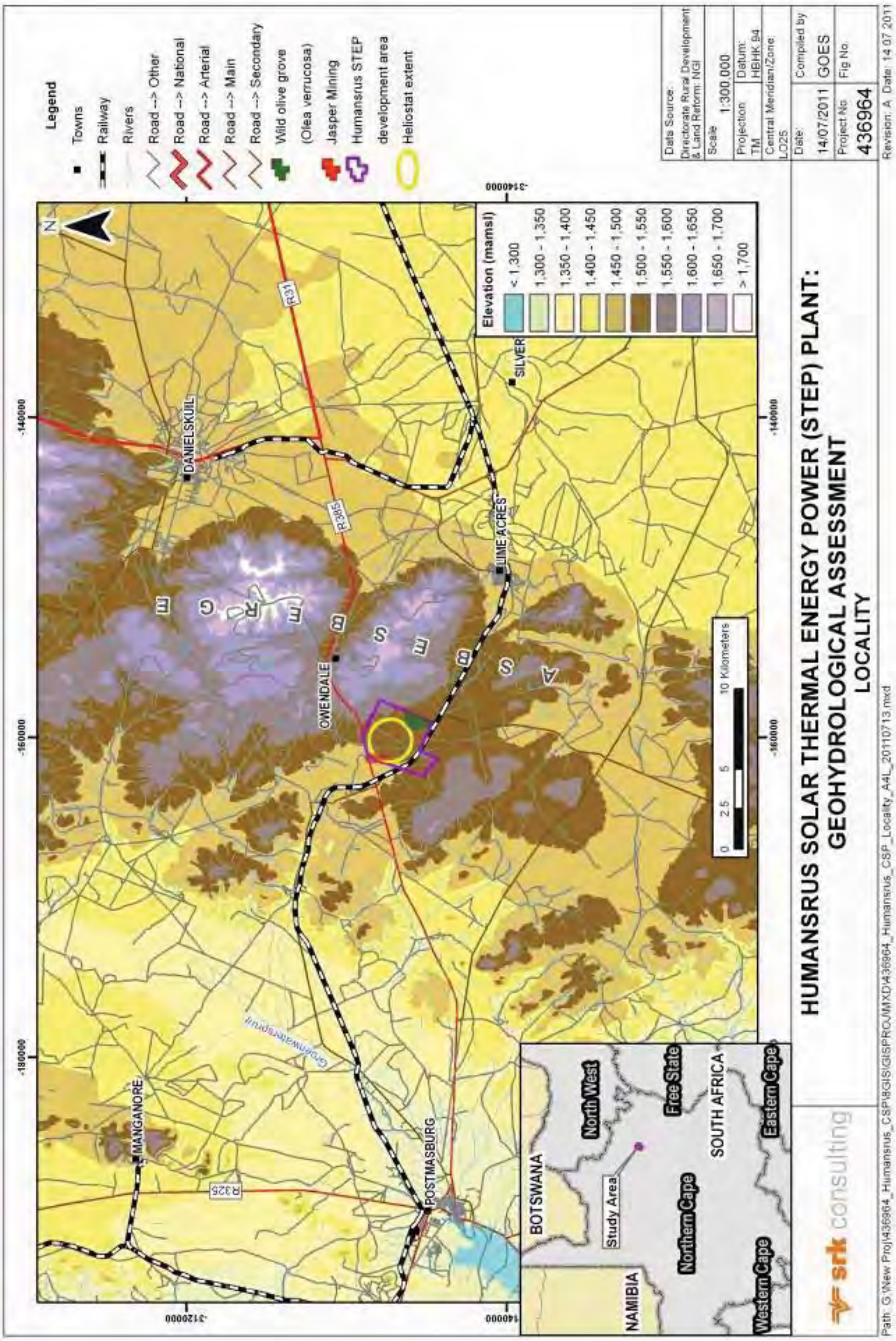

Figure 1: Locality of the Humansrus Solar Energy Thermal Power Plant site

9. Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
    1) Discuss and evaluate the findings of each of the various specialist studies;
    2) Integrate findings to identify workable solutions;
    3) Recommend appropriate mitigation measures, where required, and
    4) Formulate final recommendations.
10. Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.
11. Recommendations on any further studies / additional scope of work that may be required during or after the EIA process.

1.2 Deliverables

Project deliverables:

1. Groundwater resource assessment report;
2. Groundwater Scoping Report (for the EIA/Waste Management Licence); and
3. Groundwater EIA Report (for the EIA/Waste Management Licence).

1.3 Methodology

The methodology employed for the investigation up to scoping level was as follows:

- All existing groundwater related information was collated and reviewed for the property and its surrounds. This included information from existing reports, the Department of Water Affairs' National Groundwater Database (NGDB), Water Authorisation and Registration Management System (WARMS database) and published maps;
- A detailed hydrocensus was carried out on existing boreholes, shallow wells and springs on the property, as well as a representative number of private boreholes, wells and springs that occur on the surrounding properties. During this field survey water levels, current abstraction, type of equipment, water usage, and basic chemistry based on field testing and any other information that was available from the owners/operators were measured and recorded;
- Groundwater management units (GMUs) were delineated for the site and the recharge, exploitation potential, and water balance of the groundwater resources in each GMU were derived. For this purpose the GIS grids generated for the DWA National Groundwater Resource Assessment, Phase 2 was used. The quality of the groundwater resources in each GMU was also assed. All data were captured into an ArcGIS 10 database and the aquifers defined and groundwater flow directions, aquifer boundaries, e.g. structural and lithological were defined;
- The current and anticipated groundwater uses were compared to the exploitation potential of the aquifers in the GMUs;
- Potential groundwater bearing structures and formations were mapped on satellite imagery and aerial photographs using the ArcGIS desktop software. The geological data of the area

were obtained and georeferenced for use in the GIS. The boreholes and other relevant groundwater information were superimposed on GIS generated maps for analysis; and

- The data were analyses and collated for the Scoping Report.

1.4 Work Programme

A hydrocensus of the boreholes on the Farm Humansrus and adjacent farms was conducted on 14 and 15 July 2011. All available geohydrological information (borehole depth, yield, groundwater intersections, groundwater use and estimated abstraction, etc.) was collected from the respective owners during this visit. Boreholes were visited and the relevant geohydrological data (like groundwater levels, quality, equipment, etc.) were measured and recorded. Simultaneously the local geology was noted and red flag areas identified.

2 Project Description

SolarReserve SA (Pty) Ltd (here after referred to SRSA) plans to construct a Solar Thermal Energy Power Plant (here after referred to as a STEP Plant) on the Humansrus farm. The STEP Plant generates power by concentrating the heat from the sun on a receiver where after the salt (heat transfer medium) is heated for the generation of electricity. Unlike wind and photovoltaic technology, the technology implemented by the proposed STEP Plant has the ability to store energy, which means that electricity can be delivered as and when needed dependent solely on demand and not climatic factors.

STEP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) arranged within a circle shaped heliostat field with an estimated land coverage of 3 km^2. The tower is erected slightly off-centre in the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver on top of the tower. The concentrated sunlight within the receiver, heats molten salt to over 550ºC, which then flows into a salt thermal storage tank.

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower;
- The salt complex is pumped from the cold salts thermal storage tank to the central receiver. The salt complex is transported through the central receiver tower by means of extremely thin tubes;
- The molten salt complex is heated up to approximately 566ºC and is circulated in the central receiver tower;
- The molten salt concentration is then transported to the hot salt thermal storage tank;
- Energy is transferred by means of a heat exchanger or steam generator to generate steam for the turbine;
- The highly pressurised steam is then passed through a steam turbine to generate electricity;
- The salt complex cools down to an approximate 288ºC in the steam generator; and

- After this process is completed, the molten salt concentrate is transported to the cold salt thermal storage tank – in order for the electricity generation cycle to commence once more.

The STEP Plant comprises four main subsystems which will be summarised below:

1. Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats;
2. Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
3. The Power Block; and
4. Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Three (3) different plant setups are under investigation for the Humansrus site of which 3 (Hybrid Cooled Zero Discharge System) is the preferred setup. The annual water demands of the different setups are as follow:

1. Dry Cooled Zero Discharge System - 169,200 m^3
2. Dry Cooled Non Zero Discharge System - 211,900 m^3
3. Hybrid Cooled Zero Discharge System - 246,200 m^3

3 Baseline Data

3.1 Physiography and Climate

The Farm Humansrus is located in a north-west – south-east running valley with two semi-parallel ranges of hills occurring on the western and eastern sides of the farm (**Figure 1**). This valley is controlled by faults on the two flanks with the eastern hills formed by hard, weather-resistant banded ironstone and jaspilite. The eastern hills form part of the Asbestos Hills stretching from Kuruman in the north to Prieska in the south.

The elevation of the study area varies between 1 460 mamsl in the far north-west and 1 630 mamsl on the eastern side of Humansrus. Hills on the western side of the valley are more gentle with only a few points where the elevation reaches >1,600 mamsl. The central valley on Humansrus farm is elevated between 1,500 and 1,540 mamsl.

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000 are summarized in **Table 1** below. The data indicate that January is the hottest month with an average maximum daily temperature of 32^{o}C and June the coldest with an average maximum daily temperature of 18^{o}C. During June and July the average minimum daily temperature drops to <3^{o}C.

Table 1: Temperature data for Kimberley (South African Weather Service)

KIMBERLEY CLIMATIC AVERAGES 1960-2000													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP	32.6	31.2	28.9	25	21.5	18.4	18.8	21.4	25.7	28	30.1	32.1	26.2
MIN TEMP	17.7	17.3	15.2	10.7	6.2	2.8	2.5	4.7	8.8	11.9	14.5	16.5	10.7
AVE TEMP	25.2	24.3	22	17.9	13.9	10.6	10.6	13.1	17.3	19.9	22.3	24.3	18.5
KIMBERLEY CLIMATIC ABSOLUTES 1960-2000													
HIGHEST TEMP	40.4	39.9	37.8	34.9	31.3	26.6	26.8	31.2	36.6	37.6	39.2	40.9	40.9
LOWEST TEMP	6.5	5.6	2	-2.8	-5.7	-7.9	-8.1	-7.8	-5.5	-0.5	2.5	3.8	-8.1

The data also indicates that the absolute maximum temperature recorded during the period was 40.9^{o}C and the lowest -8.1^{o}C.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in **Table 2** below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 2: Precipitation statistics for the Humansrus area (Source: South African Rain Atlas)

Average monthly precipitation in mm) at Measuring Station Coordinates: S28^{o}18' E023^{o}22'													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean:	64.7	76.3	77.8	42.5	15	5.2	3.6	5.6	11.2	22.2	31.3	45.9	401.1
Standard Deviation:	46	50.9	49.7	35.2	18.6	10.1	8.2	11.2	17.0	24.1	28.4	36.5	107.9

The data indicate that 84% of the precipitation occurs during the months November to April. This phenomenon is characteristic of a summer rainfall area. March is the wettest month with an average precipitation of ~78 mm, whilst July is the driest with <4 mm.

The rainfall distribution for this area is indicated in **Figure 2** over page. Rainfall generally decreases from the site (Humansrus) to the west, south and south east. The highest precipitation occurs in the mountainous area west and south west of Danëlskuil, where the MAP exceeds 520 mm. The lowest precipitation occurs at two isolated localities south east of Danëlskuil and Lime Acres respectively. These areas have a MAP of less than 360 mm.

3.2 Geology

The geology of the study area, which is located on the eastern flank of the Dimoten Syncline striking in a general north-south direction, is depicted in **Figure 3** on page 9. The geological map indicates that significant parts of the study area are covered by Recent deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersected argillaceous, loose and well weathered material up to 30 mbgl, however this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales and banded ironstone, which were deposited after a period of erosion forming a unconformity in this specific area. The upper part of this Formation consists of a 1–3 m thick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic andesitic lavas of the Ongeluk Formation. This Makganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the STEP Plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus (see **Figure 3**). The area between these faults has apparently been displaced downwards to form a graben structure.

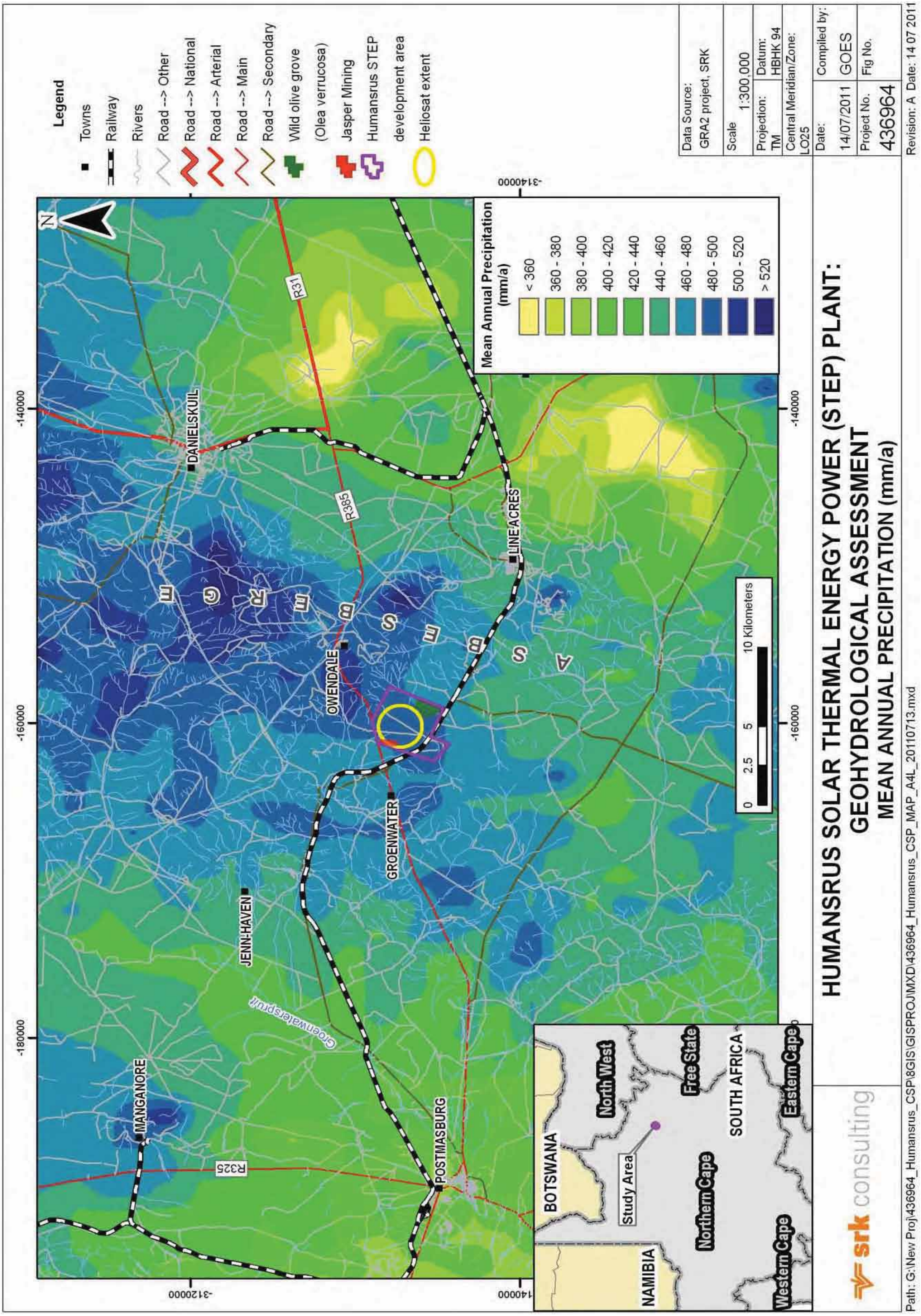

Figure 2: Rainfall distribution in the Humansrus area

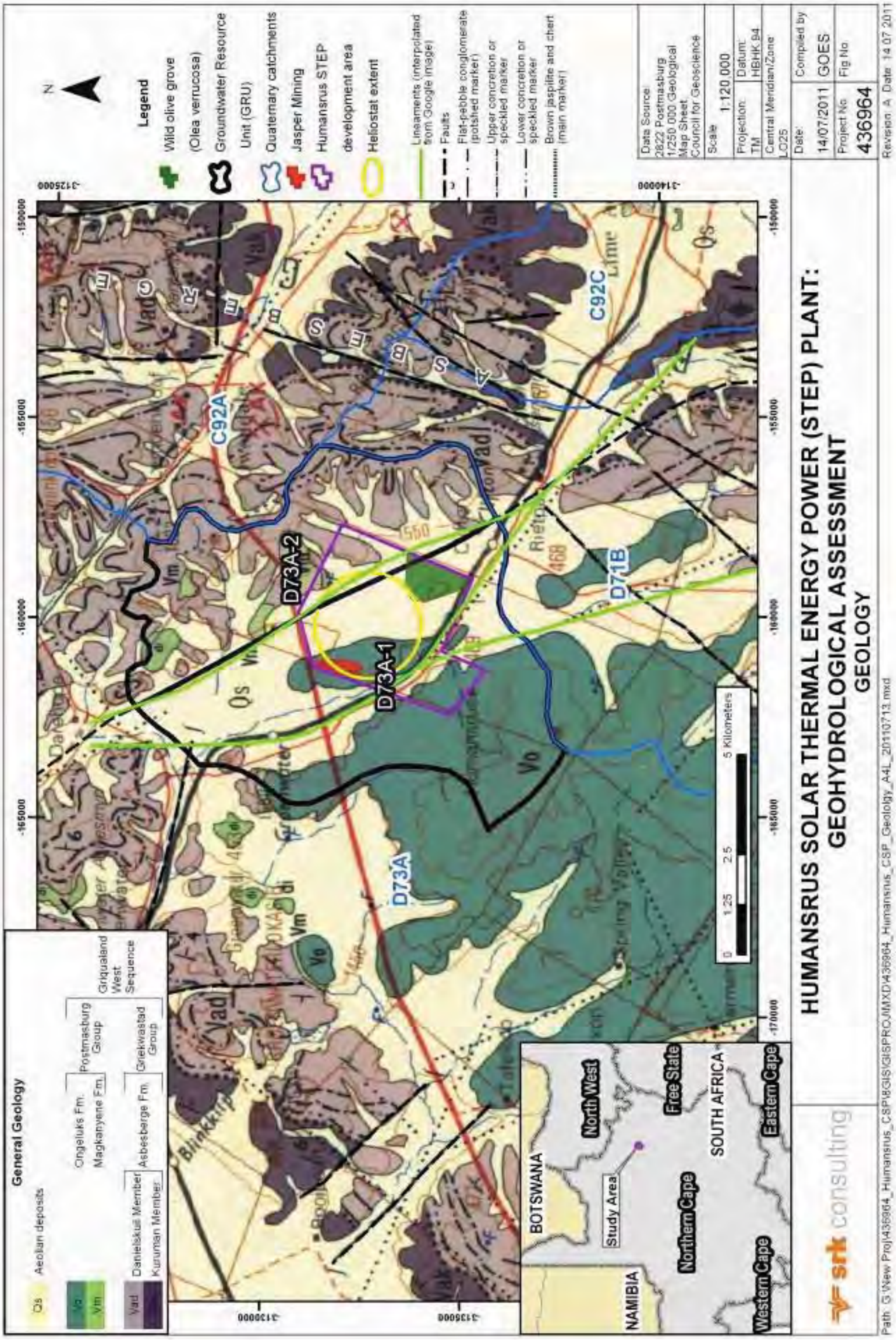

Figure 3: Geology of the Humansrus area (after Council for Geoscience)

3.3 Hydrogeology

3.3.1 Aquifer Type

Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers (**Figure 4**). This type of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operates in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shale and mudstone, which rather deform than fracture under stress.

Some unconfined interganular aquifers (also known as primary aquifers) also occur in and near the main drainage channel of the area at Groenwater station north-west of Humansrus. Here the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. All these result in a poorly developed primary aquifer that is very vulnerable to droughts.

3.3.2 Hydrocensus Results

The hydrocensus results are summarized in **Table 3** (page 12) with the localities of these boreholes indicated in **Figure 5**. Forty-one (41) boreholes and one (1) spring were surveyed on the Farm Humansrus and its surrounds.

Four anomalously high yielding boreholes were located in the area, i.e. boreholes HS2, GR10, GR11 and GR12. These boreholes are located on the two graben-faults in the area with boreholes GR10, GR11 and GR12 on the western fault and borehole HS2 on the eastern fault. Borehole HS2 intersected highly fractured lava and tillite, as evident from drill cuttings around the borehole. It was reportedly yield tested by Mr Scholtz at 40 ℓ/s. However, during removal of the test pump, it got stuck in the borehole at 60 mbgl, probably as a result of the borehole collapsing due to an insufficient length of casing been inserted. This borehole cannot be used and a new borehole needs to be drilled adjacent to it for production purposes, if required. Borehole HS4, which is also located on or close to the eastern fault, has only a maximum immediate yield of 1 ℓ/s. It is believed that this relative shallow borehole (54 m) was not drilled deep enough to intersect the main fault and hence the relative low yield. Borehole GR11 is a replacement borehole drilled for borehole GR10 and is ~5 m from the latter. This borehole and borehole GR12, were previously used to irrigate ~25 ha of lucerne.

The average borehole yield of the surveyed boreholes is 4.6 ℓ/s. This value is skewed by a few extraordinary high yielding boreholes. Therefore the median borehole yield of 1.4 ℓ/s gives a much better indication of the borehole yield that can be expected from a successful borehole drilled in this area. Boreholes drilled to intersect the graben faults could be much higher yielding, possibly 20 ℓ/s to as high as 40 ℓ/s.

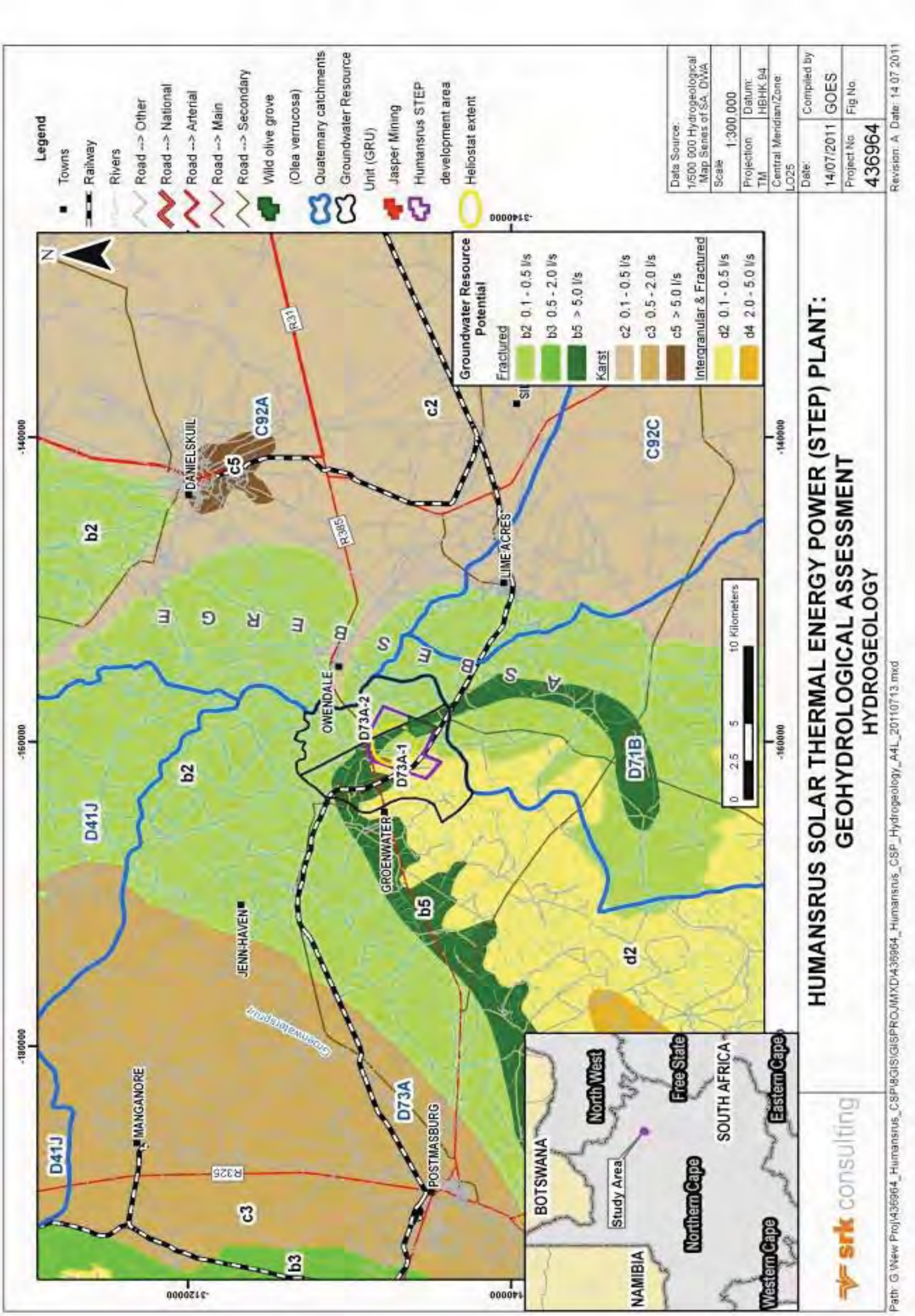

Figure 4: Aquifer type and yield potential in the Humansrus area (after the DWA 1:500 000 scale hydrogeological map series data)

Table 3: Summary of hydrocensus results of the Humansrus area.

Bh Nr	Date	Latitude	Longitude	Elevation (mamsl)	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Pump intake (mbgl)	Use	pH	EC (mS/m)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Land reform												
GR1	15-Jul-11	-28.29228	23.31879	1499	73	4.0	19.00	None		Domestic			G47253, Pump removed
GR10	15-Jul-11	-28.28773	23.34227	1476		20.0	5.87	None					
GR11	15-Jul-11	-28.28773	23.34225	1477	60	20.0	7.05	None					Replacement bh for GR10
GR12	15-Jul-11	-28.27770	23.33874	1467	28	10.0	2.12	None					
GR13	15-Jul-11	-28.25558	23.32697	1458	0		0.00	None		Irrigation	7.22	132	Spring
GR14	15-Jul-11	-28.25672	23.33109	1461	9			WP 100mm cylinder	5	Domestic, Stock	7.70	33	Closed
GR15	15-Jul-11	-28.27567	23.33025	1488	91		19.49	None					
GR16	15-Jul-11	-28.26194	23.35528	1495	73		18.79	WP 75mm cylinder		Stock	7.45	43	
GR17	15-Jul-11	-28.25250	23.35111	1493	52			WP 60mm cylinder		Stock	7.37	61	
GR2	15-Jul-11	-28.29878	23.31550	1496	60			50mm Mono		Domestic			Pump out of order, Closed
GR3	15-Jul-11	-28.28208	23.31056	1485	64	3.5	29.11	40mm Submersible	55	Domestic	7.90	97	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	15-Jul-11	-28.27552	23.31678	1479	32	0.3	27.59	None					Tested by SRK in 2007, Likely partially collapsed
GR5	15-Jul-11	-28.27740	23.30551	1463	50	4.1	17.33	None					Tested by SRK in 2007
GR7	15-Jul-11	-28.27743	23.30550	1464	78	1.4	17.07	None					Drilled by SRK 2008, Blow yield
GR8	15-Jul-11	-28.27703	23.33501	1470	11			Handpump					Closed
GR9	15-Jul-11	-28.27719	23.33510	1471	15		4.00	40mm submersible					Out of order
Farm:	Humansrus - Owner: Mr. Allen Scholtz												
HS1	14-Jul-11	-28.27903	23.36406	1491	50	1.8	27.27	40mm Submersible	45	Domestic, Stock	7.15	52	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	14-Jul-11	-28.27681	23.36466	1467	107	40.0	28.02	None					Water strike at 98 mbgl Fractured lava and tillite
HS3	14-Jul-11	-28.28088	23.36538	1493	36	0.2		None					Roots at 10 mbgl
HS4	14-Jul-11	-28.29156	23.37531	1530	54	1.0		WP 90mm cylinder	42	Stock	7.90	54	Bees in borehole
HS5	14-Jul-11	-28.32079	23.35028	1525	54	1.8	18.27	WP 90mm cylinder	42	Stock			Out of order, Water flows in @ 10 mbgl
HS6	14-Jul-11	-28.28322	23.39720	1627	210	0.5		None					Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk												
SE1	14-Jul-11	-28.32690	23.36535	1519	84	3.6		WP 65mm cylinder	45	Stock			Baseplate closed
SE10	14-Jul-11	-28.32897	23.37159	1515	60	2.5		None					Collapsed at 6.8 mbgl
SE2	14-Jul-11	-28.32920	23.36567	1521	24	0.3		WP 65mm cylinder	24	Stock			Baseplate closed
SE3	14-Jul-11	-28.32963	23.36553	1522	33	0.5	17.00	WP 65mm cylinder	30	Domestic, Stock			
SE4	14-Jul-11	-28.32989	23.36586	1522	35	1.0		40mm Submesible	30	Domestic, Stock	7.23	90	Baseplate closed
SE5	14-Jul-11	-28.32921	23.36266	1516	35	1.9		WP 100mm cylinder	18	Stock			Baseplate closed
SE6	14-Jul-11	-28.33779	23.35252	1567	150	0.3	73.44	WP 65mm cylinder	81	Stock	7.70	70	Water strike at 75 mbgl
SE7	14-Jul-11	-28.32590	23.34681	1534	15	0.1	12.35	Solarpump	14	Stock	7.90	59	Alt Nr GW9
SE8	14-Jul-11	-28.32722	23.34662	1537	30	0.0		None					Dry
SE9	14-Jul-11	-28.32923	23.37240	1516	60	4.2		None					Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk												
CN1	15-Jul-11	-28.32497	23.39030	1506			31.71	WP 60mm cylinder	39	Domestic			
CN2	15-Jul-11	-28.32503	23.38942	1535				50mm Mono	42	Domestic, stock	6.85	32	Closed, Pump yield = 0.9 ℓ/s
CN3	15-Jul-11	-28.32493	23.38938	1535		0.3	29.65	None					
CN4	15-Jul-11	-28.32333	23.38965	1541			32.46	WP 60mm cylinder	36	Stock			
CN5	15-Jul-11	-28.32609	23.38891	1534		0.7	25.79	None					Was equipped with 40mm Subm., Intake @ 45m
CN6	15-Jul-11	-28.32919	23.38791	1528			19.31	None					
CN7	15-Jul-11	-28.32916	23.38609	1523		0.9	12.22	None					Blocked 0.2m below water level
CN8	15-Jul-11	-28.32973	23.38429	1526				None					Blocked at 16.7 mbgl, Dry
CN9	15-Jul-11	-28.33991	23.38789	1517			9.27	WP 60mm cylinder	21	Stock	7.25	51	
CN10	15-Jul-11	-28.34507	23.38803	1514			9.18	WP 60mm cylinder	24	Stock	7.20	59	
					Average	4.6					7.4	64.1	
					Median	1.4					7.4	59.0	

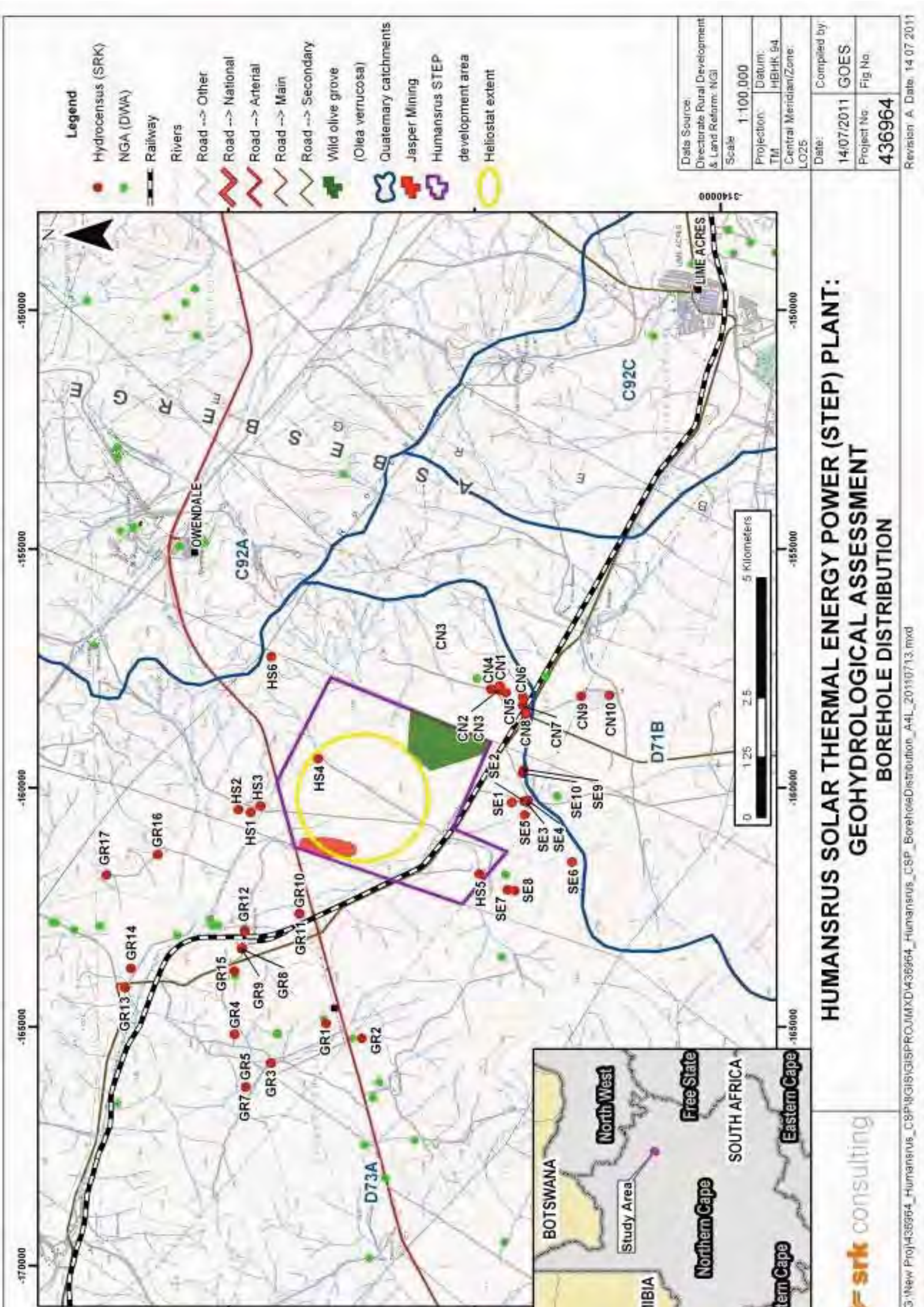

Figure 5: Localities of surveyed boreholes in the Humansrus area

3.3.3 Current Abstraction

The estimated abstraction from the Farm Humansrus and the surrounding areas is summarised in **Table 4** page 15. In the case of electric pumps, the estimates are based on pump yields and daily operating hours as reported by the owners. For windpumps a 24 h/d operation at 12% of the maximum yield was assumed (which is determined by the cylinder size). This assumption is based on the author's personal experience in the Karoo area. Based on these assumptions a total abstraction of approximately 104 000 m^3/a is calculated for the study area. Nearly 66% (~68 000 m^3/a) of this volume is abstracted in the Groenwater rural area, of which ~54% is for domestic use and 46% (31 500 m^3/a) spring flow at GR13.

No large scale irrigation currently takes place in the area and most of the abstracted groundwater is used for stock watering and domestic use. However, groundwater was previously abstracted from boreholes GR11 and GR12 at a rate of ~180 000 m^3/a to irrigate 25 ha of lucerne. This abstraction continued for several years and was only ceased after this portion of Groenwater was bought by the Department of Rural Affairs and Land Reform (pers. Comm. Mr. Scholtz).

3.3.4 Groundwater Resource Potential

The Humansrus area falls within the Quaternary Drainage Region D73A (see **Figure 3** and **Figure** 5) for which the amount of water available under General Authorisation is listed under Zone A of the Groundwater Taking Zones, where no water may be taken from this drainage regions except as set out under Schedule 1[1] and small industrial users[2] (DWAF, 2004). Therefore, if the water demand is to be satisfied from the groundwater resources a Water Use Licence Application will have to be submitted.

Two (2) Groundwater Resource Units (GRU's) were defined for this area. These are based on surface drainage, measured groundwater elevations and lineaments such as faults and dykes. The boundaries of these GRU's are indicated in **Figure 3**. The GRA2 grid datasets (DWAF, 2005) were used to derive the MAP, effective recharge and groundwater resource potential for these GRU's. As boreholes cannot intersect all the available recharge in an area, an exploitability factor (DWAF, 2005) was used to calculate the volume of groundwater that can actually be abstracted through boreholes. Current abstraction based on the hydrocensus data was subtracted from this value to determine the current Groundwater Exploitation Potential. These calculated values are summarised in **Table 5** on page 16.

[1] Not taking more than 10 cubic metres from groundwater on any given day.

[2] •"Small industrial users" mean water users who qualify as work creating enterprises that do not use more than twenty cubic metres per day (i.e. 20 000 litres/day) and identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented, under the following categories:-

a) 1: food processing;
b) 2: prospecting, mining and quarrying;
c) 3: manufacturing;
d) 5: construction

Table 4: Estimated groundwater abstraction in the Humansrus area

Bh Nr	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Use	Estimated Annual Abstraction (m^3)	Comments
Farm:	Groenwater				TOTAL	68,223	
GR1	73	4.0	19.00	None	Domestic	11,000	Pump removed, Abstraction was ~11,000 m^3/a
GR10		20.0	5.87	None			
GR11	60	20.0	7.05	None			Previous abstraction 120,000 m^3/a
GR12	28	10.0	2.12	None			Previous abstraction 60,000 m^3/a
GR13	0		0.00	None	Irrigation	31,500	Spring - rough estimate - difficult to measure flow
GR14	9			WP 100mm cylinder	Domestic, Stock	3,406	Closed
GR15	91		19.49	None			
GR16	73		18.79	WP 75mm cylinder	Stock	1,514	
GR17	52			WP 60mm cylinder	Stock	1,135	
GR2	60			50mm Mono	Domestic	7,900	Pump out of order, Previously pumped at ~7,900 m^3/a
GR3	64	3.5	29.11	40mm Submersible	Domestic	11,038	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	32	0.3	27.59	None			Tested by SRK in 2007, Likely partially collapsed
GR5	50	4.1	17.33	None			Tested by SRK in 2007
GR7	78	1.4	17.07	None			Drilled by SRK 2008, Blow yield
GR8	11			Handpump		730	Closed
GR9	15		4.00	40mm submersible			Out of order - not used anymore
Farm:	Humansrus				TOTAL	17,082	
HS1	50	1.8	27.27	40mm Submersible	Domestic, Stock	10,512	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	107	40.0	28.02	None			Water strike at 98 mbgl Fractured lava and tillite
HS3	36	0.2		None			Roots at 10 mbgl
HS4	54	1.0		WP 90mm cylinder	Stock	6,570	Bees in borehole
HS5	54	1.8	18.27	WP 90mm cylinder	Stock		Out of order, Water flows in @ 10 mbgl
HS6	210	0.5		None			Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside				TOTAL	10,549	
SE1	84	3.6		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE10	60	2.5		None			Collapsed at 6.8 mbgl
SE2	24	0.3		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE3	33	0.5	17.00	WP 65mm cylinder	Domestic, Stock	1,135	
SE4	35	1.0		40mm Submesible	Domestic, Stock	1,971	Baseplate closed
SE5	35	1.9		WP 100mm cylinder	Stock	3,406	Baseplate closed
SE6	150	0.3	73.44	WP 65mm cylinder	Stock	1,135	Water strike at 75 mbgl
SE7	15	0.1	12.35	Solarpump	Stock	631	Alt Nr GW9
SE8	30	0.0		None			Dry
SE9	60	4.2		None			Collapsed at 8 mbgl
Farm:	Clifton				TOTAL	8,089	
CN1			31.71	WP 60mm cylinder	Domestic	1,135	
CN2				50mm Mono	Domestic, stock	3,548	Closed, Pump yield = 0.9 ℓ/s
CN3		0.3	29.65	None			
CN4			32.46	WP 60mm cylinder	Stock	1,135	
CN5		0.7	25.79	None			Was equipped with 40mm Subm., Intake @ 45m
CN6			19.31	None			
CN7		0.9	12.22	None			Blocked 0.2m below water level
CN8				None			Blocked at 16.7 mbgl, Dry
CN9			9.27	WP 60mm cylinder	Stock	1,135	
CN10			9.18	WP 60mm cylinder	Stock	1,135	
					TOTAL FOR STUDY AREA	103,942	

Table 5: Groundwater exploitation potential of the Humansrus area

Groundwater Resource Unit	Area (m^2)	Area (km^2)	No. of cells	MAP (mm/a)	Recharge Factor (%)	Average Mean Annual Recharge (m^3/a)	Average Mean Annual Recharge (mm/a)	Groundwater Exploitation Potential (m^3/a) Wet Season	Groundwater Exploitation Potential (m^3/a) Dry Season	Volume of Water stored in Aquifer (m^3/a)	5m Drawdown Storage Volume (m^3/a)
Quaternary Catchment											
D73A	1,558,947,048	1,558.95	63,737	407	2.10%	23,021,400	8.6	19,554,500	15,472,300	333,785,000	25,459,600
Groundwater Resource Units (GRU's)											
D73A-1	42,490,000	42.49	4,249	476	2.00%	627,462	9.4	437,116	325,853	9,097,502	693,916
D73A-2	27,820,000	27.82	2,782	487	2.00%	410,826	9.9	340,868	268,020	5,956,520	454,336
TOTAL						***1,038,287***		***777,984***	***593,873***	***15,054,022***	***1,148,252***
Humansrus CSP Development Area											
Development Area	13,560,000	13.56	1,356	488	2.10%	200,244	10.1	170,089	134,581	2,903,322	221,452

The GRA2 data indicate that the Humansrus GRU (D73A-1) has an estimated average mean recharge of approximately 627 000 m^3/a, i.e. 2% of the MAP of 476 mm. The mean annual recharge in the Humansrus area is shown in **Figure 6** page 17. The groundwater exploitation potential was calculated to vary from 326 000 m^3/a for dry seasons to 437 000 m^3/a for wet seasons, i.e. a mean of approximately 381 000 m^3/a. The volume of groundwater that is potentially stored in the aquifers of the Humansrus GRU has been calculated as approximately 9.1 million m^3.

Based on information supplied by SSI, the maximum water demand of any of the three types of STEP Plants that is under consideration, is 246 200 m^3/a for the Hybrid Cooled Zero Discharge Plant.

Hourly water demand ranges from 41.5 m^3/h (11.53 ℓ/s) under full load to 8.35 m^3/h (2.32 ℓ/s) during off times. *Note: For this study, as a worst case scenario, this maximum demand figure was used for comparison to the sustainable amount of water available for exploitation*.

Comparing this maximum water demand (worst case scenario) to the exploitation potential of the Humansrus GRU (D73A-1), it is evident that this demand is well within (65%) the long term yield capacity of the aquifers of the GRU.

3.3.5 Depth to Water Table and Inferred Groundwater Flow Directions

Depth to water table at Humansrus varies from 18 to 28 mbgl.

The hydrocensus data and data from the NGDB were used to plot the groundwater elevations on the topgraphical map, from which the groundwater flow directions were inferred (**Figure 7**). The groundwater elevations normally mimics the surface elevation contours and generally flows from higher lying to lower lying areas. The inferred flows are from the surrounding high lying flanks of the valley towards the centre lower lying floor of the valley at Humansrus and then along the valley towards the north-west. These groundwater elevations indicate that the southern part of the surveyed area (i.e. the farm Clifton and part of the farm Sunnyside) falls outside the Humansrus GRU in another drainage region (D71B).

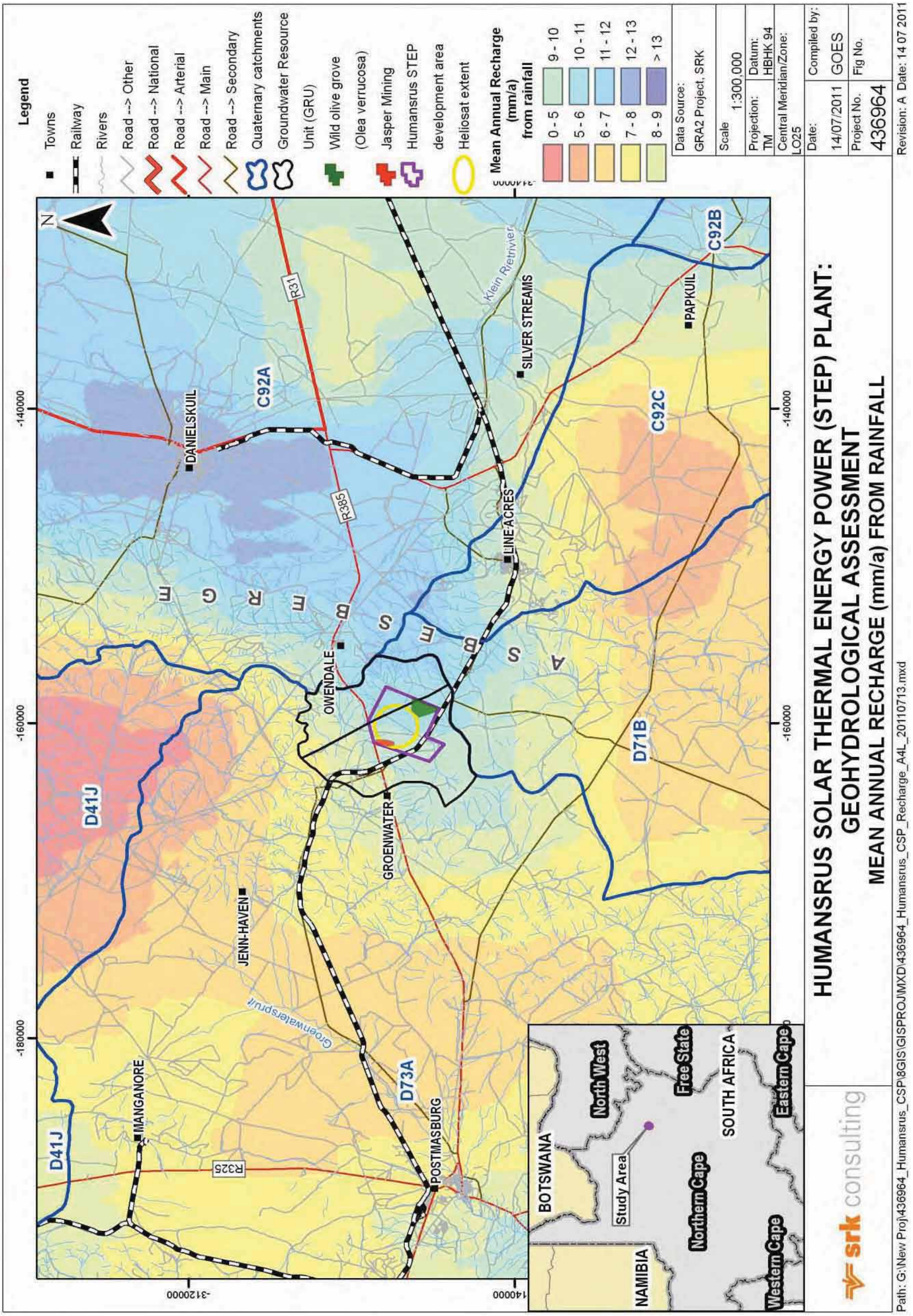

Figure 6: Mean annual recharge in the Humansrus area

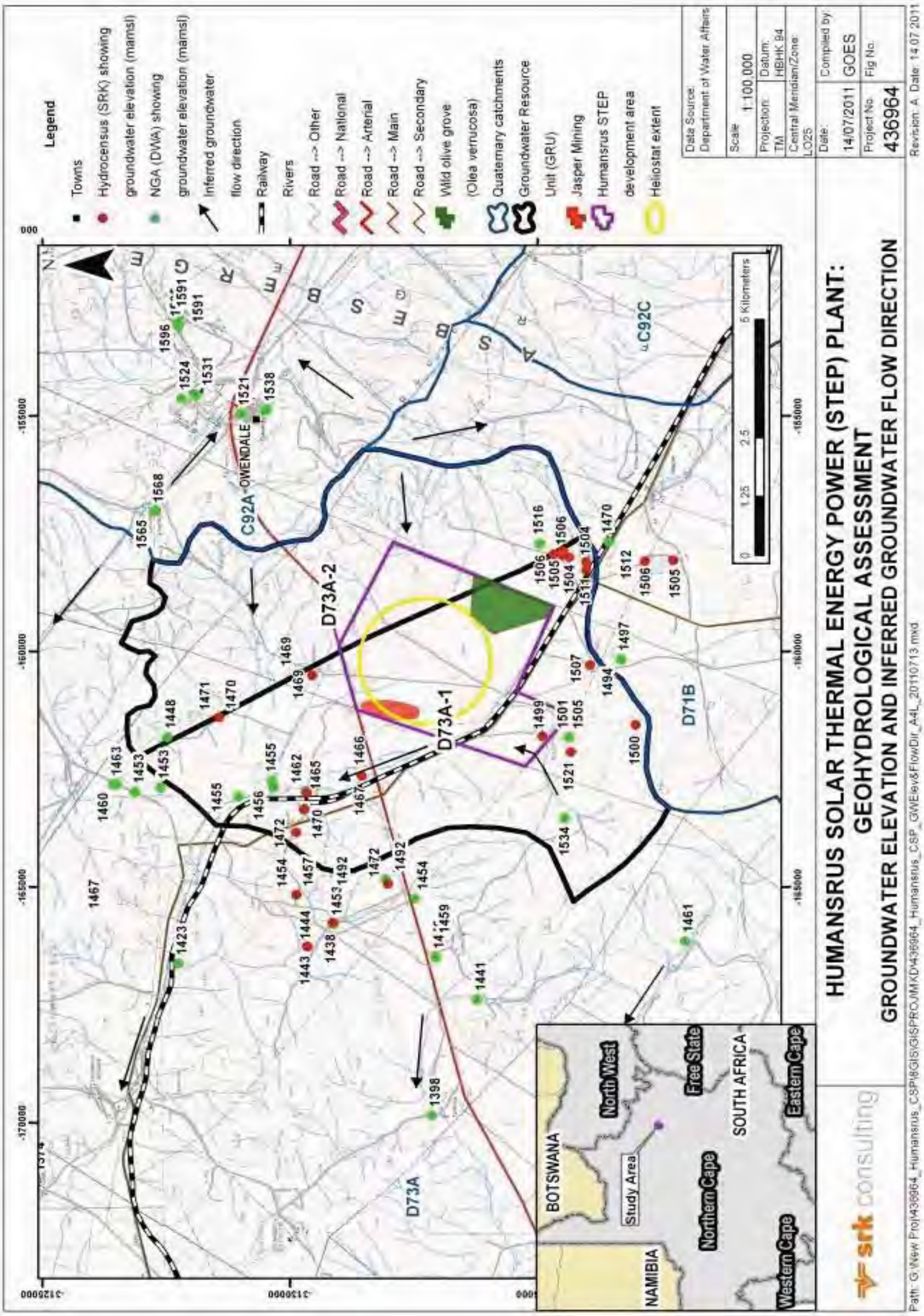

Figure 7: Groundwater elevations and inferred flow directions in the Humansrus area

3.3.6 Groundwater Quality

The groundwater salinity (expressed as Electrical Conductivity in mS/m) of the Humansrus area is shown in **Figure 8** (page 20). The groundwater quality varies throughout the area with the best quality of groundwater occurring in the recharge areas, i.e. the jaspilite and banded ironstone hills in the eastern and northern parts of the study area. However, the groundwater quality throughout the area is generally good and based on the field measured Electrical Conductivity's (EC), which ranged between 32 and 132 mS/m (mean EC = 59 mS/m), suitable for human consumption[3]. Noticeable anomalies in the field measured EC's were recorded near potential pollution sources (e.g. stock pens) in areas with shallow water levels. This indicates that the aquifers are easily polluted by surface pollution sources due to a rapid recharge and relative quick vertical infiltration.

The average EC and pH values of the surveyed boreholes are 66.8 and 7.5 respectively and correlate well with the median values. This means that there are not highly anomalous values for these parameters which skew the average values. Borehole GR14 and the spring GR13 are in the same area with largely different EC values. The relative high EC measured at the spring can likely be attributed to surface pollution from animals drinking at this open water source. Boreholes GR14 and CN2 are drilled in the Daniëlskuil Member (jaspilite) of the Asbestos Hills Formation and yield groundwater with very low EC values. The Asbestos Hills Formation in this area is characterized by a very good groundwater quality.

3.3.7 Aquifer Vulnerability

Figure 9 shows aquifer vulnerability as determined by evaluating seven parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible away from the high risk areas in the north and east. Best position will be in the south-western parts of the farm where the aquifer vulnerability is lowest.

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[3] ≤150 mS/m is acceptable for long term human consumption (SABS, 2006)

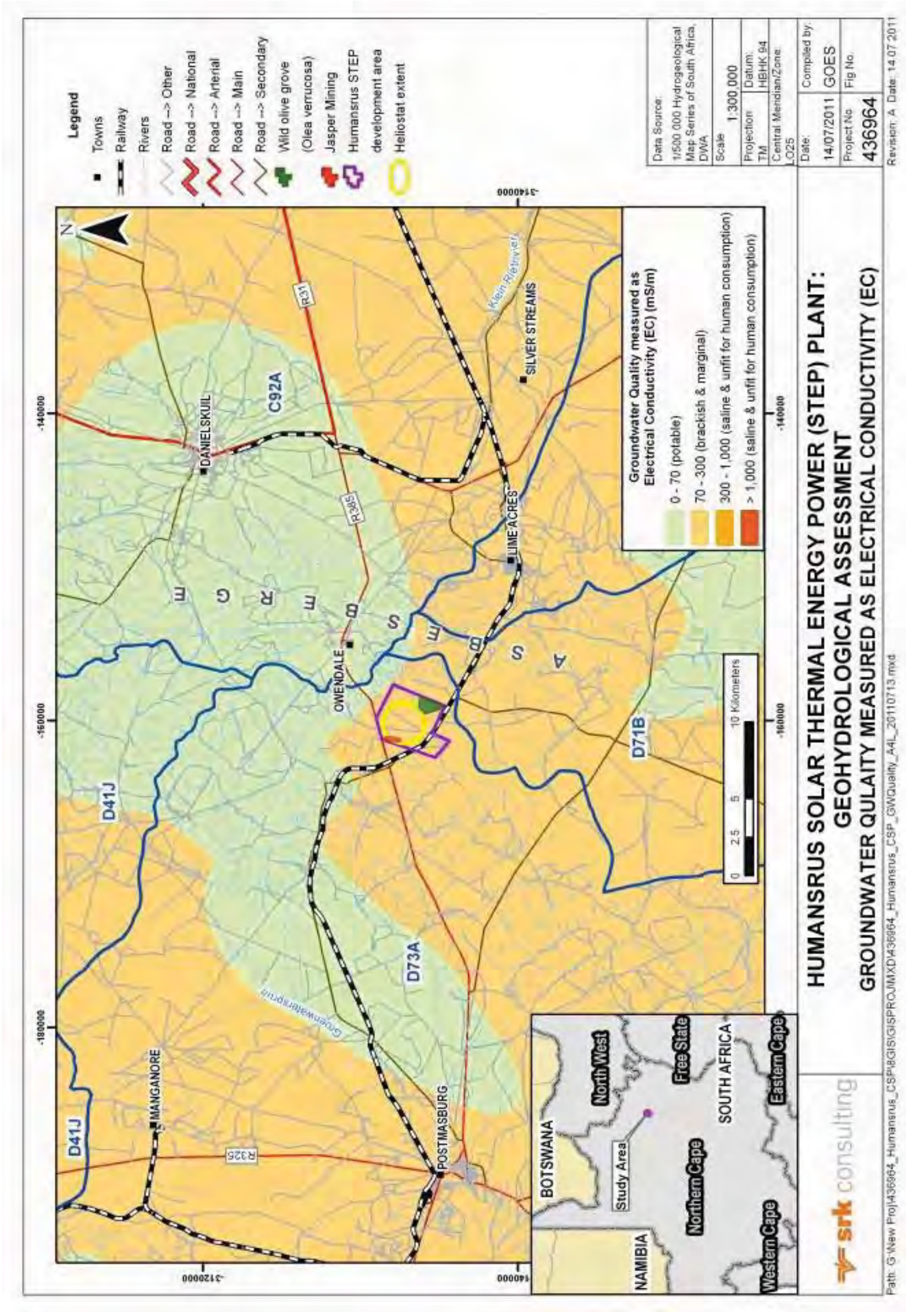


Figure 8: Groundwater salinity in the Humansrus area

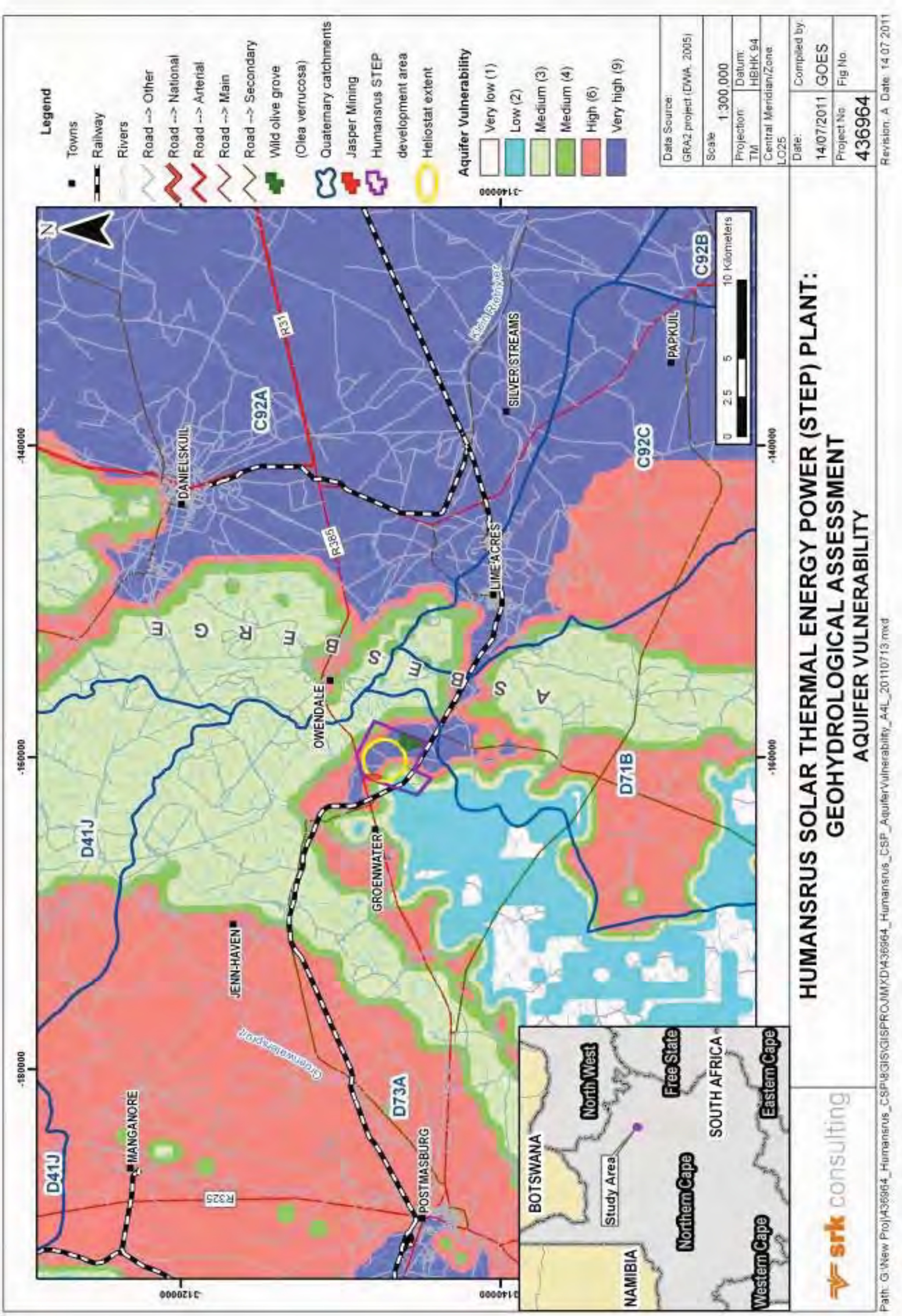


Figure 9: Aquifer vulnerability map of the Humansrus area

4 Conclusions

Based on the information discussed in this report the following can be concluded regarding the groundwater conditions at Humansrus:

- Local geological observations during the hydrocensus and lineament mapping from Google Earth images indicate that the valley at Humansrus farm is a result of graben faulting;
- Maximum immediate yields of boreholes drilled along these two graben faults are very high, but otherwise borehole yields seldom exceed 4 ℓ/s;
- The high yielding borehole HS2 drilled on the eastern graben fault intersected highly fractured lava and tillite in the fault zone and had a reported tested yield of 40 ℓ/s. This borehole is blocked at 60 mbgl by a pump that got stuck and cannot be used;
- Two boreholes (GR11 and GR12) located along the western graben fault at Groenwater were previously utilized for irrigation purposes and groundwater was abstracted at a rate of 180 000 m^3/a without an apparent significant negative impact on the aquifer;
- Relative little groundwater is abstracted from this area and groundwater is mainly used for stock watering and domestic purposes;
- Most of the calculated groundwater abstraction occurs in the Groenwater rural area with the Groenwater spring the main contributor;
- Groundwater quality measured as salinity (EC) in the surveyed area is generally good to very good with a mean EC of 59 mS/m. The EC only deteriorates near pollution sources such as stock pens, pit latrines and soak away pits. The best quality groundwater occurs near the recharge areas of the Asbestos Hills Formation in the eastern parts of the Humansrus valley;
- Groundwater exploitation figures for the area indicate that the expected maximum water demand of 246 200 m^3/a for the STEP Plant is only ~65% of the Exploitation Potential of the Humansrus GRU (D73A-1). Therefore, satisfying the STEP Plant's water demand from the local groundwater resources should not have an unacceptable negative influence on groundwater resources of the area;
- The General Authorisation for taking of groundwater from Drainage Region D73A is zero, except for schedule one and small scale industrial purposes. Therefore, if the water demand is to be satisfied from the groundwater resources, a Water Use Licence Application will have to be submitted to the DWA;
- The best areas for future production boreholes for the STEP Plant are the two graben faults at Humansrus with the eastern fault the prime choice;and
- From aquifer vulnerability point of view the proposed area for the STEP Plant is favourable as long as possible sources of groundwater pollution are kept away from the two graben faults, especially the north-eastern and eastern parts of the farm. Best area for the evaporation pond will be the south-western part of the farm where aquifer vulnerability is low. The groundwater level in this area is ~18 mbgl with argillaceous material expected in the upper part of the geological profile which will give some protection from surface pollution.

5 Recommendations

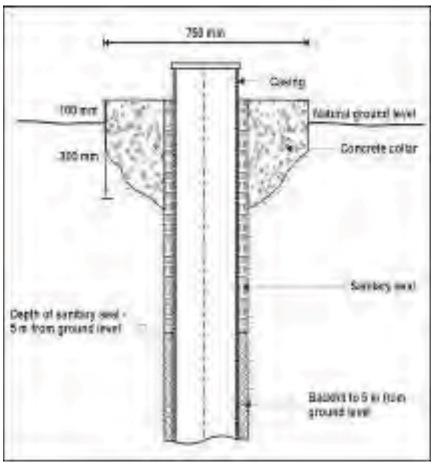
Based on the conclusion of this preliminary report the following is recommended:

1. The Solar Power Tower and evaporation ponds must be placed close to the centre of the valley at Humansrus as far away as possible from the two graben faults;
2. Heliostats can be placed all over the area as these do not pose a groundwater pollution hazard;
3. Future production boreholes must be concentrated on the two graben faults with the eastern fault the primary choice;
4. All existing boreholes must be properly sealed at the surface to prevent surface pollution of the groundwater. This measure will also prevent bees from invading the borehole;
5. A more detailed hydrogeological impact assessment including drilling of test boreholes and test pumping of existing and the test boreholes must be carried out;
6. At least three (3) shallow monitoring boreholes (two downstream and one upstream) must be drilled and pump tested near the evaporation ponds to obtain aquifer parameters for the numerical model and contamination transport model. These boreholes can be used for monitoring purposes in future;
7. The reportedly high yielding borehole HS2, which is unusable due to a pump stuck in it, should be replaced with a new production borehole drilled adjacent to it. The new borehole must be pump tested according to the DWA requirements. This will provide invaluable information regarding aquifer parameters of the fault zone for use in the groundwater numerical model;
8. Existing borehole HS4 must also be yield tested to obtain aquifer parameters in an area with a much lower aquifer potential; and
9. In order to safeguard the groundwater supplies from contamination and equipment from theft and damage, two zones of protection must be established around each production borehole.

Inner protection Zone

The inner protection zone is an area of at least 50 m x 50 m, centred on the actual borehole. The following measures must be applied in this protection zone:

- No pit latrines, VIP's, soak-aways or septic tanks – to prevent effluent from percolating into the aquifer and borehole;
- No storage of fuel, lubricants or other hazardous substances without a leak prove;
- Production boreholes for domestic use must be equipped with a sanitary seal – to prevent contaminated surface water and spilled fuel from percolating down the casing into the borehole;
- The concrete collar around borehole casing must be at least 100 mm higher than the floor or surface level



to prevent spilled fuel, water from leakages, wash water, etc to enter the borehole;

- No ponding of surface water must be allowed, i.e. the area must be sloped for surface water to drain away from this zone;
- Vegetation, other than trees and large bushes, should be maintained in this zone – Note: Roots of bushes and trees growing near boreholes often grows into the borehole where it can cause considerable problems;
- The borehole and pumping equipment must be housed in a lockable pump house. For this purpose a removable cage manufactured out of galvanised steel mesh and corrugated steel sheets is recommended. This cage, rather than a brick building, is recommended as it can be readily removed in case the borehole is damaged or if it needs to be re-developed and cleaned.
- The production boreholes, as well as other monitoring boreholes in the area, must be properly sealed to prevent entry of reptiles, insects, birds and small rodents.
- The entire area should be properly fenced with a lockable gate to prevent unauthorised entry and to exclude animals. The gate must be positioned and of such a type that allows easy vehicle access.
- A signboard must be erected on the gate warning people of the dangers and that unauthorised entry is not allowed.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted hydrogeological and environmental practices.

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SolarReserve SA (Pty) Ltd

Humansrus Solar Thermal Energy Power Plant

Postmasburg

Heritage Scoping

Issue Date: 10 June 2011

Revision No.: 1……………………

Project No.: …………………………….

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Declaration of Independence

The report has been compiled by PGS Heritage & Grave Relocation Consultants an appointed Heritage Specialist for SSI. The views stipulated in this report are purely objective and no other interests are displayed during the decision making processes discussed in the Heritage Impact Assessment Process that includes the Scoping as well as this final report

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EXECUTIVE SUMMARY

PGS Heritage & Grave Relocation Consultants was appointed by SSI Environmental Division to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the Concentrated Solar Project for SolarReserve SA (Pty) Ltd, on the farm 469 "Humansrus" close to Postmasburg in the Northern Cape Province.

The Heritage Scoping Report, that forms part of the HIA, has shown that the area between Postmasburg and Daniëlskuil generally referred to as the Ghaap plato has a rich history of occupation from the Stone Age with hunter gatherers to the Thlaping and Thlaro during the Iron Age period. The 1800's saw the rise of the Griqua people in the area and their loss of sovereignty after 1880 to Cape rule.

Initial field work has also identified heritage sensitive areas within the study area that will need further investigation during the HIA/EIA phase.

These findings provide the basis for the recommendation of further field thruthing through an archaeological walk down covering the whole of the study area. The aim of this will be to compile a comprehensive database of heritage sites in the study area, with the aim of developing a heritage management plan for inclusion in the EMP as derived from the EIA.

CONTENTS **Page**

List of Appendices

List of Figures

1 INTRODUCTION

PGS Heritage & Grave Relocation Consultants was appointed by SSI Environmental Division to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the Concentrated Solar Project for SolarReserve SA (Pty) Ltd, on the farm 469 "Humansrus" close to Postmasburg in the Northern Cape Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The Heritage Impact Assessment aims to inform the EIA in the development of a comprehensive EMP to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This Heritage Scoping Report was compiled by PGS Heritage & Grave Relocation Consultants (PGS).

The staff at PGS has a combined experience of nearly 40 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Principal Archaeologist for this project, and the two field archaeologist, Henk Steyn and Marko Hutton are registered with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company Natura Viva cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC)

and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHAP (Association of Professional Heritage Assessment Practitioners – Western Cape).

1.3 Assumptions and Limitations

Not subtracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist had been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA) Act 107 of 1998
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
iv. Development Facilitation Act (DFA) Act 67 of 1995

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impacts Assessment (EIA) – Section (32)(2)(d)
    d. EMP (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)
iv. Development Facilitation Act (DFA) Act 67 of 1995
    a. The GNR.1 of 7 January 2000: Regulations and rules in terms of the Development Facilitation Act, 1995. Section 31.

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34 (1) of the NHRA states that "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…". The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage". In accordance with legislative requirements and EIA rating criteria, the regulations of SAHRA and ASAPA have also been incorporated to ensure that a comprehensive legally compatible AIA report is compiled.

Terminology

Abbreviations	*Description*
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PSSA	Palaeontological Society of South Africa
ROD	Record of Decision
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was

executed by human agency and which is older than 100 years, including any area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in the change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Refer to **Appendix C** for further discussions on heritage management and legislative frameworks

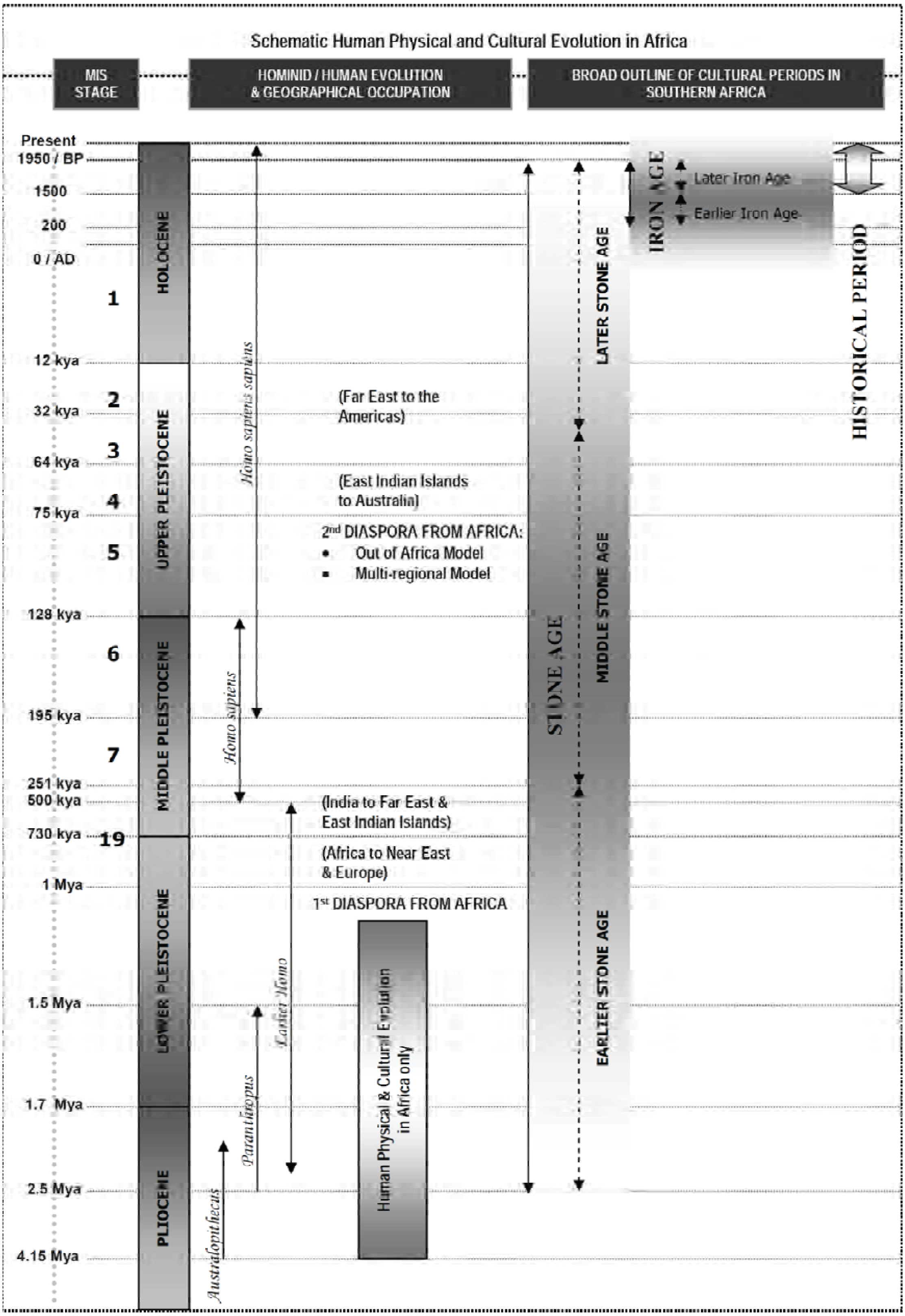

Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

Location	(E23.37224,S28.32263), The land is situated 30 kilometres west of Postmasburg on the R385.
Land	1431 Hectares of land under option.
Land Description	The land is greenfield veld (bush) type, zoned for agricultural use however used for grazing at present.

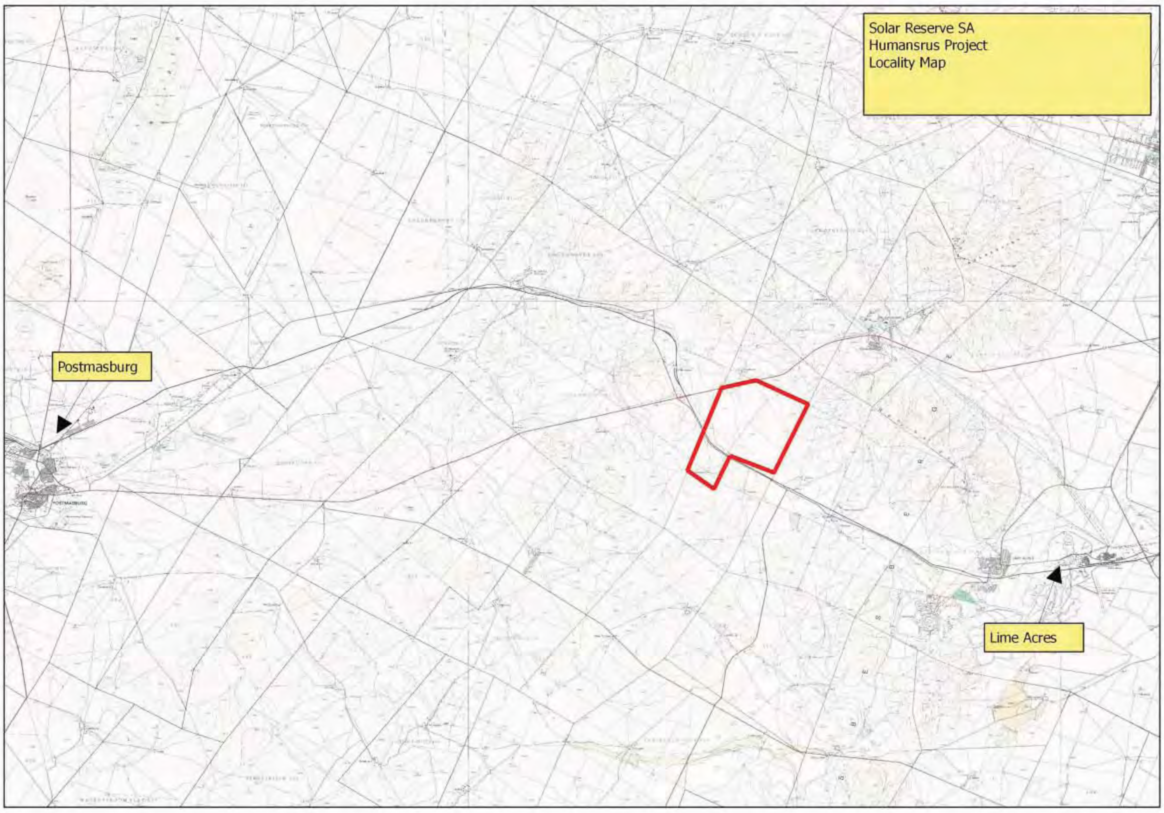

Figure 2 - Humansrus locality

2.2 Technical Project Description

Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW electricity in the Northern Cape. This facility will utilise the sun as the fuel source.

The CSP plant comprises of four main subsystems and is summarised below:

- **Solar Field** – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- **Molten Salt Circuit** which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- **The Power Block**; and
- **Auxiliary facilities and infrastructure** which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

2.3 Project overview

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. This project focuses on the possible establishment of a Concentrating Solar Power (CSP) plant in the Northern Cape area. The proposed CSP plant is proposed to consist of a maximum installed capacity of up to 100 MW. The plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

Figure 3 - An example of a power plant using central receiver technology. This is a 10MW demonstration plant that was built in the United States – image courtesy NREL.

The CSP Plant being considered is a molten salt-type, Central Receiver technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

A heliostat (***Figure 4***) is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in an elliptical formation around the focal point with the majority of the reflective area weight to the more effective side of the heliostat field

Figure 4 - Single heliostat – image courtesy NREL

The central receiver is situated on the top of the central tower (***Figure 5***). This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

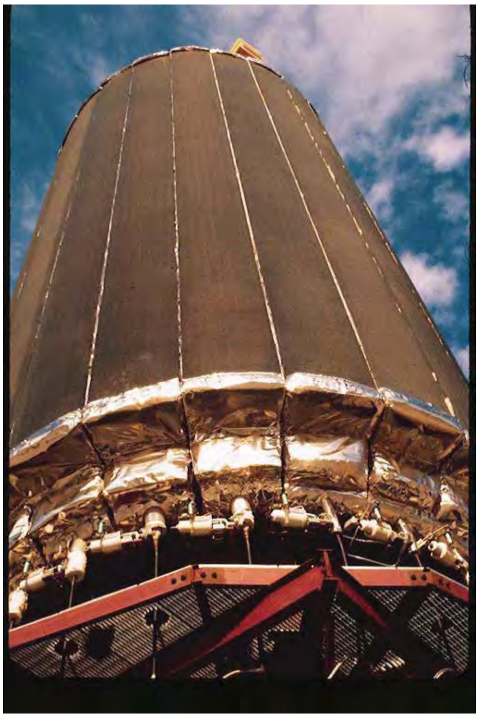

Figure 5 - Receiver heat exchange panels – image courtesy NREL

Power is generated through a conventional Rankine cycle (steam turbine process). The working fluid is a salt mix of a 60:40 ratio of Sodium Nitrate ($NaNO_3$) and Potassium Nitrate (KNO_3). The cold salt is pumped up the central tower at approximate 300°C and flows through the central receiver where it is heated to approximately 550°C after which it can be stored for use in the conventional power generation process (maintaining 98% thermal efficiency)(***Figure 6***).

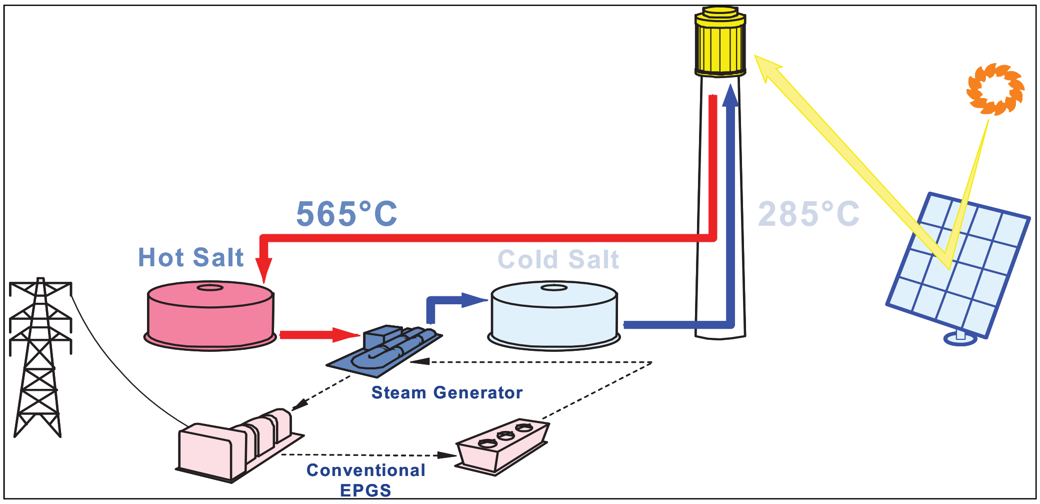

Figure 6 - Flow diagram showing the power generation process in a CSP plant.

3 CURRENT STATUS QUO

3.1 Site Description

The property (**Figure 7**) is bordered to the north by the R385 which connects Daniëlskuil and Postmasburg (**Figure 8**), and the D3381 gravel road, from Lime Acres, which divides the south western section of the property (**Figure 9**).

The central portion of the property is undulating with the low-lying areas covered in grasveld. The areas to the west and east of the central flat lands is characterised by rising rocky ridges covered with shrubs and trees. The farm is currently being used for grazing by livestock and for the breeding of horses.

The southern and south western section of the study area is characterised by perennial stream and a tributary running down from the south western section of the study area. Due to the intermittent rainfall of the area the stream has created a dry pan/flood plain that is only filled during high rainfall episodes (**Figure 10**).

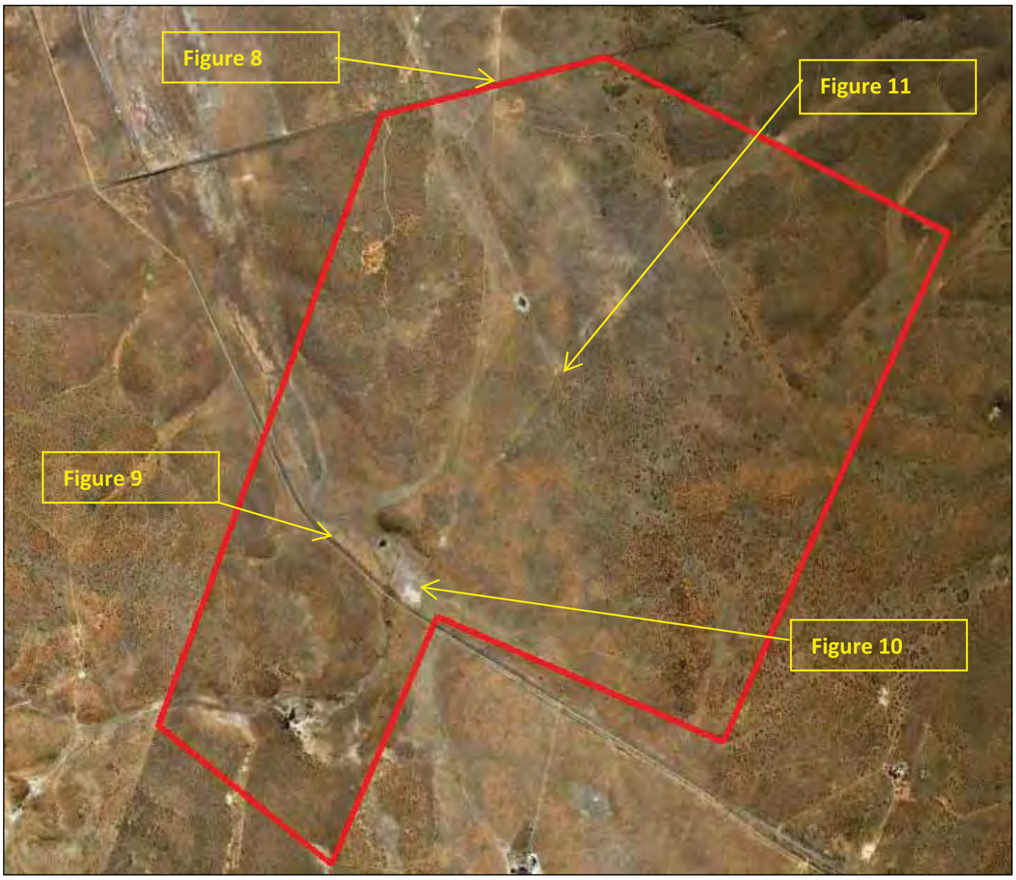

Figure 7 – Aerial view of study area with position of photographs shown

Figure 8 – View of to the R385 towards Postmasburg (Study area on the left)

Figure 9 – View of gravel road and rail line in the southern section of the study area

Figure 10 – View of dry pan from rail line in southern section of the study area

The south eastern section of the study area is also characterised by clumps of wild olive trees (*Olea europea*) (**Figure 11**).

Figure 11 – Wild olive trees in the study area (Webley, 2010)

3.1.1 Archival findings

The archival research focused on available information sourced that was used to compile a background history of the study area and surrounds. This data then informed the possible heritage resources to be expected during field surveying.

Palaeontology (*Refer to Annexure A for full Report*)

The south-western and north-eastern portions of the study area are underlain by Late Precambrian (Early Proterozoic) sediments of the Late Precambrian **Transvaal Supergroup** within the Prieska Subbasin, as shown on the geological map in **Figure 12**.

The **Daniëlskuil Formation** (Vad) of the **Ghaap Group** (Asbestos Hills Subgroup) consists of some 200m of banded iron formations (BIF) that are almost 2.5 billion years old (Eriksson *et al.* 2006 and references therein). The only fossils that are likely to occur here are microbial assemblages embedded within finer-grained cherts or forming stromatolites (microbial mounds; Almond & Pether 2008).

The fossil record of the Early Proterozoic **Postmasburg Group** of the Transvaal Supergroup is very sparse (Almond & Pether 2008). Stromatolitic bioherms (microbial reef mounds) up to 5m long and 3m thick that are made up of manganese-rich laminated carbonates are recorded from the glacially-influenced **Makganyene Formation** (Vm) by Polteau *et al.* (2006). These carbonate rocks are interbedded with glacial diamictites in the Prieska Subbasin. The intimate association of warm-water carbonates and cold-water glacial deposits at low palaeolatitudes is of palaeoclimatic significance (See also Polteau 2000, 2005). No fossils are recorded from the overlying **Ongeluk Formation** (Vo), dated at approximately 2.2 Ga (billion years) which consists largely of basaltic and andesitic lavas that were erupted both subaerially and under water (Eriksson *et al.* 2006).

The central part of the study area is largely blanketed by unconsolidated aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (Qs), the geology of which is reviewed by Partridge *et al.* (2006).

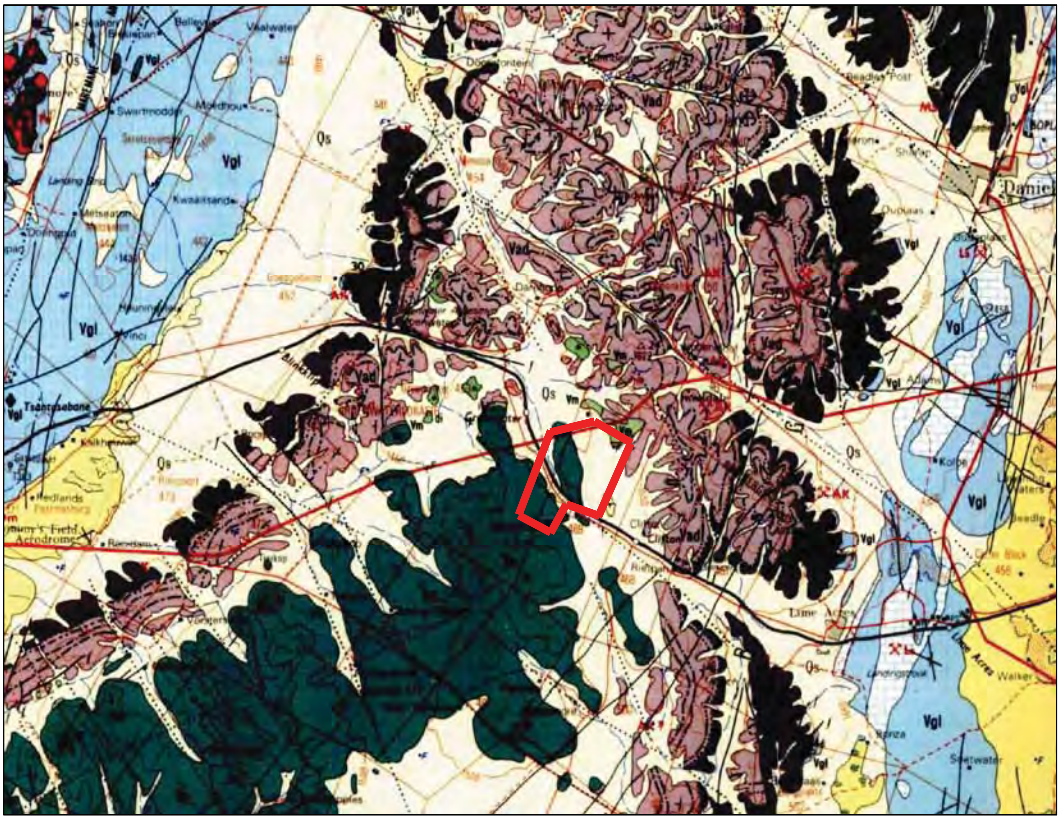

Figure 12 – Extract from 1: 250 000 geological map 2822 Postmasburg (Council for Geoscience, Pretoria) showing geology of the Humansrus study area in the Asbesberge (red polygon)

Archaeology

Stone Age

The Early inhabitants of Griqualand, both west and east, were the San people historical referred to as the Bushmen. Henderson (2000) describes some of the empirical evidence that points to the presence of the San people in the interior regions of South Africa. Among the things Henderson describes are the stone tool scatter and rock engravings near water course and/or sources such as springs; engravings are also noted as a common feature in small Koppies that define the landscape of the interior regions of South Africa.

Such evidence is corroborated with finds made in the study area in an initial study conducted in the survey area in 2010 by Webley. The field work found concentrations of Stone Age material around the dry pan in the southern section of the study area (**Figure 13**).

Other material culture found in the region that point to the presence of San people in the region include remains of ostrich shell-beads and ostrich egg-shell that were used by the San people to carry water and as drinking vessels. James Backhouse (1844), describing his journey to Klaarwater (modern-day Griquatown) in 1839, notes stopping at Spuigslang Fountain where he observed Bushmen women and their children coming to the fountain for water using egg-shell for bottles and vessels. Henderson identifies the same localities in her 2000 report namely 'Spuigslang Fountain' and the 'Farm Spoedaan' in the Hay District. The similar egg-shell remains that Backhouse notes to have seen being used by the Bushmen women and children have been found in the area south-east of Hay District (Henderson, 2000).

General consensus between archaeologists working in the Northern Cape is that archaeological remains are mostly grouped around water sources (river systems, springs and pans) and other geographical structures such as ranges of hills or shelters found in broken country. These observations by various archaeologists in the 1970-1990, have been corroborated by more recent archaeological surveys for developments such as PGS (2009-2010), Webley & Halkett (2008), Webley et al. (2010), Webley & Halkett (2010), Morris (2008, 2010) and, Van Reyneveld (2005).

Archaeological excavations done at two specularite mines Doornfontein (Beaumont & Boshier, 1974) and Blinkklipkop (Thackery & Beaumont, 1983) produced artefacts and radiocarbon data dating back to 800 AD. The data also reflects an occupation from around 800AD up to around 1850AD, with glass beads, metal items indicating European contact in the upper layers.

Figure 13 – Low density scatter of MSA finds (Webley, 2010)

Rock Art

The Northern Cape is well known for its rock art in the form of rock painting and engravings, with the archaeological databases at the National Museum in Bloemfontein and the McGregor Museum in Kimberley containing hundreds of documented rock art sites with archaeological field work on projects such as transmission line construction leading to the discovery of new sites (PGS, 2010).

Known engraving sites close to the study area are at:

- Danielskuil: Ouplaas (Morris & Beaumont, 1994), Townlands (Collins, 1973; Wilman, 1933);
- Lime Acres: Carter Block (Morris, 2008; Wilman, 1933);
- The farm Lemoenkloof just north of the study area (pers. Comms with Mst. Scholtz)

Iron Age

Iron Age expansion southwards past Kuruman in to the Ghaap plato and towards Postmasburg is dated to the 1600's (Humphreys, 1976 and Thackeray, 1983). Definite dates for Tswana presense in the Postmasburg area are around 1805 when Lichtenstein visited the area and noted the mining activities of the Tswana (probably the Thlaping) tribes in the area.

The area of Danielskuil was named by the Thlaro as *Thlaka la tlou* (reeds of the elephant) and with the Thlaping they settled the area from Campbell in the east to Postmasburg and towards the Langeberg close to Olifantshoek in the west before 1770 (Snyman, 1988) (**Figure 14**).

The Korana expansion after 1770 started to drive the Thlaro and Thlaping further north towards Kuruman (Shillington, 1985)

Figure 14 – Thlaping and Thlaro areas of residence, 1800-1870

Post 1800's

Ouzman (2005) traces the Korana to what he calls "pre-colonial Kora" in the Cape Province and their father (of "frontier Korana") to James Bloem, a 'white' Prussian from Thuringa who immigrated to the Cape in 1780, escaping to Namaqualand after accusations of murdering his wife.

Historical Context

Below we trace the formation of the Griqua nation and the establishment and the development of Griqualand in order to observe the evolution of the cultural landscape of Hay District where our study site is located.

The Formation of the Griqua Nation and the Establishment of Griqualand

The establishment of Griqualand, now characterised by Griquatown (south-west) and Campbell (south-east of the study area) and Daniëlskuil (Griequaland West) among the popular towns of Griqualand came about with the trekking of the so called 'Bastaards'- a name that acknowledges multiple ethnogenesis (Ross, 1976) in Ouzman (2005) and '....other lesser privileged inhabitants from the Cape Colony during a period when their rights to land and livestock were being eroded in Cape Colony' (Cronje, 2006). In the Cape they had been conscripted to serve in the commandos established by the Cape Government. Not incline to conscription, and possibly other laws of the Cape Colony they decided; under the leadership of Adam Kok I (1710-1795)(**Figure 15**), to trek (emigrate) to the interior regions of the country; in the processes occupying areas of land in the Orange River region.

It is here that in the second half of the 18th century Adam Kok I and his followers became dominant inhabitants of the region. However, following his emancipation in the mid-18th century, Kok I is suggested to have moved to the area immediate of Piketberg where in 1751 he acquired grazing rights to a farm, Stinkfontein, from the Dutch East India Company. It is here that a number of Khoi (Hottentots) descents, namely the Goringhaiqua and the Namaqua and some 'Bastaards' attached to Adam Kok I group first established themselves. Adam Kok I possibly got married to the daughter of the Xarixuriqua chief; a move that could have potentially strengthen his hold and enhanced his status among his group and followers as the leader of the newly formed nation to be later called, the Griqua's (circa. 1813).

Adam Kok I initiated longstanding relations between himself, his successors and the administrators of the Cape Colony; in the process attracting either official support and/or sanctions (Cronje, 2006). This led to his recognition by the Cape Colony as the headman over the Khoi in the region, subsequently assuming the title of a chief or captaincy, Kaptyn as referred to in the Affairs of the Cape of Good Hope, 1871. His stay in the area did not last long as they had to move to the Kamiesberg area to escape increasing pressure and encroachment by the farmers who were moving west coast of the Cape Colony in their search for new lands for grazing and cultivation. Access to water sources also played a significant role in this encroachment.

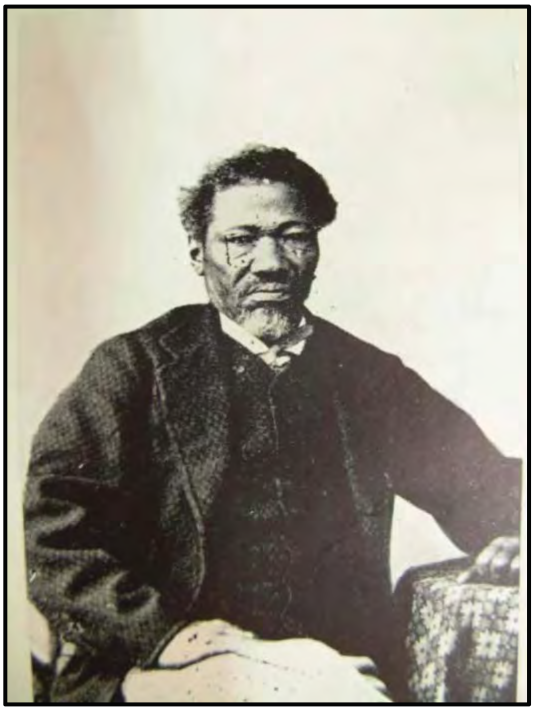

Figure 15 – Adam Kok I

Another resettlement by Kok and his group took place when he sent his son, Cornelius I, to explore the area along the Orange River; during this process several cattle posts were established for grazing purposes. Cronje (2006) suggests that, "in the course of time they increasingly adopted the Cape Dutch language but gave it their own idiom"; this became the language for the Griqua people. This is important because language is a defining trait of any nation and many Griqua people still speak Afrikaans to this day. However, the identity politics and rights to land of this newly formed nation did not end there as they continued for many generations to come which included periods of contestation for chieftainship and land between and among the Griqua's and many other nations, both 'black' and 'white'.

These contestations were pertinent in the period after Kok I stepped down as the chief of the Griqua people in Campbell, relinquishing his powers as chief to his son Cornelius Kok I. At the same time Adam Kok II (in Griquatown in 1816) was elected by London Missionary Society (LMS) as the overall chief in Griquatown.

The LMS tried to persuade the Griqua to abolish their hereditary leadership in favour of elected officials. Kok and Barend Barends did not take well to this proposed

practice and moved away with their followers –Kok to Campbell and Barends to Daniëlskuil (Snyman, 1988).

The San residing at Daniëlskuil was not impressed with the new arrivals and a period of conflict resulted between Barends' Griqua and the local San inhabitants. This continued until 1820 when Jager Afrikaner (San representative) and Barends proclaimed a truce. The Griqua stayed fairly autonomous up to 1860 after which landowner's right and the expansion of the colonial empire started to encroach on their land.

In the 1860's this dispute of ownership of the Campbell lands and the surrounding areas between the Orange Free State and the Zuid Afrikaansche Republiek of the Transvaal on the one hand and Waterboer supported by the Cape Government on the other resulted in the eventual demise of the Griqua territory.

"*The basis of Free State claims to the Campbell lands was the deed of sale dated December 1861 signed by Henry Harvey who purported to be the authorised agent of Adam Kok III*" (Cronje, 2006). Meaning that Kok III had sold land to the Orange Free State without consulting with Waterboer, a process which had been negated by Sir Cathcart's devaluation of the treaty that had been sign earlier between Andries Waterboer and D'Urban. In the process Henry Harvey had also sold land of Kok III which did not belong to the Griqua government seated in Philippolis. Fires of these land claim sagas where propelled further when diamond field were discovered in the region.

This led to the 1871 discussion between Barkly (who had personally visited the area and the newly discovered diamond fields at Kimberley), the Presidents of the Orange Free State and the Zuid Afrikaansche Republiek to submit the border dispute with Waterboer to arbitration.

This process of border negotiation and arbitration ended with the 1871 declaration by Barkly (who had acceded to Waterboer's request) of Griqualand West as a British territory. This resulted in the division of Griqualand into Western and the Eastern parts.

By 1880 the whole of Griqualand West was under Cape rule and numerous locations were set aside for the Southern Tswana. The locations furthest to the west were those of Daniëlskuil, Groenwater, Blinkklip and Skeifontein (**Figure 16**) (Shillington, 1985).

Figure 16 – Griqualand West locations, 1880-1900 (Shillington, 1985)

The Hay district

The Hay district is named after Lieutenant- General Charles Craufurd Hay. C.C. Hay was Lieutenant- General and Acting Governor of the Cape Colony in 1870. Hay was born 1809 and passed away in 1873 on the Isle of Wight. Hay accepted the position of lieutenant-general at the Cape on 25 January 1869, when Sir Philip Wodehouse left the Cape. Hay then acted as Governor and High Commissioner from 20 May until 31 December 1870.

During these months he resided over the dispute of the Griekwa Chief Nicolaas Waterboer and the Free State Government. Hay accepted Waterboer's Claims and championed his cause against the Free State government that proclaimed the Campbell Lands as Free State Territory.

His protracted handling of the situation lead to numerous treaties after him stepping down as Acting Governor and leaving South Africa to settle on the Isle of Wight. (Standard Encyclopaedia of Southern Africa).

Humansrus Farm History

The survey diagram of the general area (SG3296/1878) (Webley, 2010) identifies the adjoining farms Groenwater and Lemoenkloof (*Figure 17*) but Humansrus is not named suggesting it acquired its name after 1878.

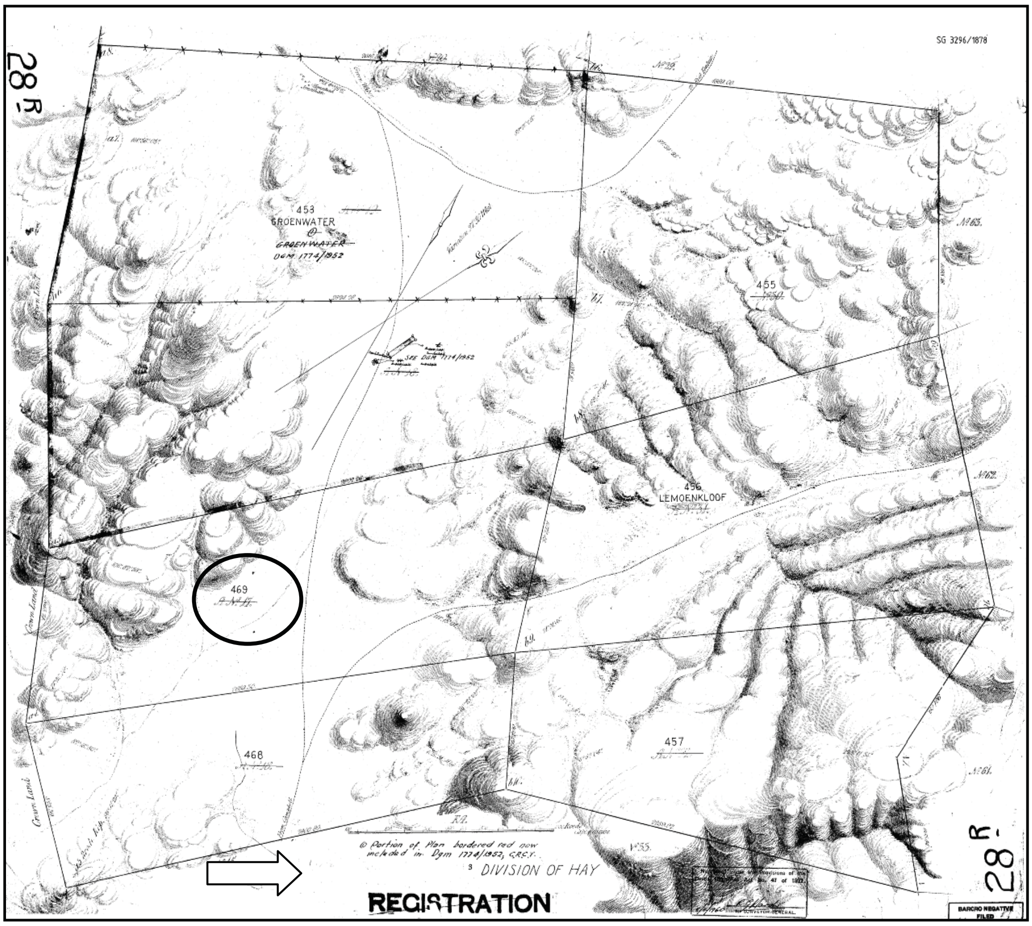

Figure 17 - Survey diagram (SG3296/1878) for the general area. The Farm 469 is indicated by the circle. Lemoenkloof and Groenwater are situated on the northern and western boundaries. There are no homesteads shown on Farm 469.

An overlay of the 1878 map with a recent 1:50 000 topographical map revealing two main roads traversing the study area. The one road branches of towards Daniëlskuil while the main road continues on through the area of the current Groenwater Station and further north. Snyman (1988) confirms these routes as being in existence since 1816 when the original route from Griquastad via Postmasburg to Kuruman changed to go via Daniëlsrus, which was a shorter route.

Figure 18 - Survey diagram (SG3296/1878) with overlay of current 1:50 000 topographical map (Wagon routes in dashed green)

Webley (2010) indicates that the current owner's (Mr. Scholtz) grandfather purchased the portion of the farm on which the old Humansrus house is located, during the 1940's. No other information on the Human family other than the headstone in the family graveyard close to the ruins of the original farmstead is available - Hester G. Schoeman (ne Human) born 23 September 1877 - died 28 May

1913. Some tentative research indicates the grave of an A.J. Human (born in 1878) located in the Daniëlsrus cemetery – a possible family link that could be researched further if required.

3.1.2 Findings of the Heritage Scoping Document

The findings can be compiled as follow and is combined to produce a heritage sensitivity map for the project:

Palaeontology

No further palaeontological studies are recommended for this development.

Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably in situ, and alert SAHRA as soon as possible so that appropriate action (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.

Archaeology

The possibility of archaeological finds in the study area has been indicated by previous research in the greater Daniëlskuil-Postmasburg and Ghaap plato area. This is confirmed by a short reconnaissance survey by Webley (2010) and an initial site visit by an archaeologist from PGS of the study area. Concentrations of Stone Age artefact around the dry pans and rivers were found as well as spot finds in the flat sandy areas.

Although the current owners indicated no knowledge of rock art it is recommended that special attention is given to rocky areas as such sites could be prevalent.

Historical

As the area of Groenwater was settled since 1880 as a location for the Thlaping and Thlaro the possibility of scattered homesteads cannot be excluded and the report of Webley (2010) indicates the existence of structures only demarcated by single rows of rocks, indicating the position of the house foundations.

The position of the two wagon routes through the study area also leaves the possibility for ephemeral camp sites and outspans in the study area.

To be able to compile a heritage management plan to be incorporated into the EMP the following further work was required for the HIA for inclusion in the EIA.

Archaeological walk through the whole of the study area, with specific attention given to the areas around pans, outcrops, wagon route alignments and historical structures will be required.

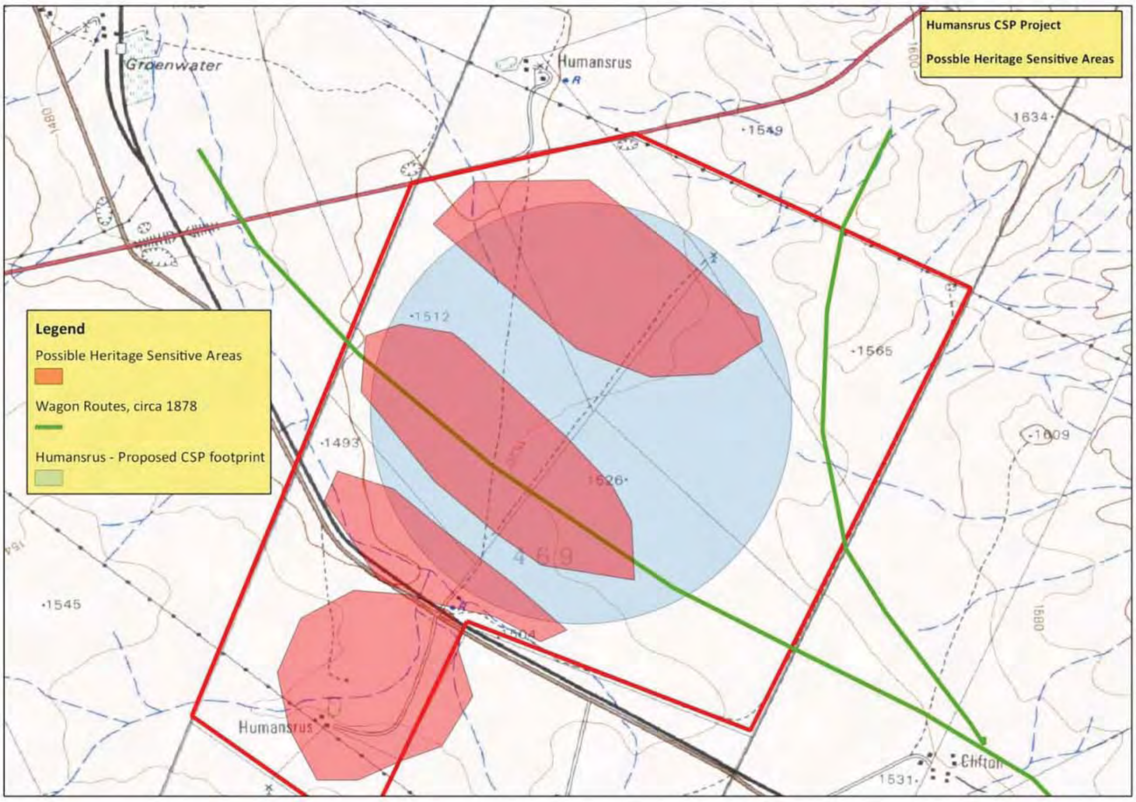

Figure 19 – Heritage Sensitivity Map

3.2 Environmental Issues and Potential Impacts

ISSUE	**Impact on archaeological sites**
DISCUSSION	As seen from the archival work and discussion in Sections 3.1.1-3.1.2 the possibility of archaeological finds have been identified as being high and thus further field work is required to develop a comprehensive Heritage Management Plan.
EXISTING IMPACT	None known
PREDICTED IMPACT	Unidentified archaeological sites and the discovery of such sites during construction can seriously hamper construction timelines.

	Field work can thus provide valuable information on such site in the study area and provide timeous management of such site through realignment of development or mitigation of such sites where needed.
EIA INVESTIGATION REQUIRED	Archaeological walk down of study area
CUMULATIVE EFFECT	None foreseen at this stage.

ISSUE	**Impact on palaeontological sites**
DISCUSSION	As seen from the archival work and discussion in section 3.1 the possibility of palaeontological finds have been identified as being low and thus no further field work is required.

ISSUE	**Impact on historical sites**
DISCUSSION	As seen from the archival work and discussion in section 3.1-3.2 the possibility of historical finds have been identified as being high and thus further field work is required to develop a comprehensive Heritage Management Plan.
EXISTING IMPACT	None known
PREDICTED IMPACT	Unidentified historical structure and the discovery of such structures during construction can seriously hamper construction timelines. Field work can thus provide valuable information on such site in the study area and provide timeous management of such site through realignment of development or mitigation of such sites where needed.
EIA INVESTIGATION REQUIRED	Archaeological walk down of the study area will identify possible impacted sites

ISSUE	**Impact on graves and cemeteries site**
DISCUSSION	The existence of some graves and cemeteries has been verified during the archival research.
EXISTING IMPACT	None known
PREDICTED IMPACT	Unidentified graves and cemeteries and the discovery of such structures during construction can seriously hamper construction timelines. In the event that these graves and cemeteries could not be avoided a grave relocation proses needs to be started. Such a process impacts on the

	spiritual and social fabric of the next of kin and associated communities. Field work can thus provide valuable information on such site in the study area and provide timeous management of such site through realignment of development or relocation of such sites where needed.
EIA INVESTIGATION REQUIRED	Archaeological walk down of the study area will identify possible impacted sites
CUMULATIVE EFFECT	None foreseen at this stage.

4 CONCLUSIONS AND RECOMMENDATIONS

Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Scoping Report has shown that the area between Postmasburg and Daniëlskuil generally referred to as the Ghaap plato has a rich history of occupation from the Stone Age with hunter gatherers to the Thlaping and Thlaro during the Iron Age period. The 1800's saw the rise of the Griqua people in the area and their loss of sovereignty after 1880 to Cape rule.

Initial field work has also identified heritage sensitive areas within the study area that will need further investigation during the HIA/EIA phase.

These findings provide the basis for the recommendation of further field thruthing through an archaeological walk down covering the whole of the study area. The aim of this will be to compile a comprehensive database of heritage sites in the study area, with the aim of developing a heritage management plan for inclusion in the EMP as derived from the EIA.

The data will be compiled in a report that will utilise the Plan of Study for the EIA/HIA (**Appendix B**) as well as the significance rating (**Appendix E**) that will assist in incorporating the impacts on heritage resources into the total EIA report.

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Appendix A

PALAEONTOLOGICAL DESKTOP STUDY

RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

Proposed Humansrus Solar Thermal Energy Power Plant development on Farm 469, near Postmasburg, Northern Cape Province

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May 2011

The company SolarReserve SA (Pty) Ltd is proposing to develop a 100MW (maximum_ concentrated solar power (CSP) plant on Farm 469, Hay RD (Humansrus, Kheis Local Municipality) situated in the Asbesberge range, approximately 30 km east of Postmasburg (Map Fig.1).

The geology of the proposed development area is shown on 1: 250 000 geological map 2822 Postmasburg (Council for Geoscience, Pretoria) (Fig. 2). Brief explanatory notes are printed on the published map.

The south-western and north-eastern portions of the study area are underlain by Late Precambrian (Early Proterozoic) sediments of the Late Precambrian **Transvaal Supergroup** within the Prieska Subbasin, as shown on the geological map in Fig. 2.

The **Daniëlskuil Formation** (Vad) of the **Ghaap Group** (Asbestos Hills Subgroup) consists of some 200m of banded iron formations (BIF) that are almost 2.5 billion years old (Eriksson *et al.* 2006 and references therein). The only fossils that are likely to occur here are microbial assemblages embedded within finer-grained cherts or forming stromatolites (microbial mounds; Almond & Pether 2008).

The fossil record of the Early Proterozoic **Postmasburg Group** of the Transvaal Supergroup is very sparse (Almond & Pether 2008). Stromatolitic bioherms (microbial reef mounds) up to 5m long and 3m thick that are made up of manganese-rich laminated carbonates are recorded from the glacially-influenced **Makganyene Formation** (Vm) by Polteau *et al.* (2006). These carbonate rocks are interbedded with glacial diamictites in the Prieska Subbasin. The intimate association of warm-water carbonates and cold-water glacial deposits at low palaeolatitudes is of palaeoclimatic significance (See also Polteau 2000, 2005). No fossils are recorded from the overlying **Ongeluk Formation** (Vo), dated at approximately 2.2 Ga (billion years) which consists largely of basaltic and andesitic lavas that were erupted both subaerially and under water (Eriksson *et al.* 2006).

The central part of the study area is largely blanketed by unconsolidated aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (Qs), the geology of which is reviewed by Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools. The fossil record of the Kalahari Group as a whole is generally sparse and low in diversity. The Gordonia Formation dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying Dwyka Group may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands. These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying calcretes might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be occasionally expected within Kalahari Group sediments and calcretes, notably those associated with

ancient alluvial gravels. The younger fluvial and alluvial sands and gravels within the proposed development area are unlikely to contain any substantial fossil or subfossil remains.

The overall palaeontological sensitivity of the Transvaal Supergroup and Kalahari Group sediments mapped within the study region, including the sandy to gravely superficial sediments (alluvium, colluvium, soils), is low to very low (Almond & Pether 2008). The proposed development has a small footprint and deep excavations are not envisaged for CSP installations. **For these reasons, no further palaeontological studies are recommended for this development.**

Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably *in situ*, and alert SAHRA as soon as possible so that appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

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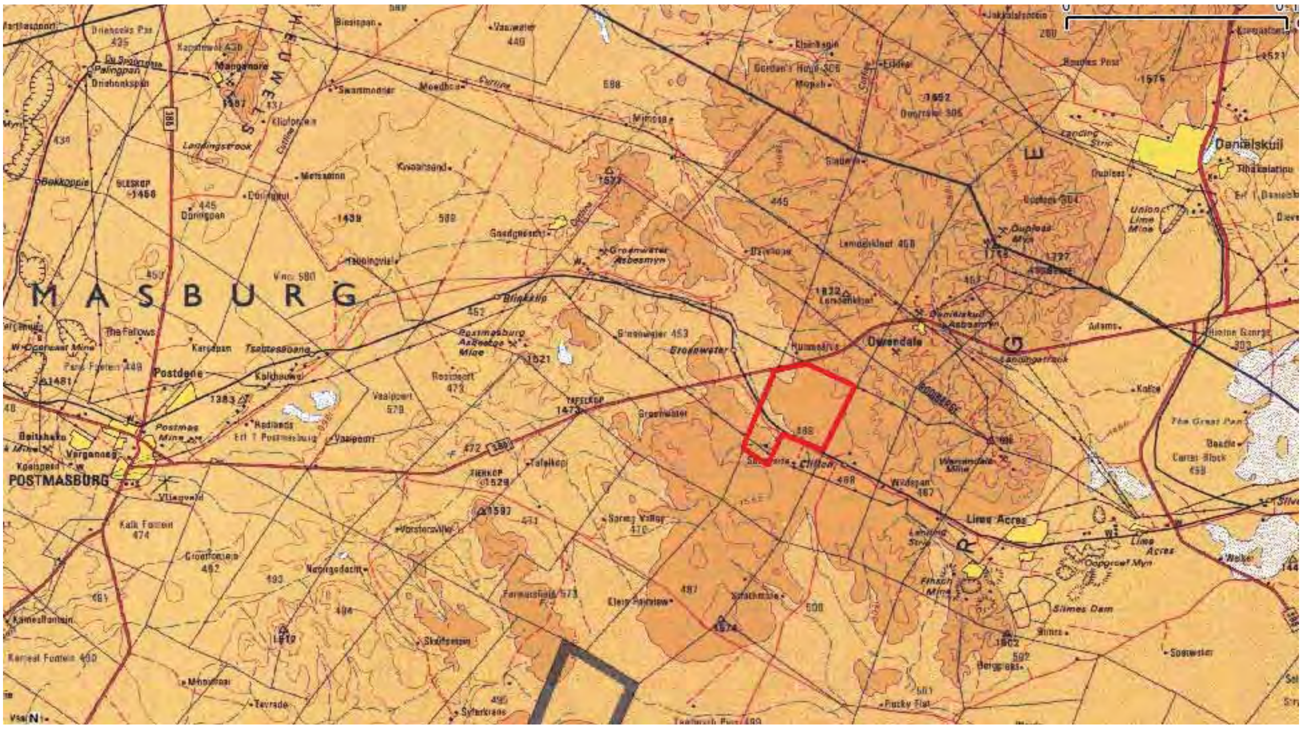

Fig. 1. Map showing the location of the Farm 469 (Humansrus) in the Asbesberge mountain range on the south side of the R31, *c*. 30km east of Postmasburg, Northern Cape Province (red polygon)

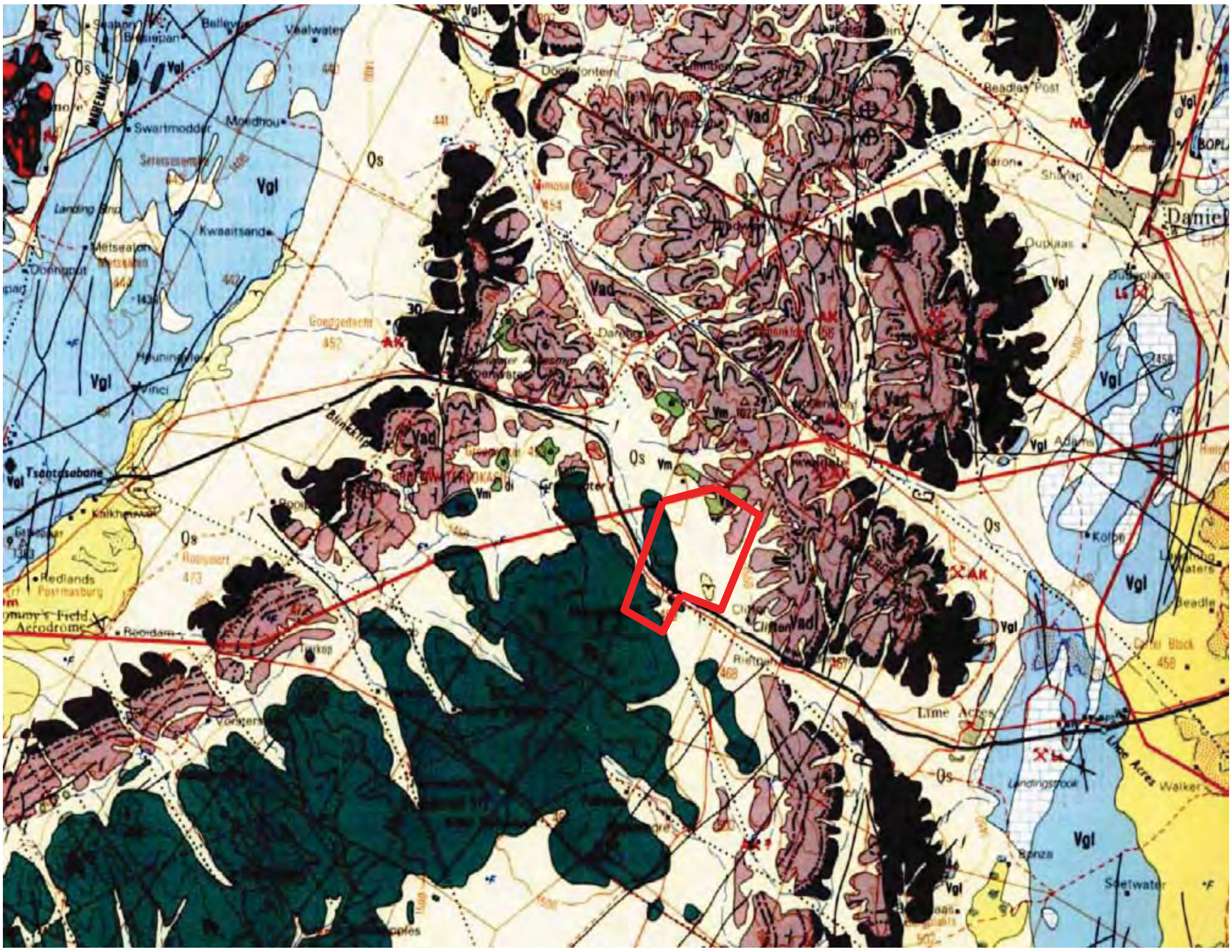

Fig. 2. Extract from 1: 250 000 geological map 2822 Postmasburg (Council for Geoscience, Pretoria) showing geology of the Humansrus study area in the Asbesberge (red polygon).

Geological units mapped within the study area include:

TRANSVAAL SUPERGROUP

Ghaap Group (Asbestos Hills Subgroup):
Vad (purplish-grey) = Daniëlskuil Formation (banded iron formation, 2.4Ga)

Postmasburg Group:
Vm (pale green) = Makganyene Formation (glacial diamictite)
Vo (dark green) = Ongeluk Formation (lavas, 2.2 Ga)

LATE CAENOZOIC DRIFT
Qs (pale yellow) = aeolian sand of the Gordonia Formation (Kalahari Group)
Dark yellow = alluvium

QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHAP (Association of Professional Heritage Assessment Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

PLAN OF STUDY FOR EIA

The following will be required to manage the heritage resources within the final corridor alignment.

6.1 Methodology

Aerial Photographical Survey

Aerial photographs will be utilised to identify possible places where archaeological sites might be located.

Physical Surveying

The fieldwork component will consist of a selective walk through/site visit of the proposed alignment and is aimed at locating heritage resources falling within (and directly adjacent to) the proposed alignment. The locations of all heritage resources that are recorded during the survey will be documented using a hand-held GPS. Furthermore, the documentation will reflect a brief qualitative description and statement of significance for each site and includes a photographic record of all the sites.

It is important to also note that informal social consultation (i.e. with local community members, residents and knowledgeable individuals) will be undertaken during the fieldwork component. The aim of social consultation is to identify any tangible and intangible resources (i.e. sacred places, myths and indigenous knowledge systems) that may exist.

6.2 Deliverable

A report will be written which would include the following components:

- The identification and mapping of all heritage resources in the affected area;
- An assessment of the significance of such resources in terms of the heritage assessment criteria;

- An assessment of the impact of the development of such heritage resources;
- If heritage resources will be adversely affected by the proposed development, consideration of the
- alternatives; and
- Proposed mitigation of any adverse effects during and after the completion of the proposed development.

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the construction company's cost. Thus, the construction company will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and

regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix D

HERITAGE ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

The Heritage Impact Assessment (HIA) report to be compiled by PGS Heritage and Grave Relocation Consultants (PGS) for the proposed Humansrus Project will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consisted of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists444qsddd'='[', aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
  - Density of scatter (dispersed scatter)
    - Low - <10/50m^2
    - Medium - 10-50/50m^2
    - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate pylon position

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 1: Site significance classification standards as prescribed by SAHRA

FIELD RATING	**GRADE**	**SIGNIFICANCE**	**RECOMMENDED MITIGATION**
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

Appendix E

THE SIGNIFICANCE RATING SCALES FOR THE EIA

THE SIGNIFICANCE RATING SCALES FOR THE EIA

1. Introduction

Although specialists are given free reign on how they conducted their research and obtained information, they are requested to provide the reports in a specific layout and structure, so that a uniform specialist report volume can be produced.

To ensure a direct comparison between various specialist studies, six standard rating scales are defined and used to assess and quantity the identified impacts. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on three criteria, namely:

- The relationship between impacts/issues and impact status (Box 1);
- The relationship between impacts/issues and spatial scale (Box 2);
- The relationship between impacts/issues and temporal scale (Box 3);
- The relationship between impacts/issues and probability (Box 4
- The relationship between impacts/issues and severity (Box 5);

These five criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of impacts

Rating	**Description**	**Quantitative Rating**
Positive	A benefit to the receiving environment.	+
Neutral	No cost or benefit to the receiving environment.	N
Negative	A cost to the receiving environment.	-

Box 2: Spatial scale of impacts

Rating	**Description**	**Quantitative**

		Rating
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Box 3: Temporal scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years.	1
Medium	Medium term; Reversible over time; 5 – 15 years.	2
High	Long term; Approximate lifespan of the project: 16 -30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Box 4: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Box 5: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction.	2
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value.	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example, the permanent change to topography resulting from a quarry.	4

Box 6: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	No Impact	Zero impact.	0

An example of a ratings table:

		Alternative A						Alternative B					
Issue	Specific Impact	Status	Extent	Duration	Probability	Intensity	Significance	Status	Extent	Duration	Probability	Intensity	Significance
Soils	Potential loss of soil types of high agricultural potential	-	1	1	4	4	**-10**	-	1	1	4	4	**-10**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**

NOISE IMPACT ASSESSMENT OF THE PLANNED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT PROJECT POSTMASBURG, NORTHERN CAPE PROVINCE

(SCOPING REPORT FINAL DRAFT)

(JULY 2011)

REPORT PREPARED BY JONGENS KEET ASSOCIATES

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CONTENTS

FIGURES

NOISE IMPACT ASSESSMENT OF THE PLANNED
HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT PROJECT
POSTMASBURG, NORTHERN CAPE PROVINCE

1 INTRODUCTION

1.1 General

It is planned to build a Solar Thermal Energy Power Plant (otherwise known as a Concentrating Solar Power Plant or CSP Plant) with a capacity of 100MW approximately 30km east of Postmasburg in the Northern Cape Province. The proposed site is located on the Farm 469 Hay RD (Humansrus). Refer to Figure 1. An environmental impact assessment (EIA) is being undertaken. As part of the EIA, a noise impact assessment has been undertaken by Jongens Keet Associates (JKA). The study was undertaken by Mr Derek Cosijn and Dr Erica Cosijn. This report documents the findings of the Scoping phase of the investigation.

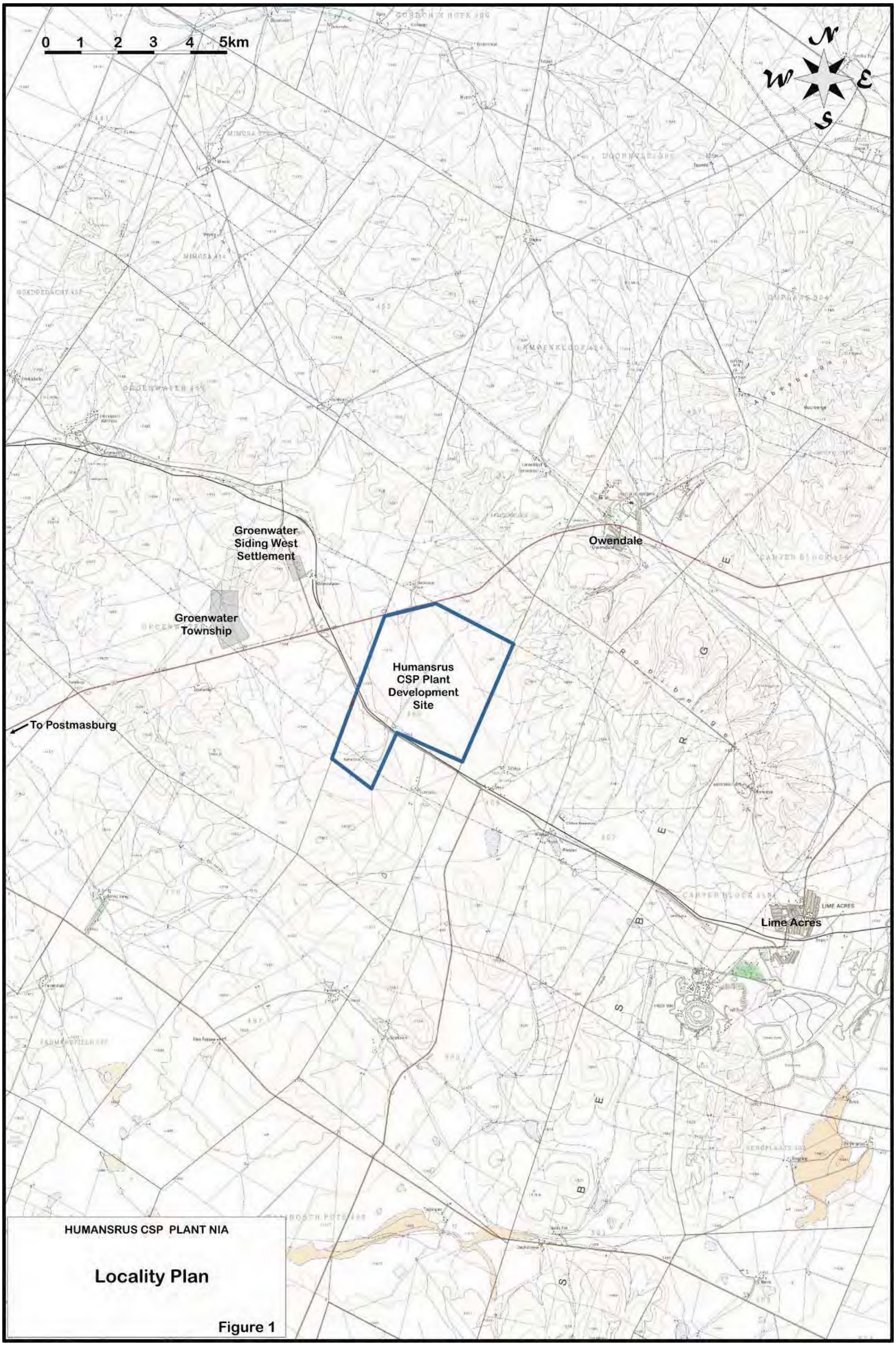
1.2 Terms of Reference

The terms of reference (TOR) are as follows:

i) A sufficiently detailed quantitative (by measurement) and qualitative assessment within the area of influence of the planned new CSP Plant was to be undertaken in order to enable a full appreciation of the nature, magnitude, extent and implications of the potential noise impact.
ii) The initial level of investigation was to that of an environmental Scoping.
iii) All aspects of the investigation were to conform to the requirements of relevant environmental legislation and noise standards.
iv) The potential impacts of the pre-construction, construction and operational phases of the project were to be assessed.

1.3 Location and Extent of the Study Area

The core study area of the noise impact assessment is that within the potential noise area of influence of the planned CSP Plant. Essentially the whole area within at least 10 kilometres of the site boundaries has been evaluated. Where necessary however, and particularly in regard to the CSP-generated traffic impact, a wider area of influence has been considered. Preliminary calculations indicate that the offset of the 35dBA noise footprint of the CSP Plant will be at approximately 4750 metres, while that of the 45dBA contour will be at approximately 2200 metres.


0 1 2 3 4 5km
N
W
E
S
Groenwater Siding West Settlement
Groenwater Township
Owendale
Humansrus CSP Plant Development Site
To Postmasburg
Lime Acres
HUMANSRUS CSP PLANT NIA
Locality Plan
Figure 1

1.4 Scope and Limitations

The optimum position of the CSP Plant on the site has not been specified for this study. The farm is large and there are a large number of possible development site options for the CSP Plant on the farm. The optimum development site is likely to be determined only during the EIA phase. Thus it was not possible at this stage to calculate and assess the specific detailed noise impacts at each noise sensitive site related to a specific development site. The approach was rather to determine conservatively the extent of the potential noise impact, namely the 35dBA noise contour.

Although much of the technical detail of the planned CSP Plant is already determined, the specific noise characteristics of some plant and equipment to be installed are not. Conservative predictions based on equipment baseline noise levels of typical plant that will be installed have therefore been made.

2 DETAILS OF THE PLANNED CSP PLANT

The planned CSP Plant will have an electricity generating capacity of 100MW. The whole installation will comprise:

i) The Solar Field which consists of all services and infrastructure related to the management and operation of the heliostats.

ii) The Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;

iii) The Power Block; and

iv) Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Based on the solar insolation characteristics of the Postmasburg area, the power station will be able to operate on average for up to 10 hours during the day (08h00 to 18h00) in the summer.

3 REGIONAL OVERVIEW: DETAILS OF THE STUDY AREA

Only the details relevant to the noise impact assessment are given.

3.1 Topography

The topography of the area can be defined as hilly terrain. The development site itself is relatively flat.

3.2 Land Use

The area to the east of Postmasburg is predominantly agricultural, interspersed with mining activities. Other significant land uses in the area are:

i) Residential.
  a) Various farmhouses and farm labourer residences.
  b) The residences in Groenwater Village (Metsimetala) and the village to the west of the Groenwater Siding.
  c) The Owendale residential township.
  d) The Lime Acres Mine residential township.
  e) The Goedgedacht/Jenn-Haven residential township.

ii) Educational. There are three schools in the study area:
  a) Refentse Primary school in Groenwater Village.
  b) Two schools in Lime Acres Mine Village.

iii) Recreationally facilities at the mine at Lime Acres and at Owendale.

3.3 Roads

There are two major roads and several tertiary roads servicing the area:

i) Provincial Road TR07001 (Route R385) from Postmasburg to Kimberley.

ii) Provincial Road DR3381 from intersection with road TR07001 (Route R385) near Groenwater Railway Siding to Road D3359 (near to the Lime Acres Mine).

3.4 Railway Lines

The Postmasburg - Beaufort-West railway line passes to the south-west of the development site dividing a small portion to the south from the main site. The line carries 14 trains per day (data obtained from Transnet Freight Rail).

3.5 Factors of Acoustical Significance

The hilly terrain will influence the propagation of the noise from the new power plant.

A significant meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels.

Temperature inversions have a significant effect on the noise propagation character of the area. Temperature inversions tend to increase noise levels at some distance from a source. A temperature inversion is formed when air near the ground is cooler than the air above. This occurs mainly at night or to a lesser extent during cloudy days away from large bodies

of water. Stable conditions with high humidity and very low velocity wind conditions are necessary. As cool air is denser than warm air, sound rays are refracted towards the cooler air, that is, towards the ground.

3.6 Noise Sensitive Receptors

The residential, educational and recreational land uses are considered to be noise sensitive receptors (NSR). Refer to Figure 2.

For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible. The following 1:50 000 topographical cadastral maps were used:

- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982.

4 METHODOLOGY

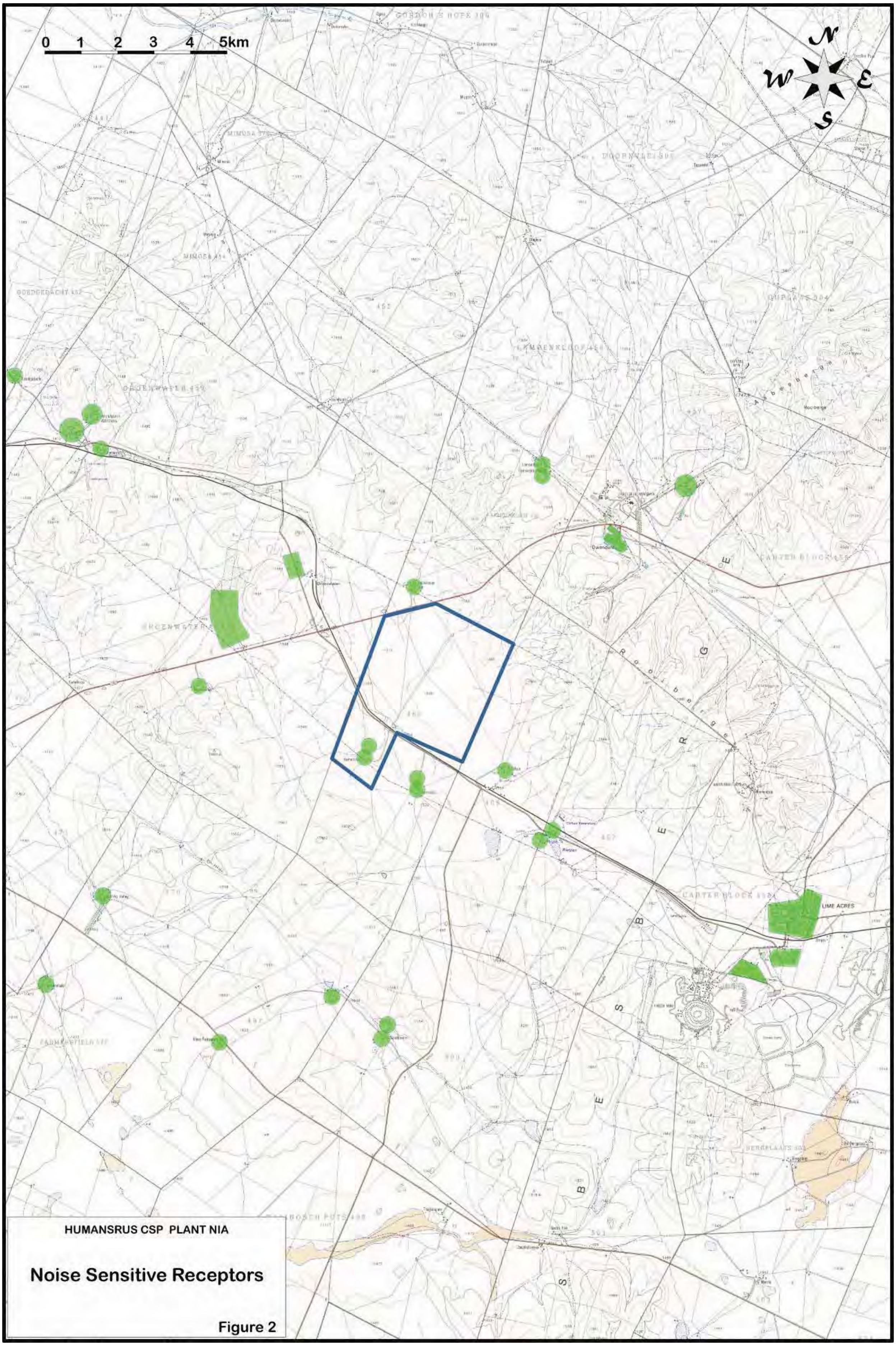
4.1 General

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328:2008: *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of a Scoping. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The investigation comprised the following:

i) Determination of the existing situation (prior to the planned development).

ii) Determination of the situation during and after development.

iii) Assessment of the change in noise climate and impact.


0 1 2 3 4 5km
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GORDON'S HOPE
MIMOSA
DOORNVLEI
LIME ACRES
CARTER BLOCK
HUMANSRUS CSP PLANT NIA
Noise Sensitive Receptors
Figure 2

4.2 Determination of the Existing Conditions

This phase comprised the following:

i) The relevant technical details of the planned CSP Plant (as known at this stage), the existing traffic patterns and the existing and planned land use in the study area were reviewed in order to establish a comprehensive understanding of all aspects of the project that will influence the future noise climate in the two respective study areas.

ii) Using these data, the limits of the study area were determined and the potential noise sensitive areas, other major noise sources and potential problems in these areas were identified.

iii) Applicable noise standards were established. The National Noise Control Regulations and the SANS 10103:2008 standards were applied.

iv) The existing *noise climate* of the study area was determined by means of a field inspection and a noise measurement survey. The measurement survey appropriately covered the whole extent of the study area, focussing specifically on the identified noise sensitive/problem areas. Measurements were taken at 6 monitoring sites. The daytime conditions were measured. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the Code of Practice SANS 10103. A Type 1 Integrating Sound Level meters was used for the noise measurements. All measurements were taken under dry weather and normal traffic (that is mid-week/school term) conditions. Refer to Appendix B for details of the measurement survey.

v) On the general field inspection and at the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and that, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

vi) The existing noise climates along the main roads as related to the current traffic volumes and patterns were established. These traffic noise levels were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise* for Route. The latest traffic was used as the baseline reference. The calculated 24-hour period noise indicators, as well as those for the daytime period and night-time period provided the main data for the impact assessment. The measured data provided

a field check of the acoustic conditions. See Section B3.4 in Appendix B for details of the road traffic noise impact.

vii) A general analysis of the rail traffic impact was undertaken. Refer to Section B3.5 in Appendix B for the rail traffic noise impact on the study area.

4.3 Assessment of Planning/Design Phase and Construction Phase Impacts

Aspects of the pre-design field surveys and construction activities that potentially will have a noise impact were identified and, where appropriate, mitigation measures have been recommended.

4.4 Assessment of Operational Phase Impacts

The main focus of the operational phase assessment was to establish the nature, magnitude and extent of the potential change in *noise climate* in the study area directly related to and within the area of influence of the development site. The likely noise that will be generated by the CSP Plant operations was established and this was used to determine a preliminary footprint of impact. The final design of the power plant is not yet available and the noise profile was thus calculated from data at similar type facilities.

5 NOISE SOURCES AND NOISE SENSITIVE AREAS

5.1 Noise Sources

The main noise sources presently affecting the study area and the additional sources that will affect the area once the CSP Plant is commissioned are:

i) Road traffic noise from the traffic on Road TR07001 (Route R385) and Road DR3381.

ii) Railway traffic on the line on the Postmasburg – Beaufort-West line.

iii) The Lime Acres Mine.

iv) The Groenwater Asbestos Mine.

v) Noise from general farming operations.

vi) On Farm Humansrus just north of the development property, the farmer mills corn three days per week and also has a rock crushing facility that operates sporadically.

vii) Future: CSP (proposed by SolarReserve SA) and Photovoltaic Plants (proposed by Intekon).

5.2 Noise Sensitive Areas

The noise sensitive sites/areas in the study area that are potentially affected by the development of the CSP Plant on this site are the suburban areas, settlements and farm residences, schools and recreational areas listed in Section 3.2 and as shown in Figure 2.

6 THE RESIDUAL (EXISTING) NOISE CLIMATE

The determination of the residual (existing) noise climate in the study area is based on the measurements and observations made in the area, and where relevant also from the calculation of the noise from the traffic on the main roads.

The areas remote from the main roads are quiet and are typical of a rural/agricultural noise environment. In the residential townships of Groenwater, Groenwater Siding West, Goedgedacht/Jenn-Haven, Lime Acres Mine and Owendale the existing residual noise climate is typical of a suburban environment. The noise climate in areas close to Road TR07001 and Road R3381 are degraded. There is a noise nuisance factor in areas close to the railway lines when trains pass. Refer to Appendix B for details.

7 THE PREDICTED NOISE CLIMATE

7.1 CSP Plant Generated Noise Footprint

With the construction of the CSP Plant the noise climates close to these facilities will alter. The main noise sources at the CSP Plant will be from the cooling fans (at the EPGS), the salt pumps and the steam generating unit. The noise from the cooling fans will be the loudest. It is predicted that the noise from the CSP Plant could be the following at the given offsets from the cooling fan installation:

Offset from the Plant		Noise Level (dBA)
1000m	-	54
2000m	-	46
3000m	-	41
4000m	-	37
5000m	-	34

Assuming daytime operations, noise sensitive sites (in a rural setting) further than 2100 metres away from the Plant will not be impacted by the noise from the Plant. If, for any reason, night-time operations are allowed then noise sensitive sites within 4750 metres of the Plant will be impacted. The construction of the power generation unit of the CSP plant is recommended at an offset of at least 2500 to 5000 metres from the nearest noise sensitive receptor, depending on the intended periods of operation.

7.2 CSP Plant Generated Traffic

The total volume of traffic generated by the CSP Plant will be very small in comparison to the total volume of traffic on the adjacent main roads.

8 CONCLUSIONS

The following may be concluded from the foregoing analysis:

i) The residual noise climate area of the CSP Plant development is typical of a rural environment.

ii) The areas close to the main roads and the railway line in the study area are degraded with regard to rural residential and suburban residential living.

iii) The CSP Plant will introduce a loud noise source into the area.

iv) For daytime operation of the CSP Plant, an area within a radius of 2200 metres of the plant (45dBA contour) could potentially be adversely affected by the noise from the plant.

9 RECOMMENDATIONS

The following are recommended:

i) The power generation unit of the CSP Plant should be constructed at an offset of at least 2500 to 5000 metres from the nearest noise sensitive receptor, depending on the intended periods of operation.

ii) An up-to-date traffic count on Roads TR07001 and Road R3381 should be undertaken by the Northern Cape province Department of Transport.

iii) Not all of the Noise Sensitive Receptors identified in this report are confirmed as such and should be verified by the Social Impact Team.

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APPENDIX A

GLOSSARY OF TERMS
AND
NOISE IMPACT CRITERIA

APPENDIX A: GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

  $L_{pA} = 10 \log (p_A/p_o)^2$ where:

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2004. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.
- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.

- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of +10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the National Department of Environmental Affairs.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The “A”-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound** means the aural sensation caused by rapid, but very small, pressure variations in the air. In quantifying the subjective aural sensation, “loudness”, the letters dBA after a numeral denote two separate phenomena:
    - “dB”, short for *decibel*, is related to the human’s subjective response to the change in amplitude (or largeness) of the pressure variations.
    - The “A” denotes the ear’s different sensitivity to sounds at different frequencies. The ear is very much less sensitive to low (bass) frequency pressure variations compared to mid-frequencies.

  The level of environmental sound usually varies continuously with time. A human’s subjective response to varying sounds is primarily governed by the total sound energy

received. The total sound energy is the average level of the fluctuating sound, occurring during a period of time, multiplied by the total time period. In order to compare the effects of different fluctuating sounds, one compares the average sound level over the time period with the constant level of a steady, non-varying sound that will produce the same energy during the same time period. The average energy of sound varying in amplitude is thus equivalent to the continuous, non-varying sound. The two energies are equivalent.

- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.
- **SANS 10103** means the latest edition of the South African National Standard SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
- **SANS 10210** means the latest edition of the South African National Standard SANS 10210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **SANS 10357** means the latest edition of the South African National Standard SANS 10357 titled *The Calculation of Sound Propagation by the Concawe Method*.
- Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)					
	Outdoors			Indoors with open windows		
	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

TABLE A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quiet
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the environmental guidelines of the World Bank and World Health Organisation, which specify 55dBA during the day (06:00 to 22:00) and 45dBA during the night (22:00 to 06:00) for residential purposes, determined over any hour. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (dBA)	Estimated Community/Group Response	
	Category	**Description**
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community/group action
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5dBA will be 'little' with 'sporadic complaints'. For an increase of equal or more than 5dBA the response changes to 'medium' with 'widespread complaints'.
- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated

community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

In the National Noise Control Regulations which are applicable in Northern Cape Province, an intruding noise is defined as ‘disturbing’ if it causes the ambient noise level to rise by 7dBA or more.

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and the general *noise climate* investigation related to the potential noise impact of a proposed Solar Thermal Energy Power Plant (otherwise known as a Concentrating Solar Power Plant or CSP Plant) project on the Farm 469 Hay RD, Northern Cape Province are dealt with in this Appendix. The site is located approximately 30 kilometres east of Postmasburg.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 *Methods for Environmental Noise Impact Assessments*. Noise measurements were taken at six main monitoring sites in the study area in order to establish the residual (existing) *noise climate*.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication*. A Type 1 Integrating Sound Level Meter, a Rion NA-28, was used for the noise measurements. The meter was calibrated at an accredited acoustical laboratory within the last 12 months. The calibration status of the meter was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz was applied to the meter. A Rion Sound Calibrator NC-74 was used.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. The frequency weighting setting was set on “A” and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 10 minutes were used. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the Sites. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meters were set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of each meter.

At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

At each measurement site a portable recording weather station, a Kestrel 4000 Pocket Weather Tracker (Serial No. 569322) was set up in the vicinity of the sound level meter and the wind speed, temperature, humidity, barometric pressure, and altitude were recorded. The wind direction was determined by means of a compass; and the cloud cover was noted by direct observation.

B3. MEASUREMENT DATA

B3.1. Measurement Sites

Noise measurements to establish current ambient noise conditions were taken at six (6) main sites in the study area, as indicated in Figure B1 and Table B1.

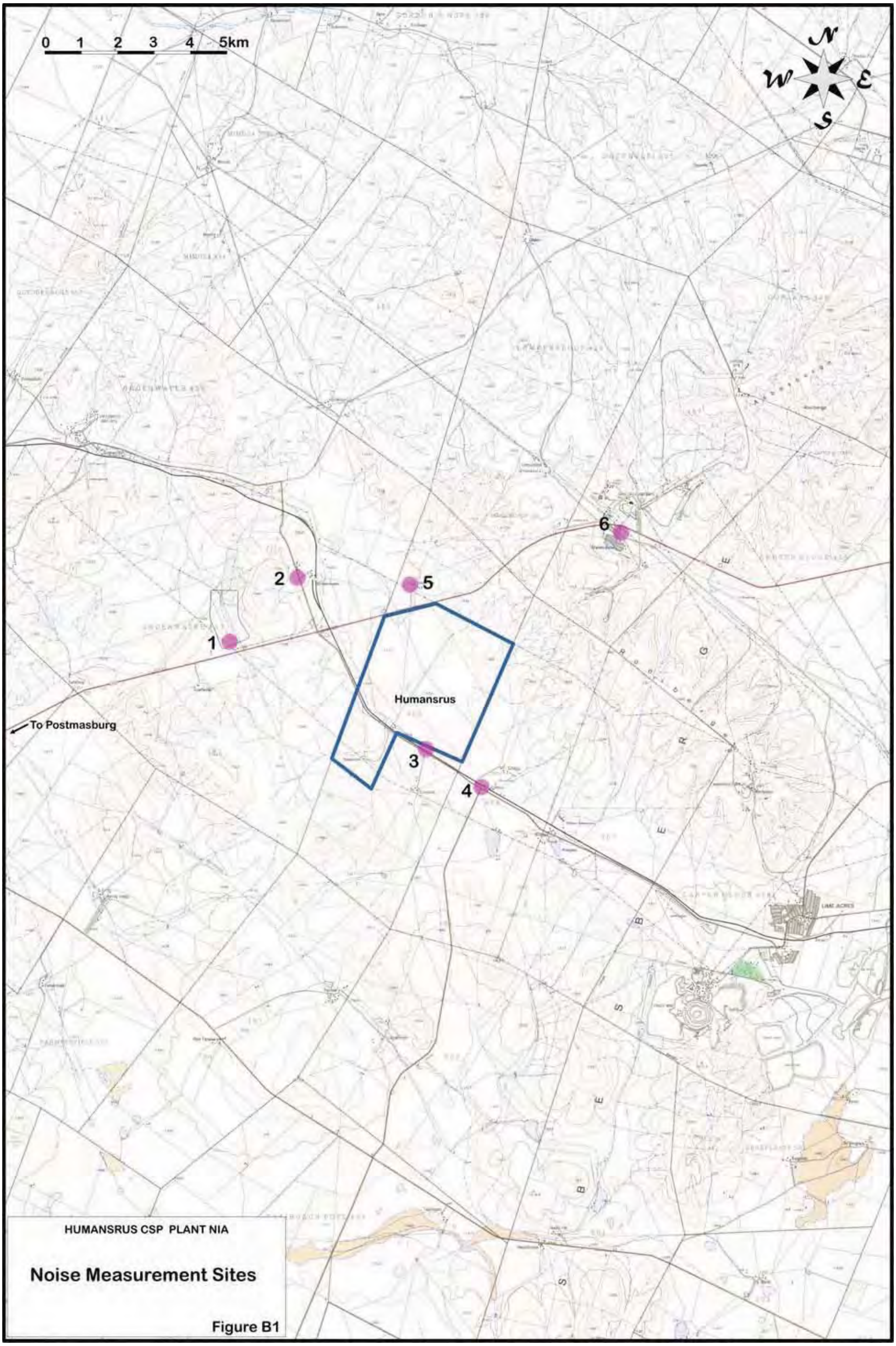
B3.2. Measurement Dates/Times

General observation of the noise conditions in the study area as well as the site specific sound pressure level (noise) measurements and observations were taken on Thursday 5 May 2011 from 10h00 to 13h00.

B3.3. Noise Measurement Details

B3.3.1. *Summary of the Residual Sound Pressure Level Measurements*

The results of the residual noise condition measurement survey are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).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Noise Measurement Sites
Figure B1

TABLE B1: MEASURED CURRENT RESIDUAL NOISE LEVELS IN THE HUMANSRUS CSP STUDY AREA (YEAR 2011)

Site No	Location Description	GPS Co-ordinates	Measured Sound Pressure Level (dBA)			Estimated Sound Pressure Level* (dBA)		
			L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
1	On the southern side of Groenwater Village (Metsimatala)	S28°17.659' E23°18.914'	50.3	68.8	34.4	41		<30
2	Just to the south of the Village at Groenwater Siding	S28°16.970' E23°20.060'	43.4	55.4	27.1	28		<25
3	At entrance to Farm Sunnyside (AJ de Klerk) on Road DR3381	S28°18.213' E23°15.885'	48.8	63.6	32.7	26		<25
4	At Clifton Siding, 30 metres north of centreline of Road DR3381	S28°19.776' E23°23.037'	47.2	52.3	32.1	28		<25
5	On entrance road to residence on Farm Humansrus, approximately 150 metres north of centreline of Road TR7001 (Route R385)	S28°17.039' E23°21.836'	48.5	52.8	39.6	40		<30
6	Just outside entrance to Owendale Village, approximately 180 metres south of centreline of Road TR7001 (Route R385)	S28°16.000' E23°25.334'	53.0	65.6	37.9	40		<30

Notes:

* Based on road traffic:

i) Site 3: Night-time estimates at farmhouse 1000m south of road.

ii) Site 4: Night-time estimates at farmhouse 700m north of road.

B3.3.2. *Determination of Night-time noise*

No night-time measurements were taken. The typical night-time residual noise conditions were established from night-time general *acoustic observations* in the area, the minimums of the daytime measurements, from previous measurements in similar areas, and from the traffic noise calculations (refer to Section B5.3).

The farming areas relatively far from the main roads and the other major noise sources are generally very quiet. The ambient noise levels are of the order of 26dBA to 41dBA during the late evening period and at night. It should, however, be noted that these levels can often be elevated significantly by the presence of insects, bats, frogs and other wildlife. These conditions generally are a seasonal phenomenon.

B3.4. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on the following main roads through the area and the roads that directly affected the CSP Plant project were calculated:

i) Provincial Road TR07001 (Route R385) from Postmasburg to Kimberley.

ii) Provincial Road DR3381 from intersection with road TR07001 (Route R385) near Groenwater Railway Siding to Road D3359 (near to the Lime Acres Mine)

The traffic data were obtained from the Northern Cape Province Department of Transport and Microzone Information Technology Specialists.

These calculated noise values provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation site. The Year 2008 and 2010 traffic data were used as the baseline for the calculations.

The noise levels at various offsets from the relevant road centrelines were established and are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2008, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in table), namely for the period from 22h00 to 06h00).

iii) Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in table), namely for the 24 hour period from 06h00 to 06h00).

The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

TABLE B2: EXISTING NOISE CLIMATE ADJACENT TO MAIN ROADS IN THE HUMANSRUS CSP STUDY AREA (YEAR 2011 TRAFFIC)

Offset	Noise climate alongside main roads (dBA) Year 2011 (SANS 10103 Descriptor)					
	TR07001			DR3381		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
25m	58.6	49.2	58.8	46.9	44.6	51.1
50m	55.6	46.2	55.8	43.9	41.6	48.1
100m	52.4	43.0	52.6	40.7	38.4	44.9
250m	48.0	38.6	48.2	36.3	34.0	40.5
500m	44.2	34.8	44.4	32.5	30.2	36.7
1000m	39.7	30.3	39.9	28.0	25.7	32.2
1500m	36.6	27.2	36.8	24.9	22.6	29.1
2000m	34.4	25.0	34.6	22.7	20.4	26.9

B3.5. Noise Climate Related to Railway Traffic

The Postmasburg - Beaufort-West railway line passes to the south-west of the development site dividing a small portion to the south from the main site. The line carries 14 trains per day (data obtained from Transnet Freight Rail).

With the pass-by of each train past a noise sensitive receptor there will be a fluctuation in sound pressure level ranging from the normal background noise for the area (residual noise level) to a maximum as the train passes and then reducing again to the residual level as the train moves away from the receiver point. The approximate maximum noise levels that will be experienced with the pass-by of a train at various offsets from the railway line and for various typical cross-section types are given in Table B3. Note that the noise levels for the sections at-grade and the sections on fill are the same. The values given are the unmitigated noise levels.

TABLE B3: TYPICAL MAXIMUM NOISE LEVELS FOR OPERATIONAL CONDITIONS ALONG THE RAILWAY LINES

Offset (m)	Maximum Pass-by Noise Level (L_{Amax}) (dBA)		
	At-grade/Fill Section	Cutting Section	
		3m Depth	7m Depth
25	93,3	81,5	77,9
50	88,3	75,7	71,1
100	82,2	69,3	64,3
200	75,6	62,6	57,4
300	71,9	58,9	53,4
500	66,5	53,5	48,0

i) The operations of the trains have the potential to adversely influence the noise climate of the areas along the railway corridors to a larger or lesser extent for significant distances from the tracks. The propagated noise will be attenuated with distance from the source, the nature of the ground cover on the intervening ground, and from screening by the natural topography and buildings. The wheel-rail generated noise is enhanced where the train is travelling on elevated structure.

ii) The character (qualitative aspect) of the railway operational noise will have many facets. The component of noise that will predominate at maximum operating speed will be the wheel-rail interaction noise. The noise from diesel locomotives will be much higher than that from electric locomotives. The noise from the locomotives will be slightly louder than that from the wagons. With the pass-by of each train, the perceived noise at any one receiver point within the area of influence of the train will fluctuate relatively rapidly from the normal background (ambient) noise level of the area to peak at the maximum, will then fall slightly once the locomotives have passed the closest point to the receiver to remain fairly constant at this level until the whole train has passed by the near-ground and then will fall back to the area's ambient level as the train moves into the far distance. This whole cycle can take place over a period of several minutes, depending on the length and the speed of the train.

iii) The noise of the braking systems may sometimes be audible. There will possibly be some "flange squeal" (rail-wheel interaction) heard in areas where there are tight-radius track curves. There will also be mechanical banging sounds from the wagon couplings when the trains slow down or accelerate.

iv) It is normally mandatory that a train sounds a warning horn at at-grade crossings with roads. Noise from these horn soundings can be as loud as 105dBA at 30 metres and 84dBA at 350 metres from the train.

v) The noise impact from a train relates normally to the nuisance (annoyance) impact as the train passes.

B3.6. Prevailing Noise Climate

In overview, the existing situation with respect to the existing *noise climate* in the Humansrus CSP study area was found to be as follows:

i) The main sources of noise in the area are from:
   a) Road traffic noise from the traffic on Road TR07001 (Route R385) and Road DR3381.
   b) Railway traffic on the line on the Postmasburg – Beaufort-West line
   c) The Lime Acres Mine.
   d) The Groenwater Asbestos Mine.
   e) Noise from general farming operations.
   f) On Farm Humansrus just north of the development property, the farmer mills corn three days per week and also has a rock crushing facility that operates sporadically.

ii) The main noise sensitive receptors in the area are (refer also to Figure 2 in the main report):
   a) Various farmhouses and farm labourer residences.
   b) The residences in Groenwater Village (Metsimetala) and the village to the west of the Groenwater Siding.
   c) The Owendale residential township.
   d) The Lime Acres Mine residential township.
   e) The Goedgedacht/Jenn-Haven residential township.

iii) The existing residual noise climate throughout most of the study area is typical of a rural/agricultural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time.

iv) In the residential townships of Groenwater, Groenwater Siding West, Goedgedacht/Jenn-Haven, Lime Acres Mine and Owendale the existing residual noise climate is typical of a suburban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 50dBA during the day and generally do not exceed 40dBA during the night-time.

v) Sites close to the main roads in the study area are adversely affected by traffic noise.

vi) The main roads affected are listed in Section B3.4. The ambient noise levels alongside these roads exceed the acceptable levels as recommended in SANS 10103 with respect to rural and suburban residential living and other noise sensitive land uses. The noise climates in these areas can be defined as being severely degraded for these land uses.

The areas next to the main roads are in some areas degraded for up to the following distances (based on rural residential SANS 10103 standards):

- Road TR07001 (Route R385) - 2000 metres
- Road D3381 - 600 metres

vi) The train traffic is a minor factor due to the low rail traffic volumes. The noise impact from a train relates normally to the nuisance (annoyance) impact as the train passes.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT DEVELOPMENT ON A PORTION OF THE FARM HUMANSRUS 469 NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

May 2011

Socio-Economic Impact Assessment: Scoping Phase Input

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TABLE OF CONTENTS

1. INTRODUCTION

Urban-Econ Development Economists was appointed by SSI Engineers and Environmental Consultants to undertake a socio-economic impact assessment study for the proposed construction and operation of the Humansrus Solar Thermal Power Plant or otherwise referred to as a Concentrated Solar Power (CSP) Plant, Postmasburg, Northern Cape. This report presents the socio-economic specialist's input into the scoping phase of the project.

1.1 Project background and description

Economic development and the ability of the national government to alleviate poverty are indirectly reliant on the supply of electricity in South Africa. The Integrated Resource Plan (February 2010) projected that an additional capacity of 41 346 MW will be required to support the average economic growth rate of 4.5% per annum over the next twenty years and ensure adequate reserves. The required expansion is almost two times the size of the existing capacity of the system. A significant component of the above-mentioned plan is, amongst others, the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity and involvement of Independent Power Producers in these projects.

In line with the IRP2010, SolarReserve SA (Pty) Ltd (SolarReserve) proposed the construction of a CSP Plant, to be known as the Humansrus CSP project. The CSP Plant will have an installed capacity of up to 100 MW.

SolarReserve is one of the world's leading companies in the field of renewable energy generation. The renewable energy generation market faces two fundamental problems – (1) scalability and (2) issue of electricity storage. Solar Reserve has managed to bridge these problems with their CSP technology. CSP Plants draw their heat from the sun, an unlimited source of pure clean energy – and unlike wind and photovoltaic, the technology implemented by Solar Reserve can be delivered when it is needed dependent solely on demand and not climatic factors. This feature of the technology allows Solar Reserve to bridge the key barriers pertinent to renewable energy generation – scalability and storage.

The unique components in SolarReserve's power towers are the molten salt storage loop and the power tower central receiver. The molten salt storage loop enables the plant to generate electricity whenever it is needed - 24 hours per day or during "peak demand" periods. Molten salt is an efficient and inexpensive medium to store energy. The salt used in the process is an environmentally friendly mixture of sodium and potassium nitrate, the same ingredients used in garden fertiliser.

1.2 Scope of the study

The purpose of the Socio-Economic Impact Assessment is to determine the potential positive and negative effects of the proposed CSP Plant on the local and regional economies and to compare their effects with the "no go" alternative. The "no go" alternative assumes that the proposed mining operation is not established at the intended location, nor anywhere else in the country. The "no go" alternative represents the current status of the environment, including the socio-economic situation.

The current report is prepared as part of the Socio-Economic Study and is used as inputs into the Scoping Report that is compiled by the Environmental Practitioner. The Scoping Phase inputs address only a portion of the scope of work involved in the Socio-Economic Study. Its purpose is as follows:

- Provide a description of the environment that may be affected by the proposed project; particularly its socio-economic characteristics, and

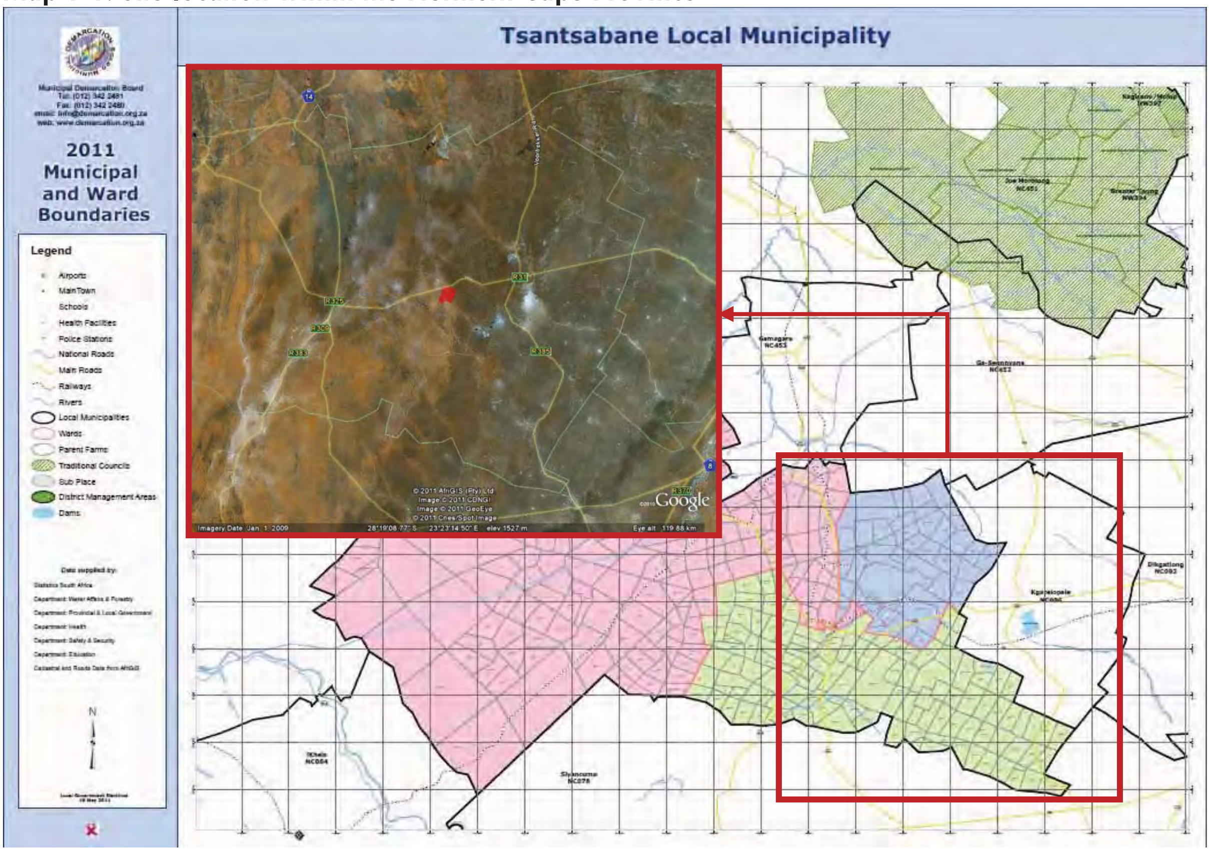
- Identify the potential impacts to be assessed in the EIA phase.

The scoping report therefore aims at identifying social, socio-economic, and economic issues that will form part of the detailed EIA phase.

1.3 Project's location and study area delineation

The proposed site for the Humansrus CSP Plant is located on a portion of the farm Humansrus No. 469 situated in the Northern Cape Province approximately 30 kilometres north-east of the town of Postmasburg. The site falls within the Tsantsabane Local Municipality (LM), which in turn forms part of the Siyanda District Municipality (DM) - one of the five districts of the Northern Cape Province of South Africa.

Map 1-1: Site location within the Northern Cape Province



Source: www.demarcation.org.za and Google Map, 2011

In order to delineate the study area, it is important to understand the concept of socio-economic impacts. Socio-economic impacts can be of a different nature and spatial extent. The latter differs significantly depending on the type of activity that is being analysed and the structure and composition of the locality where it is to be established. The more diversified the immediate locality of the project is in terms of its socio-economic variables, the more concentrated the impact will be in that area. It is very rare, though, to find a case when the demands of the proposed activity to be constructed and operated can be fully satisfied within the immediate locality of the project. Therefore, more often than not, economic impacts derived from any activity are spread throughout various administrative units. Understanding the potential distribution and concentration of impacts throughout the area is important to determine the magnitude and significance of these impacts in the context of spatial units.

The study area's delineation is usually done in terms of three levels – primary, secondary and tertiary. From a socio-economic impact perspective, the primary study area refers to the locality where the

immediate economic effects of the proposed activity will be observed. This is usually defined considering the actual location of the proposed project, proximity to skilled and unskilled labour, and juxtaposition relative to suppliers. The primary study area is usually relatively small and includes administrative units from where the majority of labour for the proposed project will be supplied and where some parts of the capital and operational budgets will be spent, such as a city, town or LM depending on data availability. The secondary study area is generally far greater than the primary study area. It usually has a relatively diversified economy, which is why it is also characterised as an area where the majority of the domestic expenditure on the project will be distributed. The third tier of a delineated study area is the tertiary study area. From an economic impact perspective, it includes all impacts that would be derived from the project's domestic expenditure.

The proposed project is located within the Siyanda DM area. The closest major town to the site by road is Postmasburg (approximately 30 km). Other towns within 50 kilometres of the proposed site are Danielskuil (approximately 30km) to the north-east and Lime Acres (approximately 27km) to the southeast. It is estimated that most of the people who will be employed by the proposed project will come from the nearby settlements and above-mentioned towns. As far as procurements of services and equipment during construction and operation of the project are concerned, some of these will be sourced from the Northern Cape. Given the fact though that its economy is not diversified, it could be argued that a significant portion of these services will be sourced from the rest of South Africa. Given the above, the following delineation of the study areas is assumed:

- Primary study area includes the site and the Tsantsabane LM;
- Secondary study area includes the Siyanda DM and Northern Cape, and
- Tertiary study area is South Africa.

1.4 Methodology for scoping phase

Given the requirements of the Scoping Phase, a three step methodology was employed to complete it. These included:

- **Introductory chapter.** The introductory chapter focuses on providing the background to the study and the project itself. It also outlines all the assumptions used in the impact modelling exercise;
- **Baseline profiling.** Baseline profiling is the key component of the Scoping Phase input to be provided by the socio-economic specialist. It includes the description of the study area in terms of selected socio-economic variables. This information is used to interpret the socio-economic impacts that could be derived from the project in the context of the local, provincial and national economies. It includes the analysis of parameters such as population size and household numbers, structure and growth of the economy, labour force, employment situation and service delivery. Profiling for the study was done making use of Quantec Research database and selected StatsSA statistics, such as Labour Force Surveys and Community Survey 2007;
- **Identifying the anticipated impacts.** This step includes the identification of the socio-economic impacts that could be expected during the construction and operational phases of the proposed CSP Plant. The list of impacts, inclusive of their nature and extent, represents the impacts that are usually associated with similar projects. Its purpose is to ensure that the specialist study contains a detailed analysis thereof, which means that their list, as well as other characteristics could change from the ones outlined in the Scoping Phase inputs report once the detailed assessment is undertaken; and

- **Reporting.** The data and information gathered during the study was included and presented as part of the Scoping Phase Input Report.

2. BASELINE INFORMATION

This chapter examines key socio-economic characteristics of the study area, as per delineation provided in the previous chapter. This is essential as it provides both qualitative and quantitative data related to the economies under observation. It should be noted that where possible information is provided for 2011, which is an estimate based on the historical trends and available statistics.

The following socio-economic indicators are analysed in this chapter:

- Population size and growth;
- Average household size;
- Income and Expenditure patterns;
- Labour Market dynamics;
- Production;
- Gross Domestic Product per Region, and
- Service delivery and access to tenure.

2.1 Population size and growth

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential to gaining an accurate perspective of those who are likely to be affected by any prospective development or project. This sub-section describes the status quo of the study area's population as estimated for 2011.

In 2011, South Africa's population is expected to be above 50 million (Table 2-1), with 1.1 million people residing in the Northern Cape area. The Siyanda DM is housing 247 611 people, or 22.5% of the provincial population while the Tsantsabane LM has a population of 29 150 people, i.e. just above 10% of the DM's population.

Table 2-1: Population size (2011) and historical growth rates (1995-2011)

Study area	2011	Historical growth rates			
		1995-2000	2000-2005	2005-2010	1995-2011
South Africa	50 430 328	1.7%	1.3%	1.1%	1.4%
Northern Cape	1 101 318	1.2%	0.4%	0.3%	0.6%
Siyanda DM	247 611	1.4%	0.5%	0.4%	0.8%
Tsantsabane LM	29 150	0.7%	0.9%	1.2%	0.9%

Source: Urban-Econ calculations based on Quantec, 2011

As indicated in the table above, the Compounded Annual Growth Rate (CAGR) of the primary study area's population between 1995 and 2011 was 0.9%. It was higher than the CAGR of the Siyanda DM and the provincial population during the same period, but lower than that of South Africa's population. Whilst the population of the Siyanda DM, Northern Cape and South Africa experienced a slowdown in their growth rates, the primary study area's population growth rate has been increasing (Table 2-1). This could be explained due to the fact that mines constitute a prominent land use in the area, which is home to the Assmang Iron Ore Mine at Beeshoek and the newly established Kolomela under Kumba.

2.2 Household numbers and size

Household data enables a richer interpretation of the results of socio-economic impact analyses. A large increase in household numbers coupled with the increase in disposable income levels result in greater consumption, which in turn stimulate local production and as a result the economy. In addition, knowledge of the size of the study areas in terms of households is useful for interpretation of the magnitude of the economic impact that could be created by the proposed activity.

South Africa have 13 385 517 households, which means that the average household size in the country is 3.8. The Northern Cape is estimated to have above 281 015 households and a bigger average household size than in the country. The Siyanda DM has 61 453 households and the biggest average household size in all of the study areas (4.1). The primary study area is expected to have 7 485 households and almost the same average household size (3.9) as the rest of the Province and country.

Table 2-2: Household numbers (2011), household size (2011) and its historical growth rate (1995-2011)

Study area	HH number	Average HH size	Household number historical growth rates			
			1995/00	2000/05	2005/10	1995/11
South Africa	13 385 51	3.8	4.0%	2.1%	1.0%	2.3%
Northern Cape	281 015	4.0	3.6%	1.1%	-0.2%	1.5%
Siyanda DM	61 453	4.1	3.5%	1.3%	0.3%	1.7%
Tsantsabane LM	7 485	3.9	2.3%	2.0%	1.8%	2.0%

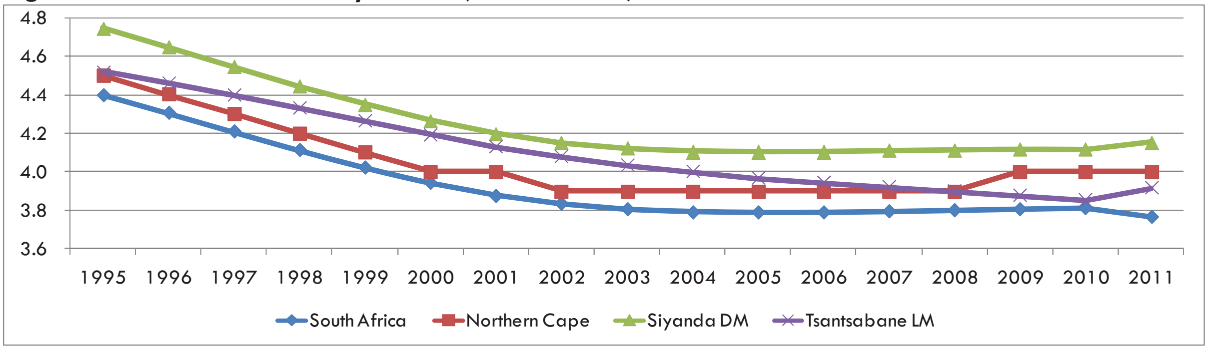
Source: Urban-Econ calculations based on Quantec, 2011

Over the years, as indicated in Table 2-2, the rates at which the numbers of households in the secondary and tertiary study areas were increasing have been slowing down, which mirrors the trend observed with respect to population dynamics in these study areas. In the primary study area, the trend though was different – with the population growth rate increasing, the household growth rate was also slowing down. When compared with population growth rates, it could be noted that the household growth rate in South Africa was on par with the population growth rate between 2005 and 2010. In the Northern Cape and the Siyanda DM, household growth rates were however significantly lower than their population growth rates, which means that the average household size in these areas has been slightly increasing.

The main factors that affect the household growth include, besides the population increase, the change in age structure and incidence rate, or the likelihood of people of a certain age to start a new household. The significant difference between a household growth rate and a population growth rate, though, is usually attributed to the change in age structure.

Household size is also influenced by many other factors such as culture, traditions, education levels, income levels, etc. Over the years, it has been observed that the size of an average household in the country has been declining (Figure 2-1).

Figure 2-1: Household size dynamics (1995 – 2011)



Source: Urban-Econ's calculations based on Quantec, 2011

As illustrated in Figure 2-1, the average household size in South Africa in 1995 was 4.4, whilst in 2011 it was 3.8. In the secondary and primary study areas, the average household size also dropped significantly between 1995 and 2011, although it should be noted that in the Northern Cape, the Siyanda DM and the Tsantsabane LM, the average household size was slightly higher than in South Africa. In the last three years, a slight increase in the average household size in all areas is observed, which could suggest that the trend of the sharp decline in the household size observed between 1995 and 2002 has been reversed.

2.3 Income and expenditure patterns

Income distribution is one of the most important indicators of social welfare, as income is a primary means by which people are able to satisfy their basic needs such as food, clothing, shelter, health, services, etc. Changes in income inflict changes in the standard of living, more specifically: a positive change in income can assist individuals, households, communities and countries to improve living standards.

There is a direct linkage between the household expenditure and economic growth. Increase in household expenditure means a greater demand for goods and services, which means an increase in production and positive change in the size of an economy. As has been seen in 2005-2006 in South Africa, robust increase in disposable income coupled with low interest rates in the country stimulated an increase in consumption by households, in particular durable and semi-durable goods, which in turn had a positive impact on the country's economy. Knowledge of the volume of the disposable income and the expenditure patterns of households, therefore, can provide vital intelligence with respect to the sectors that are most dependent on the household income and therefore would be most affected in the case of change in household income.

Table 2-2 shows income distribution in study areas as captured in the Community Survey 2007. More recent data, unfortunately, are not available, whilst historical information is not robust and reliable enough to escalate the latest figures and estimate the situation in 2011 with great confidence.

Based on the 2007 figures it could be concluded that the household income situation mirrored some of the patterns observed in the Northern Cape and in the rest of the country. First of all, the percentage of households earning less than R3 200 per month (R38 400 per annum) in the Tsantsabane LM area was slightly higher than in the Siyanda DM and the Province, but lower than in the rest of the country in 2007. Overall, more than half of households earned less than R3 200 per month in all the study areas and the country in 2007. At the same time, though the percentage of households without any income at all was significantly higher in the primary study area than in any other study area analysed. From an average household income perspective, an average household in the primary study area earned more or less the same as an average household in the Siyanda DM, what means that there are more

households in the Tsantsabane LM with a higher income, but this average household income is significantly less than households in the Northern Cape and South Africa.

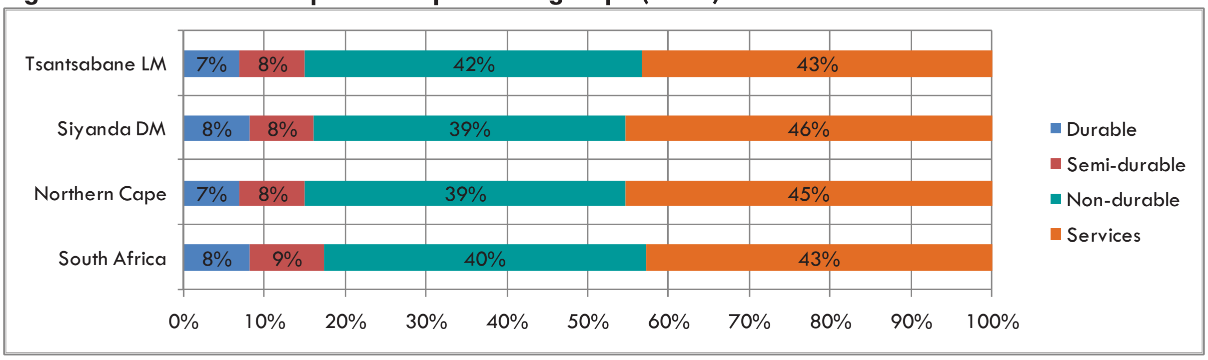
Table 2-2: Income distribution (2007)

Income category (per annum)	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM	
No income	8.2%	60.2%	6.8%	58.2%	4.9%	57.9%	11.4%	59.4%
R1 - R4 800	5.0%		3.5%		2.0%		3.1%	
R4 801 - R9 600	9.0%		7.9%		9.3%		7.9%	
R9 601 - R19 200	18.9%		20.2%		22.1%		16.7%	
R19 201 - R38 400	19.1%		19.8%		19.6%		20.3%	
R38 401 - R76 800	11.4%		13.2%		12.3%		15.3%	
R76 801 - R153 600	7.6%		8.0%		6.8%		8.9%	
R153 601 - R307 200	5.3%		4.7%		3.7%		3.6%	
R307 201 - R614 400	2.8%		2.2%		1.7%		2.5%	
R614 401 - R1 228 800	0.9%		0.6%		0.6%		0.6%	
R1 228 801 - R2 457 600	0.3%		0.2%		0.1%		0.3%	
More than R2 457 600	0.2%		0.2%		0.1%		0.1%	
No response	11.1%		12.6%		16.8%		9.4%	
TOTAL	100%		100%		100%		100%	
Weighted av. (2011 prices)	R8 920		R8 048		R6 938		R6 509	

Source: Urban-Econ calculations based on Community Survey 2007, 2011

Figure 2-2 illustrates the expenditure pattern of households in the study areas. It shows that there are slight differences between expenditure patterns of households in the Tsantsabane LM and other study areas, particularly the Siyanda DM. In the primary study area, households tend to spend the same share of their disposable income on services and non-durable goods, whilst in the Siyanda DM and the Northern Cape households tend to spend more on services than on non-durable goods. The share of disposable income spent by the Tsantsabane LM households on non-durable goods is also greater than the share of expenditure on these goods by households residing in the Siyanda DM, the Northern Cape and the rest of the country. The share of expenditure on durable goods and semi-durable goods is almost similar for all the study areas.

Figure 2-2: Household expenditure per main groups (2008)



Source: Quantec, 2011

Table 2-3 provides more detailed information on the items that households spend the largest share of their income on.

Table 2-3: Dominant expenditure items (2008)

Expenditure type	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Food, beverages and tobacco	26.3%	27.0%	26.4%	28.7%
Rent	12.4%	15.2%	15.3%	15.2%
Transport and communication	9.1%	9.1%	9.3%	8.5%
Medical services	5.9%	5.9%	5.9%	5.6%
Personal transport equipment	4.5%	3.9%	4.0%	3.7%

Expenditure type	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Clothing and footwear	5.0%	4.2%	4.1%	4.2%

Source: Quantec, 2011

As indicated in Table 2-3, expenditure on food, beverage, and tobacco products is the largest expenditure item amongst households in all areas, although households in the Tsantsabane LM tend to allocate a slightly bigger share of their income for these expenses than households in the rest of the province and country. Larger portions of the Northern Cape, Siyanda DM and the Tsantsabane LM households' incomes has to be allocated towards paying rent than is the case of households in the rest of South Africa. The Tsantsabane LM households also tend to spend a smaller share of their income on transportation than households in the Siyanda DM and the rest of the study areas. Expenditure on personal transport equipment in the primary area is lower than in the secondary and tertiary areas and spending on clothing and footwear is smaller than in South Africa, but the same as in the Northern Cape.

2.4 The labour market

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of angles, including employment rate and sectoral employment patterns.

Information box: Unemployed as per official definition

Unemployed are people, who:

a) Did not work during the seven days prior the interview;
b) Want to work and are available to start work within a week of the interview, and
c) Have taken active steps to look for work or to start some form of self-employment in the four weeks prior to the interview.

The composition of the labour force in the primary study area, Siyanda DM, Northern Cape and the country as reported by the Labour Force Survey is detailed in Table 2-4. Unfortunately, though, since the latest Labour Force survey does not report on the data for the District Municipalities, information for the study areas is sourced from the Quantec database and represents 2009 figures. This allows for a comparison between the study areas.

Table 2-4: Labour force statistics (2009)

Indicators	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Working age population	31 496 936	704 615	163 008	18 707
Non-EA	15 131 133	329 386	71 740	7 811
Labour Force	16 365 803	375 229	91 268	10 896
Employed	*12 260 902*	*271 688*	*68 166*	*6 851*
Unemployed	*4 104 901*	*103 541*	*23 101*	*4 044*
Unemployment rate	25.1%	27.6%	25.3%	37.1%
LF participation rate	52.0%	53.3%	56.0%	58.2%

Source: Quantec, 2011

In 2009, South Africa had about 31.5 million people within the working age population. Of these, about 15.1 million were non-economically active and 16.4 million formed part of the labour force. This means that the labour force participation rate in the country was 52.0%. The number of the employed

people in South Africa was about 12.3 million, leaving 4.1 million people or 25.1% of the labour force unemployed.

The Northern Cape accounted for 2.3% of the national working age population, or 704 615 people. In 2009, just over 53% of the provincial working age population participated in the economy or were economically active. These people encompassed a labour force, which was divided into 271 688 employed and 103 541 unemployed people, indicating a 27.6% unemployment rate in the province.

Siyanda DM had a bigger percentage of the working age population participating in the economic activities than that of the province and the country. In Siyanda, 56.0% of the working age population were economically active, with a 25.3% of these people being unemployed.

The primary study area had a working age population of 18 707 people and a labour force of 10 896 people, of who only 6 851 were employed. This means that in light of the labour force figure, the unemployment rate in the LM was 37.1% - significantly higher than in the Siyanda DM, the Northern Cape and South Africa. The high labour force participation rate, however, means that a significantly higher percentage of people in the Tsantsabane LM than in all the other study areas were looking for jobs.

2.5 Economic production and GDP-R

Interpretation of economic impacts requires a sound understanding of the size of the economy and its dynamics in the past. A number of indicators exists that can describe the economy of a region or an area. The most common variables that are used for the analysis include production and Gross Domestic Product per Region (GDP-R). The former represents the total value of sales of goods and services, or the turnover of all economic agents in a region; whilst the latter, using the output approach, means the sum of value added created by all residents within a certain period of time, which is usually a year. The trend at which the GDP-R has been changing in the past is also referred to as economic growth indicator. It is a measure of both the performance of an area and the well-being of the citizens of an area. Faster economic growth than population growth is taken as an indicator of a healthy economy and an improvement in citizens' well-being.

Table 2-5 provides an indication of the current estimated production and GDP-R values in the study areas. It shows that business sales in South Africa are expected to amount to R5 603 billion in 2011, in current prices which equates to R2 530 billion of gross value added. The Northern Cape accounted for about 2.0% of the national GDP-R in 2011, whilst the Siyanda DM and the Tsantsabane LM contributed 22.4% and 3.3% to the provincial economy respectively.

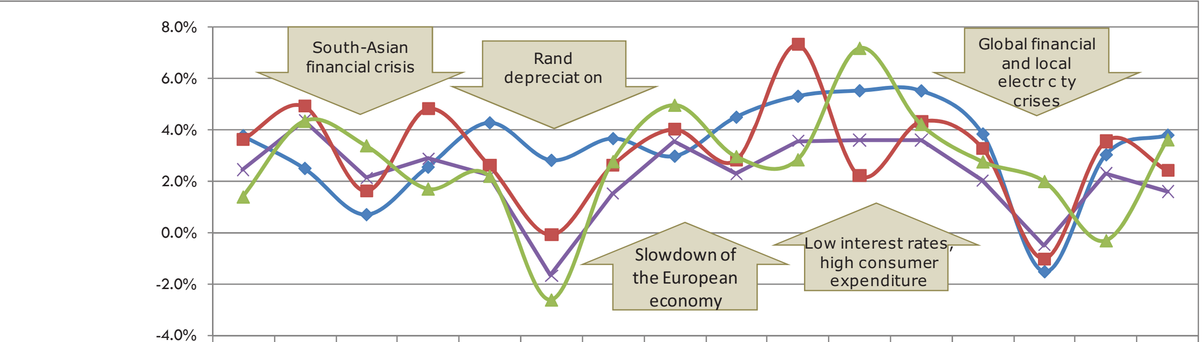
Table 2-5: Production and GDP-R figures (2011)

Study area	Production (R'ml)		GDP-R (R'ml)	
	Current prices	CAGR 1995-2010	Current prices	CAGR 1995-2010
South Africa	5 603 076	4.6%	2 530 484	3.3%
Northern Cape	104 039	3.2%	56 341	2.3%
Siyanda DM	23 380	4.2%	11 776	3.0%
Tsantsabane LM	3 476	3.8%	2 106	2.8%

Source: Quantec, 2011

Figure 2-3 illustrates the dynamics of the study areas and their sensitivity to the global and domestic changes in the economies.

Figure 2-3: GDP-R historical trends (1996-2009)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*	2011*
South Africa	3.8%	2.5%	0.7%	2.6%	4.3%	2.8%	3.7%	3.0%	4.5%	5.3%	5.5%	5.5%	3.8%	-1.5%	3.0%	3.8%
Northern Cape	2.4%	4.3%	2.1%	2.9%	2.2%	-1.7%	1.5%	3.6%	2.3%	3.5%	3.6%	3.6%	2.0%	-0.5%	2.3%	1.6%
Siyanda DM	3.6%	4.9%	1.6%	4.8%	2.6%	-0.1%	2.6%	4.0%	2.8%	7.3%	2.2%	4.3%	3.3%	-1.0%	3.5%	2.4%
Tsantsabane LM	1.4%	4.3%	3.4%	1.7%	2.2%	-2.6%	2.8%	4.9%	2.9%	2.8%	7.2%	4.2%	2.7%	2.0%	-0.3%	3.6%

Source: Urban-Econ's calculations based on Quantec, 2011

As illustrated in Figure 2-3, South Africa's economy has been sensitive to the changes on the global and regional arenas. The South Asian financial crisis in 1997-1998, Rand depreciation in 2001, slowdown of the European economy in 2003, and the major global financial and local electricity crises in 2008 all had an influence on the dynamics of the national economy one way or another. It seems that the Rand depreciation in 2001 had a greater effect on the primary and secondary areas, as this were the time when all of them had significantly lower growth rates than South Africa. Fluctuations in the global and regional economies, as well as the spin-off effects of these trends experienced in the country, also affected the growth prospects of provincial, District Municipality's and Local Municipality's economies.

The domestic electricity and global financial crises had a negative impact on the study area's economies in 2009. As illustrated in Figure 2-3, all of the analysed economies contracted, except with the Tsantsabane LM still showing positive growth. This could be explained by the fact that a significant portion of the JT Gaetsewe DM economy comprises of the mining, community and trade industry. The electricity and financial crisis experienced in 2008 had a negative impact on the production volume of the mining industry, therefore the steep decline from 2006. As a result, the size of this industry has shrunk already in 2008. The peak of the aftermath of the global financial crisis reached South Africa in 2009. This coupled with high interest rates and stricter credit policy and had a significant negative impact on the domestic demand. As a result, almost all industries experienced some level of contraction or stagnation which ultimately reduced the demand for their outputs and had a negative impact on their growth. Sectors that continued growing during this period included construction, community and government services, largely due to the investment and activity that took place in preparation for the 2010 World Cup.

The global economy, as well as South Africa's economy, is slowly recovering from the turmoil of the past few years, although it will take a few years before it reaches the level of economic growth that was observed before 2008.

2.6 Structure of economies

The structure of the economy provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure and trends of specific sectors.

Table 2-6 provides structures of study areas' economies in 2011 illustrating nominal (2011) prices and 2005 prices. It should be noted that the calculation of the structure of the economy in current and constant prices provides different results. This is due to the fact that prices on goods and services do not change proportionally over years. Prices on goods of one sector could grow faster than prices on goods or services in other sectors. The indication of the structure of the economy in basic prices or prices of 2005 as was done in this case illustrates the relative composition of the economy, but excludes the benefits or dis-benefits of that economy that might have been experienced due to price effects. This is why, the presentation of results in nominal prices is also important as it allows the illustration of the economy's structure taking into account the current market prices and therefore the effects thereof on the income or Gross Operating Surplus. The comparison of the structure of the economy in terms of basic and nominal prices also provides valuable insight into the sensitivity of that economy with respect to changes of commodity prices. An economy that generates a significant share of its GDP-R from certain commodities will most likely have a significantly different structure when compared between nominal and basic prices.

Table 2-6: Structure of the study areas' economies in 2011

Sectors	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM		
	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal %	Nominal R'ml
Primary sector	**8.2%**	**11.1%**	**29.6%**	**36.7%**	**32.3%**	**40.2%**	**42.0%**	**49.1%**	**1035**
Agriculture, forestry and fishing	2.3%	3.7%	6.6%	8.9%	14.7%	19.6%	1.3%	1.8%	37
Mining and quarrying	5.8%	7.4%	23.0%	27.7%	17.6%	20.7%	40.6%	47.4%	997
Secondary sector	**23.2%**	**23.1%**	**7.3%**	**7.1%**	**10.6%**	**10.0%**	**5.5%**	**5.1%**	**107**
Manufacturing	17.6%	17.2%	3.7%	3.6%	5.7%	5.4%	2.8%	2.7%	56
Electricity, gas and water	2.2%	2.0%	1.9%	1.7%	3.1%	2.8%	2.0%	1.7%	36
Construction	3.5%	3.9%	1.7%	1.7%	1.8%	1.8%	0.7%	0.7%	14
Tertiary sector	**68.6%**	**65.6%**	**63.1%**	**56.3%**	**57.1%**	**49.8%**	**52.5%**	**45.8%**	**965**
Trade	13.7%	13.4%	12.4%	11.3%	14.6%	12.6%	6.5%	5.7%	119
Transport, storage & comm..	10.5%	10.7%	10.5%	10.0%	11.8%	10.8%	17.1%	15.7%	330
Finance, insurance, & business	24.0%	22.8%	15.2%	13.6%	10.8%	9.4%	10.8%	9.4%	197
Com. and gov. services	20.5%	18.9%	25.0%	21.5%	20.0%	16.8%	18.1%	15.1%	318
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**2 106**

Source: Urban-Econ's calculations based on Quantec, 2011

As indicated in Table 2-6, South Africa's economy is a service economy, as the biggest share of its GDP-R is created by tertiary sectors, in particular the finance and business services sector and the community and government services sector. The primary sector that includes agriculture and mining contributes the smallest amount to the national economy, although they are strategically important for ensuring food security in the country and provision of electricity.

The structure of the Northern Cape's economy is entirely different to the composition of the national economy with the tertiary sector accounting for over 60% of its GDP-R and the primary sector playing a prominent role in the economy with just under 30% of its GDP-R. The comparison of the structure of the Northern Cape's economy in basic and nominal terms suggests that price effects have a significant impact on the structure of the economy. This is largely due to the fact that it contains a prominent primary sector, in particular the mining industry, as it is the price of commodities produced by the primary industry that can have a notable effect on the structure of any economy.

The structure of the Siyanda DM's economy is different to that of South Africa, but is quite similar to that of the Northern Cape. It is clear that it is more dependent on the primary and secondary sectors

than that in the province. Because of it, its tertiary sector is smaller than the tertiary sector in the Northern Cape.

The Tsantsabane LM's economy, which generates almost half of its GDP-R from the tertiary sector, also has a different structure with respect to primary and secondary sectors than that of the country's economy. In constant prices, the primary sector accounts for 42% of the provincial GDP-R, but in nominal prices its share is significantly higher which indicates that such an economy would be highly sensitive to fluctuations of prices on commodities, particularly those that are being mined in the area. Whilst its primary sector is vast, its manufacturing sector is small which also indicates that limited processing of the raw materials that are being mined in the area is taking place in this Municipality. Following the biggest sector in the municipality – mining – are the community services sector, transport and finance sector.

2.7 Structure of Employment

The employment structure presented largely corresponds with the structure of the economy with the tertiary sector making the largest contribution towards employment creation in all areas under analysis.

- More than two thirds of the people employed in South Africa work in the tertiary sector, in particular the community and government services sector and the trade sector. Agriculture, which accounted for 3% of the national GDP-R in 2011, on the other hand, provided 6.4% of all employment opportunities; whilst the contribution of the mining industry towards the employment in the country was smaller than its contribution towards GDP-R. Nevertheless, both of the sectors are labour-intensive and create a notable number of employment opportunities in the country, particularly in rural areas.
- Employment structure in the Northern Cape is dominated by the number of people who are working in the tertiary sector, specifically in the trade, community and government services. Its secondary sector creates 9.0% of jobs in the Province, whilst its primary sector creates 24.8%.
- Most of the people employed in the Siyanda DM are working in the tertiary sector too, specifically in the community and government services, trade and finance sector. Its secondary sector creates 10.1% of jobs, whilst its primary sector creates 36.9%.
- The employment composition in the Tsantsabane LM is quite similar to that of the Northern Cape with the sectors providing the largest numbers of jobs being the community and government services, mining and quarrying, trade, and finance sectors. The mining sector, which contributes 53.6% to the GDP-R (in nominal prices), provides only 18.2% of employment opportunities in the area. At the same time, the trade, community and government sector's employment contribution is greater than its contribution towards GDP-R.

Figure 2-4 illustrates the structure of South Africa, Northern Cape, the Siyanda DM and the Tsantsabane LM economies from an employment perspective.

The employment structure presented largely corresponds with the structure of the economy with the tertiary sector making the largest contribution towards employment creation in all areas under analysis.

- More than two thirds of the people employed in South Africa work in the tertiary sector, in particular the community and government services sector and the trade sector. Agriculture, which accounted for 3% of the national GDP-R in 2011, on the other hand, provided 6.4% of all employment opportunities; whilst the contribution of the mining industry towards the employment in the country was smaller than its contribution towards GDP-R. Nevertheless, both of the sectors are labour-intensive and create a notable number of employment opportunities in the country, particularly in rural areas.
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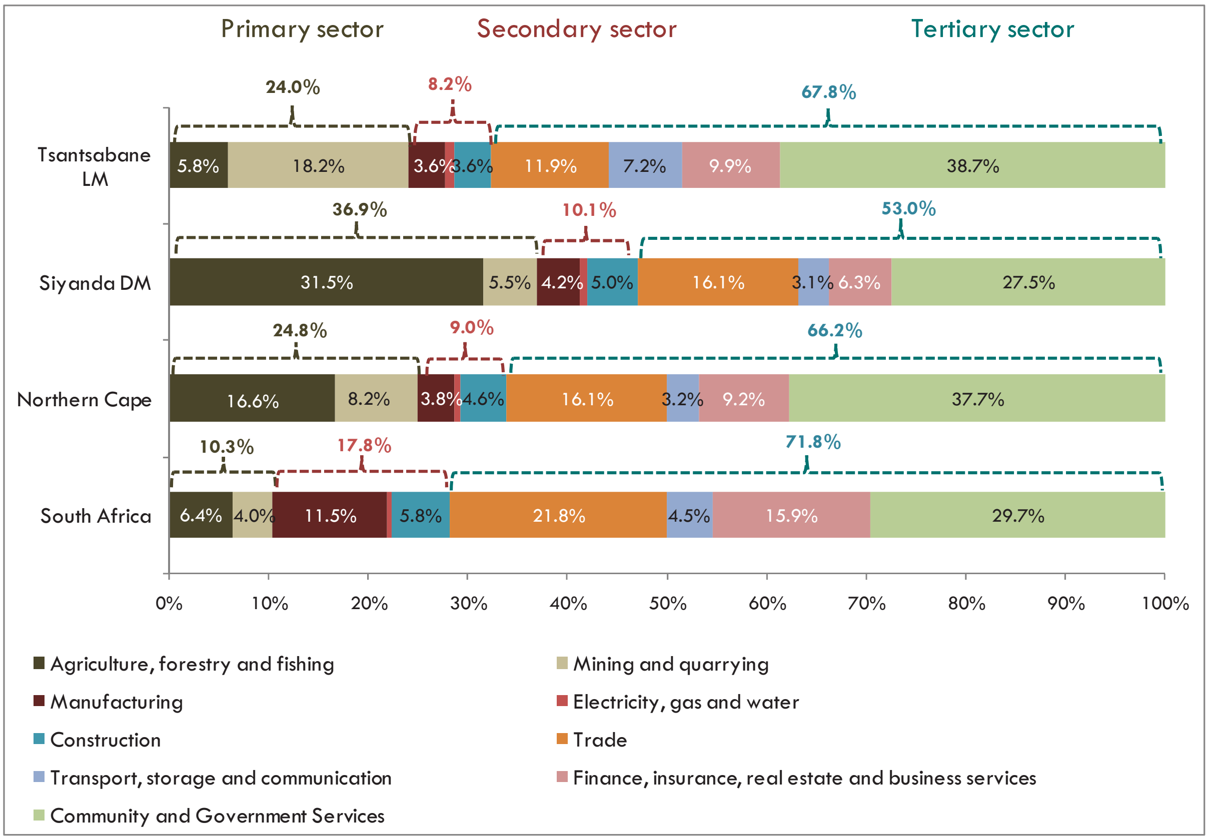
Figure 2-4: Employment structure (2011)



Source: Urban-Econ calculations based on Quantec, 2011

2.8 Basic service delivery and access to tenure

Access to basic service delivery and shelter are the indicators that allow understanding the standard of living of the households residing in the study areas. Comprehension of the extent to which households in the area have access to water, sanitation and electricity assists in understanding of the communities' plight and their needs. At the same time, knowledge of the types of dwellings that households reside in is valuable in developing a complete profile of the circumstances in which communities are living. All of above creates a baseline against which the potential impacts of the proposed activity could be assessed.

Table 2-7 provides information on the types of dwellings in which households live in the study areas. It indicates that 73% of households in the primary study area were living in formal dwellings and this figure also means that access to formal dwellings in the primary study area was the lowest amongst all study areas analysed. The Tsantsabane LM also had the highest percentage of households living in informal dwellings, such as a shack in a backyard of a formal dwelling or in an informal settlement. This suggests that local communities do require formal housing, for example, the Tsantsabane LM where one out of four households is living in an informal dwelling and that any project that would potentially increase the influx of people into the area could portray up growth of the housing problem, thus housing provision during construction and operation by the project should be received during the EIA phase.

Table 2-7: Dwelling types (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Formal dwelling	80.3%	83.2%	79.0%	73.0%
Informal dwelling	14.0%	10.3%	12.8%	21.5%
Other	5.7%	6.5%	8.1%	3.5%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-8 provides information on the access of households to electricity, using energy for lighting indictor as a proxy. The information presented in this table suggests that the primary study area's households have the least access to electricity compared to the other study areas. Only 78% of households in the Tsantsabane LM use electricity for lighting compared to 84.2% in the Siyanda DM and 85.8% in the Northern Cape. This information correlates with the situation of access to formal dwellings, as a smaller access to formal residence would suggest a smaller access to electricity.

Table 2-8: Energy for lighting (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Electricity	80.8%	85.8%	84.2%	78.3%
Other	19.2%	14.2%	15.8%	21.7%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-9 shows households' access to water. The situation in this case is quite different to that observed with regard to access to electricity and formal dwellings. Almost 75% of households in the primary study area as well as in the Northern Cape itself have access to water inside their dwellings. This is considerably higher than the 64.3% of households living in South Africa who have access to water inside their dwellings. At the same time, more than 78% of households in the Siyanda DM have access to water from inside their yard. This is not indicative to the rural nature of these regions, where due to the settlement pattern water is quite often provided to the neighbourhood rather than to the dwelling itself. Nevertheless, 4.9% of households in the primary study area and 5.6% of households in the Siyanda DM still have to rely on other sources of water which are not very reliable, such as water vendor, rain water, etc.

Table 2-9: Access to water (2011)

Item	South Africa	Northern Cape	Siyanda LM	Tsantsabane DM
Water inside dwelling or a yard	64.3%	75.0%	78.9%	74.4%
Water from point outside the yard	24.9%	20.0%	15.5%	18.7%
Other water access points	10.9%	5.0%	5.6%	4.9%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-10 provides information on access by households to sanitation. It indicates that 75.9% of households in the primary study area have a toilet, which is significantly higher than the 57.7% reported for South Africa. This is also a higher figure than that reported for the Siyanda DM and is also significantly higher than the percentage calculated for the Northern Cape at 72.2% and 67.6% respectively. This again is not indicative to the rural nature of these regions, where households who have access to toilets largely have access to pit toilets. This access to a chemical or flush toilet emphasises their access to water inside dwellings.

Table 2-10: Access to sanitation (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Chemical or Flush Toilet	57.7%	67.6%	72.2%	75.9%
Pit Toilet	25.8%	13.9%	9.5%	2.7%
Bucket system	2.7%	5.2%	6.1%	7.6%
Other	13.8%	13.3%	12.2%	13.9%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

3. SUMMARY AND POTENTIAL SOCIO-ECONOMIC IMPACTS

The proposed Humansrus CSP facility is to be located in the Tsantsabane LM about 30 kilometres southeast from Postmasburg in the Northern Cape. The Tsantsabane LM comprises of 29 150 people and 7 485 households, thus representing 2.6% of the provincial population. Over the last decade, the size of the municipality from a population perspective has been growing at a slightly quicker rate than that observed in the DM and the rest of the Province. Moreover unlike the trend observed in the province and the rest of the country, its population growth has been increasing and not declining.

Households residing in the Tsantsabane LM have relatively the same level of income as the average household in the Siyanda DM, but it is significantly lower than the average household income in the Northern Cape and even more so in South Africa. A considerably higher percentage of households in the Tsantsabane LM have no income compared to that of the other study areas. This is representative of the fact that the unemployment rate in the LM is worse than the unemployment rate in the Province and country. All of the above suggests that households residing in the Tsantsabane LM have on average lower access to employment opportunities than households in the rest of South Africa.

Households living in the primary study area have poorer access to formal dwellings and electricity that households in the rest of the province and the country. The situation with respect to the access to water and sanitation, however, is different. Compared to the percentage of households with access to water and sanitation in South Africa and in the province, a greater share of households in the Tsantsabane LM has access to water and sanitation services in their dwellings or in a yard.

The labour market in the primary study area comprised of 6 851 employed and 4 044 unemployed people in 2009. It had a bigger labour participation rate (58.2%) than in the secondary and tertiary study areas. This could be explained by the fact that a significant number of working age population in the LM remain active in the labour market, whilst the other areas have a considerable number of people who became discourage job seekers, i.e. people who are not considered to be economically active and are not included in the calculation of the unemployment rate. The fact that a significant number of people remain to be economically active in the municipality compared to their counterparts in the rest of the province could partially explain the large unemployment rate in Tsantsabane, which stands at about 37.5%. The high unemployment rate, though also shows that the local economy is not able to provide employment opportunities for a significant number of local residents, which means that any investment in the local economy that would create new sustainable jobs would be welcome.

The economy of the Municipality is relatively small (R2 billion of GDP-R) and is highly dependent on the mining sector. Since 1996 its average performance was slightly lower than in other study areas under analysis, particularly the Siyanda DM. The dependency of the local economy on the production of the mining sector makes it extremely sensitive to fluctuations of commodity prices and domestic demand for mineral, which in turn is related to the overall performance of the economy. The global recession in 2009 had exactly such an effect on the economy, when the value added of the mining sector dropped by 19%. The above emphasises the need to diversify the local economy by growing

sectors that would be less sensitive to local and global economic changes and that would offer sustainable employment opportunities in other but the mining industry.

From the employment perspective, the sectors that create the majority of jobs in the Municipality are services sectors, such as community and government services, with the mining sector following closely. Given the employment creation targets set by government in its New Growth Path and assuming that it is matched by investment, the economy of the Tsantsabane LM needs to grow at a higher rate in the future than it did in the past few years. In order to achieve these trends, though, a significant investment in the local sectors will need to be made by both private and public sectors. This means that any new development proposed for the area would most likely have a significant positive effect on the structure of the local economy (except if it is mining) and on the ability of the local economy to align itself with the new socio-economic path set up by government.

In light of the socio-economic situation in the primary study area and given the knowledge of the proposed activity, it is expected that the proposed activity, i.e. energy generation using renewable sources, will have a positive impact on the local economy by increasing the local utilities sector and creating new employment opportunities. It will also contribute to the achievement of a number of government objectives related to job creation, diversifying electricity generation capacity in the country, and combating climate change. Moreover, it could potentially stimulate further development of local industries that could become involved in manufacturing components for and maintenance of similar facilities. Through indirect and induced effects it is also expected to have a positive impact on the production volumes of supporting industries and sectors that service consumers. Although if the majority of investment will be spent on purchasing foreign equipment and machinery, the positive impact of the project could be significantly lower than the potential impact.

The establishment of a CSP Plant could result in the discontinuation of the current agricultural activities on the farm and could have a negative impact on the farms surrounding it. The actual extent of this effect will still need to be determined. Most importantly, though, the net effect of the project will need to be estimated during the socio-economic impact assessment. This refers to the comparison of the socio-economic impacts of the proposed activity with the socio-economic effects of the current activity on site.

From a social perspective, creation of new employment opportunities will most likely have a positive impact on the standard of living of the affected households. The project though could also create a number of negative socio-economic effects, particularly during construction. These include potential increase of crime in the area, increase of health concerns and potential deterioration of health due to noise and dust in the area.

Overall, the potential socio-economic impacts that could be predicted at this stage and that will need to be investigated in the specialist study include:

- Strategic macro-economic impacts:
  - Assistance in achieving government objectives;
  - Impact on balance of payment due to possibility that certain equipment and machinery will be imported;
  - Provision of electricity without putting additional pressure on water resources;
  - Reduced emissions and potential to trade in carbon credits, and
  - Potential to establish a new manufacturing industry.
- During the construction phase:
  - Temporary increase in production and GDP-R in industries supporting the construction;
  - Temporary employment creation at the construction site and supporting industries;

- Temporary increase in government revenue due to the establishment of the plant;
    - Permanent loss of production created by the current agricultural activities;
    - Permanent loss of jobs associated with the existing agricultural activities on site;
    - Influx of job seekers and associated crime concerns;
    - Possible negative health impacts associated with migrants, and
    - Temporary increase in households' income levels.
- During the operational phase:
    - Increase in production and GDP-R due to the plant's operations;
    - Creation of sustainable employment opportunities at the plant and supporting industries;
    - Increase in government revenue;
    - Skills development;
    - Improvement of living standards of positively affected households (thought employment);
    - Increase in households' income levels;
    - Change in standards of living of the directly affected households, and
    - Impact on local tourism.

Visual Impact Assessment Report

HUMANSRUS SOLAR POWER PLANT

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Newtown Landscape Architects

NLA

THE PROPOSED SOLAR POWER PLANT, NORTHERN CAPE

Specialist Study Report
VISUAL ENVIRONMENT – ASSESSMENT

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Project No:	1346/E11NC
Report Revision No:	FINAL
Date Issued:	01 August 2011
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Reference:	**Humansrus Solar Power Plant**

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Project

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, the feasibility of constructing a Concentrated Solar Power (CSP) plant (the project) with a maximum capacity of 100 MW electrically in the Northern Cape, is being assessed. The intention of this effort is to develop solar resources to generate electricity and reduce the dependence on non-renewable fossil fuel resources. This proposed facility will utilise the sun as the fuel source. The project would include a Solar Field, Molten Salt Circuit, Power Block and Auxiliary Facilities and Infrastructure and is proposed to be located on Farm 469, Hay RD (Humansrus), approximately 4 km southeast of Groenwater and 30 km east of Postmasburg. SSI Engineers and Environmental Consultants (Pty) Ltd appointed Newtown Landscape Architects cc (NLA) to carry out a Visual Impact Assessment as part of the EIA process. This *Scoping Report* is the first phase of the process. An *Assessment Report* will follow in due course. Refer to the Figure 1 „Locality" for the location of the project site.

1.2 Terms of Reference

NLA"s terms of reference are as follows:

Compilation of a *scoping report* to include the following, but not limited to:

- An introduction to the study;
- An overview of the local and regional visual and landscape character;
- A description of the potential impacts (including cumulative impacts) on visual and landscape character, and sensitive receptors occurring within the general area of the study site to be further investigated during the EIA phase of the project;
- Any assumptions, limitations and / or constraints associated with the study;
- Recommendations on any further studies that may be required during or after the EIA process.

1.3 Assumption and Limitations

It is assumed that the farmsteads that fall within the visual study area could be occupied and therefore these viewing points have been identified as potentially being sensitive. This assumption will be verified during the assessment phase. The project description is as given to NLA by the environmental consultants and this stage the exact footprint within the project site is not known.

1.4 Aim of the Study

The main aim of the study is to ensure that the visual consequences of the proposed project are understood and adequately considered in the planning process. The objectives of the study are to:

- To define the visual resource and sense of place of the study area;
- To identify the sensitive receptors / lines of site;
- To determine and rate the visual impact;
- To simulating the key proposed infrastructure components against the visual baseline;
- To assess the cumulative visual impact; and
- To provide input, together with Beal and other specialists into visual management measures to minimize negative visual impacts.

2.0 APPROACH AND METHODOLOGY

A field survey was undertaken on 27 April 2011 and the project site visited and the study area scrutinized. Photographs of the general area were taken from public roads towards the proposed project site. The study area is defined as a 20 km radius about the proposed project site. Beyond this distance the proposed CSP project would be „absorbed" into its landscape setting or reduced in scale within in the viewing arc that its impact and visual exposure would be insignificant.

To evaluate the impacts of the project the inherent scenic value of the landscape (visual resource) first needs to be determined. Data collected during a site visit allowed for a comprehensive description and valuation of the receiving environment and also for issues to be identified that must be addressed in the impact assessment phase. The full visual impact process is indicated in Diagram 1 below. The following method was used for the scoping phase of the project.

- **Site visit** - a field survey was undertaken and the study area scrutinized to the extent that the receiving environment could be documented and adequately described;
- **General landscape characterization** - landscape character types were mapped using field survey and physiographic data (from 1:50 000 maps). The description of the landscape focused on the nature of the land rather than the response of a viewer;
- **Scenic quality** - using the landscape character types, sense of place and studies for perceptual psychology, the aesthetic value of study area (scenic quality) was determined.
- **Project components** - the physical characteristics of the project components were described and illustrated by way of example.
- **Visual issues** - based on the baseline survey visual issues were identified that should be addressed in the impact assessment phase.

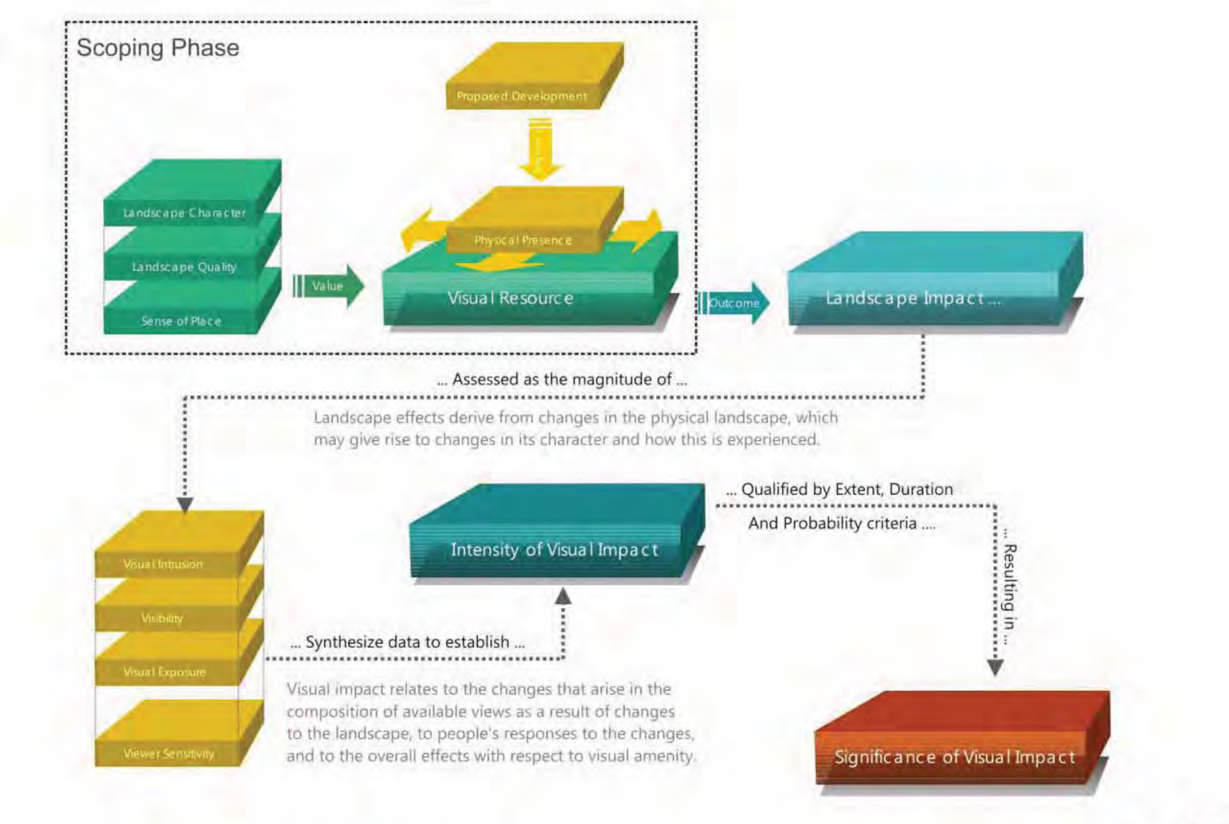

Figure 2: **VISUAL IMPACT PROCESS**

Diagram 1: Visual impact Process

3.0 DESCRIPTION OF THE PROJECT

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed. The CSP Plant is proposed to be a molten salt-type, Central Receiver technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the central receiving tower) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats. The tower is 200m from the ground up and each heliostat receiver (tracking mirror) is estimated to between 10 and 15 meters above ground level. The glare generated by the heliostat field is expected to be quite significant and this, along with the physical presents of project components, needs to be clearly understood in assessment phase of the project. The CSP plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs and the pylons that would connect the CSP to the grid are also included in the description of the project. Construction is proposed to start in Jan 2013 for a 30 month construction period.

A variety of components make up the CSP plant. They are:

The Power Block

- Tower (to concrete deck): 163.98m;
- Steam Generating Building: 43,22m;
- Water Treatment Plant: 9,19m;
- Electric Building: 8,6m;
- Control Building: 5,67m;
- Fire Water Pump Building: 4,44m;

The Administrative Area

- Administration Building 8,25m;
- Warehouse 9,2m; and
- Guardhouse 3,9m.

A heliostat is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in an elliptical formation around the focal point with the majority of the

reflective area weight to the more effective side of the heliostat field (refer to Figure 2 at the back of the report).

The central receiver is situated on the top of the central tower. This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

Power is generated through a conventional Rankine cycle (steam turbine process). The working fluid is a salt mix of a 60:40 ratio of Sodium Nitrate ($NaNO_3$) and Potassium Nitrate (KNO_3). The cold salt is pumped up the central tower at approximate 300°C and flows through the central receiver where it is heated to approximately 550°C after which it can be stored for use in the conventional power generation process (maintaining 98% thermal efficiency).

At this stage the exact footprint within the project site is not known.

4.0 THE ENVIRONMENTAL SETTING

4.1 Landscape Character

The study area is situated in the Kalahari Mountain Bushveld (Low and Rebelo) savannah biome, which typical is found on rocky, shallow soils on the hills at an altitude of 450 to 1250m. It is an open savannah dominated by Camphor Tree (*Tarchonanthus camphoratus*) and Kanibus (*Rhus undulate*) and Broom Karee (*Rhus dregeana*) become the principal shrubs. The tree layer is poorly developed and individuals of Wild Olive (*Olea europaea* subsp. *africana*) and Black Thorn (*Acacia mellifera* subsp. *detinens*) are widely scattered. The grass layer is moderately developed depending on the rockiness of the area. The primary land-use is livestock farming of cattle, goats and sheep and it is a poorly conserved biome.

The project site comprises an open grassland valley between two small ridges to the west and east of it, which merge into a general ridgeline north of the site. These ridges are have a reasonably developed savannah cover of small shrubby material. This is especially evident in the northern sectors of the site. Refer to View 4 in Figure 5 and Views 5 and 6 in Figure 6. South of the project site the valley is split by a small rise in topography that extends to the south east and the Lime Acres mining complex and town. The „central" grassland areas of the project site are used mostly for livestock grazing.

The higher hills to the far north, west (refer to Views 1 and 2 in Figure 4) and east (refer to View 7 Figure 7) of the project site are also dominated by a reasonably established savannah cover but there is a dearth of tall trees and the tree layer is generally poorly developed. Most tall trees within the study area are Blue Gums associated with farmsteads or urban developments.

The areas to the south of the project site are generally flatter and more open and dominated by grasslands, used mostly for grazing (refer to Views 9 and 10 in Figures 8). The south western section of the project site also has this character and the topography tends to rise to a shallow ridgeline running from the R385 to the Lime Acres farm road (refer to View 11 Figure 9). Further to the south west toward Lime Acres the landscape is again of a „rolling" nature and the road and other infrastructure are contained within a shallow valley between two ridges (see View 8 Figure 7).

The grassland valley system extends north of the project site and north of the R385 and is eventually „embraced" by reasonably high hills that extend further north. Figure 9 View 12 from a small settlement north west of the project site and View 3 in Figure 5 illustrate the character of the grasslands in this area.

Throughout the study area railway, road and electricity infrastructure is evident and as the traveller nears Lime Acres, mining infrastructure and urban landscapes tend to dominate. Also, to the far north east of the project side beyond the hills, are the Owendale and Danielskuil mining activities (refer to Figure 10 which identifies these areas and infrastructure).

Generally, the landscape that embraces the site in the north, west and east (Figures 4, 5 and 6) is a more distinctive and varied and tends to be more interesting than the characteristics of the study area to the south of the site, which is less diverse and more open (Figures 8 and 9).

4.2 Sense of Place and Aesthetic Value

Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more "common" elements. Generally, the greater the diversity of form, line, texture, and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications and therefore categorised as:

- High - distinctive landscape often with a strong sense of place;
- Moderate - common landscape; And
- Low - minimal landscape often with a weak sense of place and the presence of man-made structures and infrastructure that discordant and promote strong disharmony.

The study area can be divided into a number of primary „landscape types" each with its unique landscape characteristic, sense of place and aesthetic value. These are mapped in Figure 10 and include:

- Kalahari Mountain Bushland;
- Rolling grassland with drainage lines;
- Rural villages;
- Urban areas;
- Infrastructure and utilities; And
- Mining activities.

Using the criteria and values defined in Appendix A along with the discussion on landscape character in Section 4.1 above, the visual quality of the study area is rated across a range of values. Table 1 below summarises these findings.

Table 1: Value of the Visual Resource - Scenic Quality

High	Moderate	Low
Kalahari Mountain Bushveld	*Rolling open grasslands with drainage lines rural villages and towns*	*Urban, Mining and Power and Rail Infrastructure*
This landscape type is considered to have a *high* value because it is a:	These landscape types are considered to have a *moderate* value because they are:	These landscape types are considered to have a *low* value because they are:
Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a strong sense of place. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.	Common landscapes that exhibit some positive character but which have evidence of alteration /degradation/erosion of features resulting in areas of more mixed character. They are potentially sensitive to change in general and change may be detrimental if inappropriately dealt with but change may not require special or particular attention to detail.	Minimal landscapes generally negative in character with few, if any, valued features due to their inherent characteristics or due to major negative man-made impacts. Scope for positive enhancement could occur.

However, the value of the visual resource when the various landscape types are taken together (they are not perceived as one unit in the landscape as the eye is always roving and often embraces many of these landscape types in one view) and which are representative of the overall quality of the study area‟s areas landscape, the rating is *moderate* within the context of the sub-region. This is primarily due to the „intrusion‟ of mining, urban and infrastructure projects, which reduce the positive effect that the hills have on the scenic beauty of the study area. The project site would also have *moderate* rating as its scenic value is compromised by the rail and power lines to the west of the site.

5.0 VIEWS AND SENSITIVE RECEPTORS

5.1 Viewing areas

The project site lies in a shallow valley between two ridgelines that mostly contain the visuals of the heliostats (orange viewshed footprint in Figure 11) to a band of approximately 5km to the east and west of the project site. Along the length of the valley north and south of the site, exposure is greater and would affect foreground and background views i.e. up to 10 km from the site.

The central receiving tower, which is 200m tall, would be visible from a far greater distance as in indicated in the viewshed in Figure 11. However, beyond 8km it would tend to recede into the background of views and at 16km it would be deemed as „infrequently" viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention.

Public views (sensitive viewing areas) to the project site would be experienced by people living, working and passing through the study area. The closest of these viewing areas and the most exposed to the impact of the project, are the R385, which passes immediately to the north of the site and the Groenwater / Lime Acres farm road which passes immediately to the west of the site. There are a few farmsteads and residential properties (along Groenwater road immediately north west of the site) that occur near the site and the project would appear in the foreground of these views resulting in a potential high visual impact. The farmsteads (two) occur to the immediate north and south of the site. There are 3 farmsteads with potential middleground views of project activities. These are located immediately west (approximately 5km from the site) of the site and to the north east (5km) and south east (3km). Visual exposure at these greater distances is reduced but nevertheless could have an impact on these sensitive views.

The towns of Owendale, Lime Acres, Danielskuil at the settlement at Groenwater immediately north of the R385 and west of the site, would not see any components of the project as ridge lines block views towards the site.

At this stage it is not known if all the identified farmsteads are occupied. This would have to be verified in the assessment phase.

5.2 Sensitive receptors

Typically most sensitive receptors would include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape (scenic routes);

- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;

- Occupiers of residential properties with views affected by the development.

Other less sensitive receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);

- People travelling through or past the affected landscape in cars, on trains or other transport routes;

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

Given these criteria, the sensitive receptors for the study area would be:

- Visitors and people who live in the farmsteads / residential units;

- People travelling through or past the affected landscape in cars and on trains;

During the site visit, no tourist facilities were identified in the immediate vicinity and nearby environs of the project site but this must be confirmed in the assessment phase of the project.

The focus of the impact analysis during the assessment phase will therefore be on these receptors and viewing areas. Refer to Figure 11, which identifies their location.

6.0 ISSUES TO BE ADDRESSED IN ASSESSMENT PHASE

To evaluate the impacts of the CSP project at Humansrus it is assumed that the landscape has some inherent scenic value and needs to be factored into the assessment of the impact on views and aesthetics of the project. The existing visual condition of the landscape potentially affected by the proposed CSP project has been described. Its scenic quality has been rated and highly sensitive viewing areas and receptors identified and mapped. The next phase, after the scoping phase, is to assess the impacts on the visual resource and the effects the project could have on sensitive views in area.

Visual resource impacts would result from the construction, operation, and maintenance of the proposed CSP project. Specifically, impacts would result from project components being seen from sensitive viewpoints and from effects to the scenic values of the landscape. Impacts to views would be the highest when viewers are identified as being sensitive to change in the landscape, and when their views are focused on and dominated by the change. Visual impacts would occur when changes in the landscape are noticeable to viewers observing the landscape from their homes or from tourism / conservation areas, travel routes, and important cultural features and historic sites, especially when the project occurs in foreground a middleground views. The visual impacts that could result from the project would most likely be direct, adverse, and long-term and must be addressed in the assessment phase of the project. The following issues will be considered in the assessment phase:

- Establish public concern for scenic quality of the study area and their perception of what constitutes a sensitive viewing site;
- Determine the visibility of the project components by conducting view shed analyses based on the final layout and designed heights of structures;
- Understand the „glare effect" of the heliostats on the visual environment;
- Determine visual intrusion (contrast) of the proposed CSP project by simulating its physical appearance from sensitive viewing areas;
- Rate the impact of the project on the views by sensitive receptors;
- Rate the impact on the scenic quality and sense of place of the study area;
- Establish management measures (mitigation) to reduce the impact of the power line where appropriate.

*** NLA ***

APPENDIX A: DETERMINING THE VALUE OF A VISUAL RESOURCE

In order to reach an understanding of the effect of development on a landscape resource, it is necessary to consider the different aspects of the landscape as follows:

Landscape Elements and Character
The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings and roads. They are generally quantifiable and can be easily described.

Landscape character is the description of pattern, resulting from particular combinations of natural (physical and biological) and cultural (land use) factors and how people perceive these. The visual dimension of the landscape is a reflection of the way in which these factors create repetitive groupings and interact to create areas that have a specific visual identity. The process of landscape character assessment can increase appreciation of what makes the landscape distinctive and what is important about an area. The description of landscape character thus focuses on the *nature of the land*, rather than the response of a viewer.

Landscape Quality
(after Crawford 1994 and The Visual Resource Management System, Developed by The Bureau of Land Management (BLM) in the Department of the Interior of the USA Government).

Studies for perceptual psychology have shown human preference for landscapes with a higher visual complexity particularly in scenes with water, over homogeneous areas. On the basis of contemporary research landscape quality increases when:

- Topographic ruggedness and relative relief increase - topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured;
- Where water forms are present - The degree to which water dominates the scene is the primary consideration in selecting the rating score;
- Consider the overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when considering "colour" are variety, contrast, and harmony.
- Where diverse patterns of grasslands and trees occur - give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Consider also smaller scale vegetational features which add striking and intriguing detail elements to the landscape (e.g. gnarled or wind beaten trees, and Quiver trees);
- Scarcity: This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery - the scarcity factor can be used to recognize this type of area and give it the added emphasis it needs.
- Where natural landscape increases and man-made landscape decreases;
- And where land use compatibility increases and land use edge diversity decreases - Cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit.

Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace

sound, smell and any other factor having a strong impact on human thoughts, feelings and attitudes (Ramsay 1993). Thus aesthetic value encompasses more than the seen view, visual quality or scenery, and includes atmosphere, landscape character and sense of place (Schapper 1993). Refer also to Appendix A for further elaboration.

Aesthetic appeal (value) is considered high when the following are present (Ramsay 1993):

- *Abstract qualities*: such as the presence of vivid, distinguished, uncommon or rare features or abstract attributes;
- *Evocative responses*: the ability of the landscape to evoke particularly strong responses in community members or visitors;
- *Meanings*: the existence of a long-standing special meaning to a particular group of people or the ability of the landscape to convey special meanings to viewers in general;
- *Landmark quality*: a particular feature that stands out and is recognised by the broader community.

Sense of Place

Central to the concept of a sense of place is that the place requires uniqueness and distinctiveness. The primary informant of these qualities is the spatial form and character of the natural landscape together with the cultural transformations and traditions associated with historic use and habitation. According to Lynch (1992) sense of place "is the extent to which a person can recognize or recall a place as being distinct from other places - as having a vivid, or unique, or at least particular, character of its own". Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. In some cases these values allocated to the place are similar for a wide spectrum of users or viewers, giving the place a universally recognized and therefore, strong sense of place.

Scenic Beauty of Visual Resource

In determining the scenic quality of the visual resource both the objective and the subjective or aesthetic factors associated with the landscape are considered. Many landscapes can be said to have a strong sense of place, regardless of whether they are considered to be scenically beautiful but where landscape quality, aesthetic value and a strong sense of place coincide - the visual resource or perceived value of the landscape is considered to be very high.

When considering both objective and subjective factors associated with the landscape there is a balance between landscape character and individual landscape features and elements, which would result in the values as follows:

Value of Visual Resource

Derived from The Landscape Institute with the Institute of Environmental Management and Assessment (2002)

High (Distinct)	Moderate (Common)	Low (Minimal)
Areas that exhibit a very positive character with valued features that combine to give the experience of unity, richness and harmony. These are landscapes that may be considered to be of particular importance to conserve and which may be sensitive change in general and which may be detrimental if change is inappropriately dealt with.	Areas that exhibit positive character but which may have evidence of alteration to /degradation/erosion of features resulting in areas of more mixed character. Potentially sensitive to change in general; again change may be detrimental if inappropriately dealt with but it may not require special or particular attention to detail.	Areas generally negative in character with few, if any, valued features. Scope for positive enhancement frequently occurs.

Scenic Quality Inventory and Evaluation Chart

(Developed by: The Bureau of Land Management (BLM), In the Department of the Interior of the USA Government)

Key factors	Rating Criteria and Score	.	.
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. **5**	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. **3**	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. **1**
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. **5**	Some variety of vegetation, but only one or two major types. **3**	Little or no variety or contrast in vegetation. **1**
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. **5**	Flowing, or still, but not dominant in the landscape. **3**	Absent, or present, but not noticeable. **0**
Color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. **5**	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. **3**	Subtle color variations, contrast, or interest; generally mute tones. **1**
Influence of adjacent scenery	Adjacent scenery greatly enhances visual quality. **5**	Adjacent scenery moderately enhances overall visual quality. **3**	Adjacent scenery has little or no influence on overall visual quality. **0**
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for	Distinctive, though somewhat similar to others within the region.	Interesting within its setting, but fairly common within the

	exceptional wildlife or wildflower viewing, etc. *** 5+**	**3**	region. **1**
Cultural modifications	Modifications add favorably to visual variety while promoting visual harmony. **2**	Modifications add little or no visual variety to the area, and introduce no discordant elements. **0**	Modifications add variety but are very discordant and promote strong disharmony. **-4**

APPENDIX B: DECLERATION OF INDEPENDENCE

Declaration of Independence

I, Graham A Young hereby declare that Newtown Landscape Architects cc, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.

Consultant name: Graham Young

Signature:

Date: 2011 05 25

APPENDIX C: Curriculum Vitae - Graham A Young

Graham is a registered landscape architect with interest and experience in landscape architecture, urban design and environmental planning. He holds a degree in landscape architecture from the University of Toronto and has practiced in Canada and Africa, where he has spent most of his working life. During his 30 year career he has received numerous Institute of Landscape Architects of South Africa and other industry awards. He has published widely on landscape architectural issues and has had projects published both locally and internationally in design journals and books. In addition to being a founding member of Newtown Landscape Architects he is currently a senior lecturer, teaching landscape architecture and urban design at post and under graduate levels, at the University of Pretoria. He has been a visiting studio critic at the University of Witwatersrand and University of Cape Town. A 'niche' specialty of his is Visual Impact Assessments for which he was cited with an ILASA Merit Award in 1999.

EXPERIENCE: **NEWTOWN LANDSCAPE ARCHITECTS cc.** ***Founding Member***

Current
Responsible for project management, landscape design, urban design, and visual impact assessment.
Senior Lecturer: Department of Architecture, University of Pretoria.

1991 - 1994
1988 - 1989
GRAHAM A YOUNG LANDSCAPE ARCHITECT - *Sole proprietor*
Designed major transit and CBD based urban design schemes; designed commercial and recreational landscapes and a regional urban park; participated in inter-disciplinary consulting teams that produced master plans for various beachfront areas in KwaZulu Natal and a mountain resort in the Drakensberg.

1989 - 1991
CANADA - *Free Lance*
Designed golf courses and carried out golf course feasibility studies (Robert Heaslip and Associates); developed landscape site plans and an end-use plan for an abandoned mine (du Toit, Allsopp and Hillier); conducted a visual analysis of a proposed landfill site.
.

1980 - 1988
KDM (FORMERLY DAMES AND MOORE) - *Started as a Senior Landscape Architect and was appointed Partner in charge of Landscape Architecture and Environmental Planning in 1984*. Designed commercial, corporate and urban landscapes; completed landscape site plans; developed end-use master plans for urban parks, college and technikon sites; carried out ecological planning studies for factories, motorways and a railway line.

1978 - 1980
DAYSON & DE VILLIERS - *Staff Landscape Architect*
Designed various caravan parks; designed a recreation complex for a public resort; conducted a visual analysis for the recreation planning of Pilgrims Rest; and designed and supervised the installation of various private gardens.

EDUCATION:

Bachelor of Landscape Architecture, 1978, (BLArch), University of Toronto, Canada;
Senior Lecturer - Department of Architecture, University of Pretoria.

PROFESSIONAL:

Registered Landscape Architect – South African Council for Landscape Architectural Profession (2001);
Board of Control for Landscape Architects of South Africa (1987) – Vice Chairman 1988 to 1989;
Professional Member - Institute of Landscape Architects Southern Africa (1982) – President 1986 - 1988;
Member Planning Professions Board 1987 to 1989;
Member International Association of Impact Assessment;

AWARDS:

Intermediate Phase(S'kumbuto, Moshate and Uitspanplek), Freedom Park: ILASA Merit Award (2009)

Corniche Bay Resort, Mauritius: ILASA Merit Award (2009)

Torsanlorenzo International Prize, Landscape design and protection 2nd Prize Section B: Urban Green Spaces, for Intermediate Phase Freedom Park (2009)

Phase 1 and Intermediate Phase Freedom Park: Loerie Awards Gold Statue (2008)

Phase 1 and Intermediate Phase Freedom Park: Special Mention World Architecture Festival, Nature Category (2008)

Moroka Park Precinct, Soweto: ILASA Merit Award for Design (2005) and Gold Medal United Nations Liveable Communities (LivCom) Award (2007)

Isivivane, Freedom Park: ILASA Presidential Award of Excellence Design (2005)

Information Kiosk, Freedom Park: ILASA Merit Award for Design (2005)

Moroka – Mofola Open Space Framework, Soweto: ILASA Merit Award for Planning (2005)

Mpumalanga Provincial Government Complex: ILASA Presidential Award of Excellence (with KWP Landscape Architects for Design (2003)

Specialist Impact Report: Visual Environment, Sibaya Resort and Entertainment World: ILASA Merit Award for Environmental Planning (1999);

Gillooly's Farm, Bedfordview (with Dayson and DeVilliers): ILASA Merit Award for Design;

COMPETITIONS:

Johannesburg Inner City Park Design competition – with MMA architects (2009) Finalist and considered “the strongest concept” by the adjudication panel.

Pan African Parliament International Design competition – with MMA architects (2007) Finalist

Leeuwpan Regional Wetland Park for the Ekurhuleni Metro Municipality (2004) Landscape Architectural Consultant on Department of Trade and Industries Building (2002) – Finalist

Landscape Architecture Consultant on Project Phoenix Architectural Competition, Pretoria (1999): Winner;

Mpumalanga Legislature Buildings (1998): Commissioned;

Toyota Fountain (1985): First Prize - commissioned;

Bedfordview Bike/Walkway System - Van Buuren Road (1982): First Prize - commissioned;

Portland Cement Institute Display Park (1982): Second Prize

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- *Riverside Government Complex* (NLAKWP), Nelspruit, Mpumalanga;
- *Moroka Dam Parks Pre*cinct, Soweto, Gauteng.

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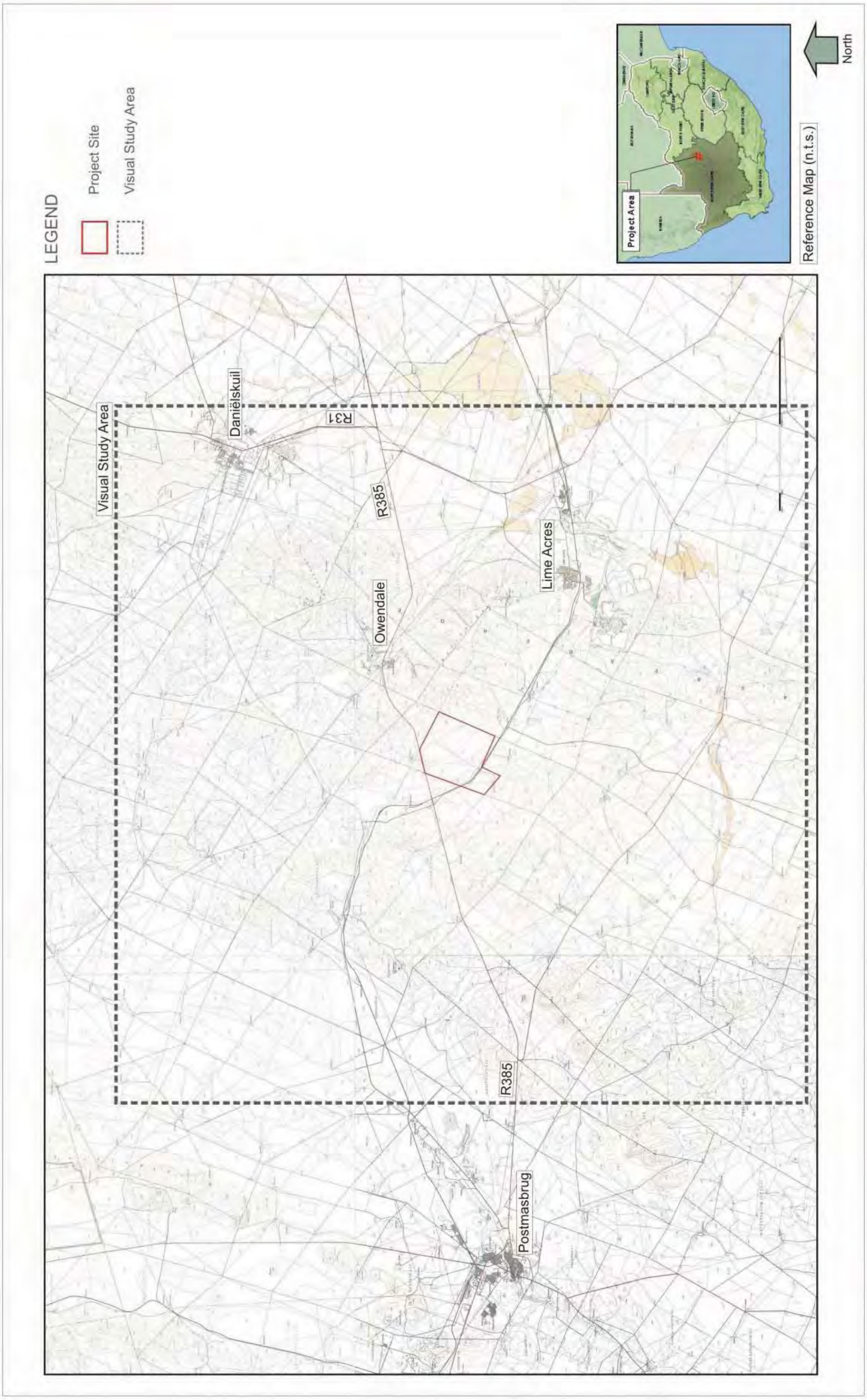


Figure 1: LOCALITY - Humansrus CSP

May 2011

LEGEND

Project Area

Existing Power Lines

An example of a power plant using central receiver technology - image courtesy NREL.

North

Figure 2: LAYOUT - Humansrus CSP

May 2011

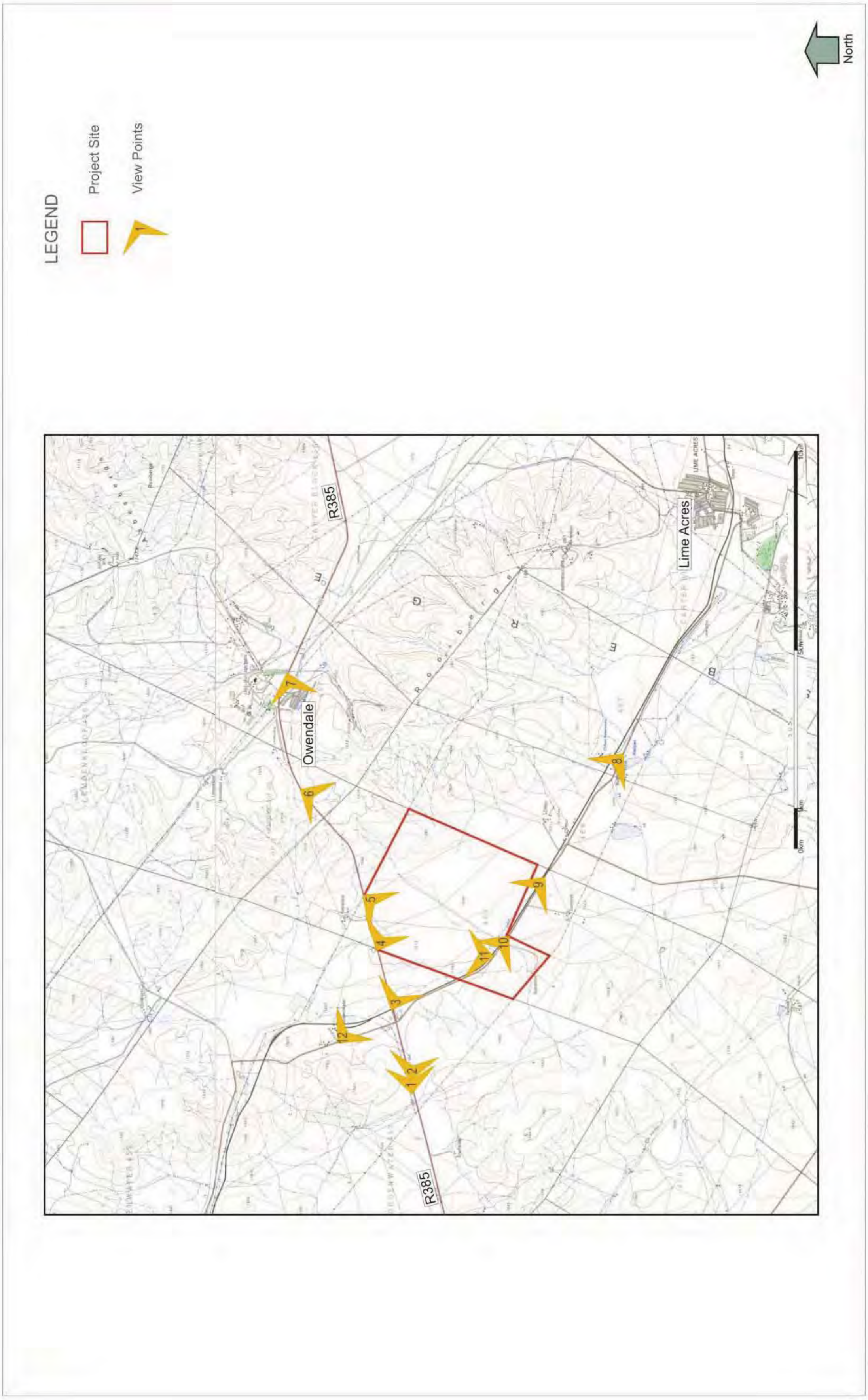


Figure 3: LOCATION OF VIEWPOINTS - Humansrus CSP

May 2011

View 1: From the R385 looking east towards the project site

View 2: From the R385 looking east towards the project site

Refer to Figure 3 for location of views

Figure 4: LANDSCAPE CHARACTER (View 1 & 2) - Humansrus CSP

May 2011

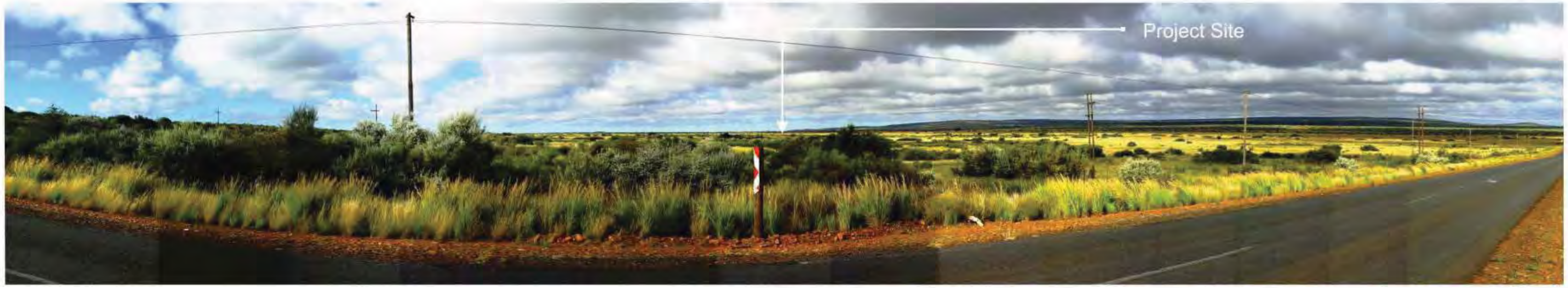
View 3: From the R385 looking east towards the project site

View 4: From the R385 looking east towards the project site at north western corner of the site

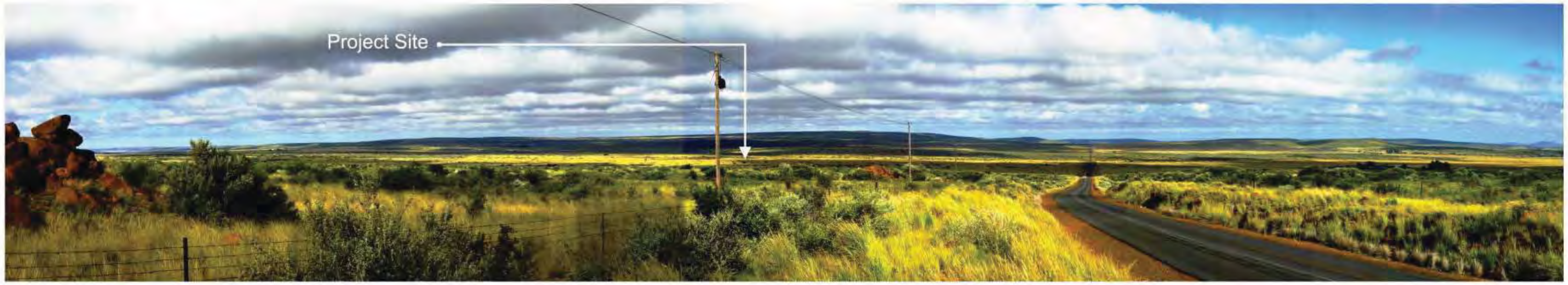
Refer to Figure 3 for location of views

Figure 5: LANDSCAPE CHARACTER (View 3 & 4) - Humansrus CSP

May 2011



View 5: From the R385 looking east towards the project site at north eastern corner of the site



View 6: From the R385 looking east towards the project site

Refer to Figure 3 for location of views

Figure 6: LANDSCAPE CHARACTER (View 5 & 6) - Humansrus CSP

May 2011

View 7: From the R385 at Owendale looking south west towards the project site

View 8: From the Lime Acers road looking north west towards the project site

Refer to Figure 3 for location of views

Figure 7: LANDSCAPE CHARACTER (View 7 & 8) - Humansrus CSP

May 2011

View 9: From the Lime Acres road looking north west towards the project site at the south eastern corner of the site

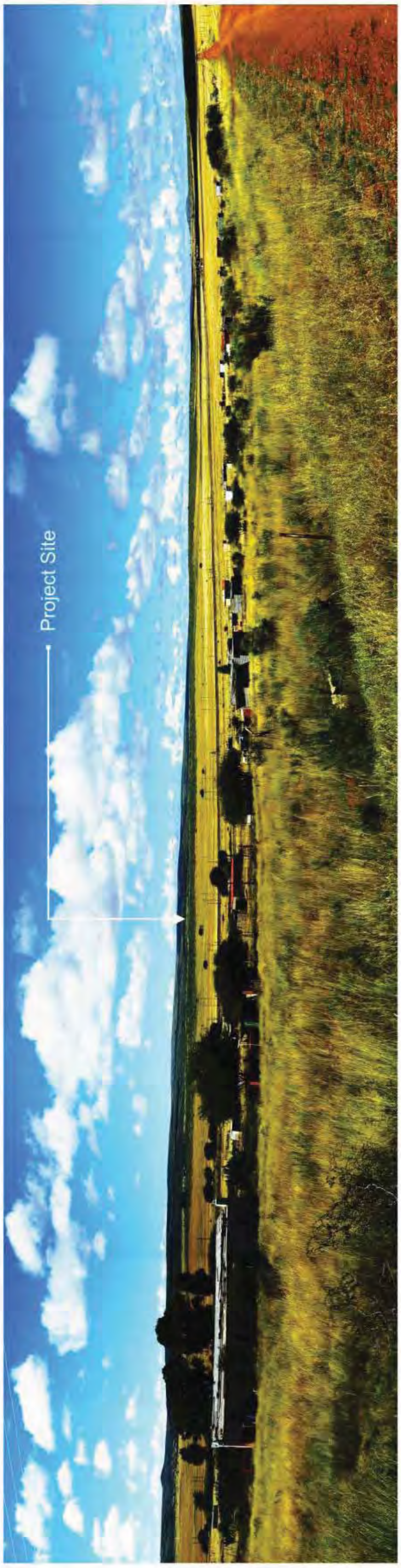
View 10: From the Lime Acres road looking north west from adjacent the project site

Refer to Figure 3 for location of views

Figure 8: LANDSCAPE CHARACTER (View 9 & 10) - Humansrus CSP

May 2011

View 11: From the Lime Acres road looking north east across the project site



View 12: From a farm road north of the R385 looking south east towards the project site

Refer to Figure 3 for location of views

Figure 9: LANDSCAPE CHARACTER (View 11 & 12) - Humansrus CSP

May 2011

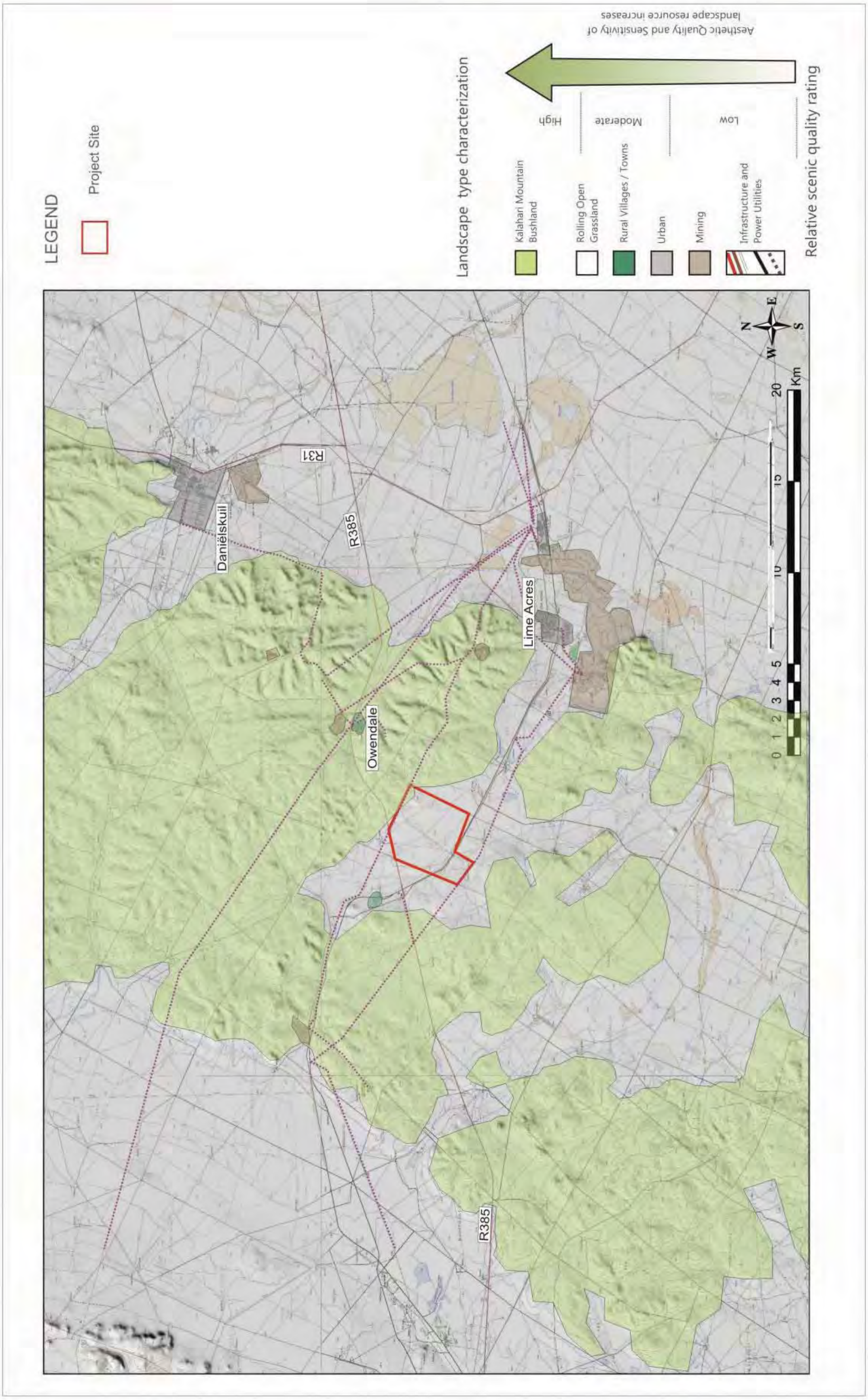


Figure 10: VISUAL RESOURCE - Humansrus CSP

May 2011

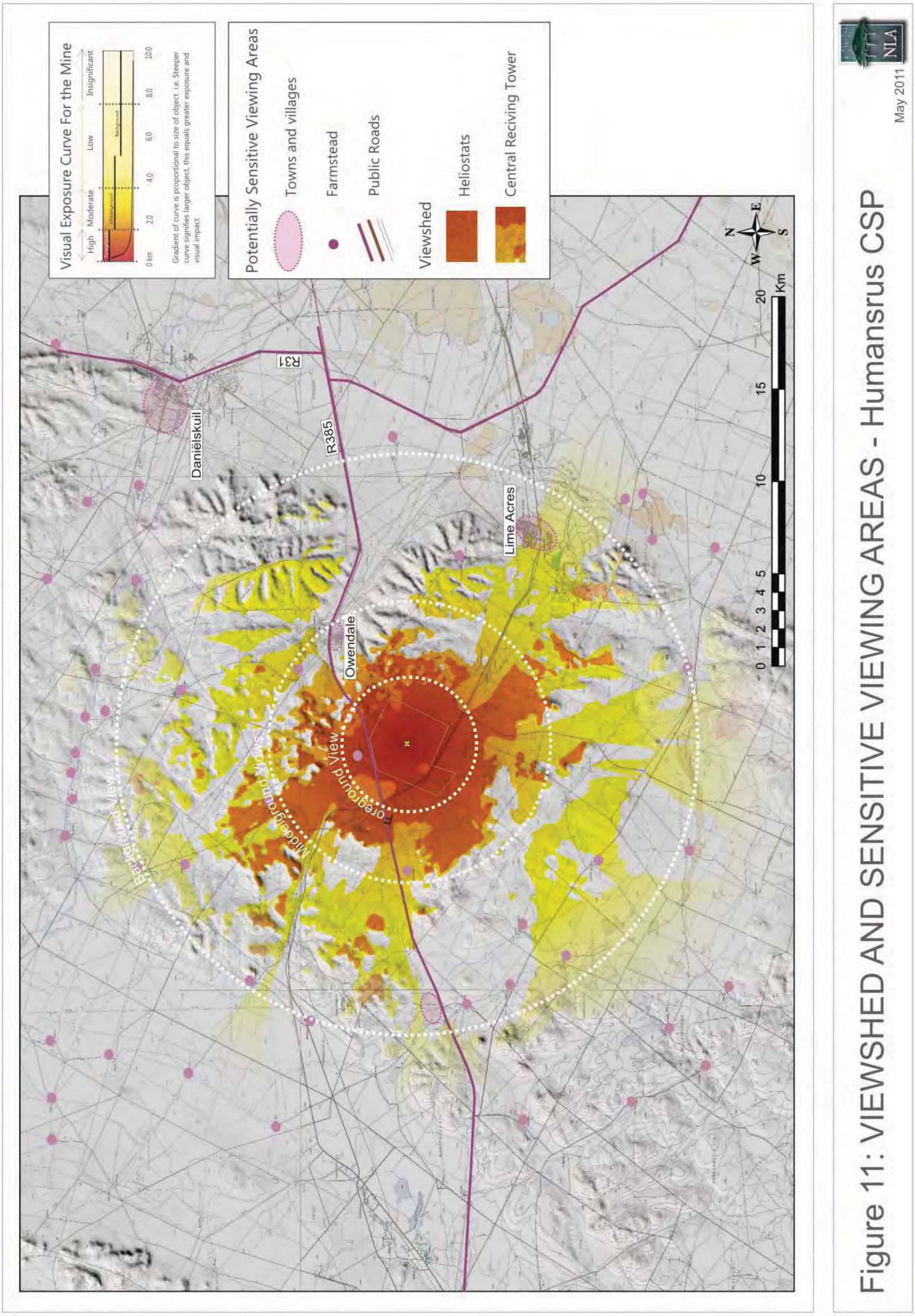


Figure 11: VIEWSHED AND SENSITIVE VIEWING AREAS - Humansrus CSP

Wetland Delineation and Assessment for the Proposed Humansrus Solar Thermal Energy Plant near Postmasburg, Northern Cape

For:

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21 Woodlands Drive
Tel: (011) 798 6000
frankb@ssi.co.za

By:

Wetland Consulting Services (Pty) Ltd

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Email: info@wetcs.co.za

Reference: 734/2011

DOCUMENT SUMMARY DATA

PROJECT:	**Wetland Delineation and Assessment for the Proposed Humansrus Solar Thermal Energy Plant near Postmasburg in the Northern Cape**
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CONSULTANT:	**Wetland Consulting Services, (Pty) Ltd.**
CONTACT DETAILS:	**Allan Batchelor** **PO Box 72295** **Lynnwood Ridge** **0040** **Telephone number: (012) 349 2699** **Fax number: (012) 349 2993** **E-mail:** allanb@wetcs.co.za

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by SSI to undertake the specialist wetland delineation and assessment as part of the EIA process currently being undertaken by SSI for the proposed Humansrus Solar Thermal Energy Plant near Postmasburg in the Northern Cape. The need for the wetland delineation was identified based on the vegetation study undertaken for the site which identified a non-perennial drainage line and associated floodplain on site.

The requirement to establish the existence and/or extent of wetlands and riparian areas on the property is based on the legal requirements contained in both NEMA as well as the Water Act. Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively around them to minimize any potential impacts.

The purpose of this document is to describe the wetlands and riparian habitat within the study area, to identify expected impacts on the wetland and riparian habitats due to the proposed developments and to provide recommendations regarding appropriate mitigation and/or management measures to be implemented should the proposed activities be authorised.

2. SCOPE OF WORK

The following task formed part of the agreed upon scope of work for this initial baseline report:

- **Baseline Wetland Assessment:**
  - ⇒ Conduct a desktop and field investigation of the wetlands and riparian habitats within the study area;
  - ⇒ Assess, classify, delineate and map the identified wetlands and riparian habitats;
  - ⇒ Identify and describe the functions of the wetlands and riparian habitats;
  - ⇒ Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS); and
  - ⇒ Provide a report, including maps of the wetland and riparian habitats, detailing all the information.

Following on from this initial report, a detailed impact assessment will be undertaken to assess the impacts of the proposed developments on the identified wetlands and riparian habitats

3. LIMITATIONS

The study area was visited from the 1-3 July 2011 during the middle of winter and outside of the growing season. Due to significant frosting back of vegetation and heavy grazing in places, only limited use could be made of vegetation indicators and species. Difficulty in identifying plants to species level at this time of the year are reflected in the species list.

Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 20m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

4. STUDY AREA

4.1 Location

The study area is located on the Farm Humansrus 469 approximately 30km east of Postmasburg along the R 385 road to Barkly West; the tar road forms the northern boundary of the study area. A railway line traverses the study area within the south western reaches of the site. The study area is approximately 1 250ha.

The upper reaches of the Groenwater Spruit flow across the south western reaches of the study area.

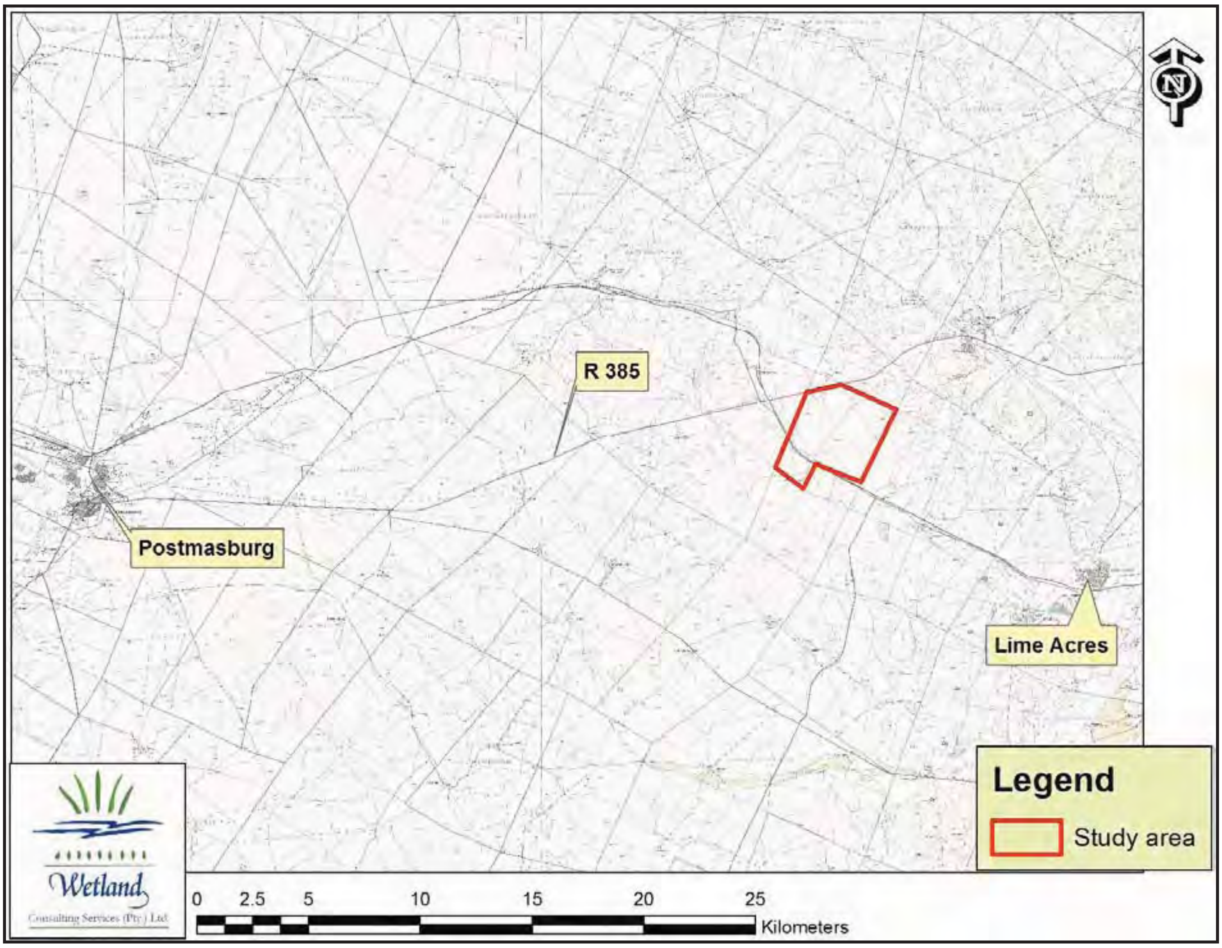

Figure 1. Map showing the location of the study area.

4.2 Catchments

The study area is located within Primary Catchment D, and more specifically within quaternary catchment D73A. The catchment is drained by the Groenwater Spruit.

Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990). Figure 2 indicates the position of study area in relation to the affected quarternary catchment. Note the low mean annul precipitation, which indicates that the study area is located within an arid environment.

Table 1. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
D73A	297 781	322.66	14.6	4.5 %

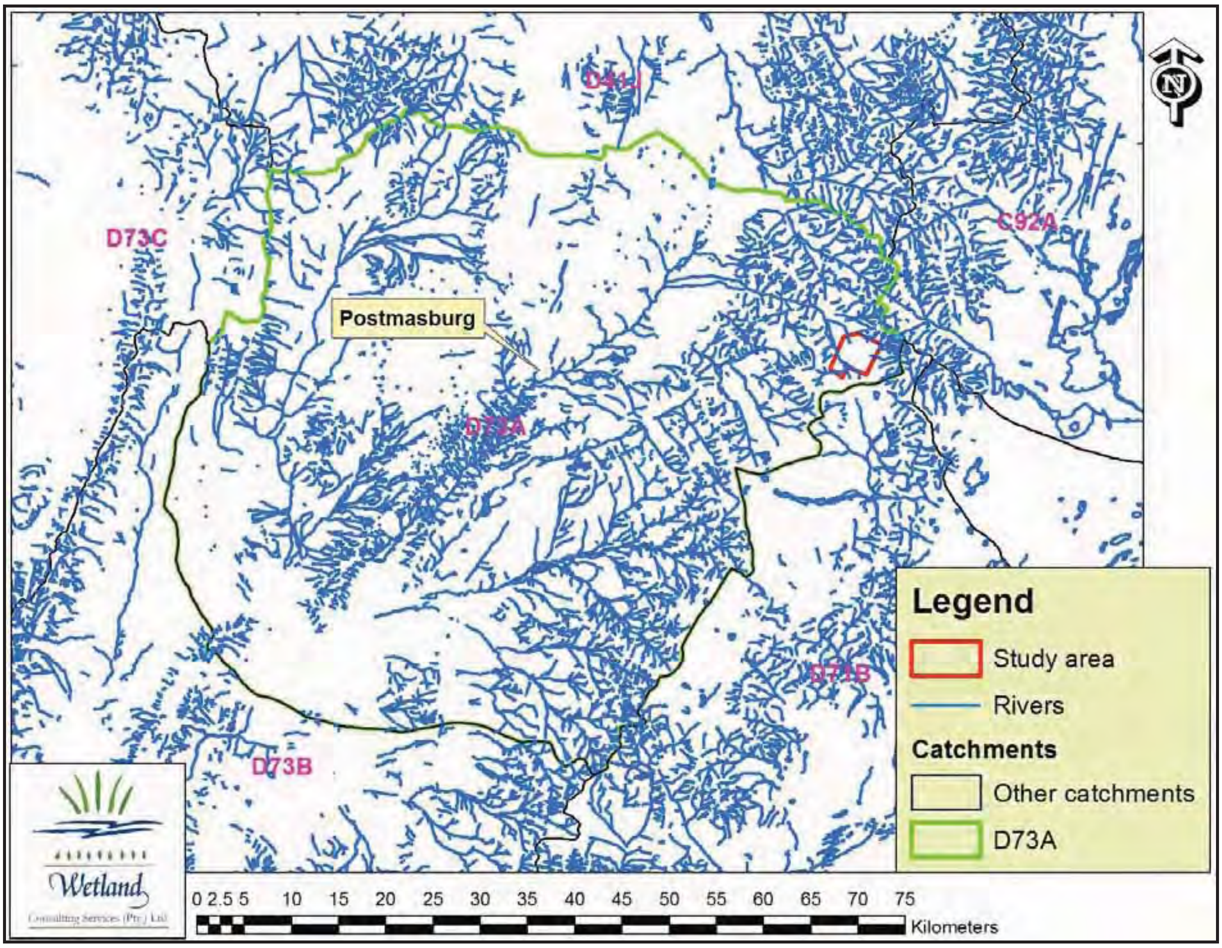

Figure 2. Map showing the study area in relation to the quaternary catchment.

4.3 Geology and Soils

No information regarding the underlying geology was available at the time of writing this report.

The soils on site were generally of a sandy nature within the valley bottom areas and on the flatter areas. The hilly sections of the site were dominated by very rocky terrain with extensive areas of exposed rocks and stones and generally shallow soils. The shallow, rocky soils encourage the surface run-off of water, while the sandy soils allow infiltration of the water into the soil. Rainfall within the area is limited (322mm per annum) and is expected to occur in high intensity storm events that result in large volumes of high velocity runoff from the rocky areas on site following these events. This is supported by the incised drainage line on site.

Within the sandy soil areas, rainfall infiltrates the sandy soil profile and is then either lost to deeper infiltration to groundwater or to evapo-transpiration, or moves through the soil as sub-surface seepage.

4.4 Vegetation

An extract of the latest vegetation mapping of South Africa, undertaken by Mucina and Rutherford (2006), is reproduced in Figure 3 below.

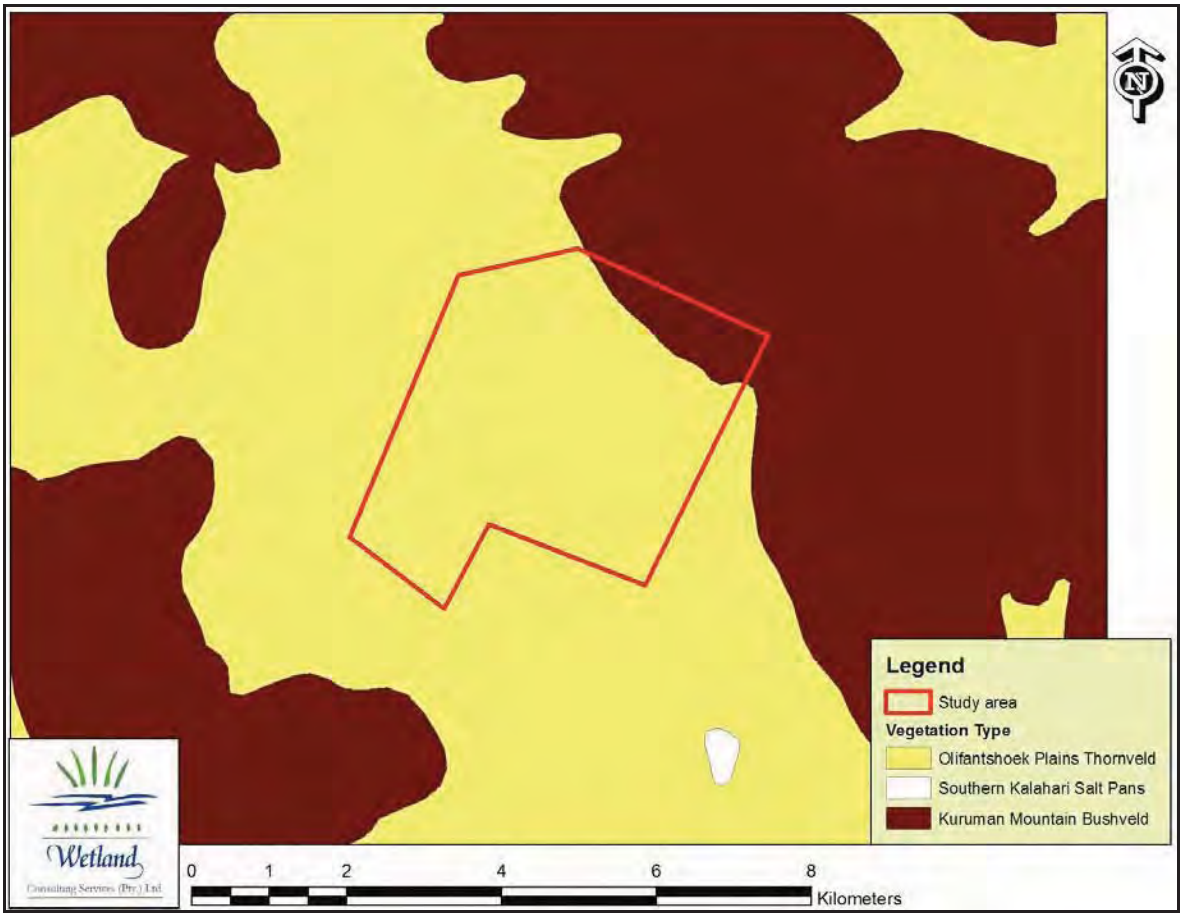

Figure 3. Vegetation types of the study area (Mucina & Rutherford, 2006).

The study area falls within the Savanna Biome and the Eastern Kalahari Bushveld Bioregion. Two vegetation types occur on site, namely Kuruman Mountain Bushveld associated with the hills in the north east of the site and Olifantshoek Plains Thornveld across the remainder of the site. Both these vegetation types are considered *Least Threatened*.

5. APPROACH

5.1 Wetland Delineation and Classification

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland and riparian habitat boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland and riparian areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands or riparian areas were then further investigated in the field.

Wetlands and riparian habitats were identified and delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator. Riparian areas are identified and delineated based mostly on vegetation indicators as well as the presence of alluvial soils

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and modified for use in South African conditions by Marneweck and Batchelor (2002).

5.2 Present Ecological State and Ecological Importance & Sensitivity

A present ecological state (PES) and ecological importance and sensitivity (EIS) assessment was conducted for every hydro-geomorphic wetland unit and riparian zone identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

6. FINDINGS

6.1 Wetland and Riparian Delineation and Classification

The National Water Act, Act 36 of 1998 (the Act), defines wetlands as follows:

> *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

Riparian habitat in turn is defined by the Act as:

> *"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."*

The 1:50 000 topographical map of the area (2823AD) indicates a number of non-perennial drainage lines within the study area. Numerous small drainage lines are shown draining onto the site from the mountains to the north and east of the site before petering out on the flat central region of the study area. In the south western portions of the site the upper reaches of the Groenwater Spruit are shown as draining across the study area in a roughly northerly direction.

The field work undertaken during July 2011 revealed that only the Groenwater Spruit and its tributary have associated riparian habitat. The remaining drainage lines indicated on the 1:50 000 topographical maps represent low points within the landscape along which water is expected to flow only occasionally following heavy storm events, but which do not differ in vegetation structure or composition from the adjacent vegetation, and do not have a defined channel. The soils within these areas also showed no hydromorphic features and were typical reddish brown terrestrial soils, presumably of the Hutton soil form. These "drainage lines" were thus not classed as either wetlands or riparian zones. A map of these drainage lines entering the site, as well as some photographs of these areas, are reproduced in Figures 4 and 5 below.

Following heavy rain, surface runoff from the rocky hills to the north and east of the study area is expected to accumulate within these low points where the sandy soil allows easy infiltration of surface water into the soil. Water is thus not retained within the upper reaches of the soil profile for an extended period that would allow the formation of wetland or riparian habitat. Rainfall that has infiltrated the soil is expected to be mostly lost to evapo-transpiration or deeper infiltration into groundwater, though some lateral seepage at depth through the soil profile is possible. To the north of the Farm Humansrus a spring is located on the Farm Groenwater (as indicated by the local farmer) at the northern end of the plain that extends into the central portions of the study area. It is possible that water infiltrating the sandy soil on site plays a role in supporting this spring. This is however mere speculation and will need to be confirmed by the groundwater and geo-technical studies of the site.

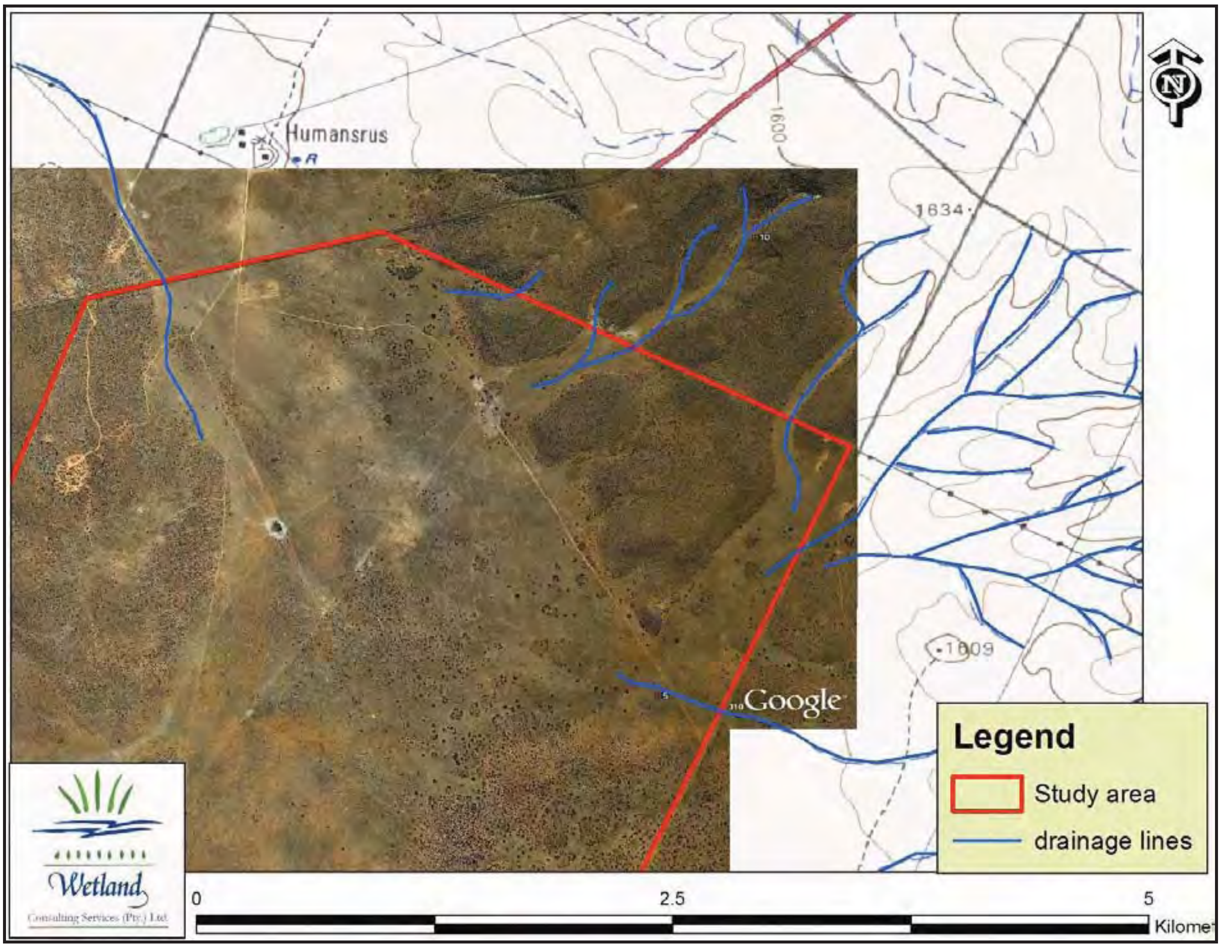

Figure 4. Map of the northern reaches of the study area indicating the drainage lines indicated on the 1:50 000 topographical maps of the area.

Figure 5. Photographs of the ephemeral “drainage lines” indicated in Figure 4. Drainage lines are indicated by a blue line.

The riparian habitat delineated along the Groenwater Spruit and its tributary is illustrated in Figure 6 below, with photographs in Figure 7.

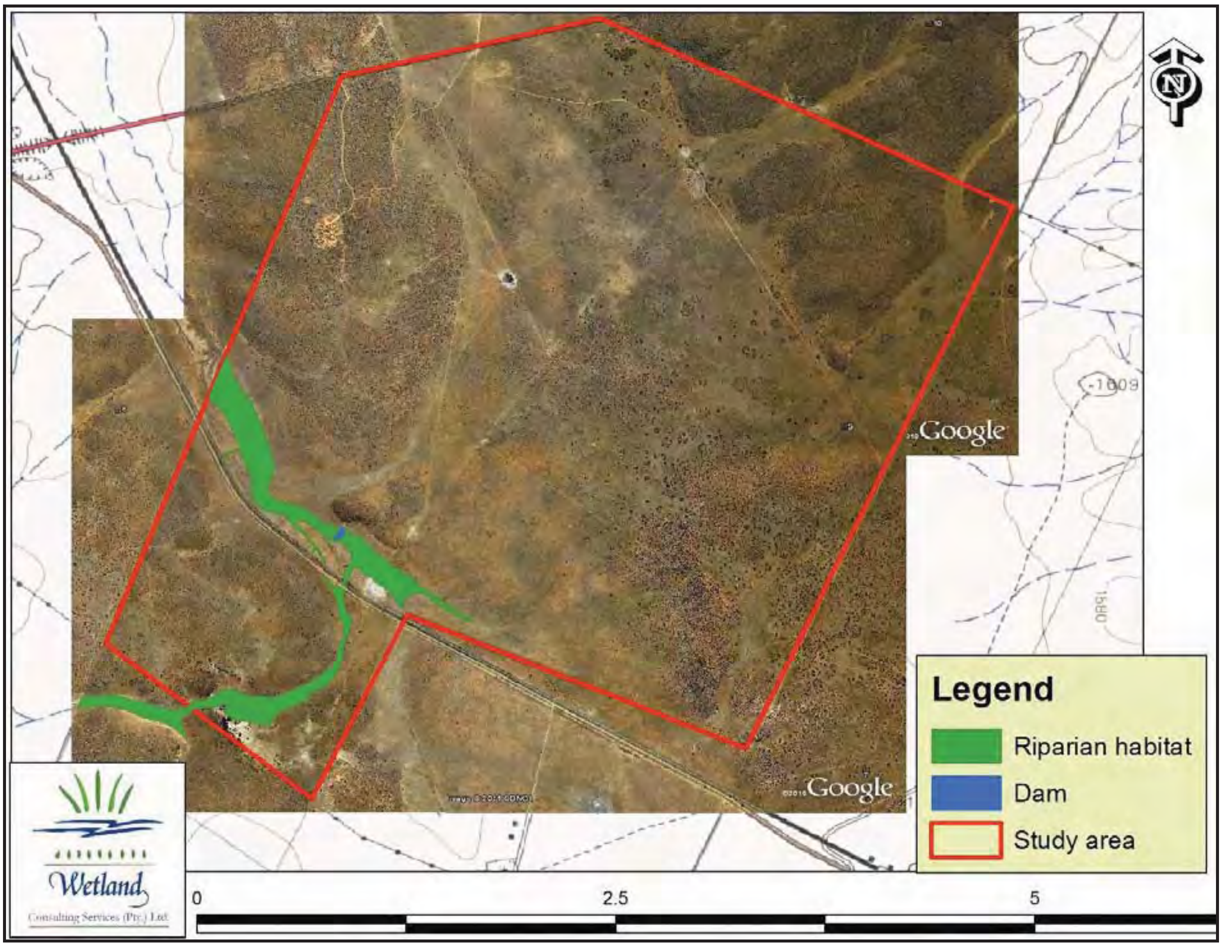

Figure 6. Map of the delineated riparian habitat associated with the Groenwater Spruit.

The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The reach of the Groenwater Spruit located upslope of the railway line and gravel road is characterised by a clearly defined, incised channel characterised by a rocky substrate. Adjacent side slopes were also generally rocky. Isolated pools of water were observed in this area. Along this section of the riparian habitat a number of tree and shrub species were observed, including *Olea europea, Rhus lancea* and *Acacia tortilis*. Grass species included *Themeda triandra, Aristida congesta, Aristida spp., Eragrostis chloromelas* and *Juncus rigidus*. Though classified as a riparian zone, isolated patches along the water course did display some wetland characteristics and sub-surface water seepage, most notably a small spring located upslope and outside of the study area in close proximity to the site boundary, as well as the area located immediately below the old farm house.

Figure 7. Photographs of the riparian habitat associated with the Groenwater Spruit (clockwise from top left): immediately upstream of the study area; directly below the old farm house; lower reaches of Groenwater Spruit on site looking upstream from northern boundary fence; and upper shallow impoundment.

To the north of the railway line upstream and immediately downstream of the small dam, the Groenwater Spruit and its tributary flow along a poorly defined channel. This section of the riparian habitat is completely devoid of trees and is dominated by various grass species. The timing of the study precluded accurate identification of many of the grass species due to the significant frosting back of vegetation that had already taken place, as well as heavy grazing by livestock. Typical species however included various *Aristida* spp., *Themeda triandra*, *Juncus rigidus*, *Eragrostis* spp, *Melinis repens*, *Sporobolus* spp. and *Cynodon dactylon*.

The lower reaches of the Groenwater Spruit on site are again characterised by a clearly defined, incised channel, the channel being broad and fairly shallow. Once again the riparian habitat is tree-less and dominated by grass species. Soils along this section of the riparian zone were typical of terrestrial soils with no signs of seepage into the stream channel. The channel was also completely dry downslope of the railway crossing.

6.2 Water Quality

At the time of the site visit in July 2011 the Groenwater Spruit on site was mostly dry with surface water restricted to small isolated pools of standing water within the stream channel. No flowing water was observed. Areas of standing water were heavily utilised and trampled by livestock.

These conditions are not ideal for the sampling of water quality and diatoms, with especially diatoms best sampled in flowing water to allow for the utilisation of the diatom pollution indices.

However, a grab water sample was collected and submitted to the ARC-ISCW for analysis of standard anions and cations, as well as an MS-ICP scan for metals. The results of the analysis are summarised in the tables below.

The water quality was sampled in the Groenwater Spruit from the largest observed extent of surface water, located below the old farmhouse (-28.320424°S; 23.352987°E). As indicated, no flowing water was present at the time of sampling, and remaining areas of standing water were heavily impacted by livestock reliant on these areas for drinking water. The impact of the livestock on the water is indicated by the elevated nitrate concentration of the water, resulting from cattle droppings in the water. Generally the water quality is however of an acceptable standard. The target water quality guidelines for aquatic ecosystems were exceeded for both Selenium and Zinc, though this is expected to be the natural condition of the stream and is not taken as being indicative of pollution.

Table 2. Results of water quality analysis for standard anions and cations.

Variable	Concentration (mg/l)
pH	8.21
EC	86.00
TDS	490.63
Alkalinity	317.00
Bicarbonate	386.74
Boron	0.07
Calcium	77.05
Carbonate	0.00
Chloride	76.60
Fluoride	0.28
Magnesium	47.60
Nitrate	**5.82**
Nitrite	0.00
Phosphate	0.00
Potassium	4.46
Sodium	30.09
Sodium Bicarbonate	0.00
Sodium Carbonate	0.00
Sulphate	55.66

Table 3. Results of the Ms-ICP scan for metals.

Element	Concentration (ppb)	Guidelines Aquatic Ecosystems
Co	0.272	≤ 0.3 µg/l
Li	0.905	
Se	3.761	≤ 2 µg/l (5 µg/l)[1]
Br	809.4	
As	1.089	≤ 10 µg/l
Zn	6.567	≤ 2 µg/l (3.6 µg/l)[2]
Sr	291.10	
Ni	1.438	
Mo	0.302	
Mn	0.098	180 µg/l
Cr	5.895	≤ 7 µg/l
V	8.789	
Ti	2.684	
B	66.15	
Be	0.00	
Cu	2.405	
Ba	66.65	
Bi	0.00	
Pb	0.00	≤ 0.2 µg/l
Tl	0.017	
Hg	0.00	≤ 0.04 µg/l
Pt	0.051	
Rb	0.825	
La	0.00	
U	3.515	
Cs	0.00	
I	48.3	
Te	0.001	
Sb	0.02	
Sn	1.275	
Cd	0.005	≤ 0.07 µg/l
W	0.023	

6.3 Functional Importance of the riparian habitat

A number of functions and ecosystem services are typically attributed to riparian habitats that are linked to the hydrology, geomorphology and vegetation characteristics of the riparian habitat in question.

The riparian habitat on site is associated with an ephemeral and highly variable stream in terms of flow characteristics, which are reflected in the riparian vegetation which is in many places poorly developed and often resembles the adjacent terrestrial habitat. Nonetheless, the riparian habitat is expected to play a role in various functions, including:

- Erosion control – the riparian vegetation stabilises river banks through the binding action of the plant roots, as well as slowing down flows through the surface roughness provided by the vegetation, further reducing erosion risk. As the riparian habitat on site is dominated by

[1] Concentration in brackets indicates the chronic effect value for Selenium as per the Guidelines for Aquatic Ecosystems.
[2] Concentration in brackets indicates the chronic effect value for Zinc as per the Guidelines for Aquatic Ecosystems.

non-woody species, the surface roughness provided by the riparian vegetation is however somewhat limited;

- Flood attenuation – the main flood attenuation function of the riparian habitat is performed when flows overtop the stream channel and spread out across the riparian habitat. This slows down flood velocities;
- Biodiversity support – the riparian habitat provides habitat differing from the surrounding terrestrial habitat and can thus support species not generally found elsewhere on site. Given the arid environment, riparian habitats within the general area are rather limited, further increasing the importance of this function;
- Water supply – the riparian habitat and associated stream represent the only natural surface water supply within the study area and thus provides important drinking areas for a variety of species, particularly bird species (e.g. Namaqua Sandgrouse were observed utilising the remaining pools of water in the stream);
- Ecological corridors – riparian areas often provide ecological corridors for the movement of fauna along the riparian habitat to other areas of suitable habitat; and
- Direct use benefits – on site, these appear to be limited, though the riparian habitat does provide livestock grazing to cattle, goats and horses.

6.4 Present Ecological Status (PES) Assessment

The present ecological state of the riparian habitat was assessed using the VegRAI Level 3 methodology.

Based on this assessment, the riparian habitat is considered to be in a B/C category, indicating a ***largely natural to moderately modified*** system.

Impacts to the riparian habitat that have resulted in degradation of the habitat can be summarised as follows:

- Livestock grazing – heavy grazing by livestock is expected to have resulted in decreased cover and abundance of especially non-woody vegetation within the riparian habitat. Decreased vegetation cover increases erosion risk within the riparian habitat, while livestock paths that lead towards remaining pools of water within the stream further exacerbate the erosion risk. A change in species composition is also likely to occur as a result of heavy grazing pressure. Areas most affected by heavy grazing include the area immediately below the old farm house, as well as around the watering trough located just to the north of the railway line and upstream of the dam;
- Road crossing – the Groenwater Spruit is crossed by both the public gravel road as well as the railway line via a number of culverts. These culverts have concentrated flows and resulted in incision of the channel downslope of the culverts; and
- Dam – the small farm dam as well as a further shallow impoundment upslope of the dam and a berm downslope of the dam have resulted in changes to the riparian vegetation through extended water retention (inundation) while also leading to further concentration of flows. Concentrated flows increase the erosion risk and have lead to channel incision within the riparian habitat.

As the definition of riparian habitat implies (see above), the primary determinant of the distribution and abundance of riparian plant biota is the hydrological regime, which in turn is defined by the depth, seasonal timing, frequency and duration of flooding (Rogers and van der Zel 1989). The volume and time distribution of run-off from the catchment are the prime determinants of the hydrological regime of a river system (Rogers 1995). The geomorphological form of the channel and riparian zone, on the other hand create the site specific condition of depth, duration, frequency and even timing of both surface and ground water fluctuations (Rogers and van der Zel 1989). The geomorphology is, in turn, a function of the run-off characteristics, the volume, timing and character of sediment delivered to the river and of the geological character and history of the local landscape (Church, 1992). The upper catchment of the Groenwater Spruit is mostly undeveloped and changes to catchment run-off quantity and quality are expected to be minimal, with the supporting hydrology of the system still largely intact. This is reflected in the overall fairly good condition of the riparian habitat on site.

Table 4. Ecological categories used for the VEGRAI scoring system (modified from Kleynhans 1996 & Kleynhans 1999).

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

6.5 Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a water course in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The riparian habitat on site is considered to be of ***High*** ecological importance and sensitivity and is placed in an ***ecological management class of B***. This rating is based mostly on the ecological

and hydrological importance of the riparian habitat (see functional assessment above) as direct human benefits provided by the system under current conditions are limited.

7. CONCLUSIONS AND RECOMMENDATIONS

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

7.1 Potential Impacts

The exact nature of the proposed Solar Thermal Energy Plant is not yet known, and the location and footprint of the proposed infrastructure has not yet been finalised. A detailed project description including maps showing the proposed infrastructure in relation to the delineated riparian habitat will be provided in the detailed impact assessment report to be completed at a later stage. However, some preliminary recommendations can already be made.

It is recommended that no infrastructure be located directly within the delineated riparian habitat on site and that existing stream crossings be utilised as access routes as far as possible. Additional road crossings across the stream should be avoided. It is also recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development. A map indicating the delineated riparian habitat with a 100m buffer zone is illustrated below.

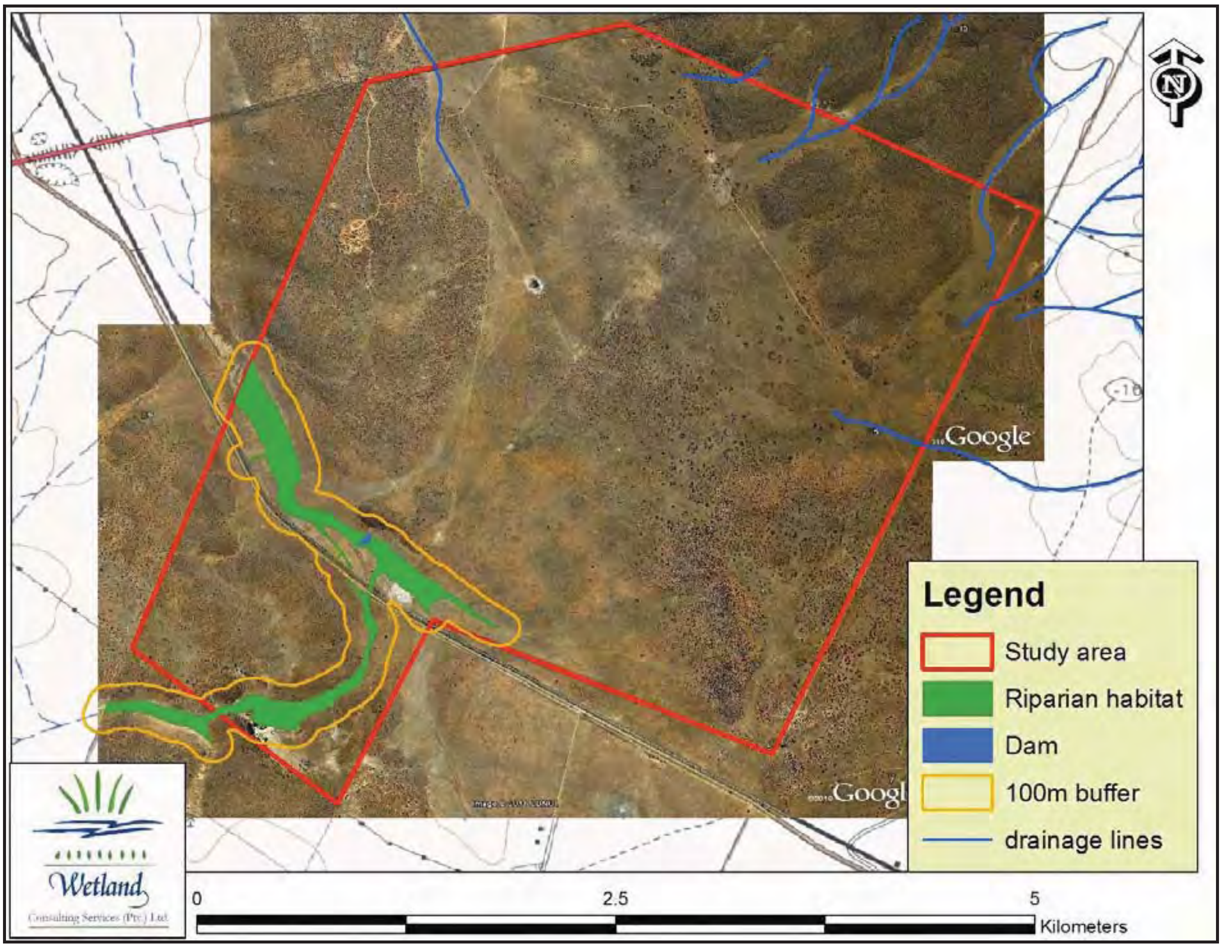

Figure 8. Map of the delineated riparian habitat with a 100m buffer zone as per the GDARD guidelines.

If the above recommendations are followed, no direct loss of riparian habitat will occur as a result of the proposed development. Indirect impacts to the riparian habitat could however result depending on the exact nature of the proposed development, predominantly as a result of changes to the quantity and quality of run-off from the catchment. Impacts include:

- An increase in impervious surfaces on site could result in increased volumes and velocities of run-off entering the stream, resulting in increased erosion and channel incision; and
- Water quality deterioration could result as a consequence of spillages or disposal of waste, as well as from the release of contaminated water or treated effluent.

A full impact assessment will be undertaken at a later stage once the exact development plans and layout have been finalised. As part of the impact assessment, the proposed development plans will be reviewed, impacts identified and assessed, and mitigation and management measures recommended.

It is however important to point out that any activity which is contemplated and which will impact on the riparian habitat within the study area is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998). As such, all proposed wetland crossings will require a Water Use License.

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SSI ENVIRONMENTAL

Environmental Impact Assessment for the proposed Humansrus Concentrating Solar Power Plant, Northern Cape Province

Tourism Assessment

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BOHLWEKI SSI ENVIRONMENTAL

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS CSP PLANT

TOURISM ASSESSMENT

Contents **Page**

List of Figures

BOHLWEKI SSI ENVIRONMENTAL

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS CSP PLANT

TOURISM ASSESSMENT

1 INTRODUCTION

Bohlweki SSI Environmental has appointed SiVEST to undertake a specialist tourism assessment for the proposed establishment of a Concentrating Solar Power (CSP) on the Farm 469, Hay RD (Humansrus), approximately 4km south-east of Groenwater and 30km east of Postmasburg, Northern Cape. This study forms part of a wider Environmental Impact Assessment (Scoping and Environmental Impact Assessment) that needs to be undertaken by the project proponent to identify and assess all the potential environmental impacts associated with the proposed project.

As part of the Scoping Report and in the context of land uses in the study area, it is important that the potential impact of the proposed development on existing and future tourism resources is assessed. However, it must be noted that this report is not intended to be a comprehensive and/or exhaustive analysis of tourism in the study area. The report is solely aimed at providing a basis from which the significance of potential impacts from the proposed development on the tourism industry can be reasonably evaluated.

This report provides an overview of the legislative framework of the tourism industry. It also covers the salient points of international, national, provincial, and local tourism. The report then describes the proposed impacts and issues of the proposed development on the tourism industry along with recommendations on mitigating potential impacts where relevant.

2 BACKGROUND

2.1 Acts and Policies

2.1.1 The White Paper on the Development and Promotion of Tourism in South Africa, 1996

The White Paper provides a broad framework to guide the development, planning and management of tourism in South Africa. The context is set through a discussion on the potential and economic role of tourism in the country and the identification of constraints that hinder the realisation of this potential. Some of the key constraints relate to inadequate

funding, limited community integration, inadequate education and training, poor environmental management, lack of infrastructure, increased levels of crime, and a lack of national, provincial and local tourism structures.

Identifying tourism as an engine for economic growth, the White Paper builds a rationale and sets a clear vision for responsible tourism development. The vision is supported by a set of guiding principles for responsible tourism development and is underpinned by economic, social and environmental objectives.

To achieve the vision, the following key performance areas for tourism development are sighted in the white paper:

- a safe and stable tourism environment;
- involvement of local communities and previously neglected groups;
- sustainable environmental management practices;
- creating a globally competitive tourism industry;
- ensuring innovative development that meet visitor requirements;
- focus on product development and diversity;
- effective training, capacity building and awareness promotion;
- aggressive and creative marketing and promotion;
- strong economic linkages with other economic sectors;
- appropriate institutional structures; and
- appropriate support infrastructure.

The White Paper goes further by recommending the formulation of a range of key policies and frameworks that will facilitate the role of tourism as an economic driver.

Areas where further policy development is required include:

- safety and security;
- education and training;
- access to finance;
- investment incentives;
- foreign investment;
- environmental management;
- product development;
- cultural resource management;
- transportation - air and ground;
- infrastructure;
- marketing and promotion;
- product quality and standards;
- regional co-operation; and
- youth development.

In addition to its recommendations on specific policy development that will smooth the progress of tourism development, the White Paper broadly defines the roles to be played by various stakeholders involved in tourism, and provides a framework for institutional arrangements for tourism in South Africa.

Although the White Paper was developed at national level, it provides an overarching framework to guide tourism development across South Africa. In this respect it allows for the alignment of National, Provincial and Local tourism development to ensure "that everyone pulls in the same direction". The White Paper does not address specific requirements on Provincial or Local level, nor does it provide the required strategic direction. Provincial and Local governments therefore need to align to, and take guidance from the National White Paper when developing their own tourism development strategies as it pertains to the specific dynamics present.

2.1.2 Institutional Guidelines for Public Sector Tourism Development and Promotion in South Africa, 1999

The Inter-provincial Technical Committee of MINMEC (a joint forum of ministers responsible for tourism matters) compiled the Institutional Guidelines, published by the Department of Environmental Affairs (DEA) in 1999. It seeks to formulate the institutional system and mechanisms to facilitate synergy in the management of tourism between the various tiers of government. The document further provides clarity on the roles, responsibilities and allocation of funding at National, Provincial and Local Government level to inform intergovernmental co-ordination on matters regarding tourism.

It is recognized in the institutional guidelines that historical development trends, macro conditions, constitutional dispensation and existing tourism structures differ at the various levels of government. Three models of institutional structures have therefore been proposed to accommodate the relevant circumstances at each level. These include:

- differentiated model;
- mainstream model and
- independent model.

One set of guidelines is proposed to ensure effective monitoring and control regardless of the model followed.

Specific guidelines and conditions with regards to the roles and responsibilities at each level of government are provided. The issues addressed and the respective guidelines in terms of the roles and responsibilities of the Municipality at local level include the following:

- introduction of tourism legislation – alignment of local by-laws and regulations with national and provincial tourism policy;
- establishing international relations and agreements – reaching agreements with cities/local authorities in other countries, with the knowledge of national and provincial government;
- international tourism marketing and promotion activities – exposure of local areas within the framework of national marketing strategies and aligned to such;
- domestic tourism marketing activities – develop domestic marketing strategies in line with provincial marketing framework;
- provision of tourism infrastructure – providing local infrastructure taking cognisance of provincial tourism strategies;
- setting of tourism standards – annual inspection, certification and registration of tourism establishments;
- promoting tourism awareness – plan and implement programmes to improve tourism awareness within local authority in line with national and provincial campaigns;
- tourism training – assist in the implementation and promotion of national and provincial training programmes;
- establishing tourism incentives, investment and financing programmes – provide advice and assistance to emerging entrepreneurs in coordination with provincial investment framework;
- tourism information management – provide appropriate information as input to national and provincial systems;
- domestic tourism information dissemination – establish local tourism information offices;
- tourist guiding training – work in collaboration with provincial authorities to ensure representative curriculum content;
- tourism development – lead tourism development in the area of consultation with provincial authorities; and
- tourism safety and security – establish local tourism safety programmes in collaboration with local business, SAPS and communities.

2.1.3 The Tourism Act, 1993

The objective of the Tourism Act is to make provision for the promotion of tourism to and in the Republic; the further regulation and rationalisation of the tourism industry; measures aimed at the maintenance and enhancement of the standards of facilities and services hired out or made available to tourists; and the co-ordination and rationalization, as far as practicable, of the activities of persons who are active in the tourism industry; with a view to the said matters to establish a board with legal personality which shall be competent and obliged to exercise, perform and carry out certain powers, functions and duties; to authorise the Minister to establish a grading and classification scheme in respect of accommodation establishments, the membership of which shall be voluntary; to authorize the Minister to establish schemes for prescribed sectors of the tourism industry, the membership of which

shall be voluntary; to make provision for the registration of tourist guides; to prohibit any person to act for gain as a tourist guide unless he has been registered as a tourist guide in terms of the Act; to authorise the Minister to make regulations; and to provide for matters connected therewith.

The Act prompted the establishment of the South African Tourism Board which acts as the juristic person with regards to this Act.

The object of the board shall be, with due regard to the sustainability of environmental resources, to promote tourism by encouraging persons to undertake travels to and in the Republic, and with a view thereto:

- to take measures in order to ensure that services which are rendered and facilities which are made available to tourists comply with the highest attainable standards;
- to manage information and conduct research relating to tourism; and
- to advise the Minister on tourism policy, either of its own volition or when requested to do so by the Minister.

2.2 Implications for Development

The legislation outlined above indicates that the proposed development has a number of restrictions, regulations and guidelines that apply to both the construction and operation phases. The tourism related legislation and guidelines encourage environmentally responsible tourism with an emphasis on sustainability.

3 TECHNICAL DETAILS OF THE PROJECT

The following chapter provides a detailed overview of the proposed technology to be implemented for the generation of electricity at the CSP Plant.

Solar Reserve is one of the world‟s leading companies in the field of renewable energy generation. The renewable energy generation market face two (2) fundamental problems – the first being scalability and the second the issue of electricity storage. Solar Reserve has managed to bridge these problems with their CSP technology. CSP Plants draw their heat from the sun, an unlimited source of pure clean energy – and unlike wind and photovoltaic, the technology implemented by Solar Reserve can be delivered as and when needed dependent solely on demand and not climatic factors. This feature of the technology allows Solar Reserve to bridge the key barriers pertinent to renewable energy generation – scalability and storage.

The technology has been proven and substantiated by one of the world"s leading technology conglomerates – Unite Technologies. Rocketdyne a subsidiary of United Technologies has demonstrated the technology at the Solar One and Solar Two Power Plants in Southern California. Solar Reserve has been granted proprietary technology know-how and an exclusive world-wide license to develop CSP Plants based on this technology.

The CSP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) in a 3 km2 area. The tower is erected in the centre of the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt to over 550ºC, which then flows into a thermal storage tank for storage (maintaining 98% thermal efficiency).

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankine cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. The plant is equipped with highly innovative technology pertaining to the solar receiver (tower) and the molten salt used for heat generation. Thermal energy is generated by means of reflecting and concentrating radiation/solar heat from heliostats to a central tower, which then converts the solar energy to electricity by means of an internal turbine combustion process.

In short the electricity generation process can be summarised as follows –

- Heliostats reflect the solar radiation towards the central receiver tower.
- The salt complex is pumped from the cold salts thermal storage tank to the central receiver where they are heated to 566ºC. The salt complex is transported through the central receiver tower by means of extremely thin tubes.
- The molten salt complex is heated up to approximately 566 C and is circulated in the central receiver tower.
- The molten salt concentration is then transported to the hot salt thermal storage tank.
- Energy is transferred by means of a heat exchanger or steam generator to generate steam for the turbine.
- The highly pressurised steam is then passed through a steam turbine to generate electricity.
- The salt complex cools down to an approximate 288ºC in the steam generator.
- After this process is completed, the molten salt concentrate is transported to the cold salt storage thermal tank – in order for the electricity generation cycle to commence once more.

The CSP plant comprises four main subsystems which will be summarised below:

- **Solar Field –** the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- **Molten Salt Circuit** which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
- The **Power Block**; and
- **Auxiliary facilities and infrastructure** which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

4 TOURISM IN SOUTH AFRICA

4.1 Defining Tourism

Tourism includes all trips away from one's usual environment, not just holiday/leisure trips. It also includes business, visiting friends and/or relatives, medical/health trips, and religious journeys, amongst others. Meanwhile a tourist (overnight visitor) is a visitor who stays at least one night in collective or private accommodation in the place visited (Statistics South Africa, 2009).

4.2 Contribution of Tourism to the Economy of South Africa

The 2011 report by the World Travel and Tourism Council indicated that South Africa Travel & Tourism (encompassing transport, accommodation, catering, recreation and services for visitors) generated R 328.2 billion of economic activity (GDP) in 2011 (World Travel and Tourism Council, 2010).

At a national level the tourism industry is expected to have the following *direct* impacts in 2011:

- Employment of 594 000 jobs to be maintained through this economic system, representing 4.5% of total employment (World Travel and Tourism Council, 2011).
- The industry is expected to contribute R 143.5 billion of the Gross Domestic Product (GDP), equivalent to 5% of GDP (World Travel and Tourism Council, 2011).
- The industry is expected to generate R 82.8 billion in visitor exports (which is equivalent to 11, 877, 000 international tourists (overnight visitor)) (World Travel and Tourism Council, 2011).
- It is anticipated the travel and tourism industry will attract capital investment of R 43.7 billion (World Travel and Tourism Council, 2011).

However, since the travel and tourism system touches upon all sectors of the economy, its real impact is far greater. South Africa"s travel and tourism economy *directly* and *indirectly* accounts for:

- 1, 334, 000 jobs, representing 10.1% of total employment (World Travel and Tourism Council, 2011)
- R 328.2 billion of GDP, equivalent to 11.4% of GDP (World Travel and Tourism Council, 2011)

Moreover over the next ten years, the World Travel and Tourism Council argue that South Africa"s travel and tourism system is expected to achieve the following (World Travel and Tourism Council, 2011):

- 5% per annum in travel and tourism GDP to R 234 billion in 2021 for the industry and 4.8% per annum to 522.4 billion GDP for the economy in 2021.
- An increase of 197, 000 (33.1%) jobs over the next 10 years which will account for 791, 000 jobs by 2021 for the industry. And 2.5% increase per annum to 1, 709, 000 (10.7% of total employment) jobs for the economy by 2021.
- International tourist arrivals are forecast to total 15,113,000 by 2021, an increase of 2.4% per annum generating expenditure of R145.1 billion.
- Attract capital investment of R43.7 billion, rising by 4.2% per annum to R66.1 billion which implies that Travel & Tourism"s share of total national investment will fall from 7.5% in 2011 to 7.2% in 2021

The tourism industry thus represents an important economic sector in South Africa, which requires attention and effort to strengthen the products, as well as linkages to other economic sectors.

5 TOURISM IN THE NORTHERN CAPE

Apart from business travel, transient travel and visiting friends and family, tourists visit the Northern Cape for ecotourism purposes due to its unique variety of natural, historical and cultural attributes. In addition, the annual floral display in the Namaqualand region is a famous characteristic of the province. The concentration of historical sites around the Kimberley area and the Kgalagadi Transfrontier conservation area are also renowned provincial tourist attractions.

Nonetheless, based on several reports by South African Tourism (South African Tourism Index, 2010), the Northern Cape is the least visited Province in South Africa in terms of both domestic and foreign tourism. This is perhaps due to the fact that the Province has not capitalised on its full potential as a tourist destination and hence is largely undiscovered by both domestic and international markets. However, the province has the potential to become a well-visited adventure and ecotourism destination in South Africa recognised for its cultural

heritage and natural resources. This can be achieved through promotion and development of tourism in the Province

In terms of foreign tourism, generally, in 2007, the Northern Cape Province attracted 2.5% of foreign tourists (Annual Tourism Report, 2009). By 2008, the figure had dropped to 1.3% and by the fourth quarter of 2009 only 1.2% of foreign tourists visited Northern Cape Province (South African Tourism Index, 2010). Countrywide, these were the lowest proportions of tourists visiting a province (South African Tourism Index, 2010). By the third quarter of 2010, Northern Cape was still the least visited Province in the country with only 1.3% of foreign tourists. The number of nights spent by foreign tourists in Northern Cape decreased from 1.2% in the third quarter of 2009 to 1.0% in the third of 2010. In the third of 2010, the province earned R 0.2 billion in total foreign revenue (South African Tourism Index, 2010). Majority of foreign tourists visit for leisure and business purposes (South African Tourism Index, 2010).

At a domestic level, the percentage of travel incidence for the adult population of South Africa for the Northern Cape specifically, is 19% of the total share of the country (South African Annual Tourism Report, 2005). With respect to the total percentage of trips emanating from provinces of origin by domestic residents, the Northern Cape only makes up 2% (lowest percentage) thereby indicating that the province is not a significant source market for domestic tourism (South African Annual Tourism Report, 2005). Similarly, the Northern Cape holds the lowest percentage of visitors received at 1.6% of the total share of the country. Furthermore, according to the South African Annual Tourism Report (2005), a large component of domestic trips taken within the tourist"s province of residence for those of the Northern Cape is intra-provincial as opposed to inter-provincial. This basically indicates that most of the travel by domestic tourists is predominantly done within the province. Three major components (more or less) equally represent the reasons for domestic travel in the Northern Cape. These being visiting family or relatives, holiday and business.

5.1 Tourism Destinations and Routes in Area of the Proposed CSP Plant

The proposed development falls within the Siyanda District Municipality (SDM) which is made up of six local municipalities; the study site is located in Tsantsabane Local Municipality which falls within this district.

Tourism is one of the most important economic sectors in the SDM (SDM, IDP, 2011/ 2012). The SDM with its contrasting landscapes is characterised by a variety of natural resources. These include National Parks and Nature Reserves as well as eco-adventures and safari lodges. Some of the National Parks and Reserves include the Kgalagadi Transfrontier Park; Spitskop Nature Reserve and Augrabies National Park. According to the SDM, (IDP,2011/ 2012), the Spitskop Nature Reserve and Augrabies National Park are not managed by the SDM but have a critical role in influencing the region"s tourism. The nearest Nature Reserve to the study area is the Witsand Nature Reserve.

5.1.1 *Witsand Nature Reserve*

The Witsand (White Sands) Nature Reserve, which lies approximately 65km to the south-west of Postmasburg, is the closest Nature Reserve to the area of the proposed CSP plant study site. The Witsand area was among the few reliable sources of permanent water in the early days and hence a number of human activities were concentrated here. In addition to that, Archaeologists discovered a number of Stone Age sites in the area.

The Witsand Nature Reserve is one of the few scenic eco-destinations in the Northern Cape. The reserve is characterised by flowing white dunes which are 10km long and 5km wide. The dunes are surrounded by red Kalahari dunes, Acacia woodland and the Langberg Mountain range. The dunes are also famous for their strange roaring sound made by the sands at Brulsand during disturbance between September and April. The Witsand Nature Reserve protects a highly sensitive ecosystem and a number of unique plants not found anywhere else in the world. Furthermore, the Nature Reserve attracts bird lovers due to its high diversity of arid region and bushveld birds including the Sociable Weaver and Africa's smallest raptor, the Pygmy Falcon. There are generally over 170 bird species in the reserve. The Nature Reserve is part of the Kalahari raptor route which will be elaborated on below. The reserve also offers self catering accommodation facilities, mainly chalets, bungalows, caravan and camping sites.

5.1.2 *Kalahari Raptor Route*

This is the only tourism route potentially affected by the proposed CSP plant. The route starts from the Kuruman Raptor Rehabilitation Centre and extends to Upington and Prieska in the south. The Kuruman Raptor Rehabilitation Centre covers 600 ha and also offers self catering accommodation facilities. At this Centre, birds in rehabilitation can be viewed at close range.

The Kalahari Raptor Route follows a number of roads to the east and north of Upington. The parts of the route that are closest to the Postmasburg area are:

- Upington to Olifantshoek, a 170km tarred road
- Volop to Olifantshoek, a 140km gravel road

The route forms part of the raptor conservation initiative initiated by the Raptor Conservation Group and the Northern Cape Department of Environment Affairs and Nature Conservation. The initiative includes monitoring of breeding populations, road surveys, farmer awareness programmes, establishing raptor conservancies, and modification of farm reservoirs and power lines to increase the safety of raptors in the area. The status of many raptor species is improving as a result, including that of the Tawny Eagle, Bateleur and Lappet-faced Vulture.

The Kalahari is home to 40 raptor and vulture species (of which 67 species are found in South Africa) and seven owl species (of which 12 species are found nationally). In addition, the Kalahari region also supports a vast selection of game farms and nature reserves such as the

Tswalu Kalahari Reserve which is one of the largest private game reserves in South Africa, covering an area of 1000km² (100 000 ha).

6 TOURISM IN AND AROUND THE PROPOSED CSP PLANTS

Where information could not be obtained at a local scale, provincial data is represented in this section. Statistics South Africa classifies tourism regions within provinces i.e. the "Rest of Northern Cape" region which comprises of towns such as Postmasburg, Daniëlskuil, Upington, Van Zylsrus, Kakamas, Augrabies, Kuruman, Olifantshoek, Loeriesfontein, Askham, Nieuwoudtville and Prieska among others. Most important of these are the towns of Daniëlskuil, which is closest to the proposed Humansrus CSP plant (approximately 30km away) and the town of Postmasburg (slightly further than 30km away). The route tourists may typically use to get to Postmasburg from the Kimberley area is the R31 and R385. R385 traverses the northern boundary of the study site and is significant as such. The route used to get to Daniëlskuil from Kimberely is the R31. Tourists using this route will not be affected by the proposed development. However, those travelling towards Postmasburg from Kuruman via Daniëlskuil are likely to be exposed to the proposed development.

6.1 Tourism Trends and Supply

The study area falls within an area that is somewhat isolated from more popular tourist routes in the region of the Northern Cape Province The closest towns where a number of tourism facilities / attractions are clustered are Postmasburg and Daniëlskuil. The R385, which traverses the northern boundary of the study site heads towards Postmasburg and is the main potential route that will be immediately affected by the proposed development. The study site, the town of Postmasburg and Daniëlskuil are described based on area characteristics in terms of land cover class (urban, rural, commercial agriculture/forest), tourist attractions and tourism growth potential.

6.1.1 Postmasburg

Postmasburg (originally known as Blinkklip/ Shining rock) is an urban area renowned for its mineral deposits since the early days and the rock art dating back 120 000 years ago at Beeshoek is evidence of presence of San / Bushman (Green Kalahari, 2011; Web Studio, 2008).

The first diamond in Postmasburg was discovered in 1918 through an open cast mine which became permanently inundated in 1935. The open cast mine is currently a 45m deep "big hole" with a variety of fish which attracts visitors. In addition, a substance known as "sibilo"

(specularite and hematite) was also primitively mined the town (Green Kalahari, 2011; Web Studio, 2008)

The town is currently characterised by land uses such as residential, small holdings as well as commercial. It is an important tourist area attracting business and, to a lesser extent, leisure tourists. The town is known for its unique green growth fed by a dam and a number of fountains. Furthermore, Postmasburg is characterised by a variety of adventure activities as well as cultural/ heritage attractions.

In terms of adventure and sport, activities such as 4x4 trails, hiking and biking are offered in the Witsands Nature Reserve (SA Venues.com, 2011; TourismRSA.com, 2011).

In addition, according to archaeological findings, the Khoisan mined specularite (a soft form of haematite which was used as a cosmetic in a few rituals) in the Blinkklipkop ("Shining Rock Hill") area around 700 AD (SA Venues.com, 2011; TourismRSA.com, 2011).

Historical and Architectural attractions in Postmasburg include (SA Venues.com, 2011; TourismRSA.com, 2011)

- The old blue dolomite Dutch Reformed Church which was built in 1908.
- In close proximity to this church is the statue of Reverend Dirk Postma.
- The "Howitzer Gun" is found in the civic centre. This honours men of Postmasburg who died during World War II.

Other attractions in and around the study area include:

- The South African National Defence Force Army Battle School located at Lohatla outside Postmasburg since early 1980s plays a role in the town"s economy (Green Kalahari, 2011; Web Studio, 2008)
- Beeshoek Golf Club
- Mount Carmel Game Farm
- Walker farm
- Selfhelp farm
- Papkuil farm
- Accommodation facilities

The supply of accommodation facilities is concentrated mainly in and around Postmasburg which is approximately 30km away from the study site. Tourist accommodation facilities around the study area can be broken up into a number of different categories:

- Bed and breakfasts,
- Guesthouses,
- Guest farms,
- Hotels/motels/Inns/ lodges,

- Conference facilities,
- Backpacker venues,
- Caravan and Camping sites,
- Chalets.

There are generally a number of tourism facilities in the wider area which indicates an excellent supply of tourist accommodation facilities in the area. Much of this is concentrated in the town of Postmasburg. Specific examples in include:

- Andrisha Motel
- Silver Fox Pub and Restaurant
- Postmasburg Hotel
- Casa Cabalero B&B
- Abendruhe

Figure 1: One of the accommodation facilities in Postmasburg.

Witsands Nature Reserve, located approximately 65km to the Southwest of Postmasburg and the closest Nature Reserve to the area of the proposed CSP plant, offers self catering accommodation facilities (i.e. chalets, bungalows as well as caravan and camping sites).

6.1.2 Daniëlskuil

Daniëlskuil lies at the foot of the Kuruman Hills, 90km south of Kuruman. Tswana once occupied the land on which it is built before it became home to the Griqua. The name,

„Daniel"s Den" was first found in documents by the missionary, Campbell, in 1820. The name derives from a natural crater in a limestone formation, reminding observers of the Biblical story of Daniel. Though small, the town thrives on limestone quarrying, diamond mining and a large farming community (SA Venues.com, 2011).

The small town of Daniëlskuil is characterised by land uses such as residential, agricultural holdings, mining, agriculture, game farming, small holdings, small commercial activities and enterprises In terms of accommodation facilities, there are various options available to tourists in and around the town, ranging from guesthouses to bed and breakfast accommodation facilities and safari lodges. Specifically, these comprise, but are not limited to, the following:

- Klein Papkuil Lodge
- Little Eden Guest House
- Mount Carmel Safaris
- Rest a While Guesthouse (Rus „n bietjie) B&B
- Vaalbos Guest House
- Die Lapa Guest House
- Finch Guest House, Lime Acres
- Idwala Guest House
- Serendipidity Guesthouse
- Plenary Hotel

People travelling between Kuruman and Kimberley are likely to use the R31 passing through the town of Daniëlskuil. There are a few activities in and close to the town that may draw in tourists. An annual horse show is held which may attract participants from the surrounding region in addition to local entrants. Tourists may also be expected from the same areas. There are several heritage sites that can be found in close proximity to Daniëlskuil. These include the Wonderwerk caves, Boesmansgat (a unique natural sinkhole, renowned as the second deepest and largest of its kind in the world, located on the farm Mount Carmel), British Fort (built during the Anglo-Boer War, located on a hillock overlooking the village) and Gaol (limestone sinkhole in which early Griqua were mistakenly thought to have incarcerated prisoners). Other activities include hiking on Mount Carmel.

From a production point of view, the town is recognized for its proximity to nearby large scale mining activities. These mines include, but are not limited to, the following:

- Dwala Lime Mines
- Finch Mine
- Lime Acres

6.1.3 Tourism in the Vicinity of the Proposed Development

There are no tourism facilities in the immediate vicinity of the proposed development. Land use focuses on stock farming, and there are no tourism facilities immediately adjacent to the site.

The study site, location of nearest towns and main tourist sites are illustrated in Figure 1 below.

Figure 2: Tourism features within a 60km radius at the Humansrus site

6.2 Tourism Demand

6.2.1 Foreign and Domestic Tourists

Statistics provided by the South African Tourism Strategic Research Unit show that the Northern Cape is the least visited province (by foreign tourists) in South Africa and that this percentage dropped from 1.3% in 2008 to 1.2% in 2009. However, the number of nights spent by foreign tourists in Northern Cape increased between 2009 and 2010 (i.e. there was a percentage change of +0.2% from 0.7% to 0.9% (South African Tourism Index, 2010)). Furthermore, only R 0.1 billion was earned in total foreign revenue in 2010 (South African Tourism Index, 2010). The majority of foreign tourists visit for leisure and business purposes. In terms of the number of bed nights spent by foreign tourists in the region, there was a rise from 97 529 in 2009 to 128 230 in 2010 expressing a 31.5% change (South African Tourism Index 2010).

According to the South African Annual Tourism Report (2009), the main purpose of visit for domestic overnight trips in the Northern Cape centred on visiting friends or relatives (45.5%) followed by holiday and recreation purposes (32.7%). Other reasons for overnight stays include for funerals followed by business purposes and "other" making up the remainder. In terms of the length of stay by tourists to the Northern Cape, many stayed from between one to three nights (40%) whilst a slightly smaller number stayed four to seven nights 32.4%. The remainder staying for longer periods from eight to more than twenty two days. The bulk of the type of accommodation that tourists generally used were staying with friends and relatives (71.3%). Other types of accommodation that make up a much smaller component but were otherwise regularly used were guest houses (5.7%), bed and breakfasts (4.3%), self catering establishments (4%) and holiday homes (2.5%). Other types make up the remainder. This statistic shows that domestic tourists who do not have friends or relatives in the province rely mainly on guest houses, bed and breakfast accommodation and self catering facilities.

6.2.2 Business Tourism

Business tourism reflects the tourist who visits an area purely to do business. Any other tourism activities such as sight-seeing or game viewing for example, are secondary. The localities nearest to the Humansrus study site, that being Postmasburg and Daniëlskuil, were both mainly dominated by business tourism (pers. comm. 2011). However, as alluded to other sections, reports show that an equal proportion (to a greater or lesser extent).is related to holiday and visiting family and relatives for the greater region. Hence, at a local scale these statistics may not be indicative of the site specific tourism dynamics of these two small towns.

This type of tourism reflects the tourist who visits an area fundamentally for business purposes (meetings, exhibitions, etc.). Any other tourism activities e.g. sight-seeing or game

viewing are secondary. Meetings are the most attractive segment within the business tourism market. The meetings market can be divided into three organisational types, Inter-Governmental Meetings Corporate Meetings, Association / NGO and Academic Meetings. Corporate meetings occur year round and school holidays make off-peak months more attractive. On the other hand, exhibitions also attract a largely number of tourists, mostly domestic tourists. It is anticipated that business tourism presents trends for high occupancy during the week and lower occupancies over the weekend. The stays are normally longer than leisure based tourism. No information was available on average stay length. There is also lack of data on differences between local and foreign arrivals in this context.

Owners of the tourism facilities in the area rely to a large extent on business tourists for the success of their operations.

6.2.3 Leisure Tourism

Leisure is the primary purpose of visits to South Africa as a whole, and in 2007 it accounted for 61.3% of visitors to the country. Leisure tourism is made up of a number of sub-groupings i.e. site seeing, seaside holidays, family holidays on game farms, game viewing and photographic safaris and hunting. Other leisure activities include sport (golf and water sports), visiting restaurants and special events. Leisure tourism in the study area consists of several hiking and safaris venues relatively distanced from Humansrus. In addition, as previously stated, an annual horse show in Daniëlskuil may boost leisure tourism. Tourists can generally stay in the various accommodation facilities in the area. Visitors from the local area are also noted visiting local restaurants and pubs. There is no data (statistics) on the number of local and foreign leisure tourists that visit the study area.

- Ecotourism

Ecotourism is a major attraction to the province. While several private safari lodges and nature reserves (For example, Witsand Nature Reserve) also offer ecotourism opportunities, these activities often do not take place within the same space at the same time. From the distinct drop off of occupancies at lodges and other bush accommodation during summer, the importance of increasing occupancy through ecotourism during the hunting season low peak period is seen to be important (KPMG, 2005).

- Adventure tourism

Adventure tourism (4x4 trails hiking, and caravan parks) does to some extent take place in the surrounding area, although it does not constitute that main driver for tourism in the study area.

- Hunting

Hunting (as a form of leisure tourism) is a relatively important sector of the tourism industry in this area. There has been a significant increase in game farming around the region and provide good opportunities for growth in hunting based tourism (Tourism Northern Cape, 2005). For lodges and other bush accommodation, this appears to be their main source of tourists. This sector has also been certainly the mainstay of leisure tourism in the greater area.

- Historical/ Heritage

The greater region of the Northern Cape possesses several historical/ heritage sites that offer the tourism opportunities. Some of these in proximity to the study site are listed below:

- War Graves 1897
- War Graves 1822
- Moffatt"s Mission Church 1833
- Rock Paintings in Langberg
- Koegelbeen Caves
- Mary Moffatt Museum
- Livingstone Church

6.2.4 Passing Through

Tourism in the area can also be attributed to tourists passing through the area via the R31 on their way to and/or from popular regional centres – i.e. Kimberley, Kuruman, Upington as well to/from regional parks and reserves e.g. the Witsand Nature Reserve, Mokala National Park, Spitskop Nature Reserve, Kgalagadi Transfrontier Park etc. Various sectors of the tourism industry (such as Guest houses, lodges, hotels, motels and restaurants) located along this route benefit to some extent from the strategic location.

6.3 Future Tourism in and Around the Study Area

It should be noted that in terms of future tourism, there is a paucity of local information for the study area, and no area-specific initiatives have been identified to date. Moreover, the May 2010, Tsantsabane Local Municipality IDP does not provide detailed information regarding future tourism in the local area. However it indicates that a strategic objective is in place to develop a Tourism Development Plan by June 2011 so as to stimulate and enhance Local Economic Development. Therefore, due to the lack of information at a local scale at this stage, this section only presents future tourism information at a district level (i.e. Siyanda District Municipality) that is relevant to the study area.

According to the Siyanda District Municipality Integrated Development Plan (IDP) (5 year Plan), 2011/2012, local tourism should become the most important economic activity in the district in the next ten years (Siyanda District Municipality, 2011/2012). In addition, given that there are a variety of natural resources in the district, the tourism potential for the area is great (Siyanda District Municipality, 2011/2012). The hot water springs and scenic natural areas in parts of the district present good development possibilities. But there is a need for innovative ideas and excellent marketing strategies in order to promote tourism and hence increase income (Siyanda District Municipality, 2011/2012).

Also, as discussed below, future industrial / infrastructural development could increase tourism (i.e. business tourism) development in the area by creating a demand for accommodation facilities for visiting technicians / engineers associated with such a development.

7 POTENTIAL IMPACT OF THE PROPOSED CSP PLANT ON TOURISM

7.1 Impact assessment relating to the Tourism Industry

The proposed CSP plant site is located in close proximity to the rural villages of Humansrus, Groenwater and Owendale. The character of the landscape is mainly natural for this locality. The proposed CSP plant therefore could have a major influence on the landscape in terms of the scale, the physical footprint and the aesthetics of the area. The degree to which the proposed development will affect the local area will vary and can be based on both positive and negative aspects. In this light, the four major environmental impacts likely to result from the power plants include visual impacts, noise impacts, land-use change impacts and corporate demand. These are elaborated on below.

7.1.1 Visual Impact Relative to Tourism

Scenically beautiful areas where leisure tourism is practiced are more likely to be visually affected by CSP plants than areas that exhibit anthropogenic objects associated with the built environment (such as concrete buildings or power lines). Generally, the natural character or scenic beauty of an area plays an important role in attracting tourists to any specific area. In terms of the aesthetic values, the study site presents a moderate to high value i.e. moderate being the common landscape and high being a distinctive landscape often with a strong sense of place (Humansrus Visual Report by Newtown Landscape Architects).

No accommodation and other tourist facilities were identified within the immediate area during field surveys. As such, it is unlikely that any negative impact will result from the proposed development from this perspective. However, tourists passing through via the R385 road

from Kimberley to Upington \Namibia via Postmasburg and Olifantsfontein and *vice versa* will most likely be affected by the proposed development from a visual point of view. As the proposed development is located directly adjacent to the R385 it may be directly visible. Moreover based on the proposed plant layout plan, the CSP plant will in very close proximity to R385. Furthermore, according to the visual report for this project (by Newtown Landscape Architects), the R385 as well as the Groenwater/ Lime Acres farm road are considered sensitive viewing areas for people passing through the area. The extent to which these roads are used by leisure tourists (those whose intention for taking the route is to appreciate the scenic value) will be determined during the EIA phase of this project.

In terms of the type of impact, the proposed development may either be positive or negative.

In a negative context, the proposed CSP plant will be an artificial anthropogenic structure which contrasts with the otherwise natural landscape. In this sense, the CSP plant could detract from the natural aesthetics of the locality. However, as evidenced in earlier sections of this report (Section 6.2), most of the tourism for Postmasburg and Daniëlskuil centres on business tourism, hence, the degree of negative impact is expected to be minimal on this basis since the type of tourists most likely to be affected are not leisure tourists per se. additionally the R31 which passes close to the site is not a scenic tourist route, and thus the aesthetic quality of the route is unlikely to be adversely affected.

In a positive context, since the proposed development can be considered new technology to the area, it may be viewed as a tourist attraction which can draw tourists to the route. However this factor would be strictly dependent on the proponent establishing a visitor information centre associated with the plant, which could then be advertised and draw visitors to the plant and the area. Additionally, local inhabitants could potentially view the plant as a symbol of progress and development in the area, especially if the plant was seen to be associated with increased job provision in the area and / or improved electricity provision. In this context the plant could be viewed as a positive symbol of the progress and development of the area. The findings of the visual study for the proposed development, as well as stakeholder input to the public participation process for the proposed development"s EIA will be instructive in this context.

7.1.2 Noise Impact Relative to Tourism

Noise generation could be a factor during the construction phase. This phase will be temporary and it is not likely to be a significant factor impacting the tourism facilities in the area since there are no tourist facilities in the immediate vicinity of the study site. It is likely that noise impacts will only affect locals in Humansrus. Negligible noise impacts are expected during the operational phase.

7.1.3 Land-use Change Relative to Tourism

The proposed development of the CSP plant will involve the transformation of the natural landscape into a man-made industrial-type facility, consequently resulting in land-use change. The development will constitute a complete transformation of a certain part of the study site. This type of land use change is in contrast to that of the surrounding area. Cattle farming and agricultural practices predominantly take place adjacent to the study site. Land uses to the west and east are vacant. In this light, the development may be viewed as a negative impact.

7.1.4 Corporate Demand

The corporate demand for tourism facilities is likely to increase in the area as a result of the proposed development (assuming this proposed development is approved and constructed). Various professional persons such as technical surveyors, engineers, environmental specialists, etc. are likely to spend nights at various accommodation facilities in the study area. This is expected during the pre-construction, construction, operation and decommissioning phases of the project to various degrees. Furthermore, the above teams are expected to visit various restaurants (which is a component of leisure tourism) while in the area. In general, the impact of the proposed development on corporate demand for tourism facilities is anticipated to be moderate during the construction phase since more workers will be required at this stage and minimal during the operational phase since the professional and maintenance team will be limited to a small group on individuals. From a corporate demand perspective, the impact would be likely to be positive.

8 CONCLUSIONS, RECOMMENDATIONS AND WAY FORWARD

8.1 Conclusions and Recommendations

The CSP plant study site is not located in close proximity to any major tourist hotspots. The closest major tourist sites are the Witsand Nature Reserve and the Kalahari Raptor Route. However, these are sufficiently distanced away from the proposed development for any significant impact to occur. The study site itself is located adjacent to the local route which links two small towns of Postmasburg and Daniëlskuil with the wider area (each of which are located some 30km either side of the study site). Tourism activities in the two small towns themselves are predominantly linked to business activities taking place in and around their respective locations. Leisure tourism forms a small component of the tourism for these towns and therefore, the proposed development is not expected to significantly negatively affect this leisure tourism aspect. Negative impacts that may potentially affect the surrounding area include visual impacts, noise impacts and land-use change impacts. Positive impacts associated with the proposed development pivots on increasing corporate demand, which

could potentially bring in additional tourism to the vicinity thereby increasing the area‟s contribution to the provincial GDP. A more detailed level of assessment is required for the EIA phase of the proposed development to quantify these potential negative and positive impacts on the tourism environment in the study area.

8.2 Way Forward

The EIA phase will focus around detailed investigations on tourism supply and demand by for instance:

- Investigating the extent to which the R385 road is utilised by leisure tourists
- Exploring several leisure tourism activities such as hunting in close proximity (within a 25km radius) to the study site.
- Obtaining detailed data (e.g. Occupancy rates, main guests as well as number of people accommodated per night) from accommodation facilities in Postmasburg and Daniëlskuil.
- Investigating how the proposed development may increase tourism demand in the area, and an investigation of any knock-on impacts on tourism supply.
- Obtaining the latest statistics on domestic and international tourist arrivals to the Province.
- Identifying any planned/ future tourism facilities in the vicinity of the study area

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ONEWORLD
sustainable investments

Humansrus CSP: Surface Hydrology Scoping Report

FINAL REPORT

5 August 2011

Appreciating your financial, social and ecological assets

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Executive Summary

The proposed Concentrating Solar Power plant (CSP) proposed at the farm 469 Humansrus in the Northern Cape Province will cover an area of about 572 ha and use about 822 m^3 of water per day or 300,000 m^3 per year during operations.

It appears unlikely that the proposed plant will have a significant effect on surface water at local scales. A small ephemeral wetland (0.2 ha), located close to the boundary of the proposed field of heliostats, is unlikely to be affected.

Further investigation by the project proposer is required into the foundations of the heliostat field. The current conceptual layout of the heliostat field covers some areas of bare rock, stony ground and reverse-angle slopes, which could affect the construction and viability of heliostats at those locations.

A solution on the source of water for the operation of the CSP needs to be identified. Depending on which source (or mix of sources) of water is identified, further investigation is required and this should be the subject of the following EIA process:

- The likelihood and quantum of a mix of sources of water required for the proposed project and the likely regional impact of this competition for water;
- The potential size and location of a well field and the likelihood of impacts on other groundwater users (communities, farmers, industrial users, ecosystems);
- Possible alternative technologies for reducing the water consumption required by the proposed CSP;
- The proposer of the project may have to consider more intensely the production costs of power given the anticipated costs of water, based on the development costs of a well-field and the likely price of water obtained from an upgraded Vaal-Gamagara water supply scheme; and
- The priority basis of supply of water from the Vaal-Gamagara water supply scheme.

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Table of Contents

1 Overview

This report is a scoping review of potential hydrological impacts of the client Concentrating Solar Thermal plant proposed for Farm 469 (Humansrus) near Postmasburg, Northern Cape. This report was prepared as part of an assessment contracted to OneWorld Sustainable Investments by SSI of Johannesburg. In execution of this Scoping Report, the author visited the site on Wednesday 11 May, 2011.

1.1 Previous Expertise of the Author of This Report

This hydrological scoping report was undertaken and compiled by Arthur Chapman in his capacity as a hydrologist working for OneWorld Sustainable Investments in Cape Town. He has an M.Sc in hydrology and 21 years experience as a hydrologist, with a background in assessing the impacts of land-use change on runoff, hydrological modelling and environmental impact assessments. These assessments range from those of similar CSP projects (at Upington and two near Groblershoop, Northern Cape); assessments of the impacts of mines on water resources (the Hillendale and Fairbreeze heavy sands project of the then Iscor at Mtunzini) and Ogies; a review of the hydrological assessments for possible nuclear power plants in the Western Cape; calculation and estimations of the impacts of afforestation on surface and ground water resources in South Africa and internationally (Uruguay) and the impacts of invasive alien plant invasion on surface water resources. He is also consulting to international clients on the impacts of climate change in Southern Africa across a range of different sectors that includes water resources, human health and energy supply.

2 Introduction

SolarReserve have proposed a concentrating solar thermal plant (CSP) in the Northern Cape on the farm 469 Humansrus near Postmasburg, adjacent to the road R385 that links Postmasburg and Kimberley. The site is located 30 km from Postmasburg and about 165km from Kimberley along the R385 road (see Figure 1), just north west of Lime Acres and south west of Danielskuil at georeference Latitude 28° 17’ S and 23° 22’ E.

The proposed CSP at Humansrus is that of the “power tower” concept, modelled on that of Solar One and Solar Two, built and proved in Southern California. The essence of the design is a field of heliostats concentrating sunlight onto a central tower located at the top of a “power tower” (see project design information given by SSI). The concentrated sunlight heats the central tower, which heats a molten salt flowing through a primary circuit. Part of the flow of molten salt is conveyed through a heat exchanger which transfers heat into a secondary circuit of water and the resulting steam drives a turbine and generator. The steam cycle will use mostly dry cooling, although the design is not yet fixed. Occasional mist-spray cooling might be required when ambient air temperatures become too high for efficient and effective cooling of the steam circuit.

The generating capacity of the plant it not yet known at of time of writing. A principle of operation is that one quarter of the captured energy is transmitted straight into the grid and the other three quarters goes into heat storage (molten salt stored in tanks) for use during night times and periods of occluded sunlight. While the specific operational requirements of the proposed CSP have yet to be determined, the plant will start generating power each day when insolation is

sufficient to provide heating for its primary thermal circuit, and it will when there is insufficient energy insolation to store and transmit power. Between these times (at night and during cloudy conditions, it will use the stored heat to generate electricity.

3 Scope and Limitations

The scope of this assessment is to investigate the possible impacts of a CSP located at the Humansrus on the hydrological functioning at the local, regional and national scale. The terms of reference for this scoping report are as follows, and not limited to:

- An introduction to the study (see above);
- An overview of the study area hydrology (status quo);
- A description of the potential impacts (including cumulative impacts) on hydrology in the general area and the province;
- Any assumptions, limitations and / or constraints associated with the study; and
- Recommendations on any further studies that may be required during or after the EIA process.

While this scoping report is confined to surface water resources, it does integrate and comment on groundwater resources, in that interactions of surface water demands with potential groundwater supplies are important, given the general aridity of the region and need for water by the proposed facility.

3.1 Description of Proposed CSP Layout

The whole proposed installation, which includes the central power tower and the field of heliostats, is estimated at being roughly 2.7 km in diameter or covering 5.7 km^2 (572 ha). The heliostat field will contain between 14,500 and 17,000 heliostats, with the power tower located off-center and closer to the northern boundary of the round heliostat field. When the heliostats are not functioning (night time), they will likely be inverted, a position in which they can be cleaned. Dust on the reflecting surface i.e. mirror will significantly reduce reflectivity and will influence efficiency of the CSP plant – making a dust control suppression plan vital during operations. The heliostat surfaces will be cleaned regularly by means of high pressure spray of demineralised water from a vehicle moving amongst them.

The area in the immediate vicinity of the central tower is likely to paved or have a concrete flooring, as will the area around other supporting infrastructure (salt storage tanks, buildings, roads and some of the electricity distribution infrastructure). The area under the heliostats may be chipped stone or the natural veld with short shrubby vegetation or maintained as bare soil. Infiltration in this area is unlikely to be affected. Runoff from rainfall on the impervious areas is likely to infiltrate without significant surface flow being generated downslope (for reasons of high porosity and infiltrability in the Kalahari Sands.

The understood requirement for water for the operation of the facility is 300,000 $m^3.a^{-1}$ or about 822 m^3d^{-1}.

4 Climate, Geology and Landscape

4.1 Physical Layout

The proposed site for the CSP is illustrated in Figure 1 below. Within this core area, no surface drainage features such as stream channels, are observable. The area is covered with sands that have a high porosity and infiltration capacity and can be classified as soils with a deep Hutton profile (See MacVicar et al., 1997). Infiltration is likely to be rapid, and surface water will exist for a short time only. Surface flows that may be generated in the hills to the north and east infiltrate rapidly into the substrata near the edges of the break in slope, creating opportunities for infiltration to groundwater greater than would be possible from rainfall directly onto the surface.

To the west, the ground rises slightly more steeply with a slope of about 1:50 or 2-3%. This higher ground, that is a significant part of the western part of the CSP footprint, is not evident from the 1:50,000 topographic map, which is somewhat misleading as to land shape. The ground is stony and also has a large floating rock component (boulders not attached to the parent rock system). A small jaspillite mine or quarry is located on this feature (See Figure 1 – which identifies the feature). Questions need to be asked about its suitability as a base for installing heliostats. In the south-western part of the proposed heliostat field, bare rock is exposed and this is unlikely to be a suitable foundation for structures. Part of the proposed heliostat field is also located on reverse slopes (slopes that are orientated away from the likely location of the central tower). These features are likely to pose significant difficulties to the design and construction of the CSP, in the opinion of the author.

There is only one identifiable drainage channel, located on the west side of site, adjacent and parallel to the railway line. Ephemeral, , it is dry most of the time. Water flows only very briefly during heavy and intense storms. This drainage system exists behind an outcrop of jasperlites and dolerites, the flow of this system is highly intermittent and a response to occasional intense rainfalls.

4.2 Climate

The area is also known as the Green Kalahari, with a hot and dry climate. During the summer months (January) the temperatures can reach up to a maximum of 42°C. Rainfall patterns reveal that during an average year about 330 $mm.a^{-1}$ precipitation occurs, (determined from Smithers and Schulze, 2002) however during wetter years rainfall of over 600 mm has been recorded, whilst exceptionally dry years the annual precipitation merely reached 200 mm. Most of the rainfall received in the area is of convective origin and occurs in summer (Preston-Whyte and Tyson, 1988). Storms are relatively brief, but peak rainfall intensities over 5, 10 and 15 minutes differ little from other parts of South Africa which receive greater annual rainfall (Smithers and Schulze, 2002).

About 5 days a month in January daily maximum temperatures reach over 35°C, with minimum relative humidities at midday dropping to 20%-30% and even lower. Frost can be severe (defined as when air temperatures at the standard thermometer measuring height of 1.3 m drops below 0°C.

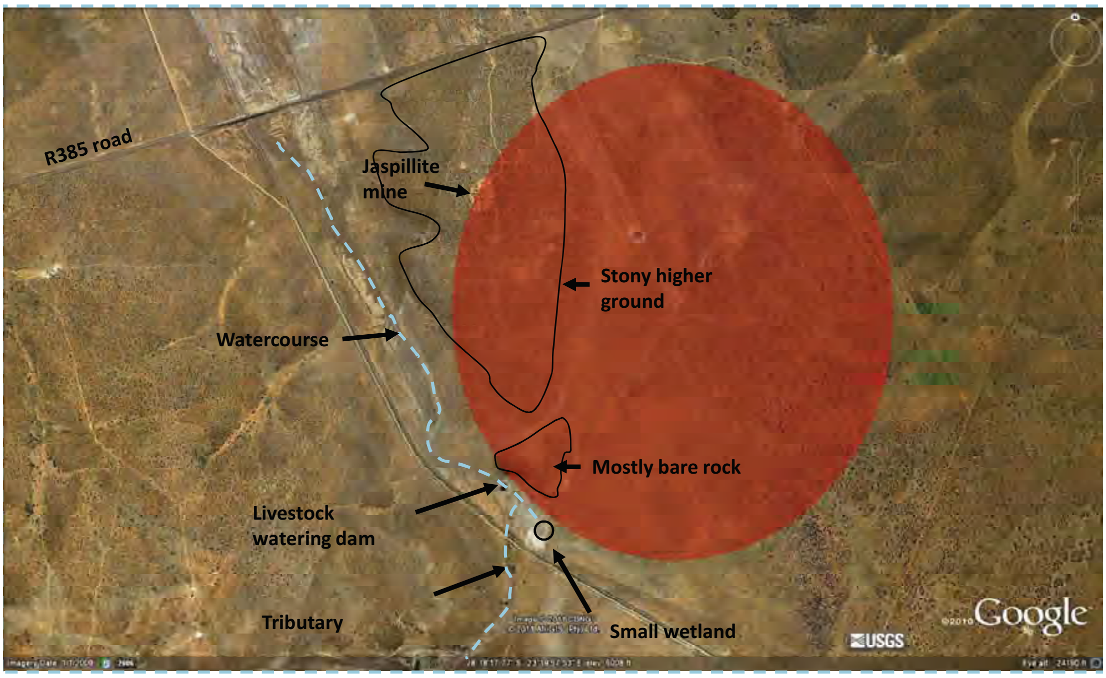

Figure 1 The proposed site of the CSP on the Humansrus farm, showing natural hydrological features (Source: Background Image: Google Earth).

Air temperatures at ground level may be several degrees lower than air temperature at thermometer measuring height. The climatological definition of a frost is 2.2°C at standard thermometer measuring height). Minimum temperatures can go as low as -7°C, but these occasions The January (14:h00) atmospheric saturation deficit averages about 40 mb (Tyson, 1986). The humidity mixing ratio (a measure of moisture content independent of temperature) for January is about 7 $g.kg^{-1}$, compared to 15 $g.kg^{-1}$ in more humid parts of the country (Preston-Whyte and Tyson, 1988. This is a measurement of the quantity of moisture in the air, measured as the number of grams of water vapour per kg of air. The quantity is controlled primarily by moisture availability, air temperature and air pressure). The dry atmosphere and good optical clarity are only a few of the reasons why this area in particular is excellent for CSP project development. Insolation of nearly 2,900 $kWh.m^{-2}.yr^{-1}$ when 1,800 $kWh.m^{-2}.yr^{-1}$ is roughly the minimum required to operate this type of CSP.

4.3 Geology and Landscape

The area is part of the Postmasburg Group, which is made up of the sub-components of the Griquatown Iron formation in the eastern higher ground, Makganyene Formation and recent Kalahari Sand Cover (Polteau, 2005). Red haematitic jaspilites are interbedded with the diamictites currently being quarried by the land owner. Diabases are intruded into the Makganyene

formation and outcrop along the central ridge. The combination of tightly packed ancient sediments, volcanic and diabase intrusions and lack of obvious faulting is likely to make evaluation of groundwater reserves difficult.

The site of the proposed CSP is mostly covered in Recent Kalahari Sands in the core of the proposed CSP site and has a slope of about 1:75 or about 1.3%, sloping downwards to the north-west. The slightly sloping ground may give distal heliostats a better, more unobstructed view of the central tower because they will be slightly higher than the more proximal ones. A reviewer of this document has noted that sloping ground is bad for CSP development and that a maximum of 3°incline can be tolerated or accommodated in the design. Total height of the individual heliostats is estimated at 15m.

5 Overview of the Hydrology of the Study Area

Pan evaporation in the area is estimated at between 2,200 and 2,600mm.a^{-1}, considerably more than the rainfall (Middleton and Bailey, 2009). The region is therefore in permanent water deficit and standing surface water, if it does not infiltrate, soon evaporates. Regional runoff can range from 0-25 mm.a^{-1} (Middleton and Bailey, 2009). Surface water generated by rainfall is confined to intense convective storms and quickly subsides. Streams in the vicinity are emphemeral. Those stream channels visited by the author had small amounts of standing water, probably a result of the very recent rainfalls, and no flows were evident Surface water storage (i.e. dams) is highly inefficient due to the high evaporation rate. Annual recharge to groundwater in the area is about 3-10 mm.a-1 (see Beekman et al., 1996).

5.1 Overview of Groundwater

The primary water source on the farm Humansrus is groundwater. There are four boreholes near the site on the farm Humansrus – north of the road (R365). According to the land-owner (Mr Scholz), the newest borehole was sunk to a depth of 107 metres and intersects the main aquifer between 97-107m below ground level and has been pump tested to a maximum of 32 l.s^{-1}. While this seems high; this quantity is also maximum pump capacity and maximum production could be even higher. The sustainability of this rate of extraction is not known (and is possibly unlikely). Another borehole in close proximity to the homestead was drilled to a depth of 50 m and it is estimated that it can supply water at 2 l.s^{-1}. (6,000 l.hr^{-1}). The quality of the groundwater is not yet known – and pending the results of the geo-hydrological investigation. The water is being used in its natural, untreated state, and TDS records revealed a range of between 0-1500 mg.l^{-1} (Middleton and Bailey, 2009).

Middleton and Bailey (2009) provided a broad estimation for groundwater availability in this area ranging between 10,000-75,000 m^3.km^{-2}.a^{-1}. Working from a utilisation rate of 822 m^3.d^{-1}, a well field of between 4 – 30 km^2 would be required to service fully the daily water needs of the facility, as a very broad estimate. A far more thorough and detailed investigation of the hydrogeological system is required before any decisions can be made on use of abstracted groundwater for CSP operations.

Given that diabase intrusions that are present on the proposed CSP site (shown for example outcropping in the area of bare rock identified in Figure 1), groundwater resources may be compartmentalised to some extent. Exploitation of the groundwater resource for CSP operational purposes will require significant investigation.

5.2 Wetlands and other Water Features

There is a small wetland near the south-western boundary of the CSP footprint, about 0.2 ha in area (See Figure 2). Colloquially known as a *pan* or *vlei*, it is shallow, had no standing water at the time of the visit but its spongy soils were damp (it had rained the night before). It appears to have a low biotic diversity. Covered mostly be a single tough type of grass about 0.6m heigh, it appears unpalatable to livestock (it has not been grazed, unlike surrounding grasslands) and is also unused by small birds. From observation, water retention is highly likely of short duration. Based on these observations and that at a regional scale other much larger pans near the Limeacres and Finsch mines had observable open water at the time of the author's visit, it is suggested that this small ephemeral wetland is of little consequence, even at local spatial scales.

The high evaporation rate and general low rainfall signifies that there is very little surface water in the area. What little surface water that exists after a storm soon evaporates or infiltrates to groundwater. At the time of the site visit (11 May 2011), the northern Cape region was at the end of the end of a particularly wet phase (caused partly by the La Niña conditions in the Pacific Ocean, which is known to cause above average rainfalls over large parts of South Africa, although not always). Despite the high rainfall, very little surface water was observed anywhere. A small dam exists about 200 m further down the drainage systems on the western boundary of the farm did have a small amount of water and is used as a water source by large livestock (See Figure 4). This dam is usually dry for most of the year. Water flowing into this dam appears to mostly come from a tributary arising off the main drainage channel to the west, on the other side of the railway line,.

Sedibeng Water is the water authority for the area in terms of water supply. The proposed site is located in the Northern Cape Proclaimed Service Area of Sedibeng Water. Proclamation means that the relevant water authority is the only party authorised to supply and manage water within its area of jurisdiction, unless agreed otherwise and excepting individual properties that manage their own water, as noted in this excerpt from the Water Supply Act (Act108, 1997) – that every Water Board:

> "*must consider every request by a water services institution for the provision of water services within its service area and may only refuse such request if, for sound technical and financial reasons, it would not be viable to provide those water services*" (Clause 32(c));

Economic growth and development is dependent on various inputs – water being one of these inputs are rated as vital to any development. The Northern Cape is characterised as a semi-arid area, which places enormous strain on existing water resources. The Sedibeng Water Authority needs to ensure that a constant supply of water is provided to its multitude of users i.e. mines, municipalities agriculture, utilities such as Eskom and Spoornet etc. The groundwater resource is not deemed sufficient at this point in time as it has not been investigated to its full extent in order to meet regional water needs. The Vaal-Gamagara Water Scheme, which is managed by the water

utility, Sedibeng Water, serves the purpose of conveying good quality water over substantial distances from the Vaal River.

Figure 2 The small ephemeral wetland (*vlei*) on the Humansrus western boundary (about 0.2 ha), looking south-east.

5.3 Water Institutions

Sedibeng Water, which began its life as a Water Board supplying water to the Welkom gold mining industry in 1979, is one of fifteen Water Boards in South Africa mandated in the National Water Act (Act 36 of 1998) to manage and supply water to users in regions across South Africa. Sedibeng Water operates in the northern parts of the Free State Province, as well as parts of North-West Province and Northern Cape Province. Sedibeng Water has some of the highest bulk tariffs of all water boards because of the distances over which it must supply water.

Figure 3 Natural drainage line, looking north-west, viewed from just below the wetland shown in Figure 2. The treeline indicates the livestock-watering dam wall.

The Vaal-Gamagara pipeline, which is now managed by Sedibeng Water, was originally built to serve the Sishen Iron Ore mine near Kathu in 1953 and was not managed at that time by Sedibeng Water. However at the start of mining operations, large volumes of good quality water was discovered at the Sishen mine, which needed to be pumped out of the ore body. This effluent was used as the primary source of water for the mining operations, and also supplied the areas of Kathu, Hotazel and beyond, utilising the pipeline installed. Due to this factor, a surplus of water in terms of supply from the Vaal Gamagara pipeline was created, allowing increased consumption at other sites along the pipeline, such as Postmasburg, supporting economic development

Figure 4 Livestock watering dam on the drainage line on the western boundary of Humansrus farm. The treeline indicates the livestock-watering dam wall.

It is estimated that mines now use about 60% of the total volume of water supplied by the pipeline (I. M. Hasenjager, pers.comm.). The Vaal-Gamagara Water Supply Scheme therefore is of very significant economic importance in the Northern Cape.

Water is abstracted from the Vaal River just downstream from its confluence with the Harts and is purified (near Delportshoop). The water is pumped about 20 km to Kneukel (near the Ulco cement works), where another pump station transports the water 117 km to the Tredwil pump station and Clifton reservoir near Lime Acres (these four reservoirs have a combined capacity of 27,000 m^3 and which serve as short-term balancing supplies – this storage facility could supply water for a day in an emergency if there was a power failure at the main pump stations and water filtration plants at Delportshoop, Kneukel and Tredwil).   From this point the water is transported along the railway line to Postmasburg where after it turns north to Kathu, Hotazel ending at Black Rocks. The pipeline diameters vary between 700 mm at the source (Vaal River near the confluence with the Harts River) to 200 mm towards its terminus (Black Rocks). The pipeline branches out to supply water to surrounding areas such as Olifantshoek (including the Kalahari East pipeline) and Beesthoek. The design capacity of the pipeline is 36.37 $Ml.d^{-1}$ or 1.5 $Ml.hr^{-1}$ (1,500 m^3,hr^{-1}). The pipeline has a maximum allocation from the Vaal River of 13.7 million $m^3.a^{-1}$ but sometimes operates at less than full capacity During drought, water restrictions are imposed on abstractions

and allocations to users are curtailed on the basis of a priority classification, as well as the short-term yield characteristics of the Vaal River.

A few kilometres from the works near Lime Acres the pipeline passes near the south west side of the site. Due to the proximity of the pipeline to the proposed Humansrus CSP it is assumed that if the line has available capacity, an extraction point can be made. The landowner at Humansrus has also planned an off-take for some farm water supplies, indicating that the potential for the CSP operations to obtain water from this source is a possibility Despite the finds of water further north, the pipeline is fully committed at present (I. M. Hasenjager, Pers. Comm). Even with the construction of the new Kumba Iron Ore mine south of Postmasburg and mine dewatering supplying further water into the Vaal-Gamagara water scheme, the pipeline is already capacity (See also the section below under Potential Impacts and Cumulative Impacts for further comment on the Vaal-Gamagara water scheme).

5.4 Permits and Licenses

If the CSP uses groundwater during operations, water abstraction and use licences will be required. It is likely that a supply from the Vaal-Gamagara Water Scheme will not need to be licensed – the general policy under the National Water Act (Act 36 of 1998) is that water from a local authority, a water board, an irrigation board or another bulk water supplier does not require registration of use. This policy is subject to verification. An application to use water from the Vaal-Gamagara pipeline must however be submitted to Sedibeng Water.

6 Potential Impacts and Cumulative Impacts on Hydrology

The proposed project is unlikely to have a significant direct impact on local surface hydrology, such as interfering with surface drainage, or preventing infiltration to groundwater in ways which could affect other local or regional groundwater users. No wetlands of local or regional consequence are deemed by the author to exist in or near the proposed facility, as noted earlier.

The project may have an impact on hydrology at regional scales. A water use rate of 822 $m^3.d^{-1}$ requires that water be imported, whether via an off-take from the Vaal-Gamagara water scheme pipeline, or from local and regional groundwater resources, or both. This potential impact required further investigation in the Environmental Impact Assessment

The Vaal-Gamagara pipeline is fully committed in terms of water delivery (I.M. Hasenjager, Sedibeng Water, pers. comm.). Although it is expected that new water resources will come online in the near future as a result of mining dewatering operations i.e. newly proposed Kumba Mine near Postmasburg, the Vaal Gamagara pipeline will not have the capacity to carry the newly proposed resource as the pipeline is already fully committed. A case is however currently being made by Sedibeng Water in support of expanding the capacity of the new pipeline along the track of the existing pipeline. However due to the rock terrain it has also been indicated that the construction of the proposed pipeline extension will be a costly exercise – increasing the cost of water delivery to the users significantly (of the order R40-R50 m^{-3}.M. Hasenjager, pers. comm.).

7 Assumptions, Limitations and Constraints

Some assumptions have been made regarding the nature of the CSP. Full design specifications are not yet available but the basic nature of the system is apparent and this document works from that level of information. This document limits itself to addressing surface water issues, but comments on groundwater components because the requirement for water means that both sources (of supplied bulk water and groundwater) will be required in constructing and operating the CSP. No particular constraints have been identified.

8 Consultations and Consultation Process

In the pursuit of the development of this report, the study author consulted:

- Mr Allan Scholtz, the farm owner at Humansrus (visit – 11 May 2011);
- Members of the Groenwater Gemeenskap Rural Development Tribal Authority (Chief J.K. Marotobolo and Councilor Esther Diraditsile);
- Mr Hasenjager (Manager: Business Development and Acting Regional Manager Northern Cape, Sedibeng Water); and
- Various web resources and documents with respect to regional hydrology and climatology.

9 Recommendations for Further Studies during the EIA process

The following should be further researched during the EIA process:

- The likelihood and quantum of a mix of sources of water required for the proposed project and the likely regional impact of this competition for water;
- The potential size and location of a well field and the likelihood of impacts on other groundwater users (communities, farmers, industrial users, ecosystems);
- Possible alternative technologies for reducing the water consumption required by the proposed CSP;
- The proposer of the project may have to consider more intensely the production costs of power given the anticipated costs of water, based on the development costs of a well-field and the likely price of water obtained from an upgraded Vaal-Gamagara water supply scheme; and
- The priority basis of supply of water from the Vaal-Gamagara water supply scheme.

Please note that the Humansrus CSP is competing for water in a region of increasing water scarcity (that arises from increasing demand). The ability of Sedibeng Water to supply the CSP's needs (at current estimated use rates) is likely to be one of the important decision points in any roll out of the project.

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Appendix C

Issues and Response Report

UPDATED ISSUES AND RESPONSE REPORT: FINAL EIAR

PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, POSTMASBURG, NORTHERN CAPE PROVINCE

DEA REFERENCE: 12/12/20/2316

Prepared for: SOLARRESERVE®

Prepared by: WorleyParsons resources & energy

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JANUARY 2012

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

UPDATED ISSUES AND RESPONSE REPORT: FINAL EIAR

TABLE OF CONTENTS

LIST OF FIGURES

Appendix List

Appendix A: Copy of newspaper adverts

Appendix B: Photographs of Site notices, Posters and Pamphlets

Appendix C: Attendance Registers and Minutes of the Meetings

Appendix D: Database of Potential I&APs Contacted

Appendix E: Database of Registered I&APs

Appendix F: Written Comment from Registered I&APs

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

UPDATED ISSUES AND RESPONSE REPORT: FINAL EIAR

1 Introduction

This report aims to record all the issues, concerns, questions and comments that were received during the progression of the Public Participation Process (PPP) of the Environmental Impact Assessment (EIA) for the proposed Humansrus Thermal Solar Energy Power Plant, as contributed by the I&AP's. This report encapsulates the process and the findings of the PPP up to the end of the Scoping Phase of the EIA. The PPP was conducted in line with Chapter 6 of the National Environmental Management Act (Act 107 of 1998) (NEMA) EIA Regulations.

This report contains all the issues and concerns raised up until the end of the Scoping Phase and is updated to include all issues from the EIAR Phase after the review of the Draft.

1.1 PURPOSE OF THE COMMENTS AND RESPONSE REPORT

The purpose of the Comments and Response Report is to create a single document that records all the comments and/or queries that were highlighted and aired by the I&AP's during the investigative process and the responses thereto.

1.2 OBJECTIVES OF COMMENTS AND RESPONSE REPORT

The objective of this Comment and Response Report is to:

- Provide a formal account of the Public Participation Process undertaken as part of the EIA Process for the proposed Humansrus Thermal Solar Energy Power Plant.
- Reflect the views, comments questions or concerns of all I&AP's on the proposed project as well as the actions taken by the Environmental Assessment Practitioner to address these issues and queries.
- Establish an efficient communication channel between the project proponent, Governing Authorities, Specialists and Environmental Assessment Practitioners.
- Allow for all issues to be recorded on the database verbatim and then summarised in the report.

1.3 PROJECT DESCRIPTION

The project as described in detail in the Scoping Report entails the proposed construction and operation of a Solar Thermal Energy Power Plant on the Farm 469 The Hay RD approximately 30 km east of Postmasburg in the Northern Cape Province. SolarReserve's technology generates power from sunlight by focusing the sun's thermal energy from the heliostat field i.e. sun tracking mirrors onto a central receiver tower. The liquid salt is circulated through tubes in the receiver, collecting the energy of the sun. Once the liquid salt has been heated to a temperature of 560 degrees Celsius it is routed to an insulated storage tank i.e. the "hot" tank, where it can be stored with minimal energy losses. The heated, molten salt is routed from the "Hot" tank to a heat exchanger for the production of energy. Steam is produced by the heat exchanger and expanded through the standard Rankin cycle steam turbine which rotates a generator to produce electricity.

The molten salt is hereafter circulated back to the "cold" storage tank and the cycle repeated. Due to the energy storage ability of the proposed technology, a CSP plant of this nature, sized at 100 MW, can generate electricity for up to 24 hours a day during the summer months and between 12 to 16 hours a day in the spring, autumn and winter months. The proposed plant will utilise hybrid cooling technology to condense the water used during the steam cycle.

2 Public Participation Process

The Public Participation Process (PPP) provides all persons who is or may be affected by the proposed project with the opportunity to become involved in the planning phases. The process of Public Participation is defined in the EIA Regulations GNR 385 as promulgated under the National Environmental Management Act 107 of 1998 (as amended in 2002).

This process is used to reflect the consultations with and conveyance of information to all I&AP's through, for example, information distributing; public meetings; focus group meetings; stakeholder workshops and consultation session.

The PPP can be categorised as follows:

Phase 1: Stakeholder Identification

Phase 2: Stakeholder Notification

Phase 3: Stakeholder Consultation

Phase 4: Comments & Response Report

The Appendices will include copies of the following:

- Appendix A: Advertisement
- Appendix B: Site Notices
- Appendix C: Attendance Registers and Minutes of the Meetings

2.1 OBJECTIVES OF PUBLIC PARTICIPATION PROCESS

The Public Participation Process aims to:

- To inform Interested and Affected Parties (I&APs) of the proposed project;
- To identify issues, comments and concerns as raised by I&APs;
- To promote transparency and an understanding of the project and its consequences;
- To serve as a structure for liaison and communication with I&APs; and
- To provide local knowledge and input in identifying potential environmental (biophysical and social) impacts and "hotspots" associated with the proposed development.

Throughout the Public Participation process various methods of notification was used to inform IAPs about the progress of the project. The various forms of notification enlisted are as follows:

- Advertisements;
- Pamphlets and posters;
- Site Notices; and
- Letters which are sent via post, fax or e-mail.

The identification of IAP's is a continuous process and all persons feeling the need to register are requested to do so.

2.2 PROJECT NOTIFICATIONS & PUBLIC MEETINGS

2.2.1 ADVERTISEMENTS

As per the statutory requirements of the 2010 EIA Regulations, I&APs were informed and the project was advertised in the following local newspapers on 14 July 2011:

- *Diamondfield Advertiser (English); and*
- *Kalahari Bulletin (Afrikaans and Setswana).*

The advertisement provided an abstract on key aspects of the proposed project (project description, location, application process and contact details of the Environmental Assessment Practitioners). Furthermore the advertisement requested I&APs to register, and to become involved in the project by submitting comments and highlighting issues of concern to the WorleyParsons RSA and SSI Environmental. The primary aim of the newspaper advert was to ensure that the widest possible group of I&APs were informed of the project.

The notification of the availability of the Draft EIAR for public review was advertised on 1 December 2011 in the following newspapers:

– *Diamondfield Advertiser (English); and*

– *Kalahari Bulletin (Afrikaans and Setswana).*

2.2.2 BACKGROUND INFORMATION DOCUMENT

A Background Information Document (BID) for the project was compiled in predominant languages of the area namely: English, Afrikaans and Setswana. The aim of this document was to provide a brief outline of the proposed project, the EIA Process, specialist studies to be undertaken, alternatives being investigated, the PP Process and lastly explained how I&APs could become involved in the project. The briefing paper, together with a *"registration and comment"* sheet was distributed to identified stakeholders and I&APs via either post or e-mail, inviting them to register for the proposed project and submit details of any issues and concerns that they may have. An introductory letter was sent to all I&APs and Stakeholders together with the briefing paper and comments sheet.

Furthermore BIDs were placed at:

– Kgatelopele Local Municipality Public Library (222 Barker Street, Daniëlskuil);

– Tsantsabane Local Municipality Public Library (Bo Street, Postmasburg); and

– Tsantsabane Local Municipality mobile Public Library in Groenwater.

2.2.3 SITE NOTICES

Site notices were prepared according to the requirement set out in the EIA Regulations. The site notices included basic information regarding the proposed project, application process, I&AP registration and contact details of the Environmental Assessment Practitioners. Three site notices (English, Afrikaans and Setswana) were place date the northern boundary of the development site in close proximity to the site entrance from the R385 – refer to Figure 1.

Figure 1: Site notice

2.3 Pamphlets and Notices

The site notice was printed on A5 sized paper (pamphlets) and distributed via the South African Post Office Services post boxes in Postmasburg (± 1 100 post boxes) and Daniëlskuil (± 800 post boxes).

Furthermore sets of A4 and A3 site notices were placed on notice boards at the following amenities frequented by I&APs in both the Postmasburg and Daniëlskuil areas:

- Postmasburg:
  - Tsantsabane Local Municipality;
  - Postmasburg Agricultural Centre;
  - SPAR; and
  - Saverite.
- Daniëlskuil:
  - Kgatelopele Local Municipality;
  - OK Foods;
  - Friendly Grocer; and
  - Saverite.

2.3.1 Public Review of Draft Environmental Scoping Report

The draft Environmental Scoping Report was available for public review at the following locations in close proximity to the study area, which were identified as readily accessible to I&APs:

- Tsantsabane Local Municipal offices;
- Postmasburg Public Library – Bo Street, Postmasburg;
- Kgatolopele Local Municipal offices;
- Daniëlskuil Public Library – 222 Barker Street, Daniëlskuil;
- Mobile Public Library in Groenwater;
- The following website: WorleyParsons RSA : www.kv3engineers.com.

The availability of this draft report was advertised in the Diamondfield Advertiser and Kalahari Bulletin on 18 August 2011. On-site notices were also placed on the perimeter of the site, pamphlets were distributed in the post boxes of Daniëlskuil, Postmasburg and Lime Acres and posters were placed on community notice boards at the following venues (Refer to **Appendix B** for the photographs of site notices, pamphlets and posters):

Daniëlskuil

- Friendly Grocer;
- OK Foods;
- Kgatelopele Local Municipality; and
- Siyanda District Offices of the Department of Social Services and Population Development.

Lime Acres

- Lime Acres Family Store

Owendale village

- Entrance gate to the Owendale village

Postmasburg

- SPAR; and
- Saverite.

A 60-calendar day period was allowed for this review process from 18 August 2011 to 17 October 2011. Stakeholders and I&APs on the project database were notified of the availability of this report via post or e-mail. The report was also distributed to all the commenting authorities for review and comment in electronic or hard copy format.

2.3.2 Final Environmental Scoping Report

The compilation of the Final Scoping Report entailed the consideration and inclusion of all relevant comments received from the public during the review of the Draft Scoping Report. The final document was submitted to DEA as well as Northern Cape Provincial Department of Environment Affairs and Conservation for authority review and decision-making and/or commenting purposes.

2.3.3 Consultation and Public Meetings

Through consultations with I&APs and Stakeholders, issues for inclusion within the Final Scoping Report were identified and recorded. Consultations took place in the form of formal meetings with I&APs and other stakeholders. The primary aims of the meetings were to:

- Disseminate background information regarding the proposed project to I&APs;
  - Supply more information regarding the EIA Process and the findings of the specialist studies undertaken during the Scoping Phase;
  - Answer questions regarding the project and the EIA Process;
  - Obtain feedback from I&APs with respect to the proposed project; and
  - Receive input regarding the Public Participation Process.

Three public meetings with I&APs were held during the public review period of the Draft Scoping Report. The meetings were held at:

- The Postmasburg Town Hall on 25 August 2011 at 17:30; and
- Groenwater Community Hall (approximately 5 km west of the Humansrus site) on 26 and 29 August 2011 at 17:30.

The purpose of the public meetings were to discuss the key findings of the Scoping Phase and provide the representatives with an additional platform to provide input to the EIA Process.

Stakeholders and I&APs were notified of the public meetings through the following methods:

- Invitation letter sent via either e-mail, registered mail and/or fax;
- Telephonic dialogue with key Stakeholders;
- Distribution of pamphlets; and
- Liaison with the relevant Ward Councillors and Ward Committee Representatives.

The minutes of the public meeting were compiled, distributed to attendees of the meetings and included in this Final Scoping Report for record purposes. Refer to **Appendix B** for the attendance registers and minutes of the meetings.

Networking with I&APs, will further continue throughout the duration of the project.

2.3.4 PUBLIC REVIEW OF DRAFT EIAR

The Draft EIA Report was available for public review at the following locations in close proximity to the study area, which were identified as readily accessible to I&APs:

- Tsantsabane Local Municipal offices;
- Postmasburg Public Library – Bo Street, Postmasburg;
- Kgatolopele Local Municipal offices;
- Daniëlskuil Public Library – 222 Barker Street, Daniëlskuil;
- Mobile Public Library in Groenwater;

The availability of this draft report was advertised in the Diamondfield Advertiser and Kalahari Bulletin on 1 December 2011. On-site notices were also placed on the perimeter of the site, pamphlets were distributed in the post boxes of Daniëlskuil, Postmasburg and Lime Acres and posters were placed on community notice boards at the following venues (Refer to **Appendix B** for the photographs of site notices, pamphlets and posters):

Daniëlskuil

- OK Foods;
- Kgatelopele Local Municipality; and

- Siyanda District Offices of the Department of Social Services and Population Development.

Postmasburg

- SPAR; and
- Saverite.

A 36-calendar day period was allowed for this review process from 1 December 2011 to 23 January 2012 excluding the holiday period over December. Stakeholders and I&APs on the project database were notified of the availability of this report via post or e-mail. The report was also distributed to all the commenting authorities for review and comment in electronic or hard copy format. The responses to the Draft EIAR were limited to the correspondence from Jacoline Mans from DAFF Northern Cape, contained in **Appendix F**.

2.3.5 Interested and Affected Parties

A database of all potential I&APs was compiled and all persons in the database was contacted and requested to register in order to be kept informed of the process throughout. The list of potential I&APs is contained in **Appendix D**. **Appendix E** contains the details of all the persons who have shown an interest in the project and who have registered as I&APs. Please note that the process of public participation is continuous and this section will be updated as the project proceeds into the EIA Phase. Notices will be sent to all registered I&AP's keeping them informed of any further public participation.

3 Comments and Responses

All comments and queries aired during the public meetings were noted and addressed in the meetings. Please refer to the minutes of the meetings in **Appendix C**. All written comments received from registered I&APs were noted and are contained in **Appendix F** and have been sufficiently addressed in the EIA Report.

4 Conclusion

No issues of great concern was raised during the public participation with regards to environmental concerns related to the proposed project which was not sufficiently addressed during the public meetings nor covered by the specialist assessments. The majority of all issues raised were of a commercial or technical nature and did not hold great relevance towards the EIA and environmental concerns.

APPENDIX A: COPY OF NEWSPAPER ADVERTS

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NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT: PUBLIC PARTICIPATION PROCESS

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008), of the availability of the Draft EIA Report for public review and comment for the proposed project:

HUMANSRUS CONCENTRATING SOLAR THERMAL ENERGY POWER PLANT DEA REF: 12/12/20/2316

PROJECT DESCRIPTION

SolarReserve SA (Pty) LTD proposes the construction and operation of a 100 MegaWatt Concentrating Solar Thermal Energy Power (CSP) plant and associated infrastructure. The proposed project location is on Farm 469, the Hay RD, in the Siyanda District Municipal area, Northern Cape. The proposed CSP plant site is approximately 6 km2 (600 ha) in extent as indicated in the initial advertisements and notices of the proposed project dated 14 July 2011.

PUBLIC PARTICIPATION PROCESS

All interested and affected parties (I&APs) wishing to participate in the Public Participation Process is invited to comment on the Draft EIA Report. All I&AP comment must be included and addressed in the final report prior to submission to the competent authority. This includes comments from the public meetings as well.

DRAFT EIA REPORT

The Draft EIA Report will be available for review and comment for a period of 35 days from 1 December 2011 to 23 January 2012. This Report will be available at the following venues:

- Groenwater Mobile Library
- Tsantsabane and Kgatolopele Local Municipal Offices
- Postmasburg and Daniëlskuil Public Libraries

Please contact Ms Leanna Rautenbach if you need a hard or electronic copy of this Report.

INTERESTED & AFFECTED PARTIES (I&AP)

Registered I&APs can submit comments/ or concerns in relation to the project to the WorleyParsons RSA contact person below on or before 23 January 2012.

Parties or persons wishing to register as an I&AP are requested to forward their contact details and comments/or concerns in relation to the project to the WorleyParsons RSA contact person provided below.

DATE OF NOTICE

1 December 2011

ENVIRONMENTAL ASSESSMENT PRACTITIONER

WorleyParsons RSA
Ms Leanna Rautenbach

P.O. BOX 36155
Menlo Park
0102
Telephone: 012 425 6300
Fax: 012 460 9978
Email: leanna.rautenbach@worleyparsons.com

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ME. NICOLENE SCHOEMAN, oudioloog en verkoopskonsultant van die Oticon-gehoorapparaatmaatskappy, het die dokters op Upington toegespreek oor wat oudiologie behels. Dr. Johann Gildenhuys, oor-, neus-, en keelspesialis by die Gordonia-hospitaal, het ook die dokters toegespreek.

Me. Magda Leibbrandt, plaaslike oudioloog, het dié dokters laat voel hoe dit voel as iemand in jou ore rondkrap.

Tydens die werksessie is timpanogramme en OAE-metings ook gedoen.

VAN links is dr. Johann Gildenhuys, me. Magda Leibbrandt, dr. Jenny Bruwer en dr. Gideon van As (agter).

Foto: verskaf

Met fliek bederf

DIE Suid-Afrikaanse Polisiediens op Rosedale het die bejaardes van die Vlytige Bejaardesentrum na die Ster-Kalahari vir 'n fliek geneem. Sers. Jacobus Benjamin, koördineerder van maatskaplike misdaadvoorkoming, en konst. Raty Links, sektorbestuurder, het hulle vergesel.

Foto: verskaf

WorleyParsons resources & energy — **EcoNomics**

KENNISGEWING VAN OMGEWINGSIMPAKASSESSERING: OPENBARE DEELNAMEPROSES

Kennis geskied hiermee kragtens die Omgewingsimpakassessering (EIA) Regulasies, gepubliseer in Staatskennisgewing Nr. R543 tot 546 (2010), gepromulgeer ingevolge Artikel 24(5) van die Wet op Nasionale Omgewingsbestuur: Afval (Wet Nr. 59 van 2008), van die beskikbaarheid van die Konsep EIA Verslag vir openbare insae en kommentaar op die voorgenome projek:

HUMANSRUS KONSENTRERENDE TERMIESE SONKRAG-AANLEG
DEA VERW.: 12/12/20/2316

BESKRYWING VAN PROJEK

SolarReserve SA (Edms) Bpk stel die konstruksie en bedryf van 'n 100 Megawatt Konsentrerende Termiese Sonkrag (CSP)-aanleg en verwante infrastruktuur voor. Die voorgestelde ligging van die projek is op Plaas 469, die Hay RD, in die gebied van die Siyanda Distriks-munisipaliteit, Noord-Kaap. Die voorgestelde CSP-aanlegterrein is ongeveer 6 km2 (600 ha) in omvang, soos aangedui in die aanvanklike advertensies en kennisgewings oor die voorgestelde projek gedateer 14 Julie 2011.

OPENBARE DEELNAMEPROSES

Alle belanghebbende en geaffekteerde partye (I&APs) wat aan die Openbare Deelnameproses wil deelneem, word genooi om kommentaar op die Konsep EIA Verslag te lewer. Alle I&AP kommentaar moet by die finale verslag ingesluit en aangespreek word voor voorlegging aan die bevoegde gesag. Dit sluit ook kommentaar van die openbare vergaderings in.

KONSEP OMVANGBEPALINGSVERSLAG

Die Konsep EIA Verslag sal vir insae en kommentaar vir 'n tydperk van 60 dae vanaf 1 Desember 2011 tot 17 Februarie 2012 beskikbaar wees. Hierdie Verslag sal by die volgende lokale beskikbaar wees:

- Groenwater Mobiele Biblioteek
- Tsantsabane en Kgatolopele Plaaslike Munisipale Kantore
- Postmasburg en Daniëlskuil Openbare Biblioteke

Kontak asseblief Me Leanna Rautenbach indien u 'n harde- of elektroniese afskrif van hierdie Verslag benodig.

BELANGHEBBENDE & GEAFFEKTEERDE PARTYE (I&AP)

Geregistreerde I&APs kan voor of op 17 Februarie 2012 kommentaar/of enige besorgdheid ten opsigte van die projek by die WorleyParsons RSA kontakpersoon hieronder indien.

Partye of persone wat as 'n I&AP wil registreer, word versoek om hulle kontakbesonderhede en kommentaar/ of enige besorgdheid ten opsigte van die projek na die WorleyParsons RSA kontakpersoon hieronder aan te stuur.

DATUM VAN KENNISGEWING

1 Desember 2011

OMGEWINGSASSESSERING- PRAKTISYN

WorleyParsons RSA
Me Leanna Rautenbach

Posbus 36155
Menlo Park
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WorleyParsons resources & energy — **EcoNomics**

KITSISO KA TSHEKATSHEKO YA DIPHELELO TSA MO TIKOLOGONG: THULAGANYO YA GO NNA LE SEABE GA BAAGI

Go dirwa kitsiso fano go tsamaisana le Melao ya Tshekatsheko ya Diphelelo tsa mo Tikologong (EIA), e e gatisitsweng mo Dikitsisong tsa Puso tsa R543 to 546 (2010), o o tlhamilweng go ya ka Karolo 24(5) ya National Environmental Management Act (Molao wa Bosetšhaba wa go Tsamaisiwa ga Tikologo) (Molao wa bo 107 wa ka 1998) le wa National Environmental Management (Molao wa Bosetšhaba wa go Laola Tikologo): Waste Act (Molao wa Matlakala) (Molao wa bo 59 wa ka 2008), wa go nna teng ga Pegelo ya EIA ya Mametlelelo ya tshekatsheko ya baagi le ditshwaelo tsa bone ya porojeke e e tshitshintsweng:

BODIRELO JWA KWA HUMANSRUS JWA MAATLA A MOTLAKASE A A DIRISANG MOGOTE WA MARANG A LETSATSI A A LAOLWANG
DEA REF: 12/12/20/2316

TLHALOSO YA POROJEKE

SolarReserve SA (Pty) LTD e tshitshinya gore go agiwe Bodirelo Jwa Maatla a Motlakase a a Dirisang Mogote wa Marang a Letsatsi a a Laolwang (Concentrating Solar Thermal Energy Power [CSP]) jwa Di-MegaWatt di le 100 gore bo dirisiwe le gore go agiwe dilo tse dingwe tse di tla tlhokegang. Lefelo le go tshitshintsweng gore porojeke eno e direlwe kwa go lone ke Polasi ya 469, ya Hay RD, mo lefelong la Mmasepala wa Kgaolo ya Siyanda, kwa Kapa Bokone. Setsha sa madirelo sa CSP se se tshitshintsweng se bokgakala jwa mo e ka nnang 6 km2 (600 ha) jaaka go bontshitswe mo diphasalatsong tsa kwa tshimologong le mo dikitsisong tsa porojeke e e tshitshinngwang tsa ka di 14 July 2011.

THULAGANYO YA GO NNA LE SEABE GA BAAGI

Batho botlhe ba ba nang le kgatlhego mo go seno ebile se ba ama (I&APs) ba ba batlang go nna le seabe mo Thulaganyong ya go Nna le Seabe ga Baagi ba laletswa go dira ditshwaelo malebang le Pegelo ya Mametlelelo ya EIA. Ditshwaelo tsotlhe tsa ba=I&AP di tshwanetse go kwalwa mo pegong ya bofelo e bile go tshwanetse ga tlotlwa ka tsone pele ga fa di romelwa kwa bathating ba ba nang le bokgoni. Seno se akaretsa le ditshwaelo tse di dirilweng mo kopanong ya baagi botlhe.

TSHEKATSHEKO YA PEGELO YA MAMETLELELO YA PATLISISO

Pegelo ya Mametlelelo ya EIA e tlile go nna teng go ka sekasekiwa le go ka tshwaela ka yone sebaka sa malatsi a le 60 go tloga ka di 1 December 2011 go ya go di 17 February 2012. Pegelo eno e tlile go nna teng kwa mafelong a a latelang:

- Groenwater Mobile Library
- Tsantsabane le kwa Diofising Tsa Mmasepala wa Gaeno tsa Kgatelopele
- Postmasburg le Dilaeborari Tsa Baagi Tsa Daniëlskuil

Re kopa gore o ikgolaganye le Ms Leanna Rautenbach fa o batla khopi ya pampiri kgotsa ya eleketeroniki ya Pegelo eno.

BATHO BA BA NANG LE KGATLHEGO MO GO SENO EBILE SE BA AMA (I&AP)

Batho ba ba Nang le Kgatlhego mo go seno Ebile se ba Ama (I&APs) ba ka romela ditshwaelo/kgotsa dilo tse ba amegileng ka tsone malebang le porojeke eno kwa mothong yo go ka ikgolaganngwang le ene wa WorleyParsons RSA ka di 17 February 2012 kgotsa pele ga moo.

Makoko kgotsa batho ba ba eletsang go ikwadisa jaaka ba-&AP ba kopiwa gore ba romele dintlha-kgokagano tsa bone le ditshwaelo/kgotsa matshwenyego ka porojeke kwa mothong yo go tshwanetseng ga ikgolaganngwa le ene wa WorleyParsons RSA yo go beilweng leina la gagwe fa tlase fano.

LETLHA LA KITSISO

1 December 2011

MOITSEANAPE WA TSHEKATSHEKO YA BOEMO JWA TIKOLOGO

WorleyParsons RSA
Ms Leanna Rautenbach

P.O. BOX 36155
Menlo Park
0102
Mogala: 012 425 6300
Fekese: 012 460 9978
Imeile: leanna.rautenbach@worleyparsons.com

Incorporating KV3 ENGINEERS — SOLARRESERVE

KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGPROSES

Kennis word hiermee gegee kragtens die Omgewingsimpakbepaling (OIB) regulasies wat verskyn in Regeringskennisgewings Nr. R543 tot 546 (2010), afgekondig ingevolge Artikel 24(5) van die Wet op Nasionale Omgewingsbestuur (Wet Nr. 107 van 1998) en die Wet op Nasionale Omgewingsbestuur: Afval (Wet Nr. 107 van 1998), dat SolarServe SA (Edms) BPK van voorneme is om gelyste aktiwiteite te onderneem wat 'n Omgewingsmagtiging en 'n Afvalbestuurslisensie van die Nasionale Departement van Omgewingsake (DOS) vereis.

HUMANSRUS KONSENTRERENDE SONTERMIESE ENERGIEKRAGAANLEG
DOS-VERW: 12/12/20/2316

PROJEKBESKRYWING

SolarReserve SA (Edms) BPK stel die konstruksie en ontwikkeling van 'n 100-Megawatt-sontermiese-energiekragaanleg (STEK-aanleg) en gepaardgaande infrastruktuur voor. Die voorgestelde STEK-aanlegterrein is ongeveer 6 km2 in omvang. Die STEK-aanleg bestaan primêr uit die volgende vier substelsels:

- Sonveld wat bestaan uit alle dienste en infrastruktuur wat verband hou met die bestuur en bedryf van 2-as sonvolgende heliostate;
- Gesmelte soutbaan wat die termiese bergingstenks vir die berging van die vloeibare sout, 'n konsentrasie-toring/ontvanger, pyplyne en hittewisselaars insluit;
- Die kragblok wat die stoom-turbine/opwekker huisves;
- Hulpfasiliteite en –infrastruktuur wat die kondensatorverkoelingstelsel, elektrisiteit-transmissielyne vir netwerkverbinding, toegangsroetes, watervoorsiening en –fasiliteite en aansitenergie-aanleg (gas of diesel) opwekkers insluit.

AANSOEKPROSES

'n Aansoek om 'n geïntegreerde permit (d.w.s. 'n Omgewingsmagtiging en Afvalbestuur-lisensie) is by die bevoegde owerheid, die DOS, ingedien. Die volgende projekverwysings-nommer is uitgereik – 12/12/20/2316. Hierdie verwysingsnommer moet in alle korrespondensie aan die Omgewingsimpak-praktisyne en die DOS aangehaal word.

AANSOEKER

SolarReserve SA (Edms) BPK

PROJEKLIGGING

Die Plaas 469, die Hay RD, in die Siyanda-distrik munisipale area, Noord-Kaap. Die voorgestelde terrein is naby die R358 geleë, ongeveer 30 km oos van Postmasburg, Noord-Kaap.

HOE OM TE REGISTREER

Partye of persone wat as 'n belangstellende en geraakte party (B&GP) wil geregistreer ten einde bykomende inligting rakende hierdie aansoek te ontvang, word versoek om hulle kontakbesonderhede en kommentaar en/of kwessies in verband met die projek aan WorleyParsons RSA of SSI Environmental te stuur – besonderhede van die kontakpersone word hieronder verstrek. Let asseblief daarop dat kommentaar/navrae binne 60 dae van die publikasie aan die omgewingskonsultant voorgelê moet word. 'n Agtergrond-inligtingsdokument is op versoek beskikbaar.

Geliewe kennis te neem dat B&GPs in kennis gestel sal word van die besonderhede van beplande openbare / fokusgroepvergaderings en die beskikbaarheid van die konsep-omvangbepalingsverslag vir openbare hersiening.

DATUM VAN KENNISGEWING

14 Julie 2011

OMGEWINGSIMPAKPRAKTISYNE

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KITSISO YA TSAMAISO YA TLHATLHOBO YA SEKGATLHA MO TIKOLOGONG

Kitsiso e neetswe malebana le Molao ya Tlhatlhobo ya Sekgatlha sa Tikologo (EIA), e e gatisitsweng mo Dikitsisong tsa Puso Nr. R543 go ya go 546 (2010), e e diranang le Karolo 24(5) ya Molao wa Bosetšhaba ya Botsamaisi ba Tikologo (Molao 107 wa 1998) le Botsamaisi ba Bosetšhaba ba Tikologo: Molao wa Matlakala (Molao 59 wa 2008) gore SolarReserve SA (Pty) LTD e e ikaeletseng go tsaya ditirwana tse kwetsweng di tlhoka laesense ya Tetlelelo ya Tikologo le ya Botsamaisi ba Matlakala go tswa mo Lefapheng la Bosetšhaba la Merero ya Tikologo (DEA):

POLANTE YA THEMALE YA MATLA YA KWA HUMANSRUS
DEA REF: 12/12/20/2316

TLHALOSO YA POROJEKE

SolarReserve SA (Pty) LTD e tshitsinya kago le tiragatso ya Polante ya Solara ya Themale ya Matla ya Mekhawate di le 100 le dikago tse di tsamaelanang (CSP). Bogolo ba porojeke: Saete e e tshitsinntsweng ya polante ke 6 km2 ka bogolo. Polante ya CSP e na le dithusatsamaiso di ken ne tse di latelang:

- Lebala la Solara le le nang le ditirelo tsotlhe le dikago tse di amanang le botsamaisi le tiragatso ya heliosetate ya letsatsi la ekesisi 2-;
- Sekete ya Molten Salt e e nang le ditanka tsa polokelo tse di bothito go boloka letswai le le mtsi, seamogedi/tora, dipeipi le ditsamaisa molelo;
- Jenereitara/Thebine ya Boloko ba Matla a tsa Matlo;
- Didiriswa tsa tlaleletso le kago tse di tsenyeletsang tsamaiso ya go gatsetsa, mela ya go tsamaisa motlakase go gokaganya keriti, ditsela tsa phitlhelelo, neelano ya metsi le sediriswa sa polante go simolola matla (dijenereitara tsa gase kgotsa tsa disele).

TSAMAISO YA TIRISO

Kopo ya tetlelelo e e lomaganeng (sk.laesense ya tetla ya tikologo le botsamaisi ba matlakala) e neilwe bobusi jo bo nang le bokgoni, e leng DEA. Nomoro ya kaelo ya porojeke e e latelang e neetswe – 12/12/20/2316. Nomoro e e tshwanetse go tlhagelela mo dikgolaganong tsotlhe go ya go Badiredi ba Tlhatlhobo ya Tikologo le DEA.

MOKOPI

SolarReserve SA (Pty) LTD

LEFELO

Polase 469, HayRD mo Lefelong la Mmasepala wa Sedika sa Siyanda, Kapa Bokone. Saete e e tshitsinntsweng e mo tseleng ya R358, e ka nna 30 km botlhaba ba Postmasburg, Kapa Bokone.

O IKWADISA JANG

Maloko kgotsa batho ba ba eletsang go ikwadisa jaaka baba nang le kgatlhego le lekoko le le amegang (I&AP)go bona tshedimosetso e nngwe malebana le kopo e ba kopiwa go romela dintlha tsa bona tsa kgolagano le ditshwaelo/kgotsa matshwenyego a bona mo porojekeng go WorleyParsons RSA kgotsa SSI Environmental – dintlha tsa batho ba go ka golaganngwang le bona di neetswe fa tlase. Elatlhoko gore ditshwaelo/dipotso di tla isiwa kwa kantorong ya tikologo mo maatsing a le 60 a kgatiso ya kitsiso eo. Tokomane ya Lemorago la Tshedimosetso e ka bonwa fa e ka kopiwa.

Itse gore I&APs e tla itsisiwe ka dintlha tsa dikopano tsa setšhaba tse di ikaeletsweng /setlhopha sa tsepo le go nna teng ga Pegelo ya Tebogape ya Setšhaba.

LETLHA LA KITSISO

14 Phukwi, Ngwaga wa kete pedi some le bongwe

BADIREDI BA TLHATLHOBO YA TIKOLOGO

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SOLARRESERVE
WorleyParsons resources & energy
SSI A DHV COMPANY

KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGPROSES

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HUMANSRUS KONSENTRERENDE SON-TERMIESE ENERGIEKRAGAANLEG

DOS-VERW: 12/12/20/2316

PROJEKBESKRYWING

SolarReserve SA (Edms) BPK stel die konstruksie en ontwikkeling van 'n 100 Megawatt Sontermiese-Energiekragaanleg (STEK-aanleg) en gepaardgaande infrastruktuur voor. Die voorgestelde STEK-aanlegterrein is ongeveer 6 km^2 in omvang. Die STEK-aanleg bestaan primêr uit die volgende vier substelsels:

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'n Aansoek om 'n geïntegreerde permit (d.w.s. 'n Omgewingsmagtiging en Afvalbestuurlisensie) is by die bevoegde owerheid, die DOS, ingedien. Die volgende projekverwysingsnommer is uitgereik – **12/12/20/2316**. Hierdie verwysingsnommer moet in alle korrespondensie aan die Omgewingsimpak-praktisyne en die DOS aangehaal word.

AANSOEKER

SolarReserve SA (Edms) BPK

PROJEKLIGGING

Die Plaas 469, die Hay RD, in die Siyanda-distrik munisipale area, Noord-Kaap. Die voorgestelde terrein is naby die R358 geleë, ongeveer 30 km oos van Postmasburg, Noord-Kaap.

HOE OM TE REGISTREER

Partye of persone wat as 'n belangstellende en geraakte party (B&GP) wil geregistreer ten einde bykomende inligting rakende hierdie aansoek te ontvang, word versoek om hulle kontakbesonderhede en kommentaar en/of kwessies in verband met die projek aan WorleyParsons RSA of SSI Environmental te stuur – besonderhede van die kontakpersone word hieronder verstrek. Let asseblief daarop dat kommentaar/navrae binne ***60 dae*** van die publikasie aan die omgewingskonsultant voorgelê moet word. 'n Agtergrondinligtingsdokument is op versoek beskikbaar.

Geliewe kennis te neem dat B&GPs in kennis gestel sal word van die besonderhede van beplande openbare / fokusgroepvergaderings en die beskikbaarheid van die konsep Omvangbepalingsverslag vir openbare hersiening.

DATUM VAN KENNISGEWING

14 Julie 2011

OMGEWINGSIMPAKPRAKTISYNE

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Me. Leanna Rautenbach

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SOLARRESERVE®

WorleyParsons
resources & energy

SSI
A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) that SolarReserve SA (Pty) LTD intends to carry out listed activities requiring both an Environmental Authorisation and a Waste Management License from the National Department of Environmental Affairs (DEA):

HUMANSRUS CONCENTRATING SOLAR THERMAL ENERGY POWER PLANT

DEA REF: 12/12/20/2316

PROJECT DESCRIPTION

SolarReserve SA (Pty) LTD proposes the construction and operation of a 100 MegaWatt Concentrating Solar Thermal Energy Power (CSP) plant and associated infrastructure. The proposed CSP plant site is approximately 6 km^2 in extent. The CSP plant comprises primarily of the following four subsystems:

- Solar Field that consists of all services and infrastructure related to the management and operation of the 2-axis sun tracking heliostats;
- Molten Salt Circuit which includes the thermal storage tanks for storing the liquid salt, a concentration tower/receiver, pipelines and heat exchangers;
- The Power Block housing the steam turbine/generator;
- Auxiliary facilities and infrastructure which includes the condenser-cooling system, electricity transmission lines for grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

APPLICATION PROCESS

An application for an integrated permit (i.e. environmental authorisation and waste management license) has been submitted to the competent authority, the DEA. The following project reference number has been issued – **12/12/20/2316**. This number is to be referenced on all correspondence to the Environmental Assessment Practitioners and the DEA.

APPLICANT

SolarReserve SA (Pty) LTD

PROJECT LOCATION

The Farm 469, the Hay RD, in the Siyanda District Municipal area, Northern Cape. The proposed site is situated just off the R358, approximately 30 km east of Postmasburg, Northern Cape.

HOW TO REGISTER

Parties or persons wishing to register as an interested and affected party (I&AP) in order to obtain additional information regarding this application are requested to forward their contact details and comments/or concerns in relation to the project to WorleyParsons RSA or SSI Environmental – details of the contact persons are provided below. Please note that comments/queries are to be submitted to the environmental consulting within ***60 days*** of publication of this notice. A background information document is available upon request.

Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

DATE OF NOTICE

14 July 2011

ENVIRONMENTAL ASSESSMENT PRACTITIONERS

WorleyParsons RSA
Ms. Leanna Rautenbach

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KITSISO YA TSAMAISO YA TLHATLHOBO YA SEKGATLHA MO TIKOLOGONG

Kitsiso e neetswe malebana le Molao ya Tlhatlhobo ya Sekgatlha sa Tikologo (EIA), e e gatisitsweng mo Dikitsisong tsa Puso Nr. R543 go ya go 546 (2010), e e diranang le Karolo 24(5) ya Molao wa Bosetšhaba ya Botsamaisi ba Tikologo (Molao 107 wa 1998) le Botsamaisi ba Bosetšhaba ba Tikologo: Molao wa Matlakala (Molao 59 wa 2008) gore SolarReserve SA (Pty) LTD e e ikaeletseng go tsaya ditirwana tse kwetsweng di tlhoka laesense ya Tetlelelo ya Tikologo le ya Botsamaisi ba Matlakala go tswa mo Lefapheng la Bosetšhaba la Merero ya Tikologo (DEA):

POLANTE YA THEMALE YA MATLA YA KWA HUMANSRUS

DEA REF: 12/12/20/2316

TLHALOSO YA POROJEKE

SolarReserve SA (Pty) LTD e tshitsinya kago le tiragatso ya Polante ya Solara ya Themale ya Matla ya Mekhawate di le 100 le dikago tse di tsamaelanang (CSP). Bogolo ba porojeke: Saete e e tshitsinntsweng ya polante ke 6 km^2 ka bogolo. Polante ya CSP e na le dithusatsamaiso di ken ne tse di latelang:

- Lebala la Solara le le nang le ditirelo tsotlhe le dikago tse di amanang le botsamaisi le tiragatso ya heliosetate ya letsatsi la ekesisi 2-;
- Sekete ya Molten Salt e e nang le ditanka tsa polokelo tse di bothito go boloka letswai le le mtsi, seamogedi/tora, dipeipi le ditsamaisa molelo;
- Jenereitara/Thebine ya Boloko ba Matla a tsa Matlo;
- Didiriswa tsa tlaleletso le kago tse di tsenyeletsang tsamaiso ya go gatsetsa, mela ya go tsamaisa motlakase go gokaganya keriti, ditsela tsa phitlhelelo, neelano ya metsi le sediriswa sa polante go simolola matla (dijenereitara tsa gase kgotsa tsa disele).

TSAMAISO YA TIRISO

Kopo ya tetlelelo e e lomaganeng (sk.laesense ya tetla ya tikologo le botsamaisi ba matlakala) e neilwe bobusi jo bo nang le bokgoni, e leng DEA. Nomoro ya kaelo ya porojeke e e latelang e neetswe – 12/12/20/2316. Nomoro e e tshwanetse go tlhagelela mo dikgolaganong tsotlhe go ya go Badiredi ba Tlhatlhobo ya Tikologo le DEA.

MOKOPI

SolarReserve SA (Pty) LTD

LEFELO

Polase 469, HayRD mo Lefelong la Mmasepala wa Sedika sa Siyanda, Kapa Bokone. Saete e e tshitsinntsweng e mo tseleng ya R358, e ka nna 30 km botlhaba ba Postmasburg, Kapa Bokone.

O IKWADISA JANG

Maloko kgotsa batho ba ba eletsang go ikwadisa jaaka baba nang le kgatlhego le lekoko le le amegang (I&AP)go bona tshedimosetso e nngwe malebana le kopo e ba kopiwa go romela dintlha tsa bona tsa kgolagano le ditshwaelo/kgotsa matshwenyego a bona mo porojekeng go WorleyParsons RSA kgotsa SSI Environmental – dintlha tsa batho ba go ka golaganngwang le bona di neetswe fa tlase. Elatlhoko gore ditshwaelo/dipotso di tla isiwa kwa kantorong ya tikologo mo maatsing a le 60 a kgatiso ya kitsiso eo. Tokomane ya Lemorago la Tshedimosetso e ka bonwa fa e ka kopiwa.

Itse gore I&APs e tla itsisiwe ka dintlha tsa dikopano tsa setšhaba tse di ikaeletsweng /setlhopha sa tsepo le go nna teng ga Pegelo ya Tebogape ya Setšhaba.

LETLHA LA KITSISO

14 Phukwi, Ngwaga wa kete pedi some le bongwe

BADIREDI BA TLHATLHOBO YA TIKOLOGO

WorleyParsons RSA
Ms. Leanna Rautenbach

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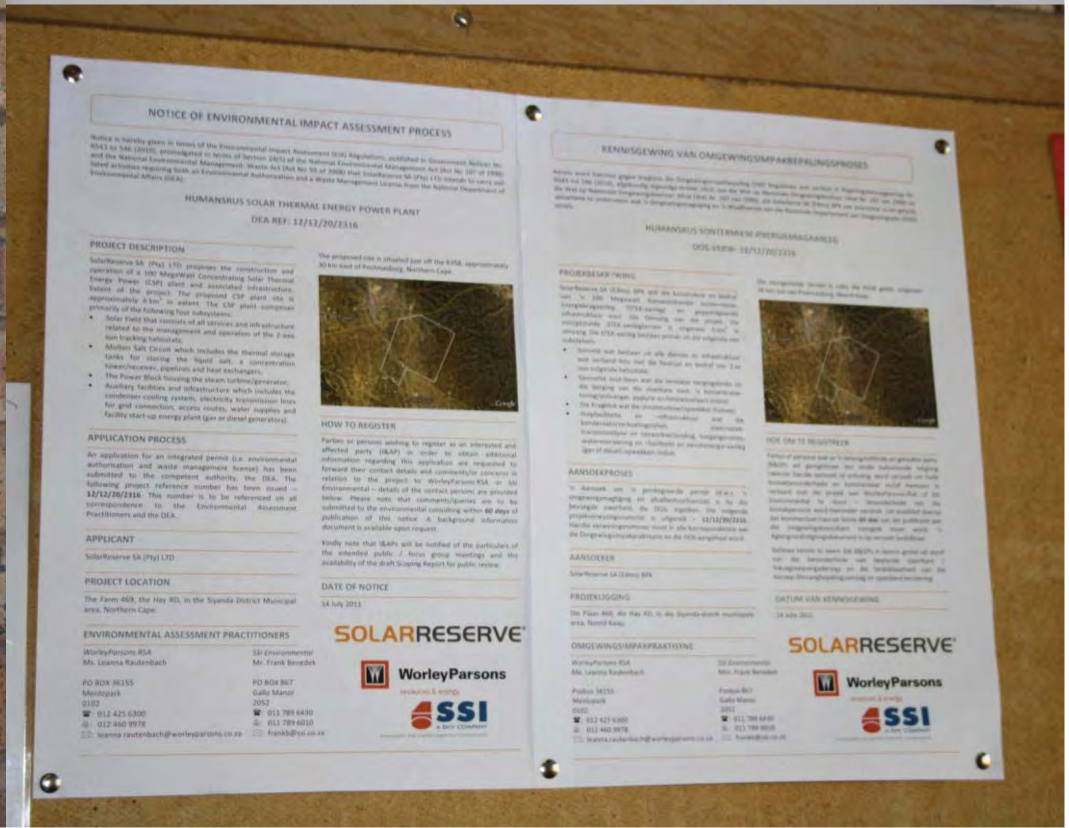
APPENDIX B: PHOTOGRAPHS OF SITE NOTICES, POSTERS AND PAMPHLETS


DANIËLSKUIL
Post Office
Poskantoor
SOLARRESERVE
WorleyParsons
SSI


NOBIS HABITATIO FELIX

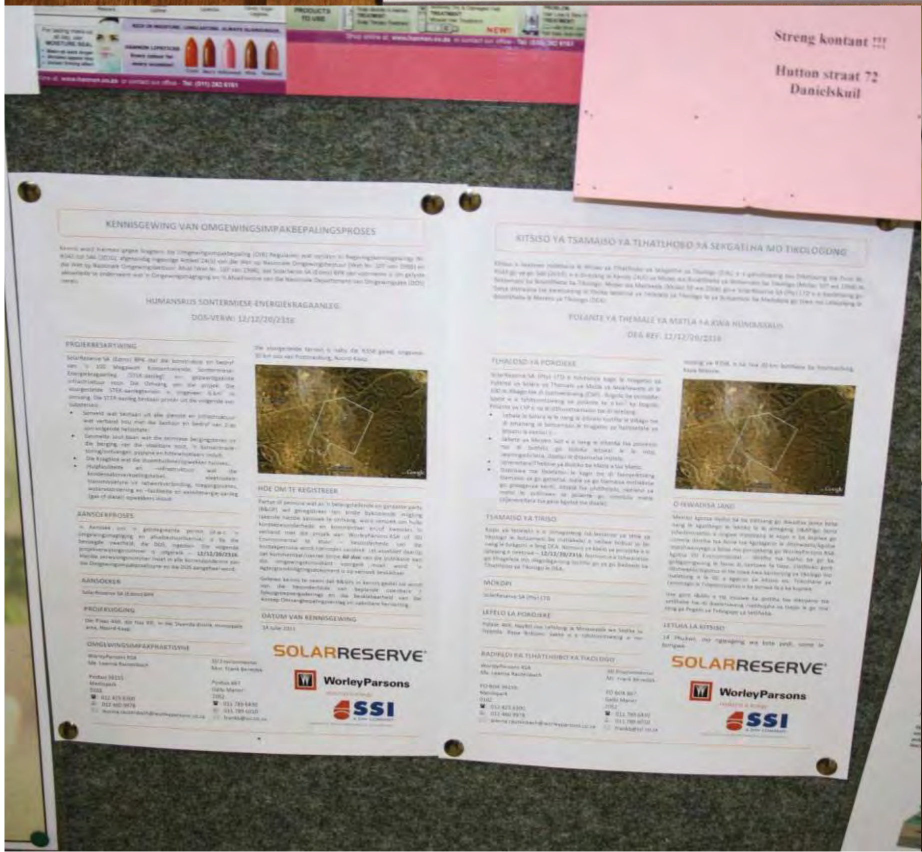

Kgatelopele
Munisipaliteit
Masepala Municipality


NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT
DEA REF: 12/12/20/2316
PROJECT DESCRIPTION
APPLICATION PROCESS
APPLICANT
PROJECT LOCATION
ENVIRONMENTAL ASSESSMENT PRACTITIONERS
HOW TO REGISTER
DATE OF NOTICE
SOLARRESERVE
WorleyParsons
SSI
KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGSPROSES
SOLARRESERVE
WorleyParsons
SSI


KLK
Landbou Beperk


SOLARRESERVE
SSI

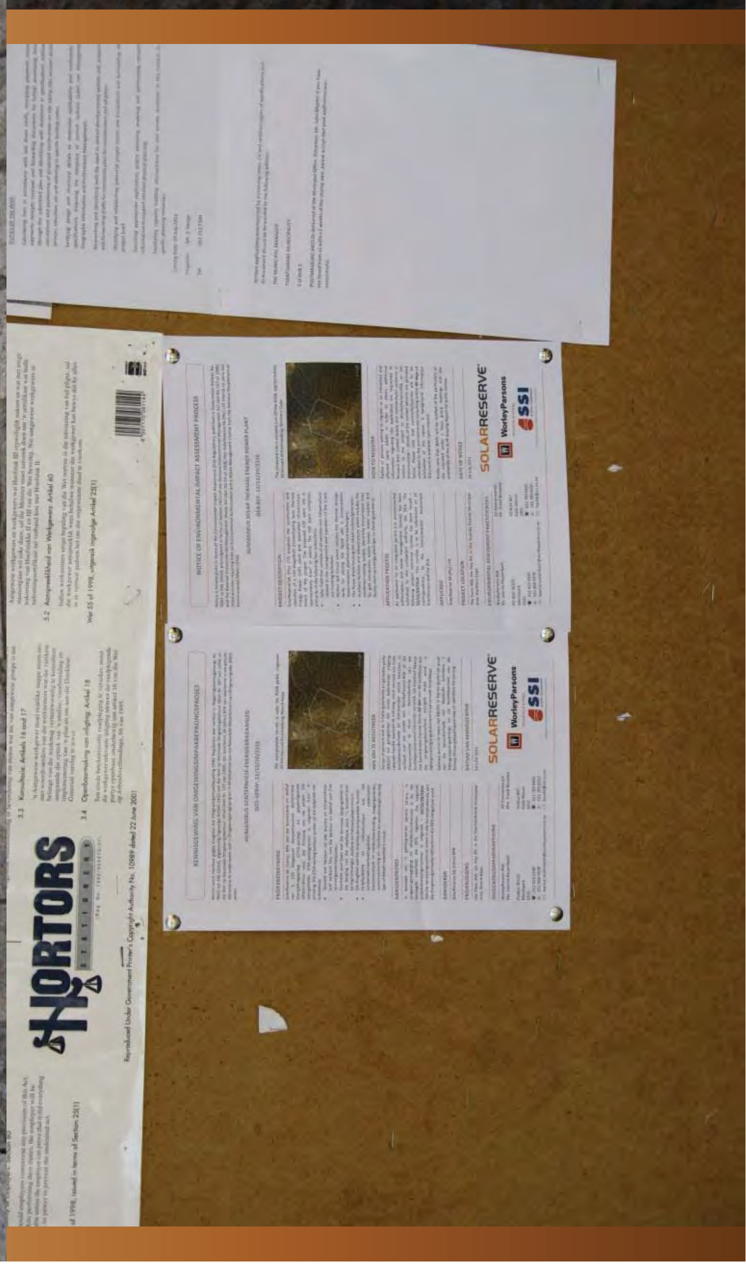

Kgatelopele
Munisipaliteit
Masepala Municipality
LIBRARY


Streng kontant !!!
Hutton straat 72
Danielskuil
KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGSPROSES
HUMANSRUS SONTERMIESE-ENERGIEFASILITEIT
KITSISO YA TSAMAISO YA TEHATLHOBO YA SEKGATLHA MO TIKOLOGONG
SOLARRESERVE
WorleyParsons
SSI


SOLARRESERVE
SSI
WorleyParsons


OK Foods
OK Foods
OK Foods


OK Foods


HORTORS
SOLARRESERVE
WorleyParsons
SSI
SOLARRESERVE
WorleyParsons
SSI


friendly
IGA
supermarket


KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGSPROSES
HUMANSRUS SONTERMIESE-ENERGIEKRAGAANLEG
DOS-VERW: 12/12/20/2316
PROJEKBESKRYWING
HOE OM TE REGISTREER
AANSOEKPROSES
AANSOEKER
PROJEKLIGGING
DATUM VAN KENNISGEWING
OMGEWINGSIMPAKPRAKTISYNE
SOLARRESERVE
WorleyParsons
SSI
PCD Assessments
Psigometriese toets
•Vak keuse toetse
•Beroeps voorligting
•Skool gereedheids toets
UITSLAE BESKIKBAAR BI
WEEK
Om u plek te bespreek kontak my.
Natasha van Niekerk
PCD Assessments
076 504 5634


POSTMASBURG
BIBLIOTEEK
LIBRARY
ARMED RESPONSE
SOLARRESERVE
SSI
SOLARRESERVE
SSI
SOLARRESERVE
SSI


SPAR


Golfing
Announcements !!!!
NORTHERN CAPE
CLEANING SERVICES
Garden Services
PRAGTIGE JACKRUSSEL REUNTJIES
TE KOOP
8 WEKE OUD
INGEËNT EN
ONTWURM
VIR NET R500 ELK
Kontak Casey Grobler:
082 438 6919/ 053 313 1405
Produksieveiling
Compion • Steenkamp • Stolper
Upington Skougronde
Donderdag, 4 Augustus 2011
om 11:00
TE KOOP :
LANGBEEN – JACK RUSSELS
STEEKHAAR TIPE
BESKIKBAAR VANAF 7 AUGUSTUS 2011
SKAKEL ELSABE 073 349 4643
~Te Koop~
Pragtige Swart
Fraanse Poedels
R1500-00 elk
4 Reuntjies + 4 Tefies
* GROOT TIPE *
* OPREG *
076 941 9481
SOLARRESERVE
SSI


POSTMASBURG
Post Office
Poskantoor


Post Office
Poskantoor


LANDBOUSENTRUM
POSTMASBURG
AGRICULTURAL CENTRE

ENVIRONMENTAL IMPACT ASSESSMENT
SOLARRESERVE

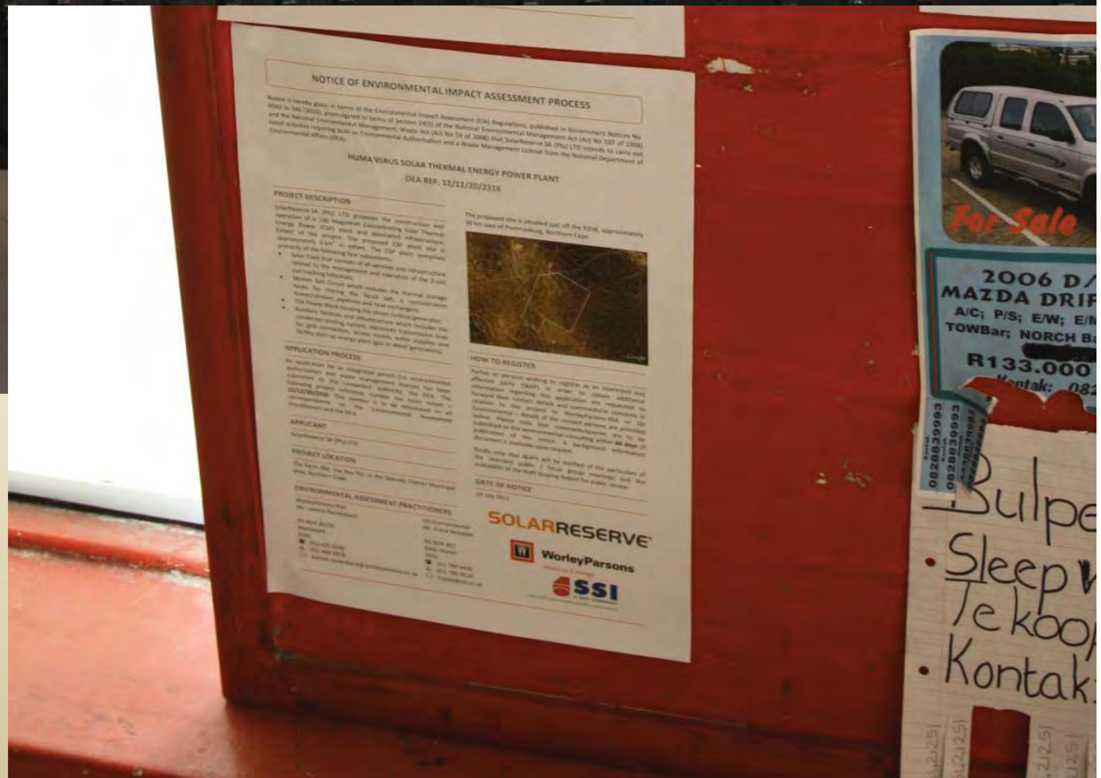

TSANTSABANE MUNICIPALITY
POSBUS 5 TEL NO: 053-313 7300 FAKS NO: 053-313 1602


KENNISGEWING VAN OMGEWINGSIMPAKBEPALINGSPROSES
Kennis word hiermee gegee kragtens die Omgewingsimpakbepaling (OIB) Regulasies wat verskyn in Regeringskennisgewings Nr. R543 tot 546 (2010), afgekondig ingevolge Artikel 24(5) van die Wet op Nasionale Omgewingsbestuur (Wet Nr. 107 van 1998) en die Wet op Nasionale Omgewingsbestuur: Afval (Wet Nr. 107 van 1998), dat SolarServe SA (Edms) BPK van voorneme is om gelyste aktiwiteite te onderneem wat 'n Omgewingsmagtiging en 'n Afvallisensie van die Nasionale Departement van Omgewingsake (DOS) vereis.
HUMANSRUS SONTERMIESE-ENERGIEKRAGAANLEG
DOS-VERW: 12/12/20/2316
PROJEKBESKRYWING
SolarReserve SA (Edms) BPK stel die konstruksie en bedryf van 'n 100 Megawatt Konsentrerende Sontermiese-Energiekragaanleg (STEK-aanleg) en gepaardgaande infrastruktuur voor. Die Omvang van die projek: Die voorgestelde STEK-aanlegterrein is ongeveer 6 km² in omvang. Die STEK-aanleg bestaan primêr uit die volgende vier substelsels:
• Sonveld wat bestaan uit alle dienste en infrastruktuur wat verband hou met die bestuur en bedryf van 2-as son-volgende heliostate;
• Gesmelte sout-baan wat die termiese bergingstenks vir die berging van die vloeibare sout, 'n konsentrasie-toring/ontvanger, pyplyne en hittewisselaars insluit;
• Die Kragblok wat die stoomturbine/opwekker huisves;
• Hulpfasiliteite en –infrastruktuur wat die kondensatorverkoelingstelsel, elektrisiteit-transmissielyne vir netwerkverbinding, toegangsroetes, watervoorsiening en –fasiliteite en aansitenergie-aanleg (gas of diesel) opwekkers insluit.
Die voorgestelde terrein is naby die R358 geleë, ongeveer 30 km oos van Postmasburg, Noord-Kaap.
AANSOEKPROSES
'n Aansoek om 'n geïntegreerde permit (d.w.s. 'n omgewingsmagtiging en afvalbestuurlisensie) is by die bevoegde owerheid, die DOS, ingedien. Die volgende projekverwysingsnommer is uitgereik – 12/12/20/2316. Hierdie verwysingsnommer moet in alle korrespondensie aan die Omgewingsimpakpraktisyne en die DOS aangehaal word.
HOE OM TE REGISTREER
Partye of persone wat as 'n belangstellende en geraakte party (B&GP) wil geregistreer ten einde bykomende inligting rakende hierdie aansoek te ontvang, word versoek om hulle kontakbesonderhede en kommentaar en/of kwessies in verband met die projek aan WorleyParsons RSA of SSI Environmental te stuur – besonderhede van die kontakpersone word hieronder verstrek. Let asseblief daarop dat kommentaar/navrae binne 60 dae van die publikasie aan die omgewingskonsultant voorgelê moet word. 'n Agtergrondinligtingsdokument is op versoek beskikbaar.
Geliewe kennis te neem dat B&GPs in kennis gestel sal word van die besonderhede van beplande openbare / fokusgroepvergaderings en die beskikbaarheid van die konsep Omvangbepalingsverslag vir openbare hersiening.
AANSOEKER
SolarReserve SA (Edms) BPK
PROJEKLIGGING
Die Plaas 469, die Hay RD, in die Siyanda-distrik munisipale area, Noord-Kaap.
DATUM VAN KENNISGEWING
14 Julie 2011
OMGEWINGSIMPAKPRAKTISYNE
WorleyParsons RSA
Me. Leanna Rautenbach
Posbus 36155
Menlopark
0102
012 425 6300
012 460 9978
leanna.rautenbach@worleyparsons.co.za
SSI Environmental
Mnr. Frank Benedek
Posbus 867
Gallo Manor
2052
011 789 6430
011 789 6010
frankb@ssi.co.za
SOLARRESERVE
WorleyParsons
resources & energy
SSI
A DHV COMPANY

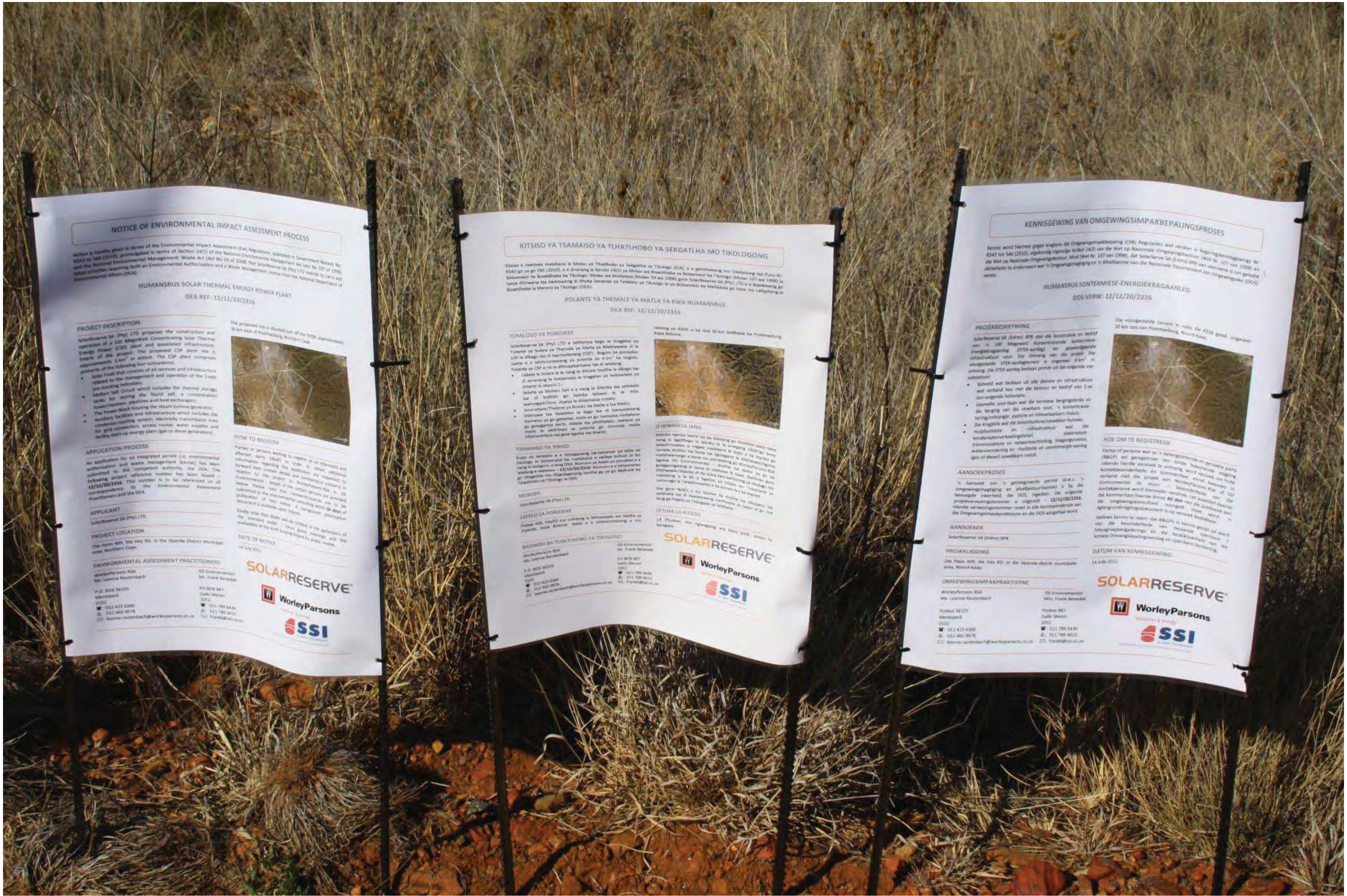

TSANTSABANE
Local Municipality
HLLO GA MANYORO
TSANTSABANE
Local Municipality
PO Box 5
Postmasburg
8420
Tel: 053 313 7300
Fax: 053 313 1602


SAVERITE
SUPERMARKET


KITSISO YA TSAMAISO YA TLHATLHOBO YA SEKGATLHA MO TIKOLOGONG
POLANTE YA THEMALE YA MATLA YA KWA HUMANSRUS
DEA REF: 12/12/20/2316
SOLARRESERVE
WorleyParsons
SSI
SUSAN : 072 947 8036
PIETER : 076 635 6111
NEW TOWN POSTMAS
PRICES:
CAR
BAKKIE
BAKKIE & CANOPY
DUBBEL CUB
TAXI/BUSSIE
7 DAYS


NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
HUMA NSRUS SOLAR THERMAL ENERGY POWER PLANT
DEA REF: 12/12/20/2316
SOLARRESERVE
WorleyParsons
SSI
For Sale
2006
MAZDA DRI
R133.000

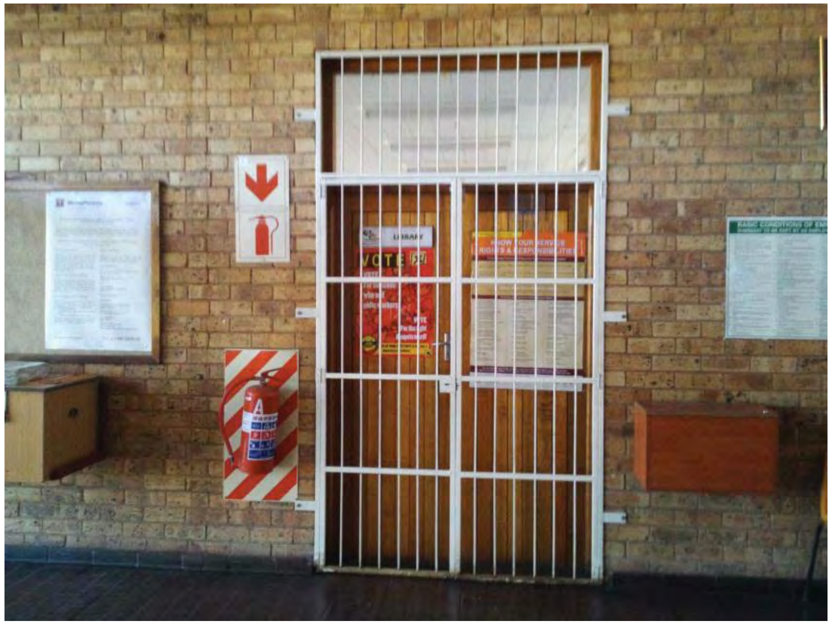
Humanrus Farm 465



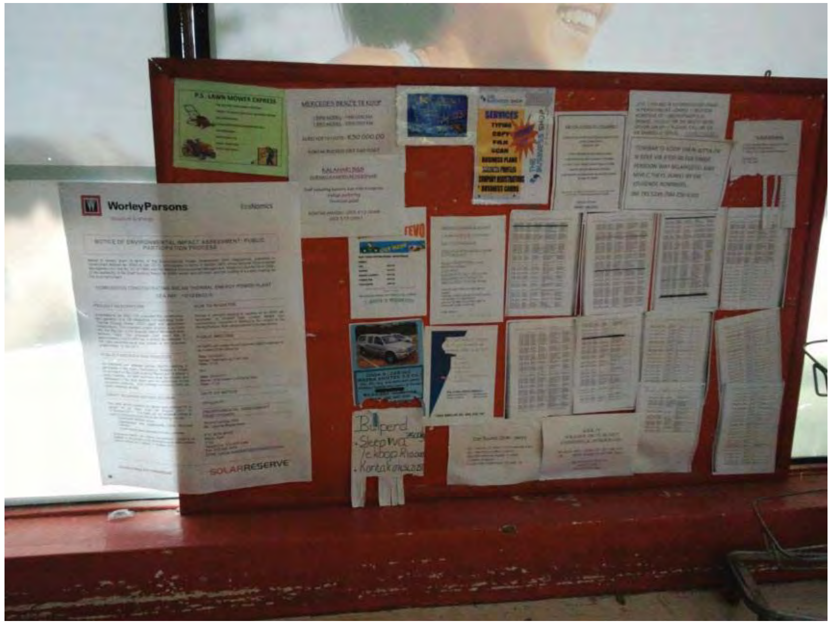
Draft Scoping Posters

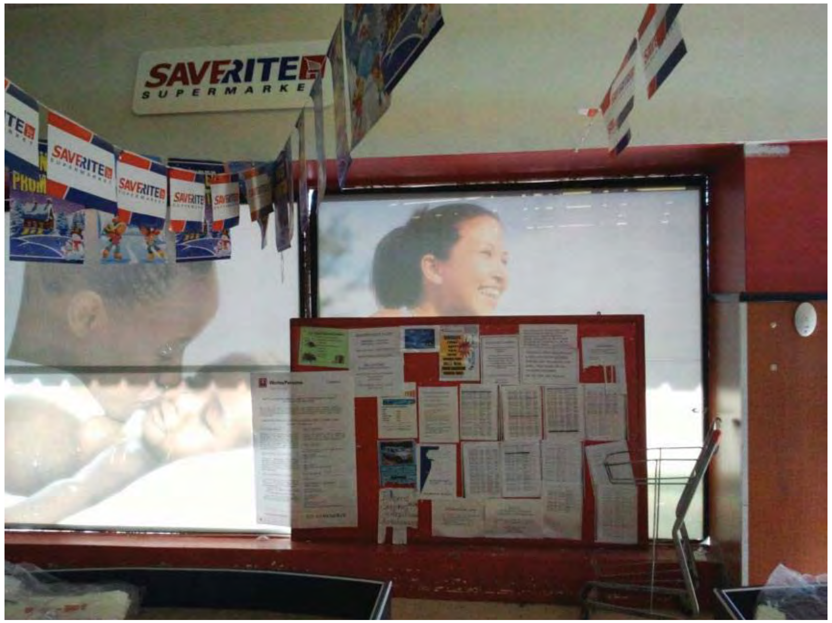
Draft Scoping Posters

Draft Scoping Posters

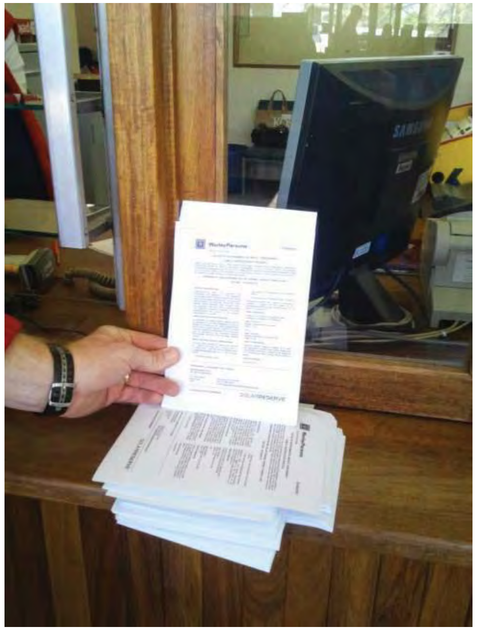


Draft Scoping Posters





Draft Scoping Pamphlets



Draft Scoping Site Notices

Draft EIAR - Humanrus Farm 465

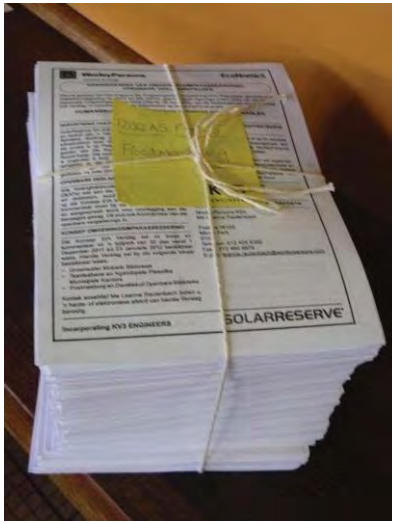
Draft EIAR Posters

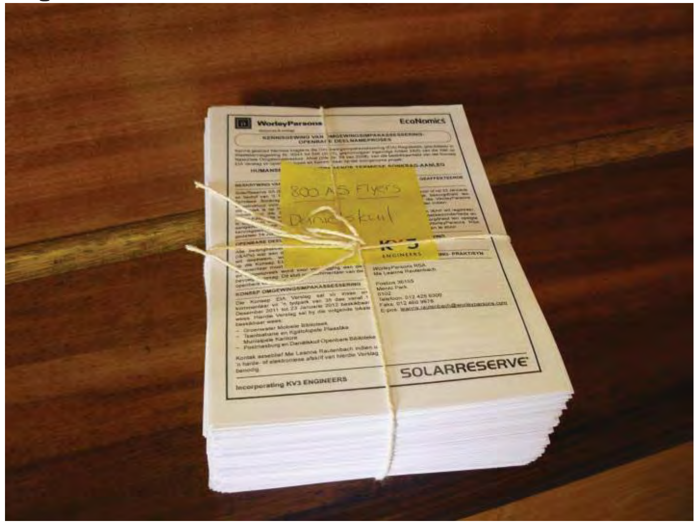
Draft EIAR Posters

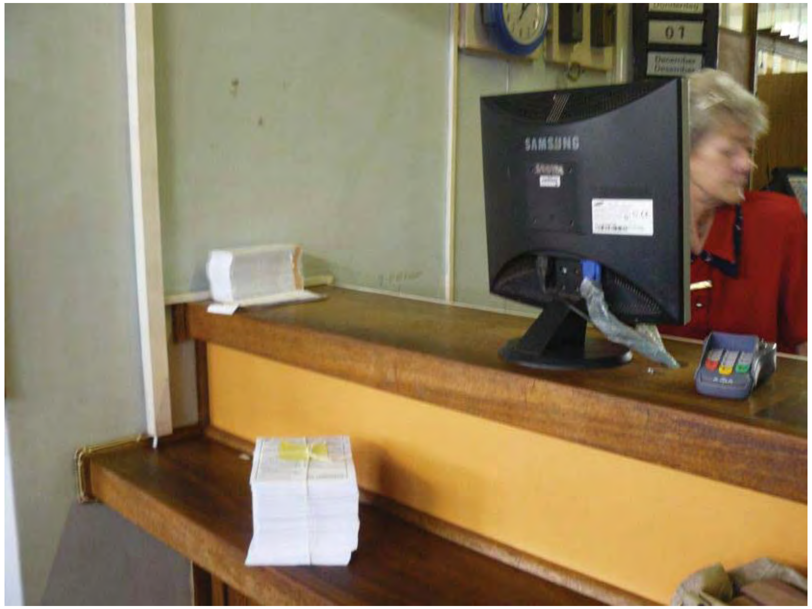
Draft EIAR Posters

Draft EIAR Posters

Draft EIAR Pamphlets







APPENDIX C: ATTENDANCE REGISTERS AND MINUTES OF THE MEETINGS

WorleyParsons
resources & energy

EcoNomics

MEETING RECORD

Project No: 257000
Project: Humansrus Solar **THERMAL ENERGY POWER PLANT**

Public Meeting Minutes

PARTICIPANT NAME & ORGANISATION		**DATE**	25 August 2011
CLIENT:	SOLARRESERVE SA **(PTY) LTD**	**TIME START**	17:30
PRESENT:	SEE ATTENDANCE REGISTER - ADDENDA 1	**TIME FINISH**	19:00
Messrs:		**LOCATION**	Postmasburg Civic Hall
		RECORDER	Leanna Rautenbach
		DOC NO	06-001
		FILE LOC	
		PROJ REF	PWE
SIGNATURE ORIGINATOR:			
WorleyParsons RSA		**DATE SIGNED:**	
SIGNATURE OTHER PARTY:			
		DATE SIGNED:	
COPIES:			

RECORD OF DISCUSSIONS

ITEM	ITEM DETAILS
	Safety Moment
1.	**WELCOME AND INTRODUCTION**
1.1	All attendees were welcomed to the first Public Meeting held on behalf of SolarReserve SA (Pty) Ltd with regards to the proposed Humansrus Solar Thermal Energy Power Plant by JC Pretorius.
1.2	The Project team was introduced – – Leanna Rautenbach – Project Manager from WorleyParsons RSA – JC Pretorius – Environmental Assessment Practitioner from WorleyParsons RSA – Terence Govender – Project Proponent/Client from SolarReserve SA – Specialist Team was also announced [Refer to attached Public Meeting Presentation].
2.	**CONDUCT OF THE MEETING**
2.1	It was stated that the focus of the meeting was to discuss and inform all parties present with regards to the proposed Humansrus Solar Thermal Energy Power Plant development and the environmental issues and components pertaining thereto.

ITEM	ITEM DETAILS
2.2	The meeting was scheduled from 17:30 – 18:30, and it was stated that this was only a guideline and by no means set in stone. JC Pretorius requested that all parties sign the attendance register prior to leaving the meeting.
2.3	JC Pretorius requested that the all questions be held until the discussion phase of the meeting, that all attendees should introduce themselves prior to asking questions or raising issues and that all cell phones are to be switched off for the duration of the meeting.
3.	**EMERGENCY PROCEDURES**
3.1	JC Pretorius informed all attendees on where the nearest exits are as well as what the procedure for evacuation would entail in the event of an emergency.
4.	**PURPOSE OF THE MEETING**
4.1	JC Pretorius indicated that the following matters will be discussed as part of the Public Meeting – – The Environmental Impact Assessment Process – The Public Participation Process – Background of the project
4.2	JC Pretorius furthermore stated that this meeting should be seen by attendees as an opportunity to receive information pertaining to the proposed project. That this meeting provided a platform for all Interested and Affected Parties (I&APs) to record and state their issues, concerns and feelings regarding the proposed development as well as to allow for fruitful interaction with the community with regards to the project and the receiving environment for which the development is proposed.
5.	**SCOPING ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT**
5.1	JC Pretorius defined the Environmental Impact Assessment (EIA) process pertaining to the following components – – What is a Scoping Assessment? – What is an Environmental Impact Assessment (EIA) – Why do we do an EIA? – Who are the regulating authorities? – What does the technical process entail? – What are the deliverables? – What is our progress to date?
5.2	The purpose of EIA process was defined and explained to attendees. JC Pretorius stated that this process allows for the assessment of activities prior to their commencement to ensure the environmental impacts can be prevented, limited or, mitigated. It was furthermore stated that this process ensures that all environmental issues are integrated into planning & decision making process by means of anticipating and minimizing potential environmental damage or degradation. Lastly it was stated that the process allows for public involvement which leads to informed decision making and improves environmental conservation efforts.
5.3	JC Pretorius informed attendees that this meeting was a legal obligation of WPRSA the Environmental Assessment Practitioners. The various pieces of legislation that was consulted for the EIA process as a whole was reviewed.

ITEM	ITEM DETAILS
5.4	With regards to the EIA process, the concepts of commenting and regulating authorities were discussed. The difference between the two entities was explained. JC Pretorius stated that for the purpose of this particular EIA, the Department of Water and Environmental Affairs (DEA) – Department of Integrated Permitting System (IPS) would be the Competent Authority presiding over the project. All other commenting and contributing parties were mentioned (refer to Public Meeting Presentation).
5.5	JC Pretorius explained the EIA process by means of breaking it down into three phases – Application, Scoping and EIA. With regards to the Application phase of the project, JC Pretorius discussed the activities applied for and the integrated application process for which was applied. It was indicated that the application was submitted to the DEA – IPS for assessment and approved. The project has been registered at the DEA and permission received for the Scoping phase. **PLEASE NOTE –** With regards to the regulations pertaining of the undertaking of an EIA with respect to amendments JC Pretorius made all attendees aware of the amendment to be submitted with regards to the existing application. It was indicated that due to the fact that ownership of an Environmental Authorisation cannot partially be transferred, the proposed overhead alignment options would have to be removed from the exiting application as these overhead lines will be the property of ESKOM. Secondly, attendees were informed that the Declaration of Independence submitted as part of the EIA Application stated that ERM would be the primary geo-hydrologists working on the project, however the consultant retracted their services and SRK Consulting (SA) (Pty) Ltd was appointed. The amended Declaration of Independence was submitted to DEA for inclusion in the original integrated application.
5.6	All components pertaining to the Scoping Process was explained to attendees and JC Pretorius explained the process from submission of the Draft document to the authorisation of the final Scoping Report to DEA for authorization – Refer to the attached Public Meeting Presentation.
5.7	All components pertaining to the detailed EIA Process was also explained to attendees and JC Pretorius explained the process from submission of the Draft document to the authorisation of the final EIA Report to DEA for authorization – Refer to the attached Public Meeting Presentation.
6.	**PUBLIC PARTICIPATION**
6.1	The concept of public participation was defined to attendees as per the EIA Regulations, promulgated under the National Environmental Management Act, in August 2010. It was stated that the reason for the meeting held on 25 August 2011 was to – – Facilitates public involvement & consultation; – Enable Interested and Affected Parties to provide input into the EIA process & share information; – Allows for public involvement, sharing of ideas and the investigation of concerns; – Vehicle to obtain public/community buy-in and ownership; – Adds value to the decision making process; – Functions as an on-going data-gathering and facilitation mechanism for input into the EIA; – Create a better understanding of the project and its objectives. JC Pretorius furthermore informed attendees of the reasons why PP is required when undertaking an EIA with regards to the procedural requirements and amendment requirements.

ITEM	ITEM DETAILS
6.2	The Public Participation Process was discussed with attendees, and all tasks executed to date were presented. JC Pretorius stated that with regards to **Project Notification and Announcement** the following tasks were undertaken – – Site notices were placed at various public locations on the 21 – 22 July 2011 Refer to the attached Public Meeting Presentation. – Initial advertisements were placed on 14 July 2011. Afrikaans and Tswana adverts were placed in the Kalahari Bulletin and an English advert in the Diamond Field Advertiser. – Written notices were furthermore sent out to various stakeholders and parties during the course of 21 – 22 July 2011, notifying parties of the proposed development. With respect to the **Scoping phase** the following tasks were executed – – Site notices were placed at various public locations on the 17 August 2011. Refer to the attached Public Meeting Presentation. – Adverts were placed in the Kalahari Bulletin and Diamond Field Advertiser on 18 August 2011 in order to notify the public of the various public meetings to be held during the month of August related to the proposed development as well as to inform them that the Draft Scoping Report is available for review at the following locations. – All relevant stakeholders were informed of project via e-mail, post and facsimile around 22 August 2011. Notices were distributed within the community at the school and at all post offices. JC Pretorius informed attendees of the **I&AP registration process** and emphasised that this task is continuous and that any and all parties can register. JC informed them that their contact details would be entered into a I&AP Database for future correspondence inclusion. The particulars of all the public meetings for the Scoping Phase were also reviewed. Two initial meetings were scheduled with regards to the proposed development – This meeting, held on 25 August 2011 at Postmasburg Civic Hall, Postmasburg as well as; – A meeting proposed for the following Friday, 26 August 2011 at Groenwater Community Hall, Postmasburg. JC Pretorius informed attendees that the DRAFT Scoping Report was made available for public review at the Postmasburg, Danielskuil and Groenwater (mobile) Public Libraries for the period of 18 August – 17 October 2011.
7.	**PROJECT OVERVIEW**
7.1	JC Pretorius presented the proposed Humansrus Solar Thermal Energy Power Plant to attendees. The discussion stated that the project will be situated on the farm Humansrus (farm 469) in the Siyanda District Municipality. It was furthermore brought to attendees' attention that the site falls within the Tsantsabane Local Municipal area, however due to the close proximity of the site to Danielskuil, the Kgatelopelo Local Municipality was also regarded as a primary stakeholder. Affected towns and localities include, Postmasburg, Danielskuil, Owendale, LimeAcres, Groenwater, Skeyfontein etc.

ITEM	ITEM DETAILS
7.2	The various outcomes of the project were highlighted to attendees with regards to the process and documentation to be provided to the authorities, the client and the public for review, comment and authorisation. JC Pretorius indicated that outcomes pertaining to the authorities would include – – Inform the decision making process for future development – Formal Application for Environmental Authorization – Submission of Draft and Final Scoping Report – Submission of Draft and Final Environmental Impact Report Whilst the following outcomes/documents would be presented to the client – – Copy of Application – Record of Public Participation – Submission of Draft and Final Scoping Report – Submission of Draft and Final Environmental Impact Report – Authorization granted/declined – obtained from Authority Lastly it was indicated that community related outcomes would include – – Assurance that the development & planning phase of the project considered all environmental & social factors – Inform the public of the proposed project, the process & the final decision from authorities – Submission of Draft Scoping Report for comment – Submission of Draft Environmental Impact Report for comment
7.3	The scope of the project with respect to all development components were discussed with attendees. A short video as introduction to the proposed facility was played for attendees as to allow for better understanding of what the various project components entail. All components pertaining to the heliostat field, power block, molten salt system and auxiliary services were described – refer to attached Public Meeting Presentation. Attendees were also informed of all the additional project related services such as the evaporation pond requirements, overhead distribution line requirements and the substation. During this section of the meeting JC Pretorius stressed the fact that all these services were of an advisory nature and that the various persons undertaking these assessments formed part of the EAP team as to ensure best implementable environmental science and project development occurs. It was also stated that the drawings pertaining to the waste (evaporation ponds) facilities and electrical (overhead distribution lines) were preliminary drawings only undertaken as to ensure that the impact of these activities on the receiving environment can be measured. He furthermore stated that these drawings and the technical design of these services will only be undertaken once EIA authorisation has been received and that these services will be done by an EPC Contractor. Possible positions of the proposed overhead lines and evaporation ponds were presented to attendees as to make them aware of the full extent of the proposed development.
7.4	JC Pretorius also explained the methodology employed for site selection purposes and presented the various criteria required for an optimal site in terms of a CSP development. The concept of project alternatives were defined and JC Pretorius indicated that according to National environmental Management Act, Act 107 of 1998 it is required that various project development alternatives be assessed. For this development Site, Technology and the NO-GO option was assessed – refer to Public Meeting Presentation attached and as eluded to in the DRAFT Scoping Report.

<table>
<tr><th>ITEM</th><th colspan="2">ITEM DETAILS</th></tr>
<tr><td>7.5</td><td colspan="2">An overview of the various specialist studies that was undertaken for the Scoping Phase was presented to all parties attending. A short summary of these specialists' tasks were also presented as per the DRAFT Plan of Study. JC Pretorius stated that for both baseline determination and impact assessment the following Specialists was included in the project team –
– Air Quality Assessment
– Avifaunal Assessment
– Biodiversity Assessment
– Geo-technical Assessment
– Geo-hydrological Assessment
– Hydrology Assessment
– Heritage Assessment
– Noise Assessment
– Soils & Agriculture Potential Assessment
– Socio-Economic Assessment
– Tourism Assessment
– Visual Assessment
– Wetland & Riparian Sensitivity Analysis
JC Pretorius brought it under the attention of the attendees that the DRAFT Scoping Report still contains information on the previous Geo-Hydrological Expert – however attendees were informed that the consultants undertaking this assessment has been changed to SRK.</td></tr>
<tr><td>7.6</td><td colspan="2">The prelim findings of all specialist investigations as per the baseline environmental assessment were discussed with attendees. JC Pretorius explained that these findings were preliminary and would be investigated and assessed in full during the EIA phase of the project. Please revert to the Public Meeting Presentation attached.</td></tr>
<tr><td>8.</td><td colspan="2">DISCUSSION</td></tr>
<tr><td>8.1</td><td colspan="2">All attendees were requested to now please provide their inputs, comments and ask questions related to the environmental components of the project.</td></tr>
<tr><td rowspan="2">8.2</td><td>A. Davids</td><td>A request was made that with regards to attendees having access to the Presentation.</td></tr>
<tr><td>JC Pretorius</td><td>It was stated that all attendees would be forwarded a copy of the presentation as well as the minutes of the meeting once drafted.</td></tr>
<tr><td rowspan="2">8.3</td><td>A. Davids</td><td>Faulty reference on presentation was highlighted by Mr Davids with regards to slide 13 – the slide reads Northern Cape Department of Roads and Public Transport, however the correct Departmental name should read Northern Cape Department of Roads and Public Works.</td></tr>
<tr><td>L. Rautenbach</td><td>The amendment was noted and the presentation changed as such.</td></tr>
<tr><td rowspan="2">8.4</td><td>A. Davids</td><td>Mr. Davids enquired on the choice of newspapers used for notification of the public. He furthermore stated that the following newspapers are very popular in the area for future reference – the Ghaap, the Kathu Gazette.</td></tr>
<tr><td>JC Pretorius</td><td>JC thanked Mr. Davids for his input and stated that this will definitely be considered for future Public Participation.</td></tr>
<tr><td>8.5</td><td>A. Davids</td><td>Mr Davids asked if the 7day notification period prior to the meeting was sufficient – and if it would not be more advantageous to have a longer notification period.</td></tr>
</table>

ITEM	ITEM DETAILS	
	JC Pretorius	It was stated that this is best practice in the industry, as it leaves enough time for arranging of schedules, but not too much so that people forget about the meeting. The 7-day notification period was just long enough to keep the meeting request fresh in all parties' minds.
8.6	A. Davids	The question was also raised as to why Kgatelopele Local Municipality was included in the project scope.
	JC Pretorius	It was explained that as the proposed development site is a border case, it was found best practice to involve and notify all possibly affected parties of the proposed development.
8.7	A. Davids	A comment was made with regards to the past asbestos health situation at Owendale. It was enquired if the consultants were aware of this matter.
	JC Pretorius	It was acknowledged that the consultants are aware of this situation and noted. No action was required.
8.8	A. Davids	With respect to the inclusion of the long list of localities possibly affected by the development, Mr Davids asked what the project proponent and consultants viewed as a locality?
	L. Rautenbach	It was defined by Leanna Rautenbach that a locality will be defined as the district regional area where in the project would be situated.
8.9	A. Davids	A Project Explanation was requested with regards to the proposed layout in terms of the various infrastructure requirements.
	JC Pretorius	The visual rendering (layout map) was presented to attendees and the explanation offered as to the position of the proposed CSP and the additional infrastructure. It was explained that due to the site's shape various constraints with respect to layout was encountered and engineering solutions needed to be acquired prior to final engineering design, to ensure that the site has sufficient space for all infrastructure requirements.
8.10	A. Davids	Mr. Davids enquired on why Humansrus was chosen as location for the development? What are the primary criteria for the site being chosen – why was Pofadder not assessed?
	T. Govender	Mr Govender explained that due to the high irradiation of the area the site was viewed to be optimal. Even though the irradiation at Pofadder is higher, the NDI at the chosen site was ideal in its current format. It was furthermore stated that this would not be the only development, and that other areas are being and would also be investigated for current and future developments.
8.11	A. Davids	Mr. Davids enquired on the current NDI for the area.
	T. Govender	Mr Govender stated that the NDI is roughly 2600kv/m^2 per year which is more than enough for the development' purposes.
8.12	A. Davids	The question was raised on why SolarReserve was in the locality? Why they wanted to be in the Tsantsabane region.

ITEM	ITEM DETAILS	
	T. Govender	Mr Govender revealed, that they are here as both a business and a community partner. Firstly SR is a business and that they are here to make money, however as SR is equity partners in all developments, they regard the community as an essential part of the development. It was furthermore stated that SR has decided to enter the market due to the National Governments Mandated on renewable energy development and the newly announced IRPP. It was thus SR's aim to bid and potentially build the Humansrus Solar Thermal Energy Power Plant as part of government's renewable energy initiative.
8.13	A. Davids	An enquiry was also made with regards to the tariffs and the renewable process.
	T. Govender	It was stated that to date the price is not know yet and that SR's tariffs will be based on an all inclusive financial model. The process was initiated by NERSA and Department of Energy.
8.14	A. Davids	Mr. Davids asked how the community will benefit from the project.
8.15	T. Govender L. Rautenbach JC Pretorius	It was explained that the proposed project will have a significant impact on the regional economy, as it will introduce roughly R 7billion into the region (project cost). It was mentioned by L. Rautenbach that entire industries will be stimulated and that a large number of jobs will be created due to this new project. The economic ripple effect was explained with regards to how an influx of people will in turn create more jobs as more money will be exchanged amongst local retailers, as the demand for household and project related items will increase.
8.16	A. Davids	In reiteration Mr Davids wanted to know what exactly the impact would be on the local communities and industries, how many jobs would be created, how many industries and what benefits the local labour force could expect. More specifically with regards to industry development, Mr Davids wanted to know if any factories or industries would be erected as part of this development.
	T. Govender L. Rautenbach JC Pretorius	It was stated that the creation of new industry does not form part of SR's mandate or scope of work for the proposed project, it was inevitable that entrepreneurs would seize the opportunity. It was furthermore stated an EPC contractor will be appointed for the construction and design of the proposed plant. It was also highlighted that although some specialist labour will have to be imported, local labour will be a definite option during construction. An emphasis was placed on the concept of local labour and SR stated that this is their ideal solution and that it would remain one of their primary aims with regards to the construction of the proposed plant. It was mentioned that roughly 60 permanent jobs would be created during operation of the plant and that all employment considered (direct, indirect and induced) and estimated 7 000 jobs will be created as a result of the proposed project. Over and above it was stated that as we are only in the scoping phase no actual findings are available to date and that these concrete findings will only be available once the full and detailed EIA has been done.
8.17	A. Davids	It was stated that various local communities do not have access to electricity and if this plant will be able to provide these local communities with the required electricity. Mr Davids enquired on what SR is going to do to get these communities connected to the grid.

ITEM	ITEM DETAILS	
	T. Govender	Mr Govender stated that it was not the mandate of SR to provide electricity to local communities, that this plant was designed to produce baseload power to supplement the national grid. He also stated that he is aware of the issue that there are several impoverished communities in the area and that SR would investigate all possible means of assisting them and empowering them. Additionally Mr Govender informed attendees about SR's intention of setting up a Development fund. The development fund will be used to benefit local impoverished communities throughout the region – it was also stated that all communities were considered as beneficiaries not only those directly affected by the project such as Groenwater. Proper consideration will be applied to determine which communities will benefit and to what extent once the Development fund has been finalised.
8.18	S. Molefe	It was also enquired on what the SSME opportunities would be with regards to the proposed development and if any were to be any.
	T. Govender	With regards to this question, Mr. Govender stated that a multitude of opportunities will be generated however these will only be revealed during the EIA phase and once the full Socio-Economic Assessment has been done. It was furthermore stated that there are a multitude of Government initiatives which can assist in this matter.
8.19	Commercial Issues	Various comments and questions regarding commercial issues were raised during this meeting that had no reference to the EIA of the proposed project. These matters were addressed by Terence Govender who in turn stated that this meeting is not the right forum for discussions of this nature as this meeting has pertinence to the EIA and not the Commercial side of the development. Terence Govender furthermore stated that these issues will be discussed at council meetings at a later stage in project development.
9.	**WAY FORWARD**	
9.1	JC conclude the meeting and thanked all attendees for attending and prompted them to go to the various facilities to review the Scoping Report and comment there on as their inputs are greatly valued.	

DISTRIBUTION LIST

DISTRIBUTION	COPY
1. Terence Govender	
2. Leanna Rautenbach	
3. Elroy Phete	
4. Mpho Mashisil	
5. JC Pretorius	
6. Alistair Davids	
7. Royden Roman	
8. Petrus	
9. Vincent Pule	
10. Jeffrey Sekeka	
11. Shele Molefi	

END OF RECORDS

WorleyParsons

resources & energy

EcoNomics

MEETING RECORD

Project No: 257000
Project: Humansrus Solar **THERMAL ENERGY POWER PLANT**

Public Meeting Minutes

PARTICIPANT NAME & ORGANISATION		**DATE**	26 August 2011
CLIENT:	SOLARRESERVE SA **(PTY) LTD**	**TIME START**	17:30
PRESENT:	SEE ATTENDANCE REGISTER - ADDENDA 1	**TIME FINISH**	19:00
Messrs:		**LOCATION**	Groenwater Community Hall
		RECORDER	Leanna Rautenbach
		DOC NO	06-002
		FILE LOC	
		PROJ REF	PWE
SIGNATURE ORIGINATOR:			
WorleyParsons RSA		**DATE SIGNED:**	
SIGNATURE OTHER PARTY:			
		DATE SIGNED:	
COPIES:			

RECORD OF DISCUSSIONS

ITEM	ITEM DETAILS
	Safety Moment
1.	**WELCOME AND INTRODUCTION**
1.1	All attendees were welcomed to the Public Meeting held on behalf of SolarReserve SA (Pty) Ltd with regards to the proposed Humansrus Solar Thermal Energy Power Plant by JC Pretorius.
1.2	Only a small group of community representatives were present at the meeting, thus requesting that a second meeting be held on the following Monday, 29 August 2011. It was requested that the meeting be held around 17:00. This was noted and a meeting was arranged for the coming Monday. It was confirmed by the CPA Secretary, Mr. Lekwane KG (Rasta) that he will inform the community of the meeting proposed for Monday personally. The attendees enquired on how the Public Participation Process works, how many meetings will be held and why a meeting has been scheduled for this phase of the project. It was stated that this was a project announcement meeting whereby attendees/I&AP's will be informed on the project and the environmental components to be affected albeit negative or positive by the development. It was furthermore stated that the project is now in the scoping phase and that another similar meeting will be held for the EIA phase of the project.

ITEM	ITEM DETAILS
1.3	Attendees mentioned that they were unsatisfied with the landowner and indicated that they had several items which they would like to discuss in this regard. It was stressed that the project proponent has been made aware of the commercial and social issues between the land owner and the community, and that all efforts possible will be made to resolve these as SolarReserve wants community buy in. Terence Govender furthermore stated that these issues should be addressed separately as an internal matter between the project proponent and the community (CPA) as it is of a commercial nature and will not add benefit to the environmental discussion proposed for this meeting. Terence Govender again requested a meeting with the CPA in order to discuss this matter.
1.4	JC Pretorius informed all attendees that this was an informative meeting and stressed that this meeting did not have the purpose for decision making and should only be viewed as an environmental information presentation and gathering session.
1.5	The Project team was introduced – – Leanna Rautenbach – Project Manager from WorleyParsons RSA – JC Pretorius – Environmental Assessment Practitioner from WorleyParsons RSA – Terence Govender – Project Proponent/Client from SolarReserve SA – Specialist Team was also announced [Refer to attached Public Meeting Presentation].
1.6	Terence Govender explained to all parties attending who WorleyParsons were and what JC Pretorius and Leanna Rautenbach role was in the process. It was stated that Leanna and JC was merely here as environmental representatives and that their task was to introduce the project to the local community and inform them on the environmental components of the project.
1.7	Terence Govender stated that this meeting would be only for discussion on environmental and social issues, and that he has requested on a multitude of occasions a meeting with the (Community Property Association) CPA to discuss additional project components and possible community participation. It was stated that SolarReserve want community buy-in and would really appreciate a meeting with the CPA. It was stated that the SolarReserve wants the community to benefit from the project and that any and all comments need to be send to the EIA Practitioners for inclusion in the final reports.
1.8	JC Pretorius informed all attendees that the applicable Scoping Documentation was available at the Groenwater Primary School – Public Library for review and that all comments should be sent to WorleyParsons RSA. Obakeng Kgoroyane enquired on the means of correspondence with the EIA Practitioners. JC Pretorius stated that any means of communication could be used to present comments to the EIA Practitioners, such as fax, email, sms, telephone conversations, registered mail etc. JC Pretorius furthermore stated that all documents will remain available to the public for a 60 day period, ending 17 October 2011.
2.	**CONDUCT OF THE MEETING**
2.1	It was stated that the focus of the meeting was to discuss and inform all parties present with regards to the proposed Humansrus Solar Thermal Energy Power Plant development and the environmental issues and components pertaining thereto.
2.2	The meeting was scheduled from 17:30 – 18:30, and it was stated that this was only a guideline and by no means set in stone. JC Pretorius requested that all parties sign the attendance register prior to leaving the meeting.

ITEM	ITEM DETAILS
2.3	JC Pretorius requested that the all questions be held until the discussion phase of the meeting, that all attendees should introduce themselves prior to asking questions or raising issues and that all cell phones are to be switched off for the duration of the meeting.
3.	**EMERGENCY PROCEDURES**
3.1	JC Pretorius informed all attendees on where the nearest exits are as well as what the procedure for evacuation would entail in the event of an emergency.
4.	**PURPOSE OF THE MEETING**
4.1	JC Pretorius indicated that the following matters will be discussed as part of the Public Meeting – – The Environmental Impact Assessment Process – The Public Participation Process – Background of the project
4.2	JC Pretorius furthermore stated that this meeting should be seen by attendees as an opportunity to receive information pertaining to the proposed project. That this meeting provided a platform for all Interested and Affected Parties (I&APs) to record and state their issues, concerns and feelings regarding the proposed development as well as to allow for fruitful interaction with the community with regards to the project and the receiving environment for which the development is proposed.
5.	**SCOPING ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT**
5.1	JC Pretorius defined the Environmental Impact Assessment (EIA) process pertaining to the following components – – What is a Scoping Assessment? – What is an Environmental Impact Assessment (EIA) – Why do we do an EIA? – Who are the regulating authorities? – What does the technical process entail? – What are the deliverables? – What is our progress to date?
5.2	The purpose of EIA process was defined and explained to attendees. JC Pretorius stated that this process allows for the assessment of activities prior to their commencement to ensure the environmental impacts can be prevented, limited or, mitigated. It was furthermore stated that this process ensures that all environmental issues are integrated into planning & decision making process by means of anticipating and minimizing potential environmental damage or degradation. Lastly it was stated that the process allows for public involvement which leads to informed decision making and improves environmental conservation efforts.
5.3	JC Pretorius informed attendees that this meeting was a legal obligation of WPRSA the Environmental Assessment Practitioners. The various pieces of legislation that was consulted for the EIA process as a whole was reviewed.
5.4	With regards to the EIA process, the concepts of commenting and regulating authorities were discussed. The difference between the two entities was explained. JC Pretorius stated that for the purpose of this particular EIA, the Department of Water and Environmental Affairs (DEA) – Department of Integrated Permitting System (IPS) would be the Competent Authority presiding over the project. All other commenting and contributing parties were mentioned (refer to Public Meeting Presentation).

ITEM	ITEM DETAILS
5.5	JC Pretorius explained the EIA process by means of breaking it down into three phases – Application, Scoping and EIA. With regards to the Application phase of the project, JC Pretorius discussed the activities applied for and the integrated application process for which was applied. It was indicated that the application was submitted to the DEA – IPS for assessment and approved. The project has been registered at the DEA and permission received for the Scoping phase. **PLEASE NOTE –** With regards to the regulations pertaining of the undertaking of an EIA with respect to amendments JC Pretorius made all attendees aware of the amendment to be submitted with regards to the existing application. It was indicated that due to the fact that ownership of an Environmental Authorisation cannot partially be transferred, the proposed overhead alignment options would have to be removed from the exiting application as these overhead lines will be the property of ESKOM. Secondly, attendees were informed that the Declaration of Independence submitted as part of the EIA Application stated that ERM would be the primary geo-hydrologists working on the project, however the consultant retracted their services and SRK Consulting (SA) (Pty) Ltd was appointed. The amended Declaration of Independence was submitted to DEA for inclusion in the original integrated application.
5.6	All components pertaining to the Scoping Process was explained to attendees and JC Pretorius explained the process from submission of the Draft document to the authorisation of the final Scoping Report to DEA for authorization – Refer to the attached Public Meeting Presentation.
5.7	All components pertaining to the detailed EIA Process was also explained to attendees and JC Pretorius explained the process from submission of the Draft document to the authorisation of the final EIA Report to DEA for authorization – Refer to the attached Public Meeting Presentation.
6.	**PUBLIC PARTICIPATION**
6.1	The concept of public participation was defined to attendees as per the EIA Regulations, promulgated under the National Environmental Management Act, in August 2010. It was stated that the reason for the meeting held on 26 August 2011 was to – – Facilitates public involvement & consultation; – Enable Interested and Affected Parties to provide input into the EIA process & share information; – Allows for public involvement, sharing of ideas and the investigation of concerns; – Vehicle to obtain public/community buy-in and ownership; – Adds value to the decision making process; – Functions as an on-going data-gathering and facilitation mechanism for input into the EIA; – Create a better understanding of the project and its objectives. JC Pretorius furthermore informed attendees of the reasons why PP is required when undertaking an EIA with regards to the procedural requirements and amendment requirements.

ITEM	ITEM DETAILS
6.2	The Public Participation Process was discussed with attendees, and all tasks executed to date were presented. JC Pretorius stated that with regards to **Project Notification and Announcement** the following tasks were undertaken – – Site notices were placed at various public locations on the 21 – 22 July 2011 Refer to the attached Public Meeting Presentation. – Initial advertisements were placed on 14 July 2011. Afrikaans and Tswana adverts were placed in the Kalahari Bulletin and an English advert in the Diamond Field Advertiser. – Written notices were furthermore sent out to various stakeholders and parties during the course of 21 – 22 July 2011, notifying parties of the proposed development. With respect to the **Scoping phase** the following tasks were executed – – Site notices were placed at various public locations on the 17 August 2011. Refer to the attached Public Meeting Presentation. – Adverts were placed in the Kalahari Bulletin and Diamond Field Advertiser on 18 August 2011 in order to notify the public of the various public meetings to be held during the month of August related to the proposed development as well as to inform them that the Draft Scoping Report is available for review at the following locations. – All relevant stakeholders were informed of project via e-mail, post and facsimile around 22 August 2011. Notices were distributed within the community at the school and at all post offices. – Additionally posters were delivered to the primary school for distribution to parents. JC Pretorius informed attendees of the **I&AP registration process** and emphasised that this task is continuous and that any and all parties can register. JC informed them that their contact details would be entered into an I&AP Database for future correspondence inclusion. The particulars of all the public meetings for the Scoping Phase were also reviewed. Two initial meetings were scheduled with regards to the proposed development – This meeting held on Friday, 26 August 2011 at Groenwater Community Hall, Postmasburg. – And an earlier meeting held on 25 August 2011 at Postmasburg Civic Hall, Postmasburg. – Additionally community members requested and additional meeting in Groenwater, proposed for Monday 29 August 2011. JC Pretorius informed attendees that the DRAFT Scoping Report was made available for public review at the Postmasburg, Danielskuil and Groenwater (mobile) Public Libraries for the period of 18 August – 17 October 2011.
7.	**PROJECT OVERVIEW**
7.1	JC Pretorius presented the proposed Humansrus Solar Thermal Energy Power Plant to attendees. The discussion stated that the project will be situated on the farm Humansrus (farm 469) in the Siyanda District Municipality. It was furthermore brought to attendees' attention that the site falls within the Tsantsabane Local Municipal area, however due to the close proximity of the site to Danielskuil, the Kgatelopelo Local Municipality was also regarded as a primary stakeholder. Affected towns and localities include, Postmasburg, Danielskuil, Owendale, LimeAcres, Groenwater, Skeyfontein etc.

ITEM	ITEM DETAILS
7.2	The various outcomes of the project were highlighted to attendees with regards to the process and documentation to be provided to the authorities, the client and the public for review, comment and authorisation. JC Pretorius indicated that outcomes pertaining to the authorities would include – – Inform the decision making process for future development – Formal Application for Environmental Authorization – Submission of Draft and Final Scoping Report – Submission of Draft and Final Environmental Impact Report Whilst the following outcomes/documents would be presented to the client – – Copy of Application – Record of Public Participation – Submission of Draft and Final Scoping Report – Submission of Draft and Final Environmental Impact Report – Authorization granted/declined – obtained from Authority Lastly it was indicated that community related outcomes would include – – Assurance that the development & planning phase of the project considered all environmental & social factors – Inform the public of the proposed project, the process & the final decision from authorities – Submission of Draft Scoping Report for comment – Submission of Draft Environmental Impact Report for comment
7.3	The scope of the project with respect to all development components were discussed with attendees. All components pertaining to the heliostat field, power block, molten salt system and auxiliary services were described – refer to attached Public Meeting Presentation. Attendees were also informed of all the additional project related services such as the evaporation pond requirements, overhead distribution line requirements and the substation. During this section of the meeting JC Pretorius stressed the fact that all these services were of an advisory nature and that the various persons undertaking these assessments formed part of the EAP team as to ensure best implementable environmental science and project development occurs. It was also stated that the drawings pertaining to the waste (evaporation ponds) facilities and electrical (overhead distribution lines) were preliminary drawings only undertaken as to ensure that the impact of these activities on the receiving environment can be measured. He furthermore stated that these drawings and the technical design of these services will only be undertaken once EIA authorisation has been received and that these services will be done by an EPC Contractor. Possible positions of the proposed overhead lines and evaporation ponds were presented to attendees as to make them aware of the full extent of the proposed development.
7.4	JC Pretorius also explained the methodology employed for site selection purposes and presented the various criteria required for an optimal site in terms of a CSP development. The concept of project alternatives were defined and JC Pretorius indicated that according to National environmental Management Act, Act 107 of 1998 it is required that various project development alternatives be assessed. For this development Site, Technology and the NO-GO option was assessed – refer to Public Meeting Presentation attached and as eluded to in the DRAFT Scoping Report.

<table>
<tr><th>ITEM</th><th colspan="2">ITEM DETAILS</th></tr>
<tr><td>7.5</td><td colspan="2">An overview of the various specialist studies that was undertaken for the Scoping Phase was presented to all parties attending. A short summary of these specialists' tasks were also presented as per the DRAFT Plan of Study. JC Pretorius stated that for both baseline determination and impact assessment the following Specialists was included in the project team –
– Air Quality Assessment
– Avifaunal Assessment
– Biodiversity Assessment
– Geo-technical Assessment
– Geo-hydrological Assessment
– Hydrology Assessment
– Heritage Assessment
– Noise Assessment
– Soils & Agriculture Potential Assessment
– Socio-Economic Assessment
– Tourism Assessment
– Visual Assessment
– Wetland & Riparian Sensitivity Analysis
JC Pretorius brought it under the attention of the attendees that the DRAFT Scoping Report still contains information on the previous Geo-Hydrological Expert – however attendees were informed that the consultants undertaking this assessment has been changed to SRK.</td></tr>
<tr><td>7.6</td><td colspan="2">The prelim findings of all specialist investigations as per the baseline environmental assessment were discussed with attendees. JC Pretorius explained that these findings were preliminary and would be investigated and assessed in full during the EIA phase of the project. Please revert to the Public Meeting Presentation attached.</td></tr>
<tr><td>8.</td><td colspan="2">DISCUSSION</td></tr>
<tr><td>8.1</td><td colspan="2">All attendees were requested to post any and all comments and questions to the environmental practitioners with regards to the proposed development. They were also informed that all comments are to be recorded and included in the minutes of the meeting for official recording purposes.</td></tr>
<tr><td rowspan="2">8.2</td><td>KG Lekwente</td><td>The question on the development size was posted to the project team.</td></tr>
<tr><td>L Rautenbach</td><td>In response it was stated that the development in its entirety would take up roughly 700ha of the farm, and the diameter of the heliostat field is approximately 2.7km.</td></tr>
<tr><td rowspan="2">8.3</td><td>O Kgoronyane</td><td>It was enquired on what the relationship was between your company (SolarReserve) and Intikon as well as clarification on the roles of these two parties with regards to the CSP Development.</td></tr>
<tr><td>JC Pretorius</td><td>JC Pretorius stated that WPRSA does not form part of either Intikon or SolarReserve, and that WPRSA was appointed as independent environmental consultants to advise SolarReserve regarding all environmental components pertaining to the proposed development.</td></tr>
</table>

ITEM	ITEM DETAILS	
	L Rautenbach	The relationship between Intikon and SolarReserve was defined as a Joint Development. It was stated that Intikon and SolarReserve has endeavoured to develop this site together due to the optimal solar irradiation in the area. Intikon will primarily be responsible for the PV technology, whereas SolarReserve will be for the CSP technology, however both parties will have equal share in the development. It was furthermore explained that this EIA is done separately from the PV EIA as SolarReserve only partnered with Intikon at a later stage, only entering the South African Renewable's market in 2011. It was stated that WPRSA is independent from both SolarReserve and Intikon – and was only appointed to facilitate environmental and community related issues and components.
8.4	JC Pretorius	JC explained by means of the visual depiction of the proposed development which areas was PV and which CSP in order to define the areas and technology currently being assessed and discussed by WPRSA.
	L Rautenbach	Leanna Rautenbach furthermore explained the reason for the dual development. It was stated that the PV technology does not have the ability to store power, thus it can only generate power during optimal sunny conditions, whereas the CSP has the built in ability to store power, and can thus generate power in both inclement and optimal weather conditions.
8.5	L Rautenbach	Parties were asked if they had asked all their questions and made their comments. It was reiterated that attendees can mull over the information over the weekend, and come Monday, present their comments and questions at the second meeting.
8.6	JC Pretorius	For clarification purposes, JC Pretorius informed Obakeng Kgoronyane of the second proposed meeting to be held on Monday, as per attendee's request.
	O Kgoronyane	Mr Kgoronyane informed the WPRSA team that according to his knowledge there is a meeting scheduled for the Monday in the Community Hall, and that the second meeting would not be possible. Leanna Rautenbach made the suggestion for Tuesday as the hall will not be available on the Monday as requested. It was then stated the hall will be booked out for the whole week during the day. Terence Govender responded to the comment by indicating the meeting will only take place in the late afternoon at 17:00. All parties agreed that this date and time was suitable and acceptable to all.
8.7	S Tanesh	Shawn asked how the community will benefit from the project.

ITEM	ITEM DETAILS	
	T. Govender L. Rautenbach JC Pretorius	Terence Govender stated that this project falls within government IPP process and the conditions are very specific stating that all projects require maximised localisation. It was furthermore stated that an estimated 30% of all project inputs can be sourced locally – albeit Kimberley, Postmasburg etc in South Africa Employment was the second local benefit – it was stated that roughly 7000 jobs will be created during the 30month construction period, direct, indirect and induced. The concept of induced employment was explained in terms of the ripple effect, as one industry will now be stimulated to generate on a mass scale, thus requiring that many more people be employed in order to supply in the demand. It was also indicated that during operations there will be roughly 17000 mirrors that will need cleaning and maintenance as well as 60 permanent jobs to operate and manage the project. Job creation jobs will be for skilled and unskilled persons. Government stated that all communities within a 50kms need to be involved. This could mean Skeyfontein, Groenwater or any local community within this radius, this is why SolarReserve has requested on a multitude of occasions for a meeting with the CPA in order to discuss community involvement and determine possible benefit. Additionally Mr Govender informed attendees about SR' intention of setting up a Development fund. He stated that he is the process of discussing with his seniors the possibility of establishing this Development Fund, as to allow for not only local impoverished communities throughout the region to benefit but also for those communities not situated in the direct vicinity of the development. SolarReserve stated that they have a corporate social mandate on how they can assist the community, again the urgent request for a meeting for a CPA meeting. The example of tourism was used to explain potential future benefits. It was stated that many people across the country and even the world will come to see this plant, and with that the tourism industry will be stimulated, as these visitors will need places to stay and eat. As SolarReserve aims to stay involved with the project over its lifespan, they want the local and bordering communities to benefit. It was stated this development will not be same as to the mines, as SolarReserve takes equity in the development and will need community buy-in as they will be present in the area for the next 30years. Terence stated that it was their mandate to remain involved up until decommissioning but if they are not made aware of the community needs and requirements, they cannot provide in the community needs. This is why the CPA meeting is so important in order to assess and determine what the collective communities' needs are.
8.8	O Kgoronyane	The question was raised on how community members can be involved in the process.
	JC Pretorius	It was stated by JC that first of all persons are to register as I&AP's and will be consulted and kept informed on the project progress.
8.9	O Kgoronyane	Hereafter clarification with regards to the IAP registration process was requested.

ITEM	ITEM DETAILS	
	JC Pretorius L Rautenbach	Leanna Rautenbach stated that all parties who signed the attendance register for attending this meeting will automatically be added on to the I&AP register. It was furthermore stated that any means of communication may be used to register – from SMS to email.
8.10	O Kgoronyane	What was the guarantee of SolarReserves of social community involvement? How can the community be guaranteed that they will benefit from the development?
	T Govender L Rautenbach JC Pretorius	SolarReserve has taken the stance that they will obtain equity in the project, meaning that they will not merely be present during the development phases however they will remain active until the plant is one day decommissioned. It was stated that SolarReserve wants community buy-in the need the community to support the project as they will be here for life. An example was used with respect to the building of a PnP – if there isn't consumer to buy products, and then it was a futile attempt to construct, like with any business, you are reliant on your directly affected communities and people to support and add value to your business. From SolarReserve's point of view we cannot promise or commit to creating jobs, as we are in the initial stages of development and investigations. However with respect to the influx of capital in to the region it is a natural occurring effect that more people will be exposed to potential jobs and more revenue. From a business point of view, SolarReserve will need to employ people to work on the plant, and this will ultimately result in people being more able to take care of their families, as an income will now be available to them. JC stated that there will be direct, indirect and induced jobs to be created. This means that the local economy will not be the only economy to benefit; the benefits will extrapolate to the region and possibly the province. It was stated by Leanna Rautenbach that to date SolarReserve cannot make a commitment to possible benefit from the project as the project is still in the EIA Phase of development. If the site is deemed not suitable for this type of development it will not be authorised by the Department thus meaning we cannot guarantee any benefits. It was stated that at this stage of the development the community benefit concept was a gentleman's agreement, as the DEA has not yet approved the development. It was stated that this stage of the development was done at financial risk of the client, every penny spent on the development is done without certainty of the project proceeding as it has not be granted an authorisation by the DEA. Only once we are certain the site is approved, then can SolarReserve start putting pen to paper to commit to community benefits. Terence Govender stated that this reason is why the development and EIA phase is so important, for now community members can ask these types of questions, so that possible solutions can be workshopped and determined for once the project is off the ground. It was stated that if there are any additional comments they can be emailed or smsed to the Environmental Practitioners. Obakeng stated that he is asking these difficult questions, as he cannot attend on Monday, and want his comments recorded in front of witnesses.

ITEM	ITEM DETAILS	
8.11	O Kgoronyane	Clarification was requested with regards to the relationship between SolarReserve and the Land owner. The relationship needs to be classified and the role of SolarReserve within this context. It was asked if SolarReserve will go into business with the landowner of if it is merely a land lease agreement. The component of conflict resolution was also aired. The crux of the question was based in the fact that to date the community did not have a good relationship with the land owner and they were afraid of not being offered a chance or opportunity with regards to applying and possibly getting jobs at the solar plant.
	T Govender	It was stated that the people will become the employees of the project company and the project company does not include the land owner. To date the land owner has no stake in the project company. It was furthermore stated by Leanna Rautenbach that the current agreement with the landowner only pertains to the "rental" of the property in question. It is a standard long term lease where by the project company rents the property to develop the solar plant.
8.12	Ditiro Kiet	Apart from the Humansrus project it was asked if there was any other project in the remainder of South Africa currently be developed or in pre-development phases.
	T Govender	Terence stated that there are several big projects currently being developed in the USA and Spain. Additionally SolarReserve is looking at developing several other projects in South Africa, the sites for these project have been developed and is currently under investigation.
8.13	Commercial Issues	Various comments and questions regarding commercial issues were raised during this meeting that had no reference to the EIA of the proposed project. These matters were addressed by Terence Govender who in turn stated that this meeting is not the right forum for discussions of this nature as this meeting has pertinence to the EIA and not the Commercial side of the development. Terence Govender furthermore stated that these issues will be discussed at council meetings at a later stage in project development. Terence Govender stated again that all other commercial related issues are to be discussed outside of this meeting, as it does not relate to the environmental components for which this meeting was intended. A request for a CPA meeting was requested by Terence Govender. Mr Lekwente KG (CPA Secretary) stated that he will try and facilitate the meeting request for SolarReserve.
9.	**WAY FORWARD**	
9.1	JC conclude the meeting and thanked all attendees for attending and prompted them to go to the various facilities to review the Scoping Report and comment there on as their inputs are greatly valued.	

DISTRIBUTION LIST

DISTRIBUTION	COPY
1. Terence Govender	
2. Leanna Rautenbach	
3. JC Pretorius	
4. J Leboko	
5. Lekwane KG	
6. O Kgoronyane	
7. D. Kiet	
8. S Tanesh	
9. G Diraditsile	

END OF RECORDS

WorleyParsons
resources & energy

EcoNomics

MEETING RECORD

Project No: 257000
Project: Humansrus Solar **THERMAL ENERGY POWER PLANT**

Project Inception Meeting Minutes - Scoping Phase

PARTICIPANT NAME & ORGANISATION		**DATE**	02 November 2011
CLIENT:	SOLARRESERVE SA **(PTY) LTD**	**TIME START**	14:00
PRESENT:	SEE ATTENDANCE REGISTER - ADDENDA 1	**TIME FINISH**	13:00
Messrs:		**LOCATION**	Department of Environmental Affairs, Pretoria
		RECORDER	Leanna Rautenbach
		DOC NO	06-004
		FILE LOC	
		PROJ REF	PWE
SIGNATURE ORIGINATOR:			
WorleyParsons RSA		**DATE SIGNED:**	
SIGNATURE OTHER PARTY:			
		DATE SIGNED:	
COPIES:			

RECORD OF DISCUSSIONS

ITEM	ITEM DETAILS
	Safety Moment
1.	**WELCOME AND INTRODUCTION**
1.1	Leanna Rautenbach introduced the Humansrus Solar Thermal Energy Power Plant to the newly appointed case officer, Masina Litsoane. Parties attending the meeting were asked to introduce themselves and shortly narrate their role in the project team.
1.2	The Project team was introduced – – Leanna Rautenbach – Project Manager from WorleyParsons RSA. – Masina Litsoane – Case Officer, IPS – Environmental side at the DEA.

ITEM	ITEM DETAILS
1.3	A short discussion was held with regards to previous meetings held between DEA, the project proponent (SolarReserve SA (Pty) Ltd) and the Environmental Assessment Practitioners (WPRSA). The meeting was used to inform the new case officer of all matters pertaining to the project and all initial discussion and meetings held with the DEA as well as to inform the case officer on the various project requirements and site limitations. Previous discussions with the Department were brought under Me. Litsoane's attention with regards the dual development, the recommended buffers as per the PV EA and the site limitations. It was proposed by Me Litsoane that these items be discussed during the site visit on Thursday 03 November 2011 in more detail as she will then be able to advise accordingly. The minutes of the meeting held with the project team on the 18th of August 2011 for reference. Matters arising from the minutes were also discussed – such as the project urgency and time line requirements.A copy of the letter requesting exemption from the Public Meeting during the EIR Phase was also presented to the case officer for consideration and comment.
2.	**MATTERS FOR CLARIFICATION**
2.1	**Clarification on Final Draft and Final Scoping Report**
	[Masina Litsoane] It was enquired on why the department received 2 copies of the SR for review and as to which report was the final for authorisation.
	[Leanna Rautenbach] It was explained that due to the very strenuous time constraints of the IPP Bidding Process, an original agreement with the DEA was made where the draft SR would be reviewed by the Department, upon submission of the final report, a letter would detail the amendments or changes and the Public Review comments would be included for perusal. This was requested to allow for quicker processing of the SR as to save some much needed time to allow for submission of this project during next year.
	[Masina Litsoane] She was not aware of this agreement between the Department and the project team, as she was only assigned to the project on Thursday 27th of October 2011. However she stated that she would try her utmost to process all energy project as fast as she can, thus requesting the site visit so quickly. She indicated that she would compile the site visit report on Friday 04 November for inclusion of the Departments comments on the project to be processed the following week. She also however stated once the documents leave her desk, she was no longer able to control the signature process and that these time frames were out of her hands.
	[Leanna Rautenbach] Thanked Masina for her attention and willingness to assist, and stated that during the weekly follow-ups she will request where the report is an aim to obtain possible time frames from the parties where the report is at that stage.
2.2	**Letter requesting Exemption**
	[Leanna Rautenbach] Feedback was requested on the letter submitted with the Final SR regarding WPRSA request to be exempted from public meeting to be held during the EIR phase of the project. A copy of the letter was presented to the Case Officer for action.
	[Masina Litsoane] Stated that she did not receive the letter as discussed. It was furthermore stated that if all possible other means were to be exercised during the EIR phase to inform IAP's that this would be acceptable; however she would formally act on the letter received.
2.3	**EIR Review and Signature process**

ITEM	ITEM DETAILS
	[Leanna Rautenbach]: The time lines for approval of the EIR was discussed and the Me Litsoane was informed were informed of the tight restrictions as per the IPP Bidding process. It was requested that a similar approach as was discussed for the SR phase be followed. It was concluded that Me Litsoane would review the Draft EIR and comment, once the final report is submitted with a letter defining the variations from the draft, she will process the report for signature.
	[Masina Litsoane] Stated that she sees no problem with the recommended approach and will aim to process all project related documents as quick as possible, however it was reiterated, that when the documents leave her office for upper management signatures she has no control over the timeframe.
2.4	**Dual development and other documents**
	[Masina Litsoane] Me Litsoane requested that if possible all written records be forwarded to her for review.
	[Leanna Rautenbach]: All communications regarding the dual development and potential conflict of interest is to be forwarded for review as requested.
2.5	**Buffer Zone discussion**
	[Leanna Rautenbach]: The approved PV development was discussed and Leanna brought the proposed buffer zones under the attention of Mr Litsoane. It was enquired on if the PV buffers are to be included in our assessment and what the merit will be.
	[Masina Litsoane] Me Litsoane stated that she will assess this during her site visit – however she concluded that regarding visual impacts, a physical buffer is far more successful than a distance buffer. She also stated that if buffers are motivated and supported by expert opinion and research they will have to consider these recommendations.
2.6	**Application amendment requirements**
	[Leanna Rautenbach]: Additionally it was enquired on the way forward regarding the amendment of the application with regards to activities to be removed and finalised.
	[Masina Litsoane] Me Litsoane indicated that upon submission of the Final EIR the application form must be updated and all activities removed and or changed to be included. A cover letter in this regard needs to be submitted with the application stating which changes had been made to the application form.
2.7	**Additional enquiry: Rooipunt Application**
	[Leanna Rautenbach]: An enquiry was made with regards to the Rooipunt application which was submitted to DEA and the way forward. It was stated that separate EIA and WASTE applications were submitted for the proposed development, and that separated EA will be required upon reaching the approval phase of the development.

ITEM	ITEM DETAILS
	[Masina Litsoane] Me Litsoane advised that the application is to be amended, as the Department no longer deals in separate applications for Waste and EIA – the rationale behind the IPS division. It was advised that the reference numbers issued for the EIA and Waste applications be sent to her for follow up and clarification. She furthermore stated that in order to award 4 separate EA's it would be best to submit 4 separate applications for the aforementioned development. This is precautionary measure for the instance an appeals process is to be followed for one of the phases, thus not upholding the entire process, only the single phase in question. Me Litsoane indicated that she will formally advise on this matter upon receipt of the reference numbers. She also stated that this will not hold up the project as the reference number will merely be split to indicate the phase of the project, and can be run concurrently with the Scoping phase.
3.	**WAY FORWARD**
3.1	Leanna Rautenbach thanked Me Litsoane for attending the meeting at such short notice, and confirmed the arrangements for the following days' site visit.

DISTRIBUTION LIST

DISTRIBUTION	COPY
1. Terence Govender	
2. Leanna Rautenbach	
3. JC Pretorius	
4. Phumeza Skepe	
5. Z. Mbili	
6. Z. Phohlo	

END OF RECORDS

APPENDIX D: DATABASE OF POTENTIAL I&APS CONTACTED

INTERESTED AND AFFECTED PARTY DATABASE (NAT. GOV.)

Last Name	First Name	Company	Designation	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
Mans	Jacoline (Mrs)	Department of Agriculture, Forestry and Fisheries	Chief Forester: NFA Regulation (Branch: Forestry)		P.O. Box 2782	8800	Upington	054 338 5860		054 334 0030	JacolineM@daff.gov.za
Collett	Anneliza (Mrs)	Department of Agriculture, Forestry and Fisheries	Directorate: Land Use and Soil Management		Private Bag X120	0001	Pretoria	012 319 7508	082 326 0003	012 329 5938	AnnelizaC@nda.agric.za
Mazwi	Nozi (Mr)	Department of Water Affairs	WQM	28 Central Road, Beaconsfield	Private Bag X6101	8300	Kimberley	053 836 7600	082 802 7128		MazwiR@dwa.gov.za

INTERESTED AND AFFECTED PARTY DATABASE (PROV. GOV.)

Last Name	First Name	Company	Designation	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
Mbanjwa	Sibonelo	Northern Cape Dept. Environmental Affairs and Nature Conservation	Deputy Director: Impact Management		Private Bag X6120	8300	Kimberley	053 807 7470			smbanjwa@ncpg.gov.za
Yaphi	Anga	Northern Cape Dept. Environmental Affairs and Nature Conservation	PEO: Impact Management	Cnr River & Mark Str, Upington	PO Box 231	8800	Upington	054 332 2885	083 301 3351	054 331 1155	ayaphi@upprov.ncape.gov.za
Fourie	Nico	Northern Cape Dept. Roads and Public Works			PO Box 3132	8301	Kimberley	053 839 2260	083 451 1046	053 839 2290	ngc@mtnloaded.co.za
Toerien	Nico	Northern Cape Dept. Agriculture, Land Reform and Rural Development	SRM: Control Technician		PO Box 52	8800	Upington	054 337 8000	071 860 7551	054 337 8001	ntoerien@gmail.com
Paulse	David	Northern Cape Dept. Environmental Affairs and Nature Conservation	Assistant Director: Permit Administration, Impact and Risk Assessment		Private Bag X6120	8300	Kimberley	053 8077430 / 58	082 335 7713	086 515 1741	permits@vodamail.co.za

INTERESTED AND AFFECTED PARTY DATABASE (LOCAL GOV)

Last Name	First Name	Company	Designation	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
van Staden	G	Siyanda District Municipality (DC8)	Executive Mayor (Cllr)	Cnr Hill and Le Roux Street, Upington	Private Bag X6039, Upington	8800	Upington	054 337 2800		054 337 2888	
Ngxanga	D.	Siyanda District Municipality (DC8)	Municipal Manager	Cnr Hill and Le Roux Street, Upington	Private Bag X6039, Upington	8800	Upington	054 337 2800		054 337 2888	dngxanga@siyanda.gov.za
Nakoo	J.	Siyanda District Municipality (DC8)	Director: Technical Services	Cnr Hill and Le Roux Street, Upington	Private Bag X6039, Upington	8800	Upington	054 337 2800		054 337 2888	
Lategan	J.G	Siyanda District Municipality (DC8)	Director: Corporate Municipal Support	Cnr Hill and Le Roux Street, Upington	Private Bag X6039, Upington	8800	Upington	054 337 2800		054 337 2888	
Rupping	Frikkie	Siyanda District Municipality (DC8)	Environmental Manager	Cnr Hill and Le Roux Street, Upington	Private Bag X6039, Upington	8800	Upington	054 337 2800	082 822 9353	054 337 2888	fpr@siyanda.gov.za
October	Mervin	Siyanda District Municipality (DC8)	Dept. Social Development	Cnr Hill and Le Roux Street, Upington	Private Bag 5892	8800	Upington	054 339 9448	082 592 9604	054 339 2349	moctober@uposbncape.gov.za
Mothibi	Hazel (Cllr)	Tsantsabane Local Municipality (NC085)	Former Mayor	13 Springbok Street, Postmasburg	PO Box 5, Postmasburg	8420	Postmasburg	053 313 7300		053 313 1602	hazel.mothibi@lgnet.org.za
Phete	**Elroy (Mr)**	**Tsantsabane Local Municipality (NC085)**	**Mayor**	**14 Springbok Street, Postmasburg**	**PO Box 5, Postmasburg**	**8421**	**Postmasburg**	**(053) 313 7300**		**(053) 313 1602**	**enjade@webmail.co.za**
Moselane	Moses Moshia (Rev)	Tsantsabane Local Municipality (NC085)	Municipal Manager	13 Springbok Street, Postmasburg	PO Box 5, Postmasburg	8420	Postmasburg	053 313 7300		053 313 1602	tsantsabane.mm@lgnet.org.za
Mora	Florence	Tsantsabane Local Municipality (NC085)		13 Springbok Street, Postmasburg	PO Box 5, Postmasburg	8420	Postmasburg	053 313 0343		053 313 1602	florence.mora@lgnet.gov.za
Henge	Salomzi	Tsantsabane Local Municipality (NC085)	Technical Services	13 Springbok Street, Postmasburg	PO Box 5, Postmasburg	8420	Postmasburg	053 313 7300	083 634 1382		solomzi.henge@gmail.com
Kgoronyane	Obakeng	Tsantsabane Local Municipality (NC085)	Ward Councillor		PO Box 1051	8421	Postmasburg		073 088 9074		kgoronyane@gmail.com
Maseng	Bernardo (Cllr)	Kgatelopele Local Municipality (NC086)	Executive Mayor	Barker Street 222, Danielskuil	PO Box 43, Danielskuil	8405	Danielskuil	053 384 8600		053 384 0326	mayorkgat@xsinet.co.za mayor@kgatelopele.gov.za
Mlambo-Izquierdo-Rodriguez	Poppy (Ms)	Kgatelopele Local Municipality (NC086)	NA	Barker Street 222, Danielskuil	PO Box 43, Danielskuil	8405	Danielskuil	053 384 8600		053 384 0326	danlime@xsinet.co.za
von Mollendorf	**Gustav (Mr)**	**Kgatelopele Local Municipality (NC086)**	**Municipal Manager**	**Barker Street 222, Danielskuil**	**PO Box 43, Danielskuil**	**8405**	**Danielskuil**	**(053) 384 8600**	**(082) 3833564**	**(053) 384 0326**	**corporateman@kgatelopele.gov.za**

INTERESTED AND AFFECTED PARTY DATABASE (STAKEHOLDERS)											
Last Name	First Name	Company	Designation	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
Sinthumule	Joas	Ngwao Boswa Kapa Bokone (Heritage Northern Cape)		22 Abattoir Rd, Ashburnham	Private Bag X5004	8300	Kimberley	053 807 4710			jsinthunule@ncpg.gov.za
Galimberti	Mariagrazia (Dr)	South African Heritage Resources Agency		111 Harrington St, Cape Town	PO Box 4637	8000	Cape Town	021 462 4502		021 462 4509	mgalimberti@sahra.org.za
Stroh	Lizelle	Civil Aviation Authority (CAA)	Obstacle Specialist	Ikhaya Lokundiza, Building 16, Treur C	Private Bag X73, Halfway House,	1685		011 545 1233			strohl@caa.co.za
Horak	Mathys	Air Traffic and Navigation Systems (ATNS)	Manager: AIS	Isando Industrial Park, Gewel Street, I	Private Bag X15	1620	Kempton Park	011 961 0307	079 879 365		thysh@atns.co.za
van Gensen	Andrea	Eskom Distribution North West Region	Enviromental Manager	120 Henry Street	PO Box 356	9300	Bloemfontein	051 404 2040		051 404 2972	andrea.vangensen@eskom.co.za
Erasmus	Suzanne	WESSA - Northern Cape Region	Regional Manager	McGregor Museum, Egerton Road	PO Box 316	8300	Kimberley	053 839 2717		053 842 1433	se@museumsnc.co.za
Anderson	Tania	WESSA - Northern Cape Region	Conservation Officer	McGregor Museum, Atlas street, Kimbe	PO Box, Kimberley, 8300	8300	Kimberley	053 839 2717	083 256 7402	053 842 1433	kmgbot@museumsnc.co.za
Ah Shene-Verdoorn	Carolyn	BirdlifeSA		Lewis House, 239 Barkston Drive, Blair	P O Box 515	2125	Randburg	011 789 1122	082 776 8333		advocacy@birdlife.org.za
Sithole	Sam	Sedibeng Water	Manager: Business Development	NA	Private Bag X5	9660	Bothaville	056 515 0200	082 806 8624		ssithole@sedibengwater.co.za
Rainier	Adele	Papkuil Farmers Union	Secretary	NA	Posbus 199	8410	LimeAcres		082 473 3019		tersia.steyn@debeersgroup.com
Weideman	Sarel	Danielskuil Farmers Union	Chairperson	NA	Posbus 288, Danielskuil	8405	Danielskuil	078 803 4545	083 262 5343		
		PPC Lime - Head Office	NA	PPC Building, 180 Katherine Street, Ba	PO Box 787416	2146	Sandton	(011)386 9000			contactus@ppc.co.za
Schoombie	Con	Lime Acres - Factory	General Manager	PPC Lime - Lime Acres	Private Bag	8410	LimeAcres	(053) 385 8200			cschoombie@ppc.co.za
Dzivhani	Mashudu	Lime Acres - Factory	Env. Manager	PPC Lime - Lime Acres	Private Bag	8410	LimeAcres	(053) 385 8200			mdzivhani@ppc.co.za
Sparks	Sarah	De Beers Consolidated Mine (Finsch Mine) Petra Diamonds	Environmental Manager	Central Ave, Lime Acres, 8410	P.O. Box 7	8410	Lime Acres	(053) 385 2111			sarah.sparks@debeersgroup.com
Jooste	Charl	Eskom									

INTERESTED AND AFFECTED PARTY DATABASE (GROENWATER COMMUNITY)

Last Name	First Name	Company	Designation	House Number	Cellphone number	Phone 2	Fax	Email Address
Augus	Jane			House no 29				
Bahule	Joseph			House no 39				
Bogodule	Abel			House no 178	076 112 1349			
Chiri	Boifarquelo			House no 479				
Chiri	Ohentse			House no 06				
Chiri	Siriah			House no 162				
Chiti	Samuel			House no 502	072 505 9111			
Dekgetsi	Paulus			House no 137	073 746 8342			
Dekgetsi	Moshe			House no 137	078 554 5189			
Dekgetsi	Patricia			House no 137	078 314 3089			
Dekgetsi	Onie			House no 137	079 377 7239			
Dikgetsi	Gaogomotse			House no 208	083 738 8300			
Dikgetsi	Abram			House no 146	073 476 3667			
Dilegetsi	Grace			House no 20				
Dipone	Conny			House no 213	073 433 3504			
Diroditsile	Betty			House no 499				
Fosi	Tsalaemang			House no 147	076 423 4700			
Fosi	Poppy			House no 444				
Gamoga	Matlhou			House no 170				
George	Naledi			House no 4	076 109 7149			
George	Kagisho			House no 494				
Goeieman	Tshepo			House no 482				
Goeieman	Letumile			House no 32	071 007 6403			
Goeieman	Masabata			House no 67	073 665 0429			
Gopolang	Hilda			House no 334	071 262 9608			
Jacobs	Lulu			House no 176				
Jacobs	Polelo			House no 488	078 352 4567			
Jacobs	Veronica			House no 108	071 552 4706			
Jonas	Ester			Groenwater	078 730 2215			
Jonas	Lorato			House no 89	072 360 0859			
Kalankate	Onalenna			House no 204				
Ketumile	Thabiso			House no 435	073 787 7849			
Kgatlhane	Malebo			House no 62	076 139 2929			
Kgoroayantsi	Ogolotse			House no 51	082 316 4746			
Kgoronyane	Kedibone			House no 7				
Kgoronyane	Obakeng	Groenwater CPA	Treasurer	Houes no 36	073 088 9074	kgoronyane@gmail.com		
Kgoronyane	Christina			House no 35	076 133 4638			
Kgoronyane	Jonas			House no 35	078 089 2038			
Kgoronyane	Kutloano			House no 460	073 243 7807			
Kgoronyane	Mama's			House no 35	084 418 3677			
Kgoronyane	Lizzy			House no 7				
Kgosiemang				House no 332	078 559 8317			
Kgumile	Nomvulelo			House no 121	083 688 0459			
Kgumile	Lendiwe			House no 92				
Kocoje	M.J.			House no 153	076 573 2902			
Kolberg	Susan			House no 209				
Kolberg	Keoneeng			House no 22	076 791 9713			
Kolberg	Gladys			House no 83	083 5197 1999			
Kolberg	Kgalalelo			House no 140				
Kolberg	Gasengwana			House no 498				

Kolberg	Seitebaleng			House no 118	071 511 7376			
Kolberg	Iris			House no 109	072 515 8898			
Kolberg	Freddy			House no 118	078 437 1318			
Kolberg	Luckyboy			House no 188	071 081 7800			
Kolberg	Bogosi			House no 16				
Kolberg	Willy			House no 50	073 450 5760			
Koloje	Gaitsewe			House no 153	076 573 2902			
Kololo	Kealeboga			House no 155	073 013 7631			
Kololo	Lillian			House no 155				
Kornet	Felicia			House no 61	072 805 5319			
Kornet	Betty			House no 61	072 717 1393			
Kweetsane	Constance			House no 447	084 313 3544			
Leberegone	Violet			House no 111				
Lekwene	A			House no 47				
Lekwene	Lydia			House no 49	071 010 7417			
Lekwene	Kgomotso			House no 10	073 745 5648			
Lekwene	Frank			House no 43	078 359 9801			
Lekwene	Katlego			House no 43				
Letlah	Saul			House no 134				
Louw	Hendrik			House no 104				
Mabale	Ishmael			House no 444	079 144 9252			
Mabale	Daniel			House no 366				
Mabale	Abram			House no 502				
Maelo	Miriam			House no 403	078 463 0519			
Mafuza	Kealeboga			House no 182	083 714 1492			
Marotobolo	Ruth			House no 473				
Masuti	Lesly			House no 440	076 466 7300			
Matihare	Tsholofelo			House no 120				
Matlhare	Dennis			House no 218				
Matlhare	Boipelo			House no 173	082 518 5632			
Matlhare	F			House no 174				
Matlhare	Moshe			House no 162				
Matlhare	Mpho			House no 120				
Matlhare	Prince			House no 151				
Matlhare	Boikanyo			House no 206	078 195 4925			
Matlhare	Kegoewtswematla			House no 173	082 631 6044			
Modise	Molly			House no 60	084 228 3496			
Modise	Abel			House no 483	073 217 0015			
Modise	Lentikile			House no 69	073 561 21314			
Modise	White			House no 158	073 671 2232			
Modise	Jeffrey			House no 152				
Moemedi	Kevin			House no 471	079 767 5142			
Moemedi	Jethro			House no 2				
Moemedi				House no 435	072 235 1809			
Moemedi	Oetsile			House no 132	083 163 4412			
Moemedi	Kenosi			House no 140				
Moemedi	Kedihilag			House no 18				
Moemedi	Aolotse			House no 18				
Moemedi	Keileng			House no 18				
Moemedi	Otsile			House no 132	079 767 3142			
Mogathi	Christopher			House no 179				
Mogatliwe	Keotebogile			House no 73	078 366 1783			
Mogatliwe	Gaepalelwe			House no 447	071 959 8021			
Mogotilwe	Moremoeng			House no 129	083 987 9727			
Mogotiwe	Boitumelo			House no 73	076 017 4010			

Mogotliwe	Maria			House no 75				
Moingothi	Annah			House no 70	079 312 9525			
Moingotli	Nomaliso			House no 12	083 420 8035			
Moingotli	Piet			House no 12	079 277 7273			
Moingotli	Bathodi			House no 12				
Moingotli	Cabel			House no 476	082 426 7096			
Mokang	Tshwaro				074 866 5479			
Mokomela	Boitomelo			House no 102				
Molefe	Martha			House no 75				
Molwagae	Minah			House no				
Monabe	Baby			House no 14				
Moncho	Olebogeng			House no 459	072 533 1174			
Moncho	Olebile			House no 46				
Moncho	Solomon			House no 44	078 528 9997			
Montshabeng	Oarabile			House no 497	072 840 8697			
Monyolo	Thataone			House no361	851 230 61920			
Monyolo	Robinah			House no 133				
Mookeng	Renny			House no 37	079 959 3042			
Moruti	Stanright			House no 160				
Moruti	Kedumetse			House no 70	078 919 1083			
Moruti	Frans			House no 164				
Moruti	Daniel			House no 160	078 379 3290			
Morwanjae	Jonas			House no 148				
Morwanyae	Tumelo			House no 148				
Morwanyae	Marshaek			House no 189	083 883 3604			
Morwanyane	Kegomodibwe			House no 148				
Mosthabang	Leeuw			House no 498				
Moswanyana	Scinah			House no 148				
Motingwe	Lovedelion			House no 500	073 5100 788			
Motlhate	Boikango			House no 206				
Motshabeng	Baitsemang			House no 474	076 559 8567			
Motshabeng	Maria			House no 504				
Motshabeng	Keitumetse			House no 400	071 433 7600			
Motshabeng	Keabetswe			House no 428	079 144 9252			
Motshabeng	Dineo			House no 151	079 933 2119			
Motshabeng	Mercy			House no 497	073 891 5386			
Motshabeng	Precious			House no 497	079 643 3828			
Motshabeng	Rehilwe			House no 497	078 796 8893			
Motshabeng	Charlotte			House no 40	082 121 4890			
Motshabeng	Oboneng			House no 40				
Motshabeng	Nancy			House no 40	073 429 3412			
Motshabeng	Kabelo			House no 365	073 047 6663			
Motshabeng	Ruth							
Motshaby	Segomotso			House no 121	0716 466 7300			
Motshoseng	Revealing			House no 504	078 432 1387			
Murray	Maria			House no 145	074 300 9199			
Murray	Petrus			House no 146				
Nkotla	Kehilwe			House no 334	072 180 1089			
Plaatjies	Jeffrey			House no 419	083 499 2082			
Rooibaadjie	Elizabeth			House no 217				
Rooibadjie	Lorato			House no 177	083 572 2670			
Rooibatjie	Moses			House no 109	079 444 9211			
Saul	Kgalalelo			House no 199	071 980 8299			
Sebape	Kenosi							
Sebape	Ernest			House no 19	073 756 1505			

Sebape	Anthony			House no 443	078 770 88904			
Sebape	Keorapetse			House no 497	079 656 60891			
Sefako	Mpho			House no 489	072 318 4497			
Sefako	Mmoioki			House no 489	074 374 3940			
Sefako	Mmoloki			House no 489				
Sefako	Margret			House no 489	072 678 1411			
Segele	Lodwa			House no 124	073 260 0548			
Segole	Margret			House no 125				
Seleka	Olebogang			House no 129	076 55 9728			
Seleke	Sarah			House no 45	073 343 2849			
Seleke	Boipelo			House no 455	082 631 6044			
Seleke	Boitumelo			House no 55	073 343 2849	74 343 2849/082 631 6044	631 6044	76 343 2849/082 631 6044
Seleke	Reuben			House no 110	074 643 5148			
Seleloshe	Puondo							
Senye	Phemelo			House no 102				
Senye	Dorcas			House no 157	076 552 01234			
Senye	Mapule			House no 29				
Smith	Martha			House no 159	074 300 9199			
Smith	Thabisho			House no 504				
Smith	Ogonogile			House no 441				
Smith	Martha			House no 159	073 895 7187			
Staffnurse	Saul			House no 148				
Van rooi	Kgakgamats			House no 404	079 552 4664			
Van rooi	Sophie			House no 404	079 552 4664			
Van rooi	Maria			House no 404	078 602 7092			
Van rooi	Kebobamang			House no 174				
Van rooi	Ohaletse			House no 174				
Van rooi	Grace			House no 17				
Voggies	Mercia			House no 430	071 250 6127			
Zondo	Petrels			House no 213	073 433 3504			
				House no 157	073 524 9952			
	O.S.			House no 120				
	Reuben			House no 34	073 131 4388			
	Kedimametsi			House no 446				
	Dineo			House no 117	071 577 6274			
	Bennet			House no 13				
	Boitomelo			House no 121				
	Tebogo			House no 143				
	Kegodiliswe			House no 162				

INTERESTED AND AFFECTED PARTY DATABASE (ADJACENT LANDOWNERS)

Last Name	First Name	Capacity	Organisation	Farm Name	Portion	Registration Division	SG number	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
Scholtz	Allen	Landowner	Private - Development Property	-	RE/469	Hay RD	C03100000000046900000		PO Box 162	8420	Postmasburg	(082) 821 2729			allanscholtz@gmail.com
Kgoronyane	Obakeng	Treasurer	Groenwater Communal Property Association	Groenwater	RE/453	Hay RD	C03100000000045300000					(073) 088 9074			kgoronyane@gmail.com
-	-		Groenwater Communal Property Association	Groenwater	4/453	Hay RD	C03100000000045300004		PO Box 787						
de Klerk	Andries Jacobus	Landowner	Private - Neighbouring property (Sunnyside)	-	1/469	Hay RD	C03100000000046900001		PO Box 787	8420	Postmasburg	(074)123 7767			
van Niekerk	Johannes Barend	Landowner	Lorisne CC (L&M Trust)	-	RE/468	Hay RD	C03100000000046800000	18 Koppies Street	Po Box 158	8420	Postmasburg				
Ndou	Livhuwani	Specialist	Transnet (Pty) Ltd	-	2/469	Hay RD	C03100000000046900002	email				(051) 408 2939	0832789499		livhuwani.ndou@transnet.net

APPENDIX E: DATABASE OF REGISTERED I&APS

REGISTERED INTERESTED AND AFFECTED PARTY DATABASE

Last Name	First Name	Company	Designation	Physical Address	Postal Address	Postal Code	City	Phone 1	Phone 2	Fax	Email Address
Stroh	Lizelle	Civil Aviation Authority (CAA)	Obstacle Specialist	Ikhaya Lokundiza, Building 16, Treur Close,	Private Bag X73, Halfway House,	1685	Midrand	011 545 1233			strohl@caa.co.za
Horak	Mathys	Air Traffic and Navigation Systems (ATNS)	Manager: AIS		Private Bag X15	1620	Kempton Park	011 961 0307	079 879 365		thysh@atns.co.za
Collett	Anneliza (Mrs)	Department of Agriculture, Forestry and Fisheries	Directorate: Land Use and Soil Management	Cnr Annie Botha and Union Streets, Pretoria, Room 282				012 319 7508	082 326 0003	012 329 5938	AnnelizaC@nda.agric.za
Viljoen	Albertus	Tshiping Water Use Association	CEO		PO Box 434	8420	Postmasburg	053 313 0595	083 649 5452	053 313 0595	info@tshiping.co.za
Venter	Sarel	Danielskuil Farmers Association	Ex-Chaiperson						082 873 4744	053 384 0625	in process of obtaining e-mail
Mans	Jacoline	Department of Agriculture, Forestry and Fisheries	Chief Forrester: NFA Regulation		PO Box 2782,	8800	Upington	(054) 338 5860		(053) 334 0030	jacolinema@daff.co.za
von Mollendorf	Gustav	Kgatelopele LM	Municipal Manager		PO Box 43	8405	Danielskuil	(053) 324 8600	(053) 384 0326		corporateman@kgatelopele.gov.za
Davids	Alister Rodger			30 8th avenue, Postdene	30 8th avenue, Postdene	8420	Postmasburg	078 833 7693	053 313 2062	086 612278	ardavids@webmail.co.za
Mashilishi	Mpho	Tsantsabane			PO Box 339	8420	Postmasburg	078 297 1771			
Roman	Royden	Blinkklip Lekgotla		68 Plein Street. Postmasburg				074 5575 341			
	Petrus	Temla 13		22 Stasie Street, Postmasburg				083 513 1260	079 576 7930		congomotaung@webmail.co.za
Pule	Vincent	Temla 13									vpule@webmail.co.za
Sekeka	Jeffrey	Temla 13		20 Uil Street, Postmasburg				083 2375 972			
Molefi	Shele							073 0566 253			
Kiet	Ditiro	Groenwater community			PO Box 271	8410	Lime Acres	053 385 0222	083 5454 9376	0866 201033	d.gkiet@gmail.com
Tanesh	Shawn	Groenwater community			PO Box 272	8411	Lime Acres	084 041 5562			echipc2002@gmail.com
Diraditsile	Gabi	Groenwater community			PO Box 424	8420	Postmasburg	083 3633 146			
Leboko	Joa	Groenwater community			PO Box 424	8420	Postmasburg	071 439 4361			
Lekwane	KG (Rasta)	Groenwater CPA	Secretary		PO Box 1381	8420	Postmasburg	073 745548			
Meyer	Jacoba	Office of the Premier					Kimberley				jakobameyer1@gmail.com

APPENDIX F: WRITTEN COMMENT FROM REGISTERED I&APS

Jc Pretorius

From: Lizelle Stroh [StrohL@caa.co.za]
Sent: Wednesday, July 27, 2011 1:31 PM
To: Benedek, Frank
Subject: RE: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant
Attachments: Windfarm Powerline Spreadsheet.xls

Please provide the WGS 84 co-ordinates towards the proposed farm, boundaries turning points, on attached spread sheet.

Thanks

Lizell Stroh
Obstacle Specialist
Procedure design and Cartography
For SA Civil Aviation Authority
Tel: 011 545 1232 | **Fax: 011 5451451** **Cell:** 083 461 6660 | **Email:** strohl@caa.co.za |
www.caa.co.za

From: Benedek, Frank [mailto:frankb@ssi.co.za]
Sent: 20 July 2011 06:10 PM
To: Lizelle Stroh
Subject: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

DEA Reference: 12/12/20/2316

Dear Me Stroh

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) of SolarReserve SA (Pty) LTD intent to construct a Concentrating Solar Thermal Energy Power Plant and associated infrastructure on a portion of the Farm 456, the Hay RD, located approximately 30 kilometers east of Postmasburg in the Siyanda District (Northern Cape Province).

In terms of the Environmental Impact Assessment ("EIA") Regulations (April 2006) promulgated under Sections 24 and 24D of the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and the National Environmental Management: Waste Act (Act No. 107 of 1998) [NEM: WA], various aspects of the intended development are considered listed activities which may have an impact on the environment, therefore requiring authorization from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

SolarReserve SA (Pty) LTD (the applicant) has appointed WorleyParsons RSA and SSI Engineers and Environmental Consultants (known as the WorleyParsons SSI Environmental Partnership or "WPSEP") as independent Environmental Assessment Practitioners to undertake the Environmental Impact Assessment (EIA) Process and the associated Public Participation Process in support of an application for Environmental Authorization and a Waste Management License.

Please find herewith attached the project Background Information Document which provides you with more information regarding the proposed project, the EIA Process and the Public Participation Process to be undertaken for this project. Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

By completing and submitting the accompanying Registration and Comment Sheet, you would automatically be registered as an I&AP on the project database. WPSEP would like to thank you, in advance, for becoming part of the process and is looking forward to receiving your valuable comments pertaining to project.

Kind regards

Ms Leanna Rautenbach
WorleyParsonsRSA (Pty) Ltd
PO Box 93155
Menlopark

Mr Frank Benedek
SSI Engineers and Environmental Consultants
PO Box 867
Gallo Manor

0102 | 2052

☎: 012 425 6300 / 🖶: 012 460 9978
✉: leanna.rautenbach@worleyparsons.com

☎: 011 789 6430 / 🖶: 011 789 6010
✉: frankb@ssi.co.za

Jc Pretorius

From: AnnelizaC [AnnelizaC@nda.agric.za]
Sent: Friday, July 22, 2011 10:37 AM
To: Benedek, Frank
Subject: RE: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

Hello

Pls note that the national Department of Agriculture (DAFF) should be supplied with a copy of all documents derived as DAFF is the custodian of all activities occurring on agricultural land.

This is not only relevant in terms of the acts that this Department is managing e.g. Act 70 of 1970 , Act 43 of 1983 etc but as well as being a commenting authority in terms of NEMA, land use ordinances etc.

Kind regards
Anneliza Collett

Mrs. Anneliza Collett
Directorate: Land Use & Soil Management
Department of Agriculture, Forestry & Fisheries
Tel: 012 - 319 7508
Fax: 012 - 329 5938
e-mail: AnnelizaC@nda.agric.za
www.agis.agric.za

From: Benedek, Frank [mailto:frankb@ssi.co.za]
Sent: 21 July 2011 06:46 PM
To: AnnelizaC
Subject: Environmental Impact Assessment: Humansrus Solar Thermal Energy Plant

DEA Reference: 12/12/20/2316

Dear Mrs Collette (DAFF – Directorate: Land Use and Soil Management)

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Notice is hereby given in terms of the Environmental Impact Assessment (EIA) Regulations, published in Government Notices No. R543 to 546 (2010), promulgated in terms of Section 24(5) of the National Environmental Management Act (Act No 107 of 1998) and the National Environmental Management: Waste Act (Act No 59 of 2008) of SolarReserve SA (Pty) LTD intent to construct a Concentrating Solar Thermal Energy Power Plant and associated infrastructure on a portion of the Farm 456, the Hay RD, located approximately 30 kilometers east of Postmasburg in the Siyanda District (Northern Cape Province).

In terms of the Environmental Impact Assessment ("EIA") Regulations (April 2006) promulgated under Sections 24 and 24D of the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and the National Environmental Management: Waste Act (Act No. 107 of 1998) [NEM: WA], various aspects of the intended development are considered listed activities which may have an impact on the environment, therefore requiring authorization from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

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Please find herewith attached the project Background Information Document which provides you with more information regarding the proposed project, the EIA Process and the Public Participation Process to be undertaken for this project. Kindly note that I&APs will be notified of the particulars of the intended public / focus group meetings and the availability of the draft Scoping Report for public review.

By completing and submitting the accompanying Registration and Comment Sheet, you would automatically be registered as an I&AP on the project database. WPSEP would like to thank you, in advance, for becoming part of the process and is looking forward to receiving your valuable comments pertaining to project.

Kind regards

Ms Leanna Rautenbach
WorleyParsonsRSA (Pty) Ltd
PO Box 93155
Menlopark

Mr Frank Benedek
SSI Engineers and Environmental Consultants
PO Box 867
Gallo Manor

0102 2052

☎: 012 425 6300 / 🖶: 012 460 9978 ☎: 011 789 6430 / 🖶: 011 789 6010
✉: leanna.rautenbach@worleyparsons.com ✉: frankb@ssi.co.za

Please, consider your environment.
Before printing this e-mail ask yourself: "Do I need a hard copy?"

Jc Pretorius

From: Thys Horak [ThysH@atns.co.za]
Sent: Friday, July 22, 2011 12:41 PM
To: Rautenbach, Leanna (Pretoria); Benedek, Frank
Subject: ADDITIONAL INFORMASTION REQUIRED

Dear Sir/Madam

This e- mail serves as an acknowledgement of receipt of your E-mail dated 20 July 2011

In order for ATNS to evaluate your request and to provide you with our position as to the Proposed Humansrus Solar Thermal Energy Power plant we require the following information please.

- The height in feet/meters of the Top of the Central receiver
- The dimensions of each Heliostat - length, width and height above ground level
- The geographical coordinates of the parcel of land on which this facility will be located. Coordinates of each corner of the land in Degrees, Minutes and Seconds to 2 decimals of a second in WGS-84 format e.g. S261615.23 E0231723.76
- The Elevation of the site – lowest and highest in meters or feet above mean sea level (AMSL)
- The location and dimensions of any structure in support of the Plant .

Once ATNS is in possession of the aforementioned the evaluation process will commence.

Kind regards

Matthys C Horak
ATM Specialist
ATNS, ATM Planning Department
Tel: 011 961 0307
Cel: 079 879 3654
E-mail: thysh@atns.co.za

Environmental Impact Assessment Proposed Humansrus Solar Thermal Energy Plant (DEA Ref: 12/12/20/2316) REGISTRATION AND COMMENT SHEET	
CONTACT DETAILS: **SSI Engineers and Environmental Consultants** Attention: Mr. Frank Benedek PO Box 867 Gallo Manor 2052 Tel: 011 789 6430 / Fax: 011 789 6010 Email: frankb@ssi.co.za	**CONTACT DETAILS:** **WorleyParsonsRSA (Pty) Ltd** Attention: Leanna Rautenbach PO Box 36155 Menlopark 0102 Tel: 012 425 6300 / Fax 012 460 9978 Email: leanna.rautenbach@worleyparsons.com

Please complete and return to Ms Leanna Rautenbach (details top right)

TITLE	MR	FIRST NAME	MATTHYS
INITIALS	M C	SURNAME	HORAK
ORGANISATION	ATNS	EMAIL	thysh@atns.co.za
POSTAL ADDRESS			
		CODE	
TEL NR	011 961 0307	FAX NR	011 961 0447

Please **formally register me as an interested and affected party** so that I may receive further information and notifications during the EIA process. **(Please circle applicable box)**	YES	NO
I would like my notifications by **(Please circle applicable box)**	Letter (mail) Email Fax	

COMMENTS (please use a separate sheet if required)

I suggest that the following issues of concern be investigated in the EIA:

I suggest the following for the EIA process and / or the public participation process:

Any other comments:

A FORMAL ATNS POSITION WILL BE DOCUMENTED ONCE WE HAVE CONCLUDED OUR EVALUATION

Please ask the following of my colleagues/friends to register as an Interested and Affected Party for this EIA:

NAME	ORGANISATION	CONTACT DETAILS

Signature

21 June 2011
Date

THANK YOU FOR YOUR CONTRIBUTION

Jc Pretorius

From: Thys Horak [ThysH@atns.co.za]
Sent: Friday, July 22, 2011 9:39 AM
To: Benedek, Frank; Rautenbach, Leanna (Pretoria)
Subject: Proposed Humansrus Solar Energy Plant
Attachments: 20110721142138923.pdf

Dear Frank and Leanna

Herewith completed Registration as Interested/Affected party to the
proposed Humansrus Solar Energy Plant.

Kind regards

Matthys C Horak
ATM Spacialist
ATNS, ATM Planning Department
Tel: 011 961 0307
Cel:079 879 3654
E-mail : thysh@atns.co.za

Jc Pretorius

From: Rautenbach, Leanna (Pretoria)
Sent: Tuesday, July 26, 2011 12:40 PM
To: Tshiping WUA
Cc: Benedek, Frank
Subject: RE: Inligting

Hi Albertus

Dankie vir die belang.

Frank, van SSI sal die publieke kontak handhaaf – maar voel vry om my te kontak as jy iets benodig.

Mbt die projeckte – ons fasiliteer slegs die Humansrus CSP Projek.

Groete

Leanna Rautenbach
Environmental Scientist

WorleyParsons
resources & energy

Incorporating KV3 ENGINEERS

From: Tshiping WUA [mailto:info@tshiping.co.za]
Sent: 26 July 2011 10:07 AM
To: Rautenbach, Leanna (Pretoria)
Subject: Inligting

Hier is my inligting vir die Groenwater & Humansrus projekte.

Albertus Viljoen
CEO - Tshiping WUA

Sel : 083 649 5452
Tel : 053 313 0595
Fax : 053 313 0595
eFax : 086 589 3482
info@tshiping.co.za
PO Box 434, Postmasburg, 8420

Jc Pretorius

From:	JacolineMa <JacolineMa@nda.agric.za>
Sent:	06 December 2011 09:55 AM
To:	Jc Pretorius
Cc:	Rautenbach, Leanna (Pretoria)
Subject:	RE: Emailing: Humansrus Protected Species Survey - BEC.pdf
Attachments:	LICENCE APPLICATION FORM PROTECTED TREES DAFF.doc

Dear J.C.

Thank you very much for the detailed report. I thoroughly enjoyed it, especially the good quality photographs that were attached. Since only 38 protected Camel thorn trees will be affected, I am of the opinion that it will not trigger a biodiversity offset. Regarding the other species with elevated conservation status (including the Wild Olive which is not protected in terms of the National Forests Act), you will have to discuss it with Nature Conservation in Kimberley. I suggest you forward the report to Mr. Julius Koen, Ms. Elsabe Swart and perhaps someone in their permit section such as Mr. David Paulse (all of them based in Kimberley) for their inputs.

Attached please find the NFA License Application form. The developer can only apply for the Forest Act License after environmental authorization was granted by DEA, as we will need a copy of it before we can issue the NFA License.

Kind Regards, Jacoline
Department of Forestry
Tel 054 338 5860

-----Original Message-----
From: Jc Pretorius [mailto:JC.Pretorius@WorleyParsons.com]
Sent: 21 November 2011 05:09 PM
To: JacolineMa
Cc: Rautenbach, Leanna (Pretoria)
Subject: Emailing: Humansrus Protected Species Survey - BEC.pdf

Good afternoon Jacoline,

Further from your comments dated 12 October 2011 on the Scoping report for the proposed Humansrus Solar Thermal Power Plant EIA (DEA Ref: 12/12/20/2316), WorleyParsons as the EAP has, over and above the Biodiversity Impact Assessment conducted for the EIAR, undertaken a detailed survey of identified protected flora species. With the attached report WorleyParsons, on behalf of SolarReserve, wish to make its intent clear of following the appropriate procedures to conduct the applications for the removal of protected species, as per the National Forests Act, Act 84 of 1998.

It would be appreciated if you could, from your valuable experience base, indicate to us the stance of DAFF on the possible removal of the mentioned species in the survey. In particular we are interested in determining what offset measures as alluded to in your Scoping Report comments DAFF would be party to?

Your inputs into the Draft EIAR and EMP would also be invaluable but that report is still in progress of being compiled and will be sent to you for comment as soon as it is out for review.

Please let us know if there are any queries in this regard and we look forward to your response.

Regards

J.C. Pretorius

WorleyParsons
TEL: +27 (0) 12 425 6300
CELL: +27 (0) 83 492 5504
FAX: +27 (0) 12 460 9978

Email: jc.pretorius@worleyparsons.com
Web: www.worleyparsons.com

Your message is ready to be sent with the following file or link attachments:

Humansrus Protected Species Survey - BEC.pdf

Note: To protect against computer viruses, e-mail programs may prevent sending or receiving certain types of file attachments. Check your e-mail security settings to determine how attachments are handled.

Appendix D

Heritage Impact Assessment

SolarReserve SA (Pty) Ltd

Humansrus Solar Thermal Energy Power Plant

Postmasburg

Heritage Impact Report

Issue Date: 1 September 2011

Revision No.: 1

Project No.:

Professional Grave Solutions (Pty) Ltd T/A PGS Heritage & Grave Relocation Consultants
PO Box 32542 Totiusdal 0134, T +27 12 332 5305 F: +27 86 675 8077
Reg No 2003/008940/07

Declaration of Independence

The report has been compiled by PGS Heritage & Grave Relocation Consultants an appointed Heritage Specialist for WorleyParson. The views stipulated in this report are purely objective and no other interests are displayed during the decision making processes discussed in the Heritage Impact Assessment Process that includes the Scoping as well as this final report

HERITAGE CONSULTANT: PGS Heritage & Grave Relocation Consultants

CONTACT PERSON: Wouter Fourie

Tel: +27 (0) 12 332 5305

Email: wouter@gravesolutions.co.za

SIGNATURE: ______________________________

ACKNOWLEDGEMENT OF RECEIPT

CLIENT: Worley Parsons RSA

CONTACT PERSON: Leanna Rautenbach,

TEL NR: +27 (0) 12 425 6300 ext. 6421

EMAIL: Leanna.rautenbach@Worleyparsons.com

SIGNATURE: ______________________________

EXECUTIVE SUMMARY

PGS Heritage & Grave Relocation Consultants was appointed by WorleyParson to undertake a Heritage ImpactAssessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the Concentrated Solar Project for SolarReserve SA (Pty) Ltd, on the farm 469"Humansrus"close to Postmasburg in the Northern Cape Province.

The Heritage Scoping Report, that forms part of the HIA, has shown that the area between Postmasburg and Daniëlskuil generally referred to as the Ghaap plato has a rich history of occupation from the Stone Age with hunter gatherers to the Thlaping and Thlaro during the Iron Age period. The 1800's saw the rise of the Griqua people in the area and their loss of sovereignty after 1880 to Cape rule.

The field work that feeds into the Heritage Impact has utilised the findings of the Scoping report to guide this work. The field work identified a total of 25 heritage sites of which the following will require further mitigation:

Archaeological Sites

PGS06 – The sites needs to be documented through a surface collection and test excavation to determine the extent of the site. This wil include mapping of the lithic distribution as well as analysis of the lithic assemblage.

Cemeteries

AC02 - PGS09 and PGS13

It is recommended that the development layout be adjusted to accommodate the cemeteries and that the cemeteries e fenced with a 10 meter buffer.

It is further recommended that in the event that the cemeteries cannot be incorporated in to the development thee graves be relocated after a full grave relocation process that includes comprehensive social consultation. The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
- Site notices indicating the intent of the relocation

- Newspaper Notice indicating the intent of the relocation
- A permit from the local authority;
- A permit from the Provincial Department of health;
- A permit from the South African Heritage Resources Agency if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- An exhumation process that will safeguard the legal implications towards the developer
- ;
- The whole process must be done by a reputable company that are well versed in relocations;
- The process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Possible infant burials at **ACO013, PGS11-13** needs to monitored during construction. However best practice would be to do test excavations to ascertain the presence of possible infant burials at each of these sites.

Further to these recommendations the general Heritage Management Guideline in Sections 6 needs to be incorporated in to the EMP for the project.

The overall impact of the development on heritage resources is seen as acceptably low and can impacts can be mitigated to acceptable levels.

CONTENTS **PAGE**

List of Appendices

LIST OF FIGURES

1 INTRODUCTION

PGS Heritage & Grave Relocation Consultants was appointed by WorleyParson to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the Concentrated Solar Project for SolarReserve SA (Pty) Ltd, on the farm 469 “Humansrus” close to Postmasburg in the Northern Cape Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The Heritage Impact Assessment aims to inform the EIA in the development of a comprehensive EMP to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This Heritage Scoping Report was compiled by PGS Heritage & Grave Relocation Consultants (PGS).

The staffat PGS has a combined experience of nearly 40 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Principal Archaeologist for this project, and the two field archaeologist, Henk Steyn and Marko Hutton are registered with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company Natura Viva cc. He is a long-standing member of the

Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHAP (Association of Professional Heritage Assessment Practitioners – Western Cape).

1.3 Assumptions and Limitations

Not subtracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist had been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA) Act 107 of 1998
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
iv. Development Facilitation Act (DFA) Act 67 of 1995

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impacts Assessment (EIA) – Section (32)(2)(d)
    d. EMP (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)
iv. Development Facilitation Act (DFA) Act 67 of 1995
    a. The GNR.1 of 7 January 2000: Regulations and rules in terms of the Development Facilitation Act, 1995. Section 31.

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34 (1) of the NHRA states that "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…". The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage". In accordance with legislative requirements and EIA rating criteria, the regulations of SAHRA and ASAPA have also been incorporated to ensure that a comprehensive legally compatible AIA report is compiled.

1. Terminology

Abbreviations	*Description*
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PSSA	Palaeontological Society of South Africa
ROD	Record of Decision
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any

area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in the change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Refer to **Appendix C** for further discussions on heritage management and legislative frameworks

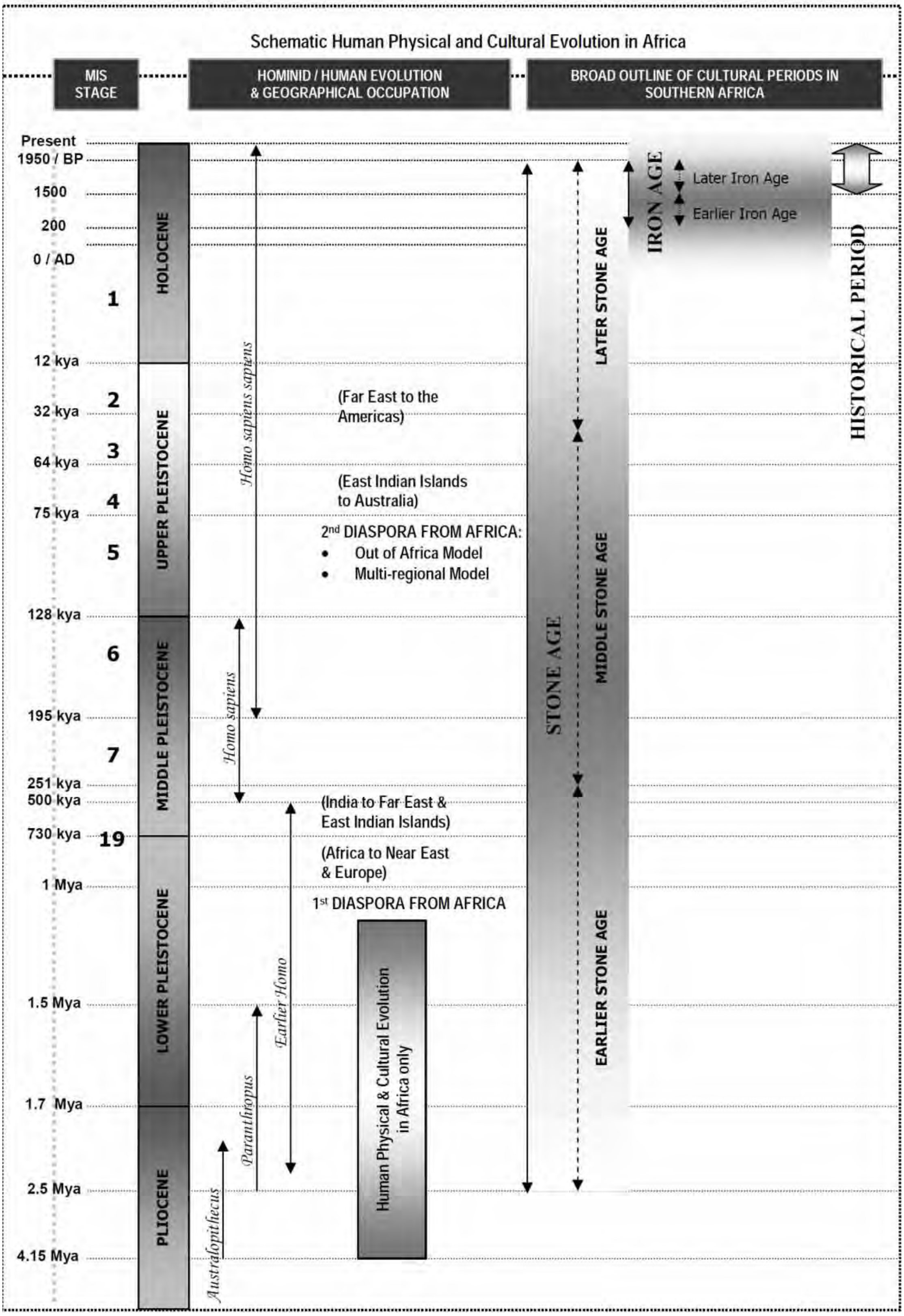

Figure 1–Human and Cultural Time line in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

Location	(E23.37224,S28.32263), The land is situated 30 kilometres west of Postmasburg on the R385.
Land	1431 Hectares of land under option.
Land Description	The land is greenfield veld (bush) type, zoned for agricultural use however used for grazing at present.

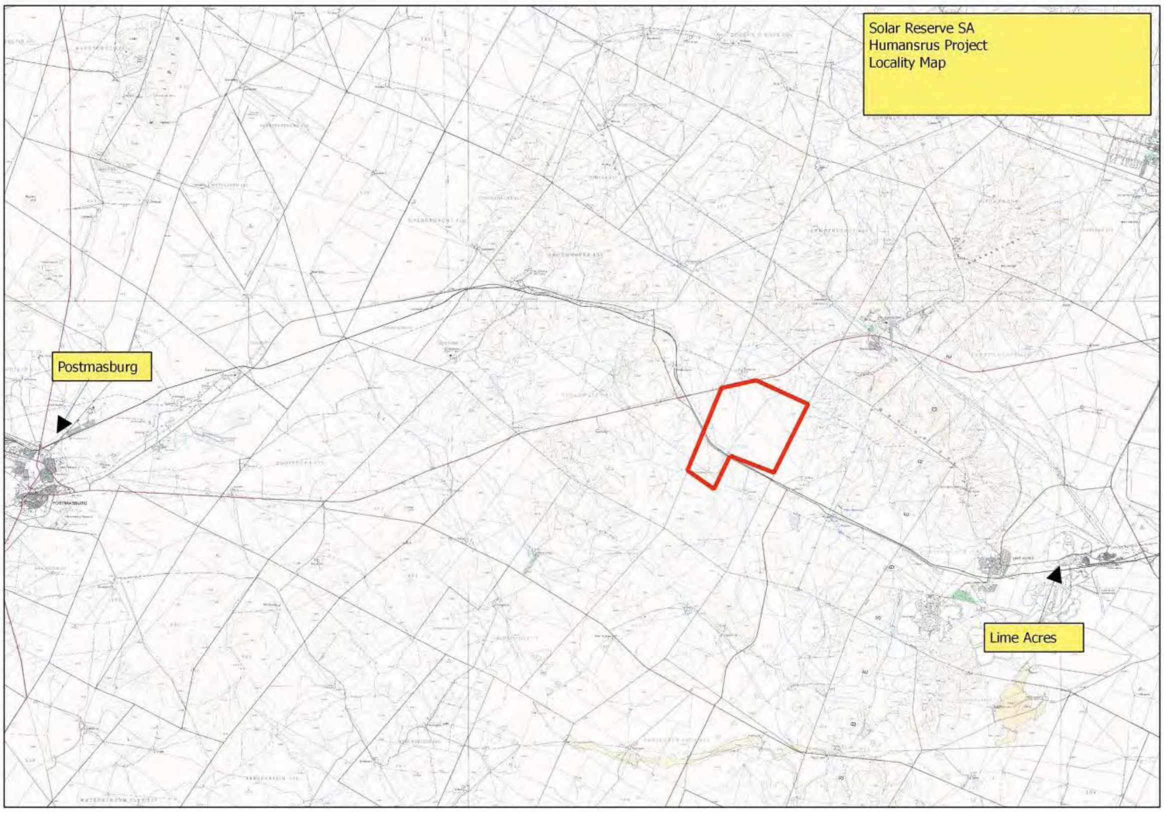

Figure 2 -Humansrus locality

2.2 Technical Project Description

Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW electricity in the Northern Cape. This facility will utilise the sun as the fuel source.

The CSP plant comprises of four main subsystems and is summarised below:

- **Solar Field** – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- **Molten Salt Circuit** which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- **The Power Block**; and
- **Auxiliary facilities and infrastructure** which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

2.3 Project overview

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. This project focuses on the possible establishment of a Concentrating Solar Power (CSP) plant in the Northern Cape area. The proposed CSP plant is proposed to consist of a maximum installed capacity of up to 100 MW. The plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

Figure 3 - An example of a power plant using central receiver technology. This is a 10MW demonstration plant that was built in the United States – image courtesy NREL.

The CSP Plant being considered is a molten salt-type, Central Receiver technology. This technology is based on the concept of thousandsof large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

A heliostat (***Figure 4***) is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in an elliptical formation around the focal point with the majority of the reflective area weight to the more effective side of the heliostat field

Figure 4- Single heliostat – image courtesy NREL

The central receiver is situated on the top of the central tower (***Figure 5***). This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

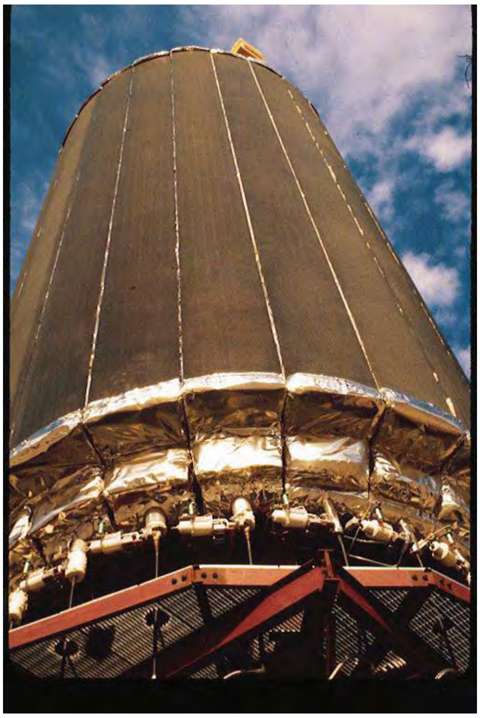

Figure 5- Receiver heat exchange panels – image courtesy NREL

Power is generated through a conventional Rankine cycle (steam turbine process). The working fluid is a salt mix of a 60:40 ratio of Sodium Nitrate ($NaNO_3$) and Potassium Nitrate (KNO_3). The cold salt is pumped up the central tower at approximate 300°C and flows through the central receiver where it is heated to approximately 550°C after which it can be stored for use in the conventional power generation process (maintaining 98% thermal efficiency)(***Figure 6***).

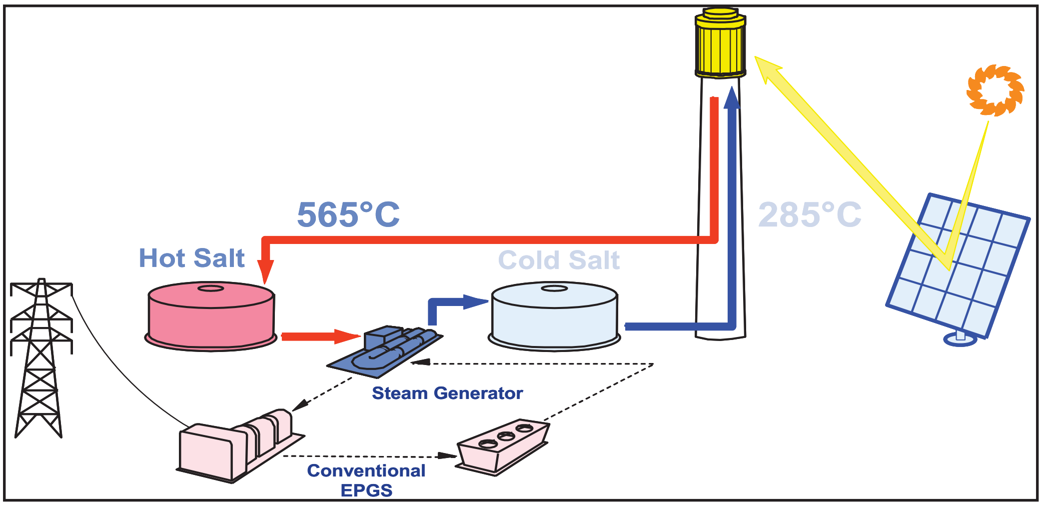

Figure 6- Flow diagram showing the power generation process in a CSP plant.

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This Heritage Impact Assessment (HIA) report was compiled by PGS Heritage and Grave Relocation Consultants (PGS) for the proposed Humansrus Project.The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consisted of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site in September 2010.

- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists (February 2011), aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- site integrity (i.e. primary vs. secondary context),
- amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium - 10-50/50m2
    - High - >50/50m2
- uniqueness and
- potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate pylon position

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site

Impacts on these sites by the development will be evaluated as follows

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 1: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

3.2 Methodology for Impact Assessment

The rating system used for assessing impacts is based on three criteria, namely:

- The relationship between impacts/issues and impact status (Box 1);
- The relationship between impacts/issues and spatial scale (Box 2);
- The relationship between impacts/issues and temporal scale (Box 3);
- The relationship between impacts/issues and probability (Box 4
- The relationship between impacts/issues and severity (Box 5);

These five criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Table 2: Status of impacts

Rating	**Description**	**Quantitative Rating**
Positive	A benefit to the receiving environment.	+
Neutral	No cost or benefit to the receiving environment.	N
Negative	A cost to the receiving environment.	-

Table 3: Spatial scale of impacts

Rating	**Description**	**Quantitative Rating**
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Table 4: Temporal scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years.	1
Medium	Medium term; Reversible over time; 5 – 15 years.	2
High	Long term; Approximate lifespan of the project: 16 -30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Table 5: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Table 6: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the	2

Rating	Description	Quantitative Rating
	water table due to water abstraction.	
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value.	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example, the permanent change to topography resulting from a quarry.	4

Table 7: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	**High**	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	**No Impact**	Zero impact.	0

An example of a ratings table:

Issue	Specific Impact	No Mitigation						With Mitigation					
		Status	Extent	Duration	Probability	Intensity	Significance	Status	Extent	Duration	Probability	Intensity	Significance
Soils	Potential loss of soil types of high agricultural potential	-	1	1	4	4	**-10**	-	1	1	4	4	**-10**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**
	Potential loss of soil types of high agricultural potential	-	1	1	3	2	**-7**	-	1	1	1	1	**-4**

4 CURRENT STATUS QUO

4.1 Site Description

The property (**Figure 7**) is bordered to the north by the R385 which connects Daniëlskuil and Postmasburg (**Figure 8**), and the D3381 gravel road, from Lime Acres, which divides the south western section of the property (**Figure 9**).

The central portion of the property is undulating with the low-lying areas covered in grasveld. The areas to the west and east of the central flat lands is characterised by rising rocky ridges covered with shrubs and trees. The farm is currently being used for grazing by livestock and for the breeding of horses.

The southern and south western section of the study area is characterised by perennial stream and a tributary running down from the south western section of the study area. Due to the intermittent rainfall of the area the stream has created a dry pan/flood plain that is only filled during high rainfall episodes (**Figure 10**).

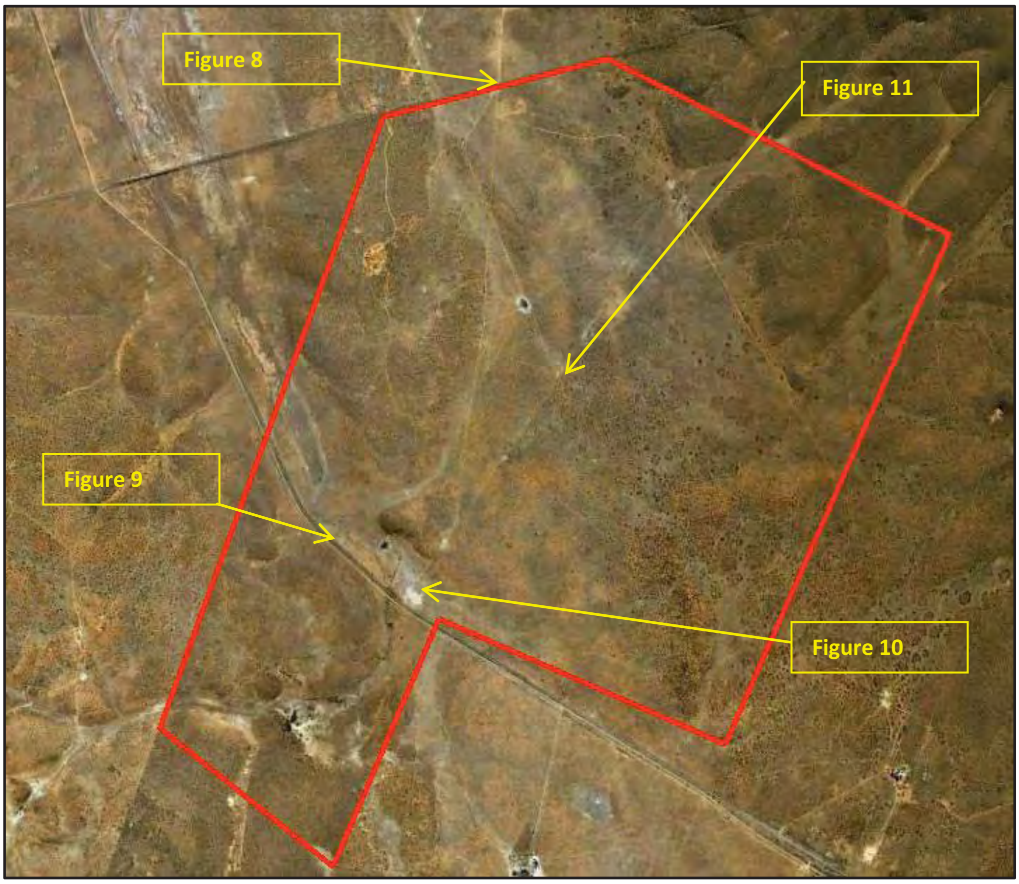

Figure 7 – Aerial view of study area with position of photographs shown

Figure 8 – View of to theR385 towards Postmasburg (Study area on the left)

Figure 9 – View of gravel road and rail line in the southern section of the study area

Figure 10 – View of dry pan from rail line in southern section of the study area

The south eastern section of the study area is also characterised by clumps of wild olive trees (*Olea europea*) (**Figure 11**).

Figure 11 – Wild olive trees in the study area (Webley, 2010)

4.1.1 Archival findings

The archival research focused on available information sourced that was used to compile a background history of the study area and surrounds. This data then informed the possible heritage resources to be expected during field surveying.

4.1.2 Findings of the Heritage Scoping Document

The findings can be compiled as follow:

Palaeontology

No further palaeontological studies are recommended for this development.

Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably in situ, and alert SAHRA as soon as possible so that appropriate action (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.

Archaeology

The possibility of archaeological finds in the study area has been indicated by previous research in the greater Daniëlskuil-Postmasburg and Ghaap plato area. This is confirmed by a short reconnaissance survey by Webley (2010) and an initial site visit by an archaeologist from PGS of the study area. Concentrations of Stone Age artefact around the dry pans and rivers were found as well as spot finds in the flat sandy areas.

Although the current owners indicated no knowledge of rock art it is recommended that special attention is given to rocky areas as such sites could be prevalent.

Historical

As the area of Groenwater was settled since 1880 as a location for the Thlaping and Thlaro the possibility of scattered homesteads cannot be excluded and the report of Webley (2010) indicates the existence of structures only demarcated by single rows of rocks, indicating the position of the house foundations.

The position of the two wagon routes through the study area also leaves the possibility for ephemeral camp sites and outspans in the study area.

To be able to compile a heritage management plan to be incorporated into the EMP the following further work was required for the HIA for inclusion in the EIA.

Archaeological walk through the whole of the study area, with specific attention given to the areas around pans, outcrops, wagon route alignments and historical structures will be required.

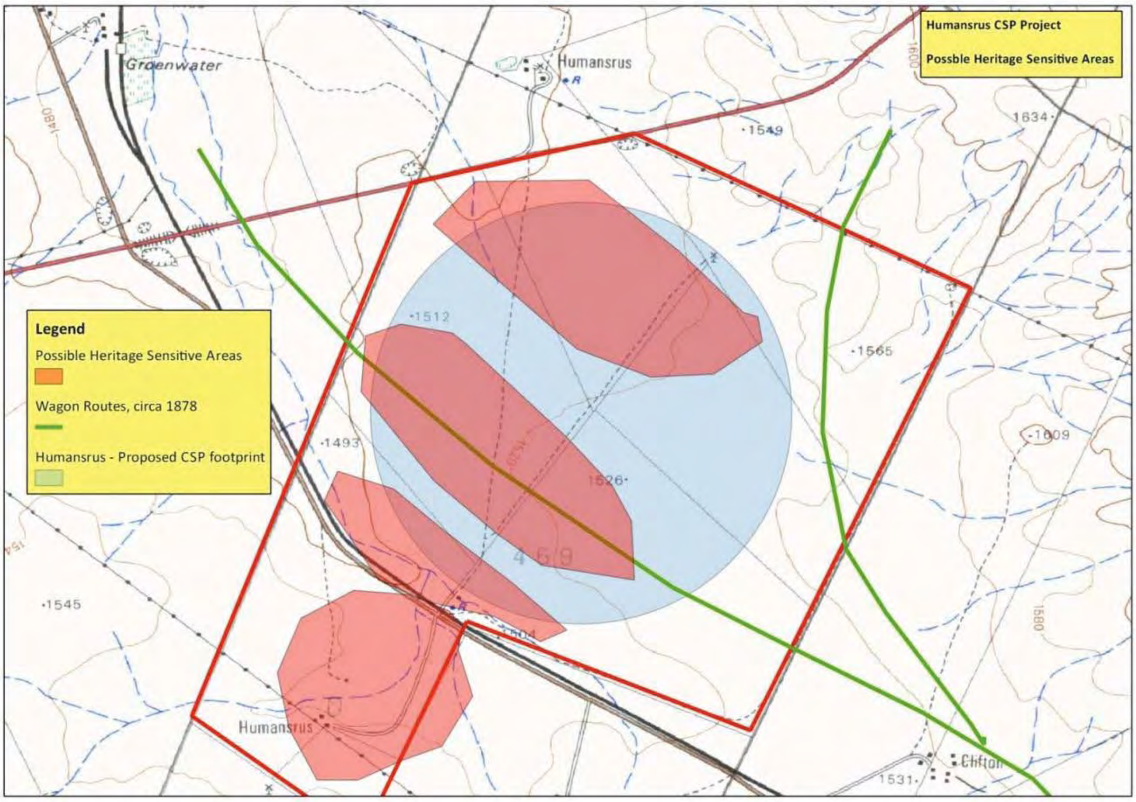

Figure 12 – Heritage Sensitivity Map

4.1.3 Field work findings

A follow up visit to the study area was conducted in August 2011 with the aim of conducting an archaeological survey of the development area and giving particular attention to the areas identified during the Scoping phase as being potentially sensitive. Due to the size of the total study area field work focused on the areas identified in ***Figure 12***as the foot print areas of the development.

The footprint area for this project covers approximately 820 hectares in total. Due to the nature of cultural remains, with the majority of artefacts occurring below surface, a controlled-exclusive surface survey was conducted over a period of 4 days on foot by an archaeologist of PGS

4.1.4 Heritage sites

The first sites discussed were identified during a survey conducted in November 2010 by the Archaeological Contracts Office (Webley, 2010) and confirmed during the field survey by PGS

in August 2011. Together with the field survey of August 2011 revealed the following further sites:

Stone Age Find spots

Coordinates:

Site Number	GPS Co-ordinates	Type	Description	Heritage Significance
PGS01	S28 17 46.2 E23 22 05.9	Stone artefacts	Low density scatter of MSA artefacts in pebble layer	Low
PGS02	S28 17 50.6 E23 21 15.3	Stone artefacts	Two large ESA cores	Low
PGS03	S28 18 52.9 E23 22 17.4	Stone artefacts	Low density scatter of MSA artefacts in pebble layer	Low
PGS04	S28 18 12.9 E23 22 04.8	Stone artefacts	Low density scatter of MSA artefacts in pebble layer	Low
PGS05	S28 18 06.4 E23 21 58.4	Stone artefacts	Low density scatter of MSA artefacts in pebble layer	Low
PGS07	S28 18 21.5 E23 21 23.2	Stone artefacts	Low density scatter of MSA artefacts in pebble layer	Low
ACO03	S28 19 16.7 E23 21 01.4	Stone artefacts	Miscellaneous scatter of ESA and LSA stone tools at the water seepage behind the house.	Low
ACO017	S28 18 52.4 E23 21 32.6	Stone artefacts around pan	Mix of ESA and MSA stone artefacts around a shallow pan	Low
ACO018	S28 18 55.9 E23 21 42.9	Stone artefacts along stream bed	MSA artefacts along banks of dry stream bed	Low
ACO019	S28 17 52.0 E23 22 16.7	Stone artefacts around pan	Mainly weathered MSA stone around the margins of a large pan	Low

The field work identified numerous areas where low density scatters of Middel and Later Stone Age lithics were present (***Figure 13***). Most of these scatters were found where pebble layers were exposed. This mostly occurred along dry river beds and pans that occur in the study area. As no context and in situ preservation were identified these sites were grade as of low heritage significance and rated as **Generally Protected C**.

Evaluating the possible impact of the development on the site the heritage significance must be considered as part of the evaluation, and thus the cost of mitigation or possible mitigation that will then have an implication on the severity of the impact.

PHS01 PGS02

Figure 13 – MSA flakes(PGS01) and ESA cores (PGS02) found during the survey

			No Mitigation					With Mitigation						
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Significance	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Significance
Destruction of site	GP.C	-	1	4	3	1	-9	GP.C	-	1	4	3	1	-9

Mitigation:

Documentation of these finds as listed in the report is seen as sufficient and no further mitigation is required.

Site PGS06

Coordinates: S28 18 19.0 E23 21 24.6

The site is situated on a low rise on the western side of the CSP foot print(*Figure 14*). The site is situated in a clearing between the shrub and grass land that characterises the rocky ridges in the western section of the study area. A medium density of MSA flakes ,cores and waste are present in situ. A small scan of a $1m^2$ produced between 20-40 flakes and cores.

Site size: Approximately 5m x 5m.

Figure 14 – View of site from north

Figure 15 – Collection of lithics from site

The site is situated away from dry river beds and pans and points to a localised Stone Age site with indications of napping (production of lithics), the position of the site points to a possible hunting/lookout base. Heritage significance of the site is seen as of Medium significance and rated as **Generally Protected B**.

			No Mitigation					With Mitigation					
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Significance	Status	Extent	Duration	Probability	Intensity	Significance
Destruction of site	GP.B	-	1	4	4	3	-12	-	1	4	3	1	-9

Mitigation:

Due to the fact that a large number of low significance lithic scatters occur through-out the impact area, the documentation of one of the more significant site will aid in the preservation of the lithic assemblage data found in the study area.

It is thus recommended that the site (**PGS06**) be documented through a surface collection and test excavation to determine the extent of the site. This wil include mapping of the lithic distribution as well as analysis of the lithic assemblage.

Cemeteries

During the field work 3 sites with stone cairns were identified as possible graves. . All three is aligned east west, which is the general alignment of graves buried as part of a Christian burial practice.

Site Number	GPS Co-ordinates	Type	Description	Heritage Significance
ACO012	S28 19 24.3 E23 21 07.4	Stone Cairn	Artificial mound of stone. It may be a grave?	If grave - High
ACO014	S28 19 25.0 E23 21 14.2	Stone Cairn	Artificial mound of stone. It may be a grave?	If grave - High
ACO015	S28 19 22.1 E23 21 16.1	Stone Cairn	Artificial mound of stone, with 3 ceramic fragments on the top.	If grave – High

Up to such time as it can be confirmed otherwise these sites must be considered as possible graves and handled as such. These 3 sites receive a provisional **heritage significance grading of 3B**. All 3 sites fall in or close to the area earmarked for a PV development in the project and the possible negative impact without mitigation is seen as **Negative High**.

			No Mitigation							With Mitigation					
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Significance	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Significance
Destruction of possible grave	3B	-	1	4	4	3	-12	3B	-	1	4	3	1	-9

Mitigation:

- Adjust the development layout and demarcate site with at least a 10 meter buffer.
- In the event that the sites cannot be excluded from the development foot print a grave relocation process as described in Section 5 of this reports needs to be implemented.

ACO2 – PGS09

Coordinates: S28 19 18.2 E23 21 03.4

A small informal partially fenced cemetery with 5 graves (***Figure 16***) was identified at this location. The graves were stoned packed and placed in a two lines and all dressings had and east to west orientation.

The graves are associated with the farmstead of which the cemetery forms part of. A single headstone(***Figure 17***) dating from 1913 was found on site.

Site size: Approximately 10m x 10m.

Figure 16 – Graves in between cactus growth

Figure 17 – Headstone in farmstead cemetery

Although a PV development has been proposed in close proximity to the cemetery a direct impact on the cemetery is not foreseen. Heritage significance of the site is seen as of High significance and rated as **Grade 3B**.

	No Mitigation							With Mitigation						
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif
Impact on cemetery outside PV area	3B	-	1	4	2	4	-11	3B	-	1	4	2	2	-10

Mitigation:

- Currently no mitigation will be required as the development plan does not foresee any activity in the direct vicinity of the cemetery.
- It is recommended that the cemetery be fenced with a 10 meter buffer and access controlled.

Site PGS14

Coordinates: S28 19 07.2 E23 20 58.0

A small informal cemetery with 4 graves (***Figure 18***) was identified at this location. The graves were situated in disturbed rocky grassland. The graves were arranged in a single line all with an east to west orientation.

Site size: Approximately 10m x 10m.

Figure 18 – View of cemetery

A PV development has been proposed in the area where cemetery is situated. Heritage significance of the site is seen as of High significance and rated as **Grade 3B**with a high negative impact probability.

	No Mitigation							With Mitigation							
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif
Destruction of cemetery inside PV impact area	3B	-	1	4	4	4	-13	3B	-	1	4	2	1	-8

Mitigation:

- Adjust the development layout and demarcate site with at least a 10 meter buffer.
- In the event that the sites cannot be excluded from the development foot print a grave relocation process as described in Section 5 of this reports needs to be implemented.

Historical Structures

Site Number	GPS Co-ordinates	Type	Description	Significance
PGS10	S28 19 14.8 E23 21 07.4	Stone circle	Single row stone lined circle. Part of homestead – probably horse training ring	Low
PGS11	S28 19 10.1 E23 21 06.3	Single dwelling	Concrete foundation of 2 room structure with associated midden	Low – Possible infant burials
PGS12	S28 19 08.5 E23 21 10.4	Stone structure	Remains of square stone structure	Low - Possible infant burials
PGS13	S28 19 08.8 E23 21 03.9	Single dwelling	Clay brick constructed ruin of house and associated midden	Low - Possible infant burials
PGS15	S28 19 08.4 E23 20 59.9	Midden and historic remains	Midden consisting of recent historic remains including car parts	Low
ACO02	S28 19 18.2 E23 21 03.2	Humansrus homestead	This includes the ruined house, shed, old dam/kraal	Low
ACO04	S28 19 23.8 E23 21 05.4	Stone kraal	A circular stone kraal beneath the transmission lines and close to the homestead	Low
ACO013	S28 19 26.2 E23 21 11.4	3 stone features	3 stone features comprising rectangular stone structures, possibly the outlines of	Low - Possible infant burials

			workers' cottages from early 20th century.	
ACO016	S28 19 20.0 E23 21 16.9	Stone Kraal	Rectangular stone kraal, measuring 20 m x 37 m.	Low

The sites identified as being part of the historical background of the development area all probably date back to the past 100 years with the single headstone in PGS09 indicating a date of around 1913 for the farm to have been inhabited.

It must be noted that most of the historical architectural structures has a **heritage significance rating of Generally Protected GP.C**.

Most of these sites will be impacted to some lesser manor by the proposed PV developments in the south-western corner of the development area. The impacts of the proposed development on these sites are rated as **negative Low**.

An exception is the possibility of infant burials at the farm worker sites of **PGS11-13** and **ACO13**

Site size: Approximately 30m x 30m.

		No Mitigation							With Mitigation					
Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif	Heritage Signif	Statsu	Extent	Duration	Probability	Intensity	Impact Signif
Destruction of site	GP.C	-	1	4	3	4	-12	GP.C	-	1	4	4	2	-10
Possible infant burials	3B	-	1	4	2	4	-11	3B	-	1	4	1	2	-8

Mitigation:

- **PGS11-13** and **ACO13** mitigation in the form of a watching brief and monitoring at these sites during construction.
- However best practice would be to do test excavations to ascertain the presence of possible infant burials at each of these sites.

4.2 Environmental Issues and Potential Impacts

			No Mitigation						With Mitigation						
Issue	Specific Impact	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif	Heritage Signif	Status	Extent	Duration	Probability	Intensity	Impact Signif
Heritage	Destruction of site with low heritage significance	GP.C	-	1	4	3	1	-9	GP.C	-	1	4	3	1	-9
	Destruction of site with medium heritage significance	GP.B	-	1	4	4	3	-12	-	1	4	3	1	-9	GP. B
	Destruction of possible graves	3B	-	1	4	4	3	-12	3B	-	1	4	3	1	-9
	Impact on cemetery outside PV area	3B	-	1	4	2	4	-11	3B	-	1	4	2	2	-10
	Destruction of cemetery inside PV impact area	3B	-	1	4	4	4	-13	3B	-	1	4	2	1	-8
	Destruction of historical sites	GP.C	-	1	4	3	4	-12	GP.C	-	1	4	4	2	-10
	Possible infant burials	3B	-	1	4	2	4	-11	3B	-	1	4	1	2	-8

5 CONCLUSIONS AND RECOMMENDATIONS

The Heritage Scoping Report, that forms part of the HIA, has shown that the area between Postmasburg and Daniëlskuil generally referred to as the Ghaap plato has a rich history of occupation from the Stone Age with hunter gatherers to the Thlaping and Thlaro during the Iron Age period. The 1800's saw the rise of the Griqua people in the area and their loss of sovereignty after 1880 to Cape rule.

The field work that feeds into the Heritage Impact has utilised the findings of the Scoping report to guide this work. The field work identified a total of 25 heritage sites of which the following will require further mitigation:

Archaeological Sites

PGS06 –The sites needs to be documented through a surface collection and test excavation to determine the extent of the site. This wil include mapping of the lithic distribution as well as analysis of the lithic assemblage.

Cemeteries

AC02 - PGS09 and PGS13

It is recommended that the development layout be adjusted to accommodate the cemeteries and that the cemeteries e fenced with a 10 meter buffer.

It is further recommended that in the event that the cemeteries cannot be incorporated in to the development thee graves be relocated after a full grave relocation process that includes comprehensive social consultation. The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
- Site notices indicating the intent of the relocation
- Newspaper Notice indicating the intent of the relocation
- A permit from the local authority;
- A permit from the Provincial Department of health;
- A permit from the South African Heritage Resources Agency if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- An exhumation process that will safeguard the legal implications towards the developer;
- The whole process must be done by a reputable company that are well versed in relocations;
- The process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Possible infant burials at **ACO013, PGS11-13** needs to monitored during construction. However best practice would be to do test excavations to ascertain the presence of possible infant burials at each of these sites.

Further to these recommendations the general Heritage Management Guideline in Sections 6 needs to be incorporated in to the EMP for the project.

The overall impact of the development on heritage resources is seen as acceptably low and can impacts can be mitigated to acceptable levels.

6 HERITAGE MANAGEMENT GUIDELINES

6.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

- (i) exceeding 5 000 m^2 in extent; or
- (ii) involving three or more existing erven or subdivisions thereof; or
- (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the South African Heritage Resources Agency (SAHRA) needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

   This survey and evaluation must include:

   (a) The identification and mapping of all heritage resources in the area affected;

(b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Cultural Resources Act;

(c) An assessment of the impact of the development on such heritage resources;

(d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:

   a. Heritage;
   b. Graves;
   c. Archaeological finds; and
   d. Historical Structures.

   This module must be tailor made to include all possible finds that could be expected in that area of construction.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.

5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.

6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.

7. After mitigation an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.

8. If during the initial survey sites of cultural significance is discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an

archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.

9. In the event that human remains are uncovered or previously unknown graves are discovered a qualified archaeologist needs to be contacted and an evaluation of the finds made.

10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA needs to be followed. This includes an extensive social consultation process.

The definition of an archaeological/palaeontological monitoring programme is a formal program of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.

The purpose of an archaeological/palaeontological monitoring programme is:

- To allow, within the resources available, the preservation by record of archaeological/palaeontological deposits, the presence and nature of which could not be established (or established with sufficient accuracy) in advance of development or other potentially disruptive works
- To provide an opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological/palaeontological find has been made for which the resources allocated to the watching brief itself are not sufficient to support treatment to a satisfactory and proper standard.
- A monitoring is not intended to reduce the requirement for excavation or preservation of known or inferred deposits, and it is intended to guide, not replace, any requirement for contingent excavation or preservation of possible deposits.
- The objective of the monitoring is to establish and make available information about the archaeological resource existing on a site.

PGS can be contacted on the way forward in this regard.

Table 8: Roles and responsibilities of archaeological and heritage management

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should sit in at all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology supportive team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology supportive team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites.	The client	Environmental Consultancy and the Archaeologist
After the specialist/archaeologist has been appointed, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

6.2 All phases of the project

6.2.1 Archaeology

Based on the findings of the HIA, all stakeholders and key personnel should undergo an archaeological induction course during this phase. Induction courses generally form part of the employees' overall training and the archaeological component can easily be integrated into these training sessions. Two courses should be organised – one aimed more at managers and supervisors, highlighting the value of this exercise and the appropriate communication channels that should be followed after chance finds, and the second targeting the actual workers and getting them to recognize artefacts, features and significant sites. This needs to be supervised by a qualified archaeologist. This course should be reinforced by posters reminding operators of the possibility of finding archaeological/palaeontological sites.

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area and small scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making and to make the correct judgment on which actions should be taken. A responsible archaeologist/palaeontologist must be appointed for this commission. This person does not have to be a permanent employee, but needs to sit in at relevant meetings, for example when changes in design are discussed, and notify SAHRA of these changes. The

archaeologist would inspect the site and any development recurrently, with more frequent visits to the actual workface and operational areas.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological/palaeontological monitoring programme.

6.2.2 Graves

In the case where a grave is identified during construction the following measures must be taken.

Mitigation of graves will require a fence around the cemetery with a buffer of at least 20 meters.

If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a rescue permit must be applied for with SAHRA and the local South African Police Services must be notified of the find.

Where it is then recommended that the graves be relocated a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation
iii. Newspaper Notice indicating the intent of the relocation

iv. A permit from the local authority;

v. A permit from the Provincial Department of health;

vi. A permit from the South African Heritage Resources Agency if the graves are older than 60 years or unidentified and thus presumed older than 60 years;

vii. An exhumation process that keeps the dignity of the remains intact;

viii. An exhumation process that will safeguard the legal implications towards the developing company;

ix. The whole process must be done by a reputable company that are well versed in relocations;

x. The process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

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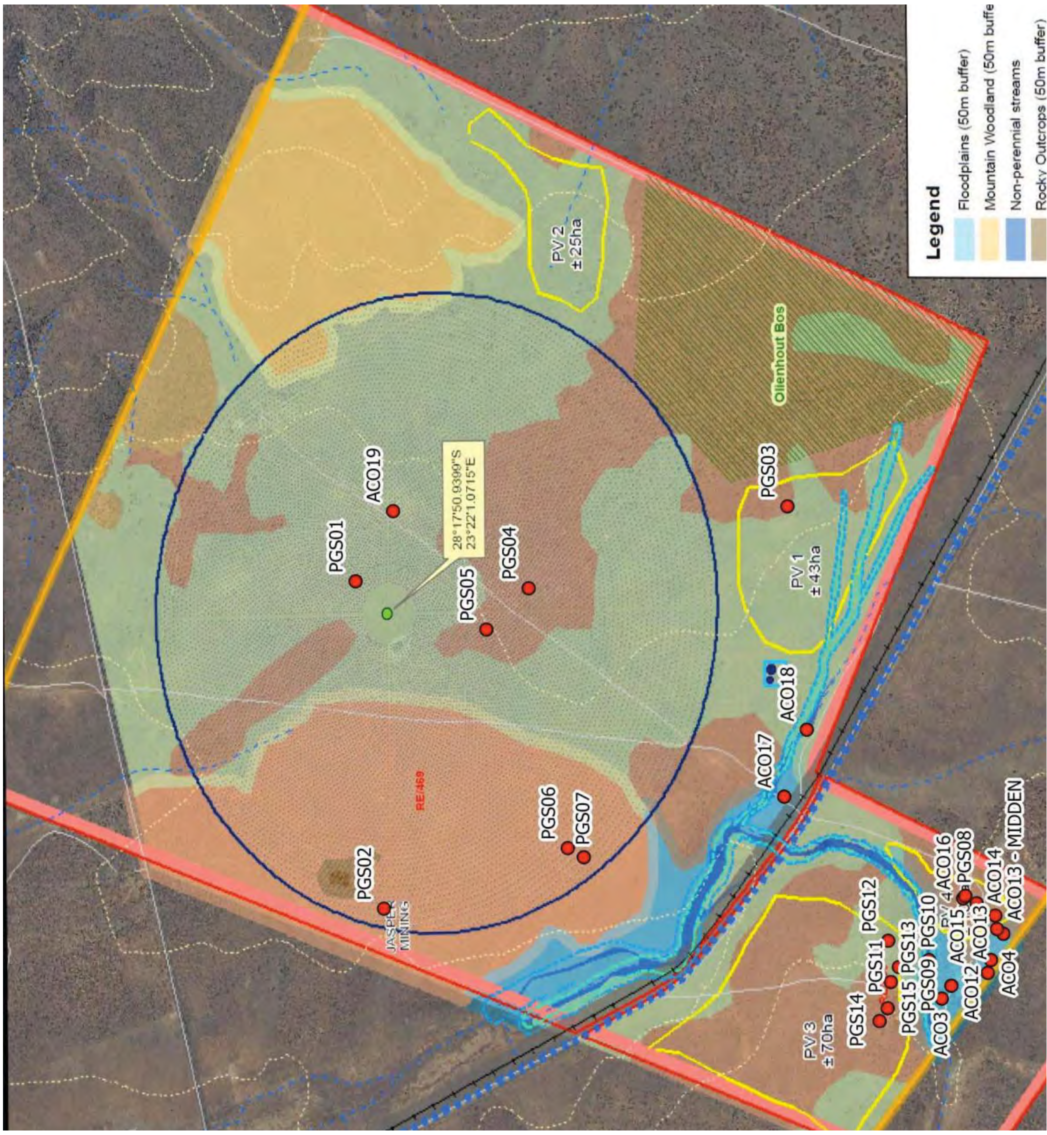
Appendix A

HERITAGE SITE DISTRIBUTION MAP



LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the construction company's cost. Thus, the construction company will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and

regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix E

Visual Impact Assessment

Visual Impact Assessment Report

HUMANSRUS SOLAR POWER PLANT

Graham A Young PrLArch
Newtown Landscape Architects

THE PROPOSED SOLAR POWER PLANT, NORTHERN CAPE

Specialist Study Report
VISUAL ENVIRONMENT – ASSESSMENT

Submitted to:
Worley Parsons RSA (Pty) Ltd
160 Garsfontein Road
Ashlea Gardens
Pretoria, 0081

Prepared by:
Newtown Landscape Architects
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Project No:	1346/E11NC
Report Revision No:	Rev 2
Date Issued:	02 December 2011
Prepared By:	Graham Young PrLArch
Reviewed By:	Graham Young PrLArch
Reference:	**Humansrus Solar Power Plant**

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Project

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, the feasibility of constructing a Concentrated Solar Power (CSP) plant (the project) with a maximum capacity of 100 MW electrically in the Northern Cape, is being assessed. The intention of this effort is to develop solar resources to generate electricity and reduce the dependence on non-renewable fossil fuel resources. This proposed facility will utilise the sun as the fuel source. The project would include a Solar Field, Molten Salt Circuit, Power Block and Auxiliary Facilities and Infrastructure and is proposed to be located on Farm 469, Hay RD (Humansrus), approximately 4 km southeast of Groenwater and 30 km east of Postmasburg. SSI Engineers and Environmental Consultants (Pty) Ltd appointed Newtown Landscape Architects cc (NLA) to carry out a Visual Impact Assessment as part of the EIA process. This *Scoping Report* is the first phase of the process. An *Assessment Report* will follow in due course. Refer to the Figure 1 'Locality' for the location of the project site.

1.2 Terms of Reference

NLA's terms of reference are as follows:

Compilation of an *assessment report* to include the following, but not limited to:

- An introduction to the study;
- An overview of the local and regional visual and landscape character;
- A description of the potential impacts (including cumulative impacts) on visual and landscape character, and sensitive receptors occurring within the general area of the study site to be further investigated during the EIA phase of the project;
- Any assumptions, limitations and / or constraints associated with the study;
- Recommendations on any further studies that may be required during or after the EIA process.

1.3 Assumption and Limitations

It is assumed that the farmsteads that fall within the visual study area could be occupied and therefore these viewing points have been identified as potentially being sensitive. The project

description is as given to NLA by the environmental consultants and at this stage the exact footprint within the project site is not known. The exact amount of cut to fill to create the terrace for the heliostats was not known when this report was being compiled. It is assumed that the terrace level will be designed to be at natural ground level (1516m) at the point where the base of the tower is located. To date visual impacts have not been raised as a concern by interested and affected parties and no tourist facilities occur within the study area.

1.4 Aim of the Study

The main aim of the study is to ensure that the visual consequences of the proposed project are understood and adequately considered in the planning process. The objectives of the study are to:

- To define the visual resource and sense of place of the study area;
- To identify the sensitive receptors / lines of site;
- To determine and rate the visual impact;
- To simulating the key proposed infrastructure components against the visual baseline;
- To assess the cumulative visual impact; and
- To provide input, together with Beal and other specialists into visual management measures to minimize negative visual impacts.

2.0 APPROACH AND METHODOLOGY

A field survey was undertaken on 27 April 2011 and the project site visited and the study area scrutinized. Photographs of the general area were taken from public roads towards the proposed project site. The study area is defined as a 20 km radius about the proposed project site. Beyond this distance the proposed CSP project would be ‘absorbed’ into its landscape setting or reduced in scale within in the viewing arc that its impact and visual exposure would be insignificant.

To evaluate the impacts of the project the inherent scenic value of the landscape (visual resource) first needs to be determined. Data collected during a site visit allowed for a comprehensive description and valuation of the receiving environment and also for issues to be identified that must be addressed in the impact assessment phase. The full visual impact process is indicated in Diagram 1 below. The following method was used for the scoping phase of the project.

- **Site visit** - a field survey was undertaken and the study area scrutinized to the extent that the receiving environment could be documented and adequately described;
- **General landscape characterization** - landscape character types were mapped using field survey and physiographic data (from 1:50 000 maps). The description of the landscape focused on the nature of the land rather than the response of a viewer;
- **Scenic quality** - using the landscape character types, sense of place and studies for perceptual psychology, the aesthetic value of study area (scenic quality) was determined.
- **Project components** - the physical characteristics of the project components were described and illustrated by way of example.
- **Visual issues** - based on the baseline survey visual issues were identified that should be addressed in the impact assessment phase.

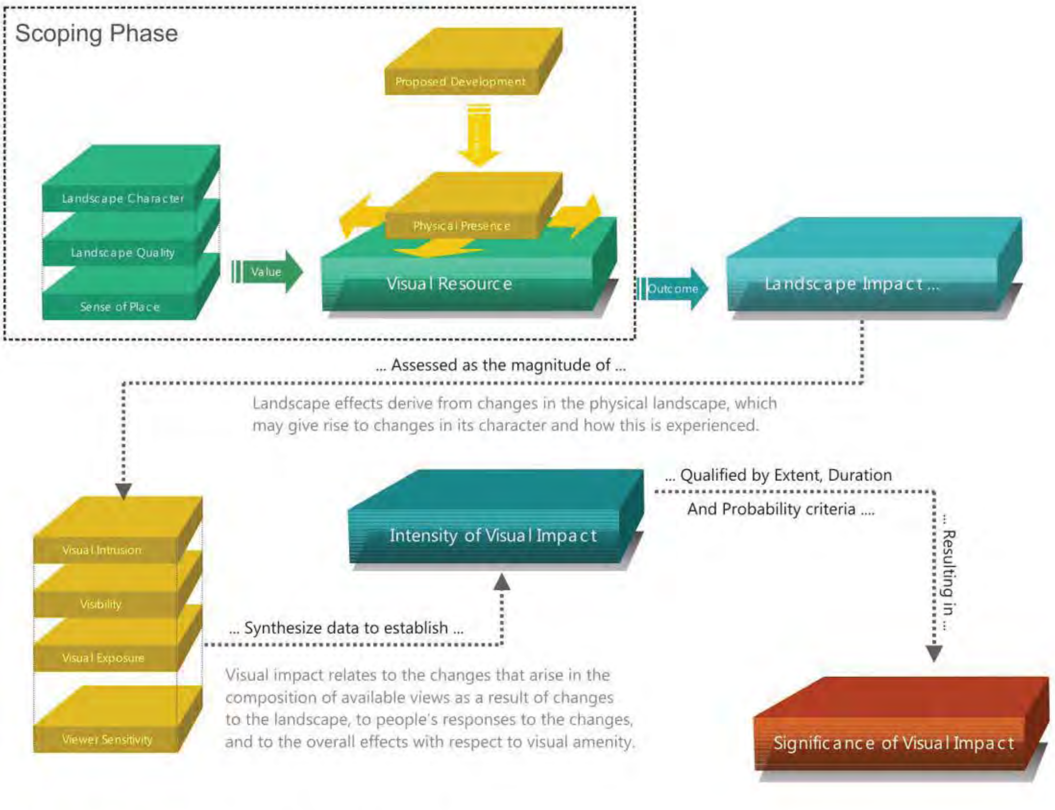


Figure 2: **VISUAL IMPACT PROCESS**

Diagram 1: Visual impact Process

3.0 DESCRIPTION OF THE PROJECT

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed. The CSP Plant is proposed to be a molten salt-type, Central Receiver technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the central receiving tower) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats. The tower is 200m from the ground up and each heliostat receiver (tracking mirror) is estimated to between 10 and 15 meters above ground level. The tower is erected in an inner circle inside the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt up to 580ºC, which then flows into a thermal storage tank for storage (maintaining 99% thermal efficiency). The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankine cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy. In order to reduce project's water consumption, a dry cooling system has been considered to condense the low pressure (LP) steam exhaust from the turbine.

The glare generated by the heliostat field is expected to be quite significant and this, along with the physical presents of project components, needs to be clearly understood in assessment phase of the project. The CSP plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs.

A variety of components make up the CSP plant. They are:
The Power Block

- Tower (to concrete deck): 163.98m;
- Steam Generating Building: 43,22m;
- Water Treatment Plant: 9,19m;
- Electric Building: 8,6m;
- Control Building: 5,67m;
- Fire Water Pump Building: 4,44m;

The Administrative Area

- Administration Building 8,25m;
- Warehouse 9,2m; and
- Guardhouse 3,9m.

A heliostat is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in an elliptical formation around the focal point with the majority of the reflective area weight to the more effective side of the heliostat field (refer to Figure 2 at the back of the report).

The central receiver is situated on the top of the central tower. This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

Power is generated through a conventional Rankine cycle (steam turbine process). The working fluid is a salt mix of a 60:40 ratio of Sodium Nitrate ($NaNO_3$) and Potassium Nitrate (KNO_3). The cold salt is pumped up the central tower at approximate 300°C and flows through the central receiver where it is heated to approximately 550°C after which it can be stored for use in the conventional power generation process (maintaining 98% thermal efficiency).

At this stage the exact footprint within the project site is not known.

4.0 THE ENVIRONMENTAL SETTING

4.1 Landscape Character

The study area is situated in the Kalahari Mountain Bushveld (Low and Rebelo) savannah biome, which typical is found on rocky, shallow soils on the hills at an altitude of 450 to 1250m. It is an open savannah dominated by Camphor Tree (*Tarchonanthus camphoratus*) and Kanibus (*Rhus undulate*) and Broom Karee (*Rhus dregeana*) become the principal shrubs. The tree layer is poorly developed and individuals of Wild Olive (*Olea europaea* subsp. *africana*) and Black Thorn (*Acacia mellifera* subsp. *detinens*) are widely scattered. The grass layer is moderately developed depending on the rockiness of the area. The primary land-use is livestock farming of cattle, goats and sheep and it is a poorly conserved biome.

The project site comprises an open grassland valley between two small ridges to the west and east of it, which merge into a general ridgeline north of the site. These ridges are have a reasonably developed savannah cover of small shrubby material. This is especially evident in the northern sectors of the site. Refer to View 4 in Figure 5 and Views 5 and 6 in Figure 6. South of the project site the valley is split by a small rise in topography that extends to the south east and the Lime Acres mining complex and town. The 'central' grassland areas of the project site are used mostly for livestock grazing.

The higher hills to the far north, west (refer to Views 1 and 2 in Figure 4) and east (refer to View 7 Figure 7) of the project site are also dominated by a reasonably established savannah cover but there is a dearth of tall trees and the tree layer is generally poorly developed. Most tall trees within the study area are Blue Gums associated with farmsteads or urban developments.

The areas to the south of the project site are generally flatter and more open and dominated by grasslands, used mostly for grazing (refer to Views 9 and 10 in Figures 8). The south western section of the project site also has this character and the topography tends to rise to a shallow ridgeline running from the R385 to the Lime Acres farm road (D3381) (refer to View 11 Figure 9). Further to the south west toward Lime Acres the landscape is again of a 'rolling' nature and the road and other infrastructure are contained within a shallow valley between two ridges (see View 8 Figure 7).

The grassland valley system extends north of the project site and north of the R385 and is eventually 'embraced' by reasonably high hills that extend further north. Figure 9 View 12 from a small settlement north west of the project site and View 3 in Figure 5 illustrate the character of the grasslands in this area.

Throughout the study area railway, road and electricity infrastructure is evident and as the traveller nears Lime Acres, mining infrastructure and urban landscapes tend to dominate. Also, to the far north east of the project side beyond the hills, are the Owendale and Danielskuil mining activities (refer to Figure 10 which identifies these areas and infrastructure).

Generally, the landscape that embraces the site in the north, west and east (Figures 4, 5 and 6) is a more distinctive and varied and tends to be more interesting than the characteristics of the study area to the south of the site, which is less diverse and more open (Figures 8 and 9).

4.2 Sense of Place and Aesthetic Value

Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more “common" elements. Generally, the greater the diversity of form, line, texture, and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications and therefore categorised as:

- High - distinctive landscape often with a strong sense of place;
- Moderate - common landscape; And
- Low - minimal landscape often with a weak sense of place and the presence of man-made structures and infrastructure that discordant and promote strong disharmony.

The study area can be divided into a number of primary ‘landscape types’ each with its unique landscape characteristic, sense of place and aesthetic value. These are mapped in Figure 10 and include:

- Kalahari Mountain Bushland;
- Rolling grassland with drainage lines;
- Rural villages;
- Urban areas;
- Infrastructure and utilities; And
- Mining activities.

Using the criteria and values defined in Appendix A along with the discussion on landscape character in Section 4.1 above, the visual quality of the study area is rated across a range of values. Table 1 below summarises these findings.

Table 1: Value of the Visual Resource - Scenic Quality

High *Kalahari Mountain Bushveld*	**Moderate** *Rolling open grasslands with drainage lines rural villages and towns*	**Low** *Urban, Mining and Power and Rail Infrastructure*
This landscape type is considered to have a *high* value because it is a: Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a strong sense of place. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.	These landscape types are considered to have a *moderate* value because they are: Common landscapes that exhibit some positive character but which have evidence of alteration /degradation/erosion of features resulting in areas of more mixed character. They are potentially sensitive to change in general and change may be detrimental if inappropriately dealt with but change may not require special or particular attention to detail.	These landscape types are considered to have a *low* value because they are: Minimal landscapes generally negative in character with few, if any, valued features due to their inherent characteristics or due to major negative man-made impacts. Scope for positive enhancement could occur.

However, the value of the visual resource when the various landscape types are taken together (they are not perceived as one unit in the landscape as the eye is always roving and often embraces many of these landscape types in one view) and which are representative of the overall quality of the study area's areas landscape, the rating is *moderate* within the context of the sub-region. This is primarily due to the 'intrusion' of mining, urban and infrastructure projects, which reduce the positive effect that the hills have on the scenic beauty of the study area. The project site would also have *moderate* rating as its scenic value is compromised by the rail and power lines to the west of the site.

5.0 VIEWS AND SENSITIVE RECEPTORS

5.1 Viewing areas

The project site lies in a shallow valley between two ridgelines that mostly contain the visuals of the heliostats (orange viewshed footprint in Figure 11) to a band of approximately 5km to the east and west of the project site. Along the length of the valley north and south of the site, exposure is greater and would affect foreground and background views i.e. up to 10 km from the site.

The central receiving tower, which is 200m tall, would be visible from a far greater distance as in indicated in the viewshed in Figure 11. However, beyond 8km it would tend to recede into the background of views and at 16km it would be deemed as 'infrequently' viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention.

Public views (sensitive viewing areas) to the project site would be experienced by people living, working and passing through the study area. The closest of these viewing areas and the most exposed to the impact of the project, are the R385, which passes immediately to the north of the site and the Groenwater / Lime Acres farm road (D3381) which passes immediately to the west of the site. There are a few farmsteads and residential properties (along Groenwater road immediately north west of the site) that occur near the site and the project would appear in the foreground of these views resulting in a potential high visual impact. The farmsteads (two) occur to the immediate north and south of the site. There are 3 farmsteads with potential middleground views of project activities. These are located immediately west (approximately 5km from the site) of the site and to the north east (5km) and south east (3km). Visual exposure at these greater distances is reduced but nevertheless could have an impact on these sensitive views.

The towns of Owendale, Lime Acres, Danielskuil at the settlement at Groenwater immediately north of the R385 and west of the site, would not see any components of the project as ridge lines block views towards the site.

At this stage it is not known if all the identified farmsteads are occupied. This would have to be verified in the assessment phase.

5.2 Sensitive receptors

Typically most sensitive receptors would include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape (scenic routes);

- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;

- Occupiers of residential properties with views affected by the development.

Other less sensitive receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);

- People travelling through or past the affected landscape in cars, on trains or other transport routes;

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

Given these criteria, the sensitive receptors for the study area would be:

- Visitors and people who live in the farmsteads / residential units;

- People travelling through or past the affected landscape in cars and on trains;

During the site visit, no tourist facilities were identified in the immediate vicinity and nearby environs of the project site but this must be confirmed in the assessment phase of the project.

The focus of the impact analysis during the assessment phase will therefore be on these receptors and viewing areas. Refer to Figure 11, which identifies their location.

6.0 LANDSCAPE AND VISUAL IMPACT

To evaluate the impacts of the CSP project at Humansrus it is assumed that the landscape has some inherent scenic value and needs to be factored into the assessment of the impact on views and aesthetics of the project. The existing visual condition of the landscape potentially affected by the proposed CSP project has been described. Its scenic quality has been rated as *moderate* within the context of the sub-region and potentially sensitive viewing areas and receptors identified and mapped. The next phase is to assess the impacts on the visual resource and the effects the project could have on sensitive views in area.

6.1 Landscape and Sense of Place Impact

The *landscape impact* or *aesthetic impact* (i.e. the change to the fabric and character of the landscape caused by the physical presence of a development) of the proposed project and its associated structures will be *high*. The proposed CSP project would have a major negative impact on the aesthetics of the landscape and would add a new and foreign dimension (man-made disturbance) to the existing character of the landscape. The cause of this relates primarily to the removal of vegetation and the exposure of large areas of soil along with the shining material associated with project components that will contrast dramatically with the existing hues and textures of the landscape. The project causes a major disturbance to the aesthetic environment and impact negatively on the sense of place of the area.

However, as stated in the approach, the physical change to the landscape caused by proposed CSP project must also be understood in terms of its impact on public (sensitive) views within the study area i.e. a project, by virtue of its visibility, must clearly interfere with or reduce the public's enjoyment and / or appreciation of the appearance of the landscape to account for a negative visual impact. The following sections will discuss the effect that the project will have on public views. The worst case scenario is used as the benchmark and the effect will be rated in terms of the *severity* of visual impact.

6.2 *Severity* of Visual Impact

The severity of visual impact is determined using, visibility, visual intrusion, visual exposure and viewer sensitivity criteria. When the *severity* (or magnitude) of impact is qualified with spatial, duration and probability criteria the *significance* of the impact can be predicted (refer to Appendix D

for criteria) and Section 10 below.

6.2.1 Visibility

In determining the visibility of the project (using viewshed analyses), its features at a variety of heights and locations, were used. Vantage points were assigned at offsets equivalent to the height above ground level of the project's most significant features (i.e. the tower and the heliostats). The 'zone of potential influence' was established at 15.0km. Over 15.0km the impact of the proposed project's features would have diminished considerably due to the diminishing effect of distance (the project recedes into the background) and atmospheric conditions (haze) on visibility. Also, at this distance the project would appear in the background of any given view and thus begin to be 'absorbed' into the landscape setting and will not feature as the focus of attention. Visual exposure is determined by qualifying the view with a distance rating to indicate the degree of intrusion and visual acuity.

A viewshed analysis was undertaken for the tower (at 180m above ground level) and the heliostats (at 15m above ground level). The spatial patterns generated by the analyses are illustrated in Figure 11. Due to the proposed project being located within a rolling topography, the visibility of the heliostats are reasonably 'contained' within a valley system extending from the northeast to the southwest of the project site. This is indicated as the dark orange pattern in Figure 11. The tower, however, would be visible over a much larger area in almost every direction from the site but the hills that surround the project site, obstruct many views to it. This is indicated with the yellow pattern in Figure 11.

The composite viewshed analysis (Figure 11) indicates that the project would indeed be visible from potentially sensitive viewing areas. Most public views to the site would however be from the R385, which passes immediately north of the site. Project components would also be visible from the dirt road (D3381) that connects the R385 to Lime Acres and which passes west of the site. A small number of farmsteads (Humansrus and Sunnyside), as well as the Groenwater community north west of the site would also be able to see the tower and the heliostats. Views from Owendale are blocked by a ridgeline and only the top section of the tower would be visible from Lime Acres. People living in and visiting Danielskuil, northeast of the site, would not be able to see any of the project components. The viewshed model indicates that the tower would be visible from approximately half of the zone of potential influence and the heliostats from a considerably smaller area, therefore its visibility, as rated according to criteria highlighted in Table 2 below, is *moderate*.

Table 2: Visibility

High	Moderate Study Area	Low
If the proposed development is visible from over half the zone of potential influence, and / or views are mostly unobstructed. The proposed intervention is visible by most people travelling through the study area and views from sensitive viewing areas (public roads, residences and/or tourist facilities) are mostly open and unobstructed.	If the proposed development is visible from less than half the zone of potential influence, and / or views are partially obstructed. The proposed intervention is visible by people travelling through the study area along the R385 and the district road to the west of the site and a reduced number of views from other sensitive viewing areas (residences).	If the proposed development is visible from less than a quarter of the zone of potential influence, and/or views are mostly obstructed. The proposed intervention is visible from the least number of people and views from sensitive viewing areas are mostly obstructed due to distance.

6.2.2 Visual Intrusion and exposure

Visual intrusion is measured as the magnitude of intrusion that an activity will impose on the landscape and its effect on available views, specifically those from within sensitive or critical viewing areas. Visual intrusion therefore deals with the notion of contextualism i.e. how well does a project component fit into (or contrast with) the aesthetic of the landscape as a whole? Photographic simulations were used to assist in determining the intrusive nature of the proposed project activities. Viewpoints representative of typical sensitive views experienced from the R385 and surrounding areas were used for the photographic simulations. The before and after scenarios are illustrated in Figures 12 to 15 and show the proposed project activities superimposed onto the existing landscape. The location of these viewpoints is indicted on Figure 3.

Views from the R385 and Humasrus

Views form the R385 and Humansrus Farmstead will be affected by project activities. As motorists travel along the R385 a variety of views will open up towards the project site. These are illustrated Figures 12 and 13. The tower and heliostats facilities will be most visible where the road is elevated as users of the road approach from the west (Figure 12) and east (Figure 13). The heliostat field and tower would appear in the middle ground of these views with moderate exposure. Immediately north of the site along the R385 and from the Humansrus farmstead,

people would have close-up (foreground views) of the project's components and high exposure.

Views from Groenwater, Sunnyside farmstead and the dirt road west of the site (D3381)

Because the heliostat field would be built on a terrace at approximately the level of the bottom of the valley which runs through the site, people in the Groenwater community, Sunnyside farmstead and those using the dirt road west and south of the site, would only see the tower protruding above the small ridge line along the western edge of the site (refer to Figures 14 and 15) thereby reducing the intrusive nature of the project. Visual exposure would be moderate from these viewing areas.

Taking the *worst case scenario* and the listed criteria into account Table 3 rates and summarises the visual intrusion and exposure of the proposed CSP activities on the various potential sensitive viewing sectors.

Table 3: Visual Intrusion and Exposure

High **Users of the R385 immediately north of the site and the Humansrus farmstead**	**Moderate** **Groenkloof community, Sunnyside farmstead and users of the dirt road (D3381) west of the project**	**Low** **For the remainder of the study area**	**Positive**
Because the proposed development: - Has a substantial negative effect on the visual quality of the landscape; - Contrasts dramatically with the patterns or elements that define the structure of the immediate landscape; - Contrasts with land use, settlement or enclosure patterns of the immediate environment; - Cannot be 'absorbed' into the landscape from key viewing areas. *Result*: **Notable change in landscape characteristics over an extensive area and/or intensive change over a localized area resulting in major changes in key views.**	Because the proposed development: - Has a moderate negative effect on the visual quality of the landscape; - Contrasts with the patterns or elements that define the structure of the landscape; - Is partially compatible with land use (utilities) patterns of the general area. - Is partially 'absorbed' into the landscape from key viewing areas. *Result:* **Moderate change in landscape characteristics over localized area, resulting in a moderate change to key views.**	Because the proposed development: - Contrasts minimally with the patterns or elements that define the structure of the landscape; - is mostly compatible with land use, (utility) patterns. - is 'absorbed' into the landscape from key viewing areas *Result:* **Moderate change in landscape characteristics over localized area resulting in a minor change to a few key views**.	The proposed development: - Has a beneficial effect on the visual quality of the landscape; - Enhances the patterns or elements that define the structure of the landscape; - Is compatible with land use, settlement or enclosure patterns. *Result:* Positive change in key views.

The construction / operational phase of the project would be the period of greatest negative impact on views in the study area. Visual intrusion would reduce dramatically at decommissioning assuming that the recommended rehabilitation measures are effectively implemented.

6.2.3 *Severity* of Visual Impact

In synthesising the criteria (visual intrusion, visibility, visual exposure and viewer sensitivity criteria) used to establish the severity of visual impact, a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement (Institute of Environmental Assessment and The Landscape Institute (1996)). The severity ratings for each viewing sector as identified above are indicated in Table 4 below and derived from the discussion in the preceding sections. These results are based on *worst-case scenarios* when the impact of all aspects is taken together.

Views from the R385 and Humasrus Farmstead

Public views from this sector would be negatively affected due to the proximity and exposure of project activities to the viewer. The scale of the project is immense and it would dominate foreground views, changing the character of the area permanently and impacting on the rural, pastoral sense of place that currently exists at the site and its immediate surrounds. However, the sensitivity towards the project is limited and people in the area have not raised aesthetic concerns about the project. Also, there are no known tourist facilities in the area that could be impacted upon. People using the R385 would definitely notice the project and its physical features but would perhaps be more curious about the new development, and the fact that it represents a 'clean source of power', than react negatively towards it. However, due to the scale and high exposure the project would have on this sector, the severity of potential impact is rated *high*.

Views from Groenwater, Sunnyside farmstead and the dirt road west of the site (D3381)

The severity of impact on views from within this sector is rated moderate as only the upper sections of the tower would be visible and mostly in middleground views resulting in a partial loss to scenic quality. Also, as mentioned above, the sensitivity of people living in the area is not high.

Table 4 below summarizes these findings.

Table 4: *Severity* of Impact

High Users of the R385 immediately north of the site and the Humansrus farmstead	Moderate Groenkloof community, Sunnyside farmstead and users of the dirt road (D3381) west of the	Low	Negligible For the remainder of the study area
Total loss of or major alteration to key elements / features / characteristics of the baseline (views and scenic quality). I.e. Pre-development landscape or view and / or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape. **High scenic quality impacts would result from potentially sensitive viewing areas.**	Partial loss of or alteration to key elements / features / characteristics of the baseline (views and scenic quality). I.e. Pre-development landscape or view and / or introduction of elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape. **Moderate scenic quality impacts would result from potentially sensitive viewing areas.**	Minor loss of or alteration to key elements / features / characteristics of the baseline (views and scenic quality). I.e. Pre-development landscape or view and / or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape. **Low scenic quality impacts would result from potentially sensitive viewing areas.**	Very minor loss or alteration to key elements / features / characteristics of the baseline (views and scenic quality). I.e. Pre-development landscape or view and / or introduction of elements that is not uncharacteristic with the surrounding landscape – approximating the 'no change' situation. **Negligible scenic quality impacts would result.**

7.0 MITIGATING MEASURES

In considering mitigating measures there are three rules that must be taken into account:

- The measures should be feasible (economically);
- Effective (how long will it take to implement and what provision is made for management/maintenance);
- And acceptable (within the framework of the existing landscape and land use policies for

the area).

To address these, the following principles have been established:

- Mitigation measures should be designed to suite the existing landscape character and needs of the locality. They should respect and build upon landscape distinctiveness.

- It should be recognized that many mitigation measures, especially the establishment of planted screens and rehabilitation, are not immediately effective.

Mitigation measures should be feasible and effective in reducing the visual impact on views from some surrounding landowners. It is proposed that the following general actions be implemented:

7.1 Site Development

- The minimum amount of existing vegetation and topsoil should be removed. Ensure, wherever possible, all existing vegetation is retained and incorporated into the site rehabilitation.

- Good 'housekeeping' (keeping the site tidy and neat) is essential throughout all phases of the project.

7.2 Earthworks

- Dust suppression techniques should be in place at all times especially during the construction phase.

- Only the footprint and a small 'construction buffer zone' around the proposed activities should be exposed. In all other areas, the existing vegetation should be retained and access prohibited during the construction phase.

- The final topography should be graded to merge and blend with the existing topography and to yield optimum use and value of the area in the future.

- The heliostat terrace is to be created at the lowest level possible to take advantage of the surrounding topography that can act as an effect visual screen (especially to views from the south and west of the site).

7.3 Rehabilitation

- An ecological approach to rehabilitation measures, as opposed a horticultural approach to rehabilitation should be adopted wherever possible. For example communities of indigenous, preferable endemic, plants enhance bio-diversity and blend well with existing vegetation. This ecological approach costs significantly less to maintain than conventional landscaping methods and is more sustainable in the long term. A registered landscape architect (SACLAP) should be consulted for this purpose.

7.4 Access Roads

- During construction and operational phases, access roads will require an effective dust suppression management programme, such as regular wetting and / or the use of non-polluting chemicals that will retain moisture in the road surface.

7.5 Lighting

Light pollution should be seriously and carefully considered and kept to a minimum wherever possible as light at night travels great distances. Security and flood lighting should only be used where absolutely necessary and carefully directed i.e. away from nearby residences and communities. Wherever possible, lights should be directed downwards so as to avoid illuminating the sky.

The negative impact of night lighting, glare and spotlight effects, can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light “spillage” beyond the immediate surrounds of the CSP site.

- Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on movement at illegal entry to the site.

- Use security lighting at the periphery of the site that is activated by movement and are not permanently kept on.

7.5 Visual Buffer

- The tower should remain as a concrete finish and no advertising should be allowed on it.

7.6 Visual Buffer

We propose that a physical visual buffer be constructed along the northern edge of project property boundary between the road reserve and the heliostat field. The buffer would form an effective screen to foreground views of the site and block from view, the heliostat field from this low perspective. Three options are proposed:

- An earth berm approximately 10m high created from excavated site material. The berm should be covered with topsoil removed and stockpiled from the construction footprint (of the berm as well as other proposed facilities) and seeded with indigenous plant materials. Refer to Figures 16 (before scenario) and Figure 17 (with 10m berm). The viewing point is from the R385 at the north eastern corner of the site.

- An earth berm approximately 5m high created from excavated site material. The berm should be covered with topsoil removed and stockpiled from the construction footprint (of the berm as well as other proposed facilities) and seeded with indigenous plant materials. Refer to Figures 16 (before scenario) and Figure 18 (with 5m berm). The viewing point is from the R385 at the north eastern corner of the site.

- Rows of Wild Olive trees (O*lea europea* subsp. *Africana).* It is a small to medium sized indigenous tree with a dense rounded crown, which occurs in the area. The lower branches should be encouraged to grown and not be pruned back, so as to achieve a visual screen as low to the ground as possible. It has a relatively fast growth rate of up to 800mm per year and could reach a height of 5 – 7m in approximately 10 years. This means that the visual buffer would not be effective immediately. Refer to Figures 16 (before scenario) and Figure 19 (with olive tree screen).

It should be noted that the earth berm options are only viable should excess soil be available from site works. If soil has to be transported from off-site the implementation of the berm would not be economically feasible.

7.7 Visitors Centre

Develop a visitor's centre that explains the new technology and conveys pertinent information about the use of solar energy to produce clean electricity.

8.0 SIGNIFICANCE OF VISUAL IMPACT

The significance of impact takes the severity of impact and qualifies this with extent, duration and probability criteria as summarized in Appendix D. Table 5 summarise the *significance* of the visual impact. These results are based on worst-case scenario. However, as the sensitivity to the project is low and people living in residences near the project site have not objected to the project nor have they raised visual issues as a concern, the probability of the impact in the rating system has been reduced (from highly probably to probable) to account for this. Also, the nature of the project would most likely induce the curiosity of people travelling through the area, who may be interested in understanding more about the generation of clean, solar energy and may want to visit the project site (i.e. tour the visitors centre). Hence, the negative visual issues related to the project could be negated and the potential of the project becoming a tourist attraction, would be real.

The significance of identified negative impacts has been expressed qualitatively as follows:

- **Insignificant -** the impact is insubstantial and does not require management;

- **Low -** Of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged;

- **Medium -** Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required;

- **High -** Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.

Table 5: *Significance* of Visual Impact – R385 and Humansrus Farm

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation	Mitigation Measures	Mitigation Potential	Significance with Mitigation
Construction Phase								
- The proposed CSP project s located in a landscape of moderate value partially tolerant of change; - The construction activities are visible from less than half the zone of potential influence, - Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. - Construction activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the short term and have a high negative effect on the visual quality of the area	Medium (2)	Severe (3)	Low (1)	Probable (2)	Moderate Negative (9)	– The minimum amount of existing vegetation and topsoil should be removed from construction areas. Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the site design. Eradication of vegetation should be done in 'natural manner', avoiding harsh straight lines. – Dust suppression techniques should be in place at all times during the construction and operational phases. – Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the of the concentrator plant, refrigeration plant, the incline and vent shafts but which still illuminate the buildings/roads. – Avoid high pole top flood and security lighting in these areas. – Build a visual buffer along the northern boundary of the site adjacent the R385.	Reasonable	Moderate Negative
Operational Phase								
- The proposed CSP project is located in a landscape of moderate value partially tolerant of change; - The operation activities are visible from less than half the zone of potential influence, -. Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. - Operation activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the long term and have a high negative effect on the visual quality of the area. -	High (3)	Severe (3)	High (3)	Probable (2)	Moderate Negative (11)	– Good housekeeping and encourage people to visit the Visitors Centre – Manage the growth of plant materials in the visual buffer	Reasonable	Moderate Negative

Table 5: *Significance* of Visual Impact – Views from Groenwater, Sunnyside farmstead and the dirt road (D3381) west of the site

Environmental Impacts	Scale	Severity	Duration	Probability	Significance without Mitigation	Mitigation Measures	Mitigation Potential	Significance with Mitigation
Construction Phase								
- The proposed CSP project s located in a landscape of moderate value partially tolerant of change; - The construction activities are visible from less than half the zone of potential influence, - Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. - Construction activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the short term and have a high negative effect on the visual quality of the area.	High (3)	Average (2)	Low (1)	Probable (2)	Moderate Negative (8)	– The minimum amount of existing vegetation and topsoil should be removed from construction areas. Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the site design. Eradication of vegetation should be done in 'natural manner', avoiding harsh straight lines. – Dust suppression techniques should be in place at all times during the construction and operational phases. – Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the of the concentrator plant, refrigeration plant, the incline and vent shafts but which still illuminate the buildings/roads. – Avoid high pole top flood and security lighting in these areas. - Build a visual buffer along the northern boundary of the site adjacent the R385.	Reasonable	High Negative
Operational Phase								
- The proposed CSP project is located in a landscape of moderate value partially tolerant of change; - The operation activities are visible from less than half the zone of potential influence, -. Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities. - Operation activities will cause a major change in landscape characteristics over localized area resulting in major changes in key views in the long term and have a high negative effect on the visual quality of the area.	High (3)	Average (2)	High (3)	Probable (2)	Moderate Negative (10)	– Good housekeeping and encourage people to visit the Visitors Centre - Manage the growth of plant materials in the visual buffer	Reasonable	Moderate Negative

9.0 CONCLUSION

Visual resource impacts would result from the construction, operation, and maintenance of the proposed CSP project. Specifically, impacts would result from project components being seen from potentially sensitive viewpoints and from effects to the scenic values of the landscape. The visual impacts that could result from the project would most likely be direct, moderately adverse and long-term.

The study area has aesthetic value, albeit compromised to some degree through current man made mining and agricultural activities. Is has also been established that whilst the landscape's scenic value is rated moderate, it is not unique within the sub-region, nor would it evoke a strong sense of place amongst locals or people visiting the study area. The region is a known mining area and no tourism activities are known within the study area. However, the visual impacts that would result from the construction and operation of the proposed CSP project will have an adverse effect on the character of the landscape and on the visual environment of people living in, working and visiting the area. However, to date visual issues have not been raised as a concern by the community.

Visual impacts would result from the construction and operation of the proposed CSP project. The significance of visual impact is *moderate* for people living in and visiting the area during both of these phases but would perhaps be more severe during the construction phase due to all the activities and the generation of potential dust in a very dry environment. This would be especially so during the period when major earthworks are being carried out.

Mitigation measures, in the form of a visual buffer along the northern boundary of the site, are feasible and can reduce the impact of the project on foreground views from the R385. Good housekeeping and the introduction of a Visitor's Center could negate any potentially negative reactions to the visual aspects of the project and even turn the project into a tourist attraction for the region.

*** NLA ***

APPENDIX A: DETERMINING THE VALUE OF A VISUAL RESOURCE

In order to reach an understanding of the effect of development on a landscape resource, it is necessary to consider the different aspects of the landscape as follows:

Landscape Elements and Character
The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings and roads. They are generally quantifiable and can be easily described.

Landscape character is the description of pattern, resulting from particular combinations of natural (physical and biological) and cultural (land use) factors and how people perceive these. The visual dimension of the landscape is a reflection of the way in which these factors create repetitive groupings and interact to create areas that have a specific visual identity. The process of landscape character assessment can increase appreciation of what makes the landscape distinctive and what is important about an area. The description of landscape character thus focuses on the *nature of the land*, rather than the response of a viewer.

Landscape Quality
(after Crawford 1994 and The Visual Resource Management System, Developed by The Bureau of Land Management (BLM) in the Department of the Interior of the USA Government).

Studies for perceptual psychology have shown human preference for landscapes with a higher visual complexity particularly in scenes with water, over homogeneous areas. On the basis of contemporary research landscape quality increases when:

- Topographic ruggedness and relative relief increase - topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured;
- Where water forms are present - The degree to which water dominates the scene is the primary consideration in selecting the rating score;
- Consider the overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when considering "colour" are variety, contrast, and harmony.
- Where diverse patterns of grasslands and trees occur - give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Consider also smaller scale vegetational features which add striking and intriguing detail elements to the landscape (e.g. gnarled or wind beaten trees, and Quiver trees);
- Scarcity: This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery - the scarcity factor can be used to recognize this type of area and give it the added emphasis it needs.
- Where natural landscape increases and man-made landscape decreases;
- And where land use compatibility increases and land use edge diversity decreases - Cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit.

Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace

sound, smell and any other factor having a strong impact on human thoughts, feelings and attitudes (Ramsay 1993). Thus aesthetic value encompasses more than the seen view, visual quality or scenery, and includes atmosphere, landscape character and sense of place (Schapper 1993). Refer also to Appendix A for further elaboration.

Aesthetic appeal (value) is considered high when the following are present (Ramsay 1993):

- *Abstract qualities*: such as the presence of vivid, distinguished, uncommon or rare features or abstract attributes;
- *Evocative responses*: the ability of the landscape to evoke particularly strong responses in community members or visitors;
- *Meanings*: the existence of a long-standing special meaning to a particular group of people or the ability of the landscape to convey special meanings to viewers in general;
- *Landmark quality*: a particular feature that stands out and is recognised by the broader community.

Sense of Place

Central to the concept of a sense of place is that the place requires uniqueness and distinctiveness. The primary informant of these qualities is the spatial form and character of the natural landscape together with the cultural transformations and traditions associated with historic use and habitation. According to Lynch (1992) sense of place "is the extent to which a person can recognize or recall a place as being distinct from other places - as having a vivid, or unique, or at least particular, character of its own". Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. In some cases these values allocated to the place are similar for a wide spectrum of users or viewers, giving the place a universally recognized and therefore, strong sense of place.

Scenic Beauty of Visual Resource

In determining the scenic quality of the visual resource both the objective and the subjective or aesthetic factors associated with the landscape are considered. Many landscapes can be said to have a strong sense of place, regardless of whether they are considered to be scenically beautiful but where landscape quality, aesthetic value and a strong sense of place coincide - the visual resource or perceived value of the landscape is considered to be very high.

When considering both objective and subjective factors associated with the landscape there is a balance between landscape character and individual landscape features and elements, which would result in the values as follows:

Value of Visual Resource

Derived from The Landscape Institute with the Institute of Environmental Management and Assessment (2002)

High (Distinct)	Moderate (Common)	Low (Minimal)
Areas that exhibit a very positive character with valued features that combine to give the experience of unity, richness and harmony. These are landscapes that may be considered to be of particular importance to conserve and which may be sensitive change in general and which may be detrimental if change is inappropriately dealt with.	Areas that exhibit positive character but which may have evidence of alteration to /degradation/erosion of features resulting in areas of more mixed character. Potentially sensitive to change in general; again change may be detrimental if inappropriately dealt with but it may not require special or particular attention to detail.	Areas generally negative in character with few, if any, valued features. Scope for positive enhancement frequently occurs.

Scenic Quality Inventory and Evaluation Chart

(Developed by: The Bureau of Land Management (BLM), In the Department of the Interior of the USA Government)

Key factors	Rating Criteria and Score	.	.
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. **5**	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. **3**	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. **1**
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. **5**	Some variety of vegetation, but only one or two major types. **3**	Little or no variety or contrast in vegetation. **1**
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. **5**	Flowing, or still, but not dominant in the landscape. **3**	Absent, or present, but not noticeable. **0**
Color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. **5**	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. **3**	Subtle color variations, contrast, or interest; generally mute tones. **1**
Influence of adjacent scenery	Adjacent scenery greatly enhances visual quality. **5**	Adjacent scenery moderately enhances overall visual quality. **3**	Adjacent scenery has little or no influence on overall visual quality. **0**
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. *** 5+**	Distinctive, though somewhat similar to others within the region. **3**	Interesting within its setting, but fairly common within the region. **1**
Cultural modifications	Modifications add favorably to visual variety while promoting visual harmony. **2**	Modifications add little or no visual variety to the area, and introduce no discordant elements. **0**	Modifications add variety but are very discordant and promote strong disharmony. **-4**

APPENDIX B: DECLERATION OF INDEPENDENCE

Declaration of Independence

I, Graham A Young hereby declare that Newtown Landscape Architects cc, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.
Consultant name: Graham Young

Signature:

Date: 2011 09 19

APPENDIX C: METHOD FOR DETERMINING THE *SEVERITY* OF VISUAL IMPACT

A visual impact study analysis addresses the importance of the inherent aesthetics of the landscape, the public value of viewing the natural landscape, and the contrast or change in the landscape from the project.

For some topics, such as water or air quality, it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. The assessment of likely effects on a landscape resource and on visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations. (The Landscape Institute with the Institute of Environmental Management and Assessment (2002).

Landscape impact assessment includes a combination of objective and subjective judgements, and it is therefore important that a structured and consistent approach is used. It is necessary to differentiate between judgements that involve a degree of subjective opinion (as in the assessment of landscape value) from those that are normally more objective and quantifiable (as in the determination of magnitude of change). Judgement should always be based on training and experience and be supported by clear evidence and reasoned argument. Accordingly, suitably qualified and experienced landscape professionals carry out landscape and visual impact assessments (The Landscape Institute with the Institute of Environmental Management and Assessment (2002),

Landscape and visual assessments are separate, although linked, procedures. The landscape baseline, its analysis and the assessment of landscape effects all contribute to the baseline for visual assessment studies. The assessment of the potential effect on the landscape is carried our as an effect on an environmental resource, i.e. the landscape. Visual effects are assessed as one of the interrelated effects on population.

Landscape Impact

Landscape impacts derive from changes in the physical landscape, which may give rise to changes in its character and from effects to the scenic values of the landscape. This may in turn affect the perceived value ascribed to the landscape. The description and analysis of effects on a landscape resource relies on the adoption of certain basic principles about the positive (or beneficial) and negative (or adverse) effects of change in the landscape. Due to the inherently

dynamic nature of the landscape, change arising from a development may not necessarily be significant (Institute of Environmental Assessment & The Landscape Institute (2002)).

Visual Impact

Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the area.

To assess the magnitude of visual impact four main factors are considered.

Visual Intrusion: The nature of intrusion or contrast (physical characteristics) of a project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use.

Visibility: The area/points from which project components will be visible.

Visual exposure: Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion.

Sensitivity: Sensitivity of visual receptors to the proposed development

Visual Intrusion / contrast

Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit into the ecological and cultural aesthetic of the landscape as a whole? Or conversely what is its contrast with the receiving environment. Combining landform/vegetation contrast with structure contrast derives overall visual intrusion/contrast levels of high, moderate, and low.

Landform/vegetation contrast is the change in vegetation cover and patterns that would result from construction activities. Landform contrast is the change in landforms, exposure of soils, potential for erosion scars, slumping, and other physical disturbances that would be noticed as uncharacteristic in the natural landscape. Structure contrast examines the compatibility of the proposed development with other structures in the landscape and the existing natural landscape. Structure contrast is typically strongest where there are no other structures (e.g., buildings, existing utilities) in the landscape setting.

Photographic panoramas from key viewpoints before and after development are presented to illustrate the nature and change (contrast) to the landscape created by the proposed development. A computer simulation technique is employed to superimpose a graphic of the development onto the panorama. The extent to which the component fits or contrasts with the landscape setting can then be assessed using the following criteria.

- Does the physical development concept have a negative, positive or neutral effect on the quality of the landscape?

- Does the development enhance or contrast with the patterns or elements that define the structure of the landscape?

- Does the design of the project enhance and promote cultural continuity or does it disrupt it?

The consequence of the intrusion/contrast can then be measured in terms of the sensitivity of the affected landscape and visual resource given the criteria listed below. For instance, within an industrial area, a new sewage treatment works may have an insignificant landscape and visual impact; whereas in a *valued* landscape it might be considered to be an intrusive element. (Institute of Environmental Assessment & The landscape Institute (1996)).

Visual Intrusion

High	Moderate	Low	Positive
If the project: - Has a substantial negative effect on the visual quality of the landscape; - Contrasts dramatically with the patterns or elements that define the structure of the landscape;	If the project: - Has a moderate negative effect on the visual quality of the landscape; - Contrasts moderately with the patterns or elements that define the structure of the landscape; - Is partially compatible	If the project: - Has a minimal effect on the visual quality of the landscape; - Contrasts minimally with the patterns or elements that define the structure of the landscape; - Is mostly compatible	If the project: - Has a beneficial effect on the visual quality of the landscape; - Enhances the patterns or elements that define the structure of the landscape; - Is compatible with land use, settlement or

- Contrasts dramatically with land use, settlement or enclosure patterns; - Is unable to be 'absorbed' into the landscape.	with land use, settlement or enclosure patterns. - Is partially 'absorbed' into the landscape.	with land use, settlement or enclosure patterns. - Is 'absorbed' into the landscape.	enclosure patterns.
Result Notable change in landscape characteristics over an extensive area and/or intensive change over a localized area resulting in major changes in key views.	*Result* Moderate change in landscape characteristics over localized area resulting in a moderate change to key views.	*Result* Imperceptible change resulting in a minor change to key views.	*Result* Positive change in key views.

Visual intrusion also diminishes with scenes of higher complexity, as distance increases, the object becomes less of a focal point (more visual distraction), and the observer's attention is diverted by the complexity of the scene (Hull and Bishop (1988)).

Visibility

A viewshed analysis was carried out to define areas, which contain all possible observation sites from which the development would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1.8m above ground level. Topographic data was captured for the site and its environs at 10 m contour intervals to create the Digital Terrain Model (DTM). The DTM includes features such as vegetation, rivers, roads and nearby urban areas. These features were 'draped' over the topographic data to complete the model used to generate the viewshed analysis. It should be noted that viewshed analyses are not absolute indicators of the level of significance (magnitude) of the impact in the view, but merely a statement of the fact of potential visibility. The visibility of a development and its contribution to visual impact is predicted using the criteria listed below:

Visibility

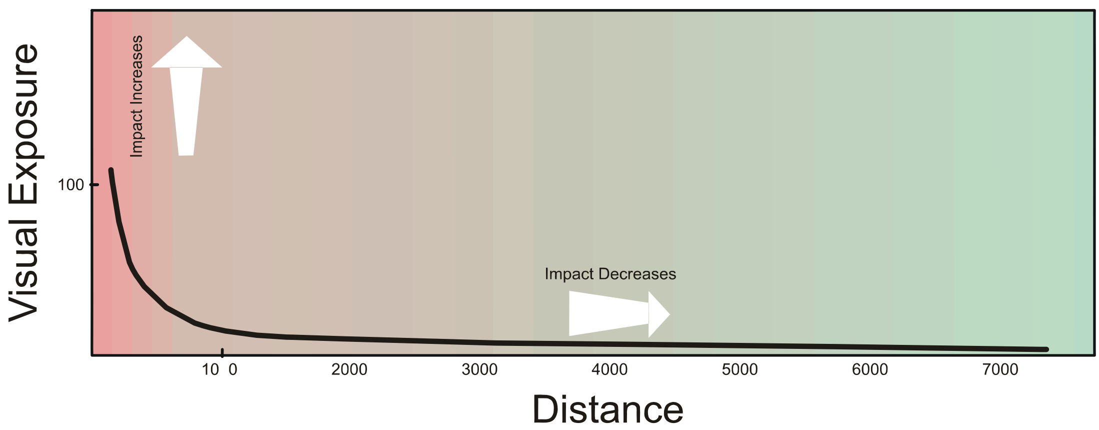
High	Moderate	Low
Visual Receptors If the development is visible from over half the zone of potential influence, and/or views are mostly unobstructed and/or the majority of viewers are affected.	*Visual Receptors* If the development is visible from less that half the zone of potential influence, and/or views are partially obstructed and or many viewers are affected	*Visual Receptors* If the development is visible from less than a quarter of the zone of potential influence, and/or views are mostly obstructed and/or few viewers are affected.

Visual Exposure

Visual exposure relates directly to the distance of the view. It is a criterion used to account for the limiting effect of increased distance on visual impact. The impact of an object in the foreground (0 – 800m) is greater than the impact of that same object in the middle ground (800m – 5.0 km) which, in turn is greater than the impact of the object in the background (greater than 5.0 km) of a particular scene.

Distance from a viewer to a viewed object or area of the landscape influences how visual changes are perceived in the landscape. Generally, changes in form, line, colour, and texture in the landscape become less perceptible with increasing distance. Areas seen from 0 to 800m are considered foreground; foliage and fine textural details of vegetation are normally perceptible within this zone. Areas seen from 800m to 5.0km are considered middle ground; vegetation appears as outlines or patterns. Depending on topography and vegetation, middle ground is sometimes considered to be up to 8.0km. Areas seen from 5.0km to 8.0km and sometimes up to 16km and beyond are considered background. Landforms become the most dominant element at these distances. Seldom seen areas are those portions of the landscape that, due to topographic relief or vegetation, are screened from the viewpoint or are beyond 16km from the viewpoint. Landforms become the most dominant element at these distances. The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. Thus, the visual impact at 1000 m would be 25% of the impact as viewed from 500 m. At 2000 m it would be 10% of the impact at 500 m. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (e.g.: Hull and Bishop (1988)) and is used as an important criteria for the study. This principle is illustrated in the figure below.

Effect of Distance on Visual Exposure



Sensitivity of Visual Receptors

When visual intrusion, visibility and visual exposure are incorporated, and qualified by sensitivity criteria (visual receptors) the magnitude of the impact of the development can be determined.

The sensitivity of visual receptors and views will be depended on:

- The location and context of the viewpoint;
- The expectations and occupation or activity of the receptor;
- The importance of the view (which may be determined with respect to is popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art).

The most sensitive receptors may include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape;
- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;
- Occupiers of residential properties with views affected by the development.

Other receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);
- People travelling through or past the affected landscape in cars, on trains or other transport routes;
- People at their place of work.

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

In this process more weight is usually given to changes in the view or visual amenity which are greater in scale, and visible over a wide area. In assessing the effect on views, consideration should be given to the effectiveness of mitigation measures, particularly where planting is proposed for screening purposes (Institute of Environmental Assessment & The Landscape Institute (1996).

Sensitivity of Visual Receptors

High	Moderate	Low
Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape; Communities where the development results in changes in the landscape setting or valued views enjoyed by the community; Occupiers of residential properties with views affected by the development.	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value); People travelling through or past the affected landscape in cars, on trains or other transport routes;	The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view (i.e. office and industrial areas). Roads going through urban and industrial areas

Severity of the Visual Impact

Potential visual impacts are determined by analysing how the physical change in the landscape, resulting from the introduction of a project, are viewed and perceived from sensitive viewpoints. Impacts to views are the highest when viewers are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the change. Visual impacts occur when changes in the landscape are noticeable to viewers looking at the landscape from their homes or from parks, and conservation areas, highways and travel routes, and important cultural features and historic sites, especially in foreground views. The severity of impact is assessed through a synthesis of visual intrusion, visibility, visual exposure and viewer sensitivity criteria. Once the magnitude of impact has been established this value is further qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact. For instance, the

fact that visual intrusion and exposure diminishes significantly with distance does not necessarily imply that the relatively small impact that exists at greater distances is unimportant. The level of impact that people consider acceptable may be dependent upon the purpose they have in viewing the landscape. A particular development may be unacceptable to a hiker seeking a natural experience, or a household whose view is impaired, but may be barely noticed by a golfer concentrating on his game or a commuter trying to get to work on time (Ittleson *et al.,* 1974).

In synthesizing these criteria a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgment. (Institute of Environmental Assessment and The landscape Institute (1996)).

Severity of Visual Impact

High	Moderate	Low	Negligible
Total loss of or major alteration to key elements/features/characteristics of the baseline.	Partial loss of or alteration to key elements/features/characteristics of the baseline.	Minor loss of or alteration to key elements/features/characteristics of the baseline.	Very minor loss or alteration to key elements/features/characteristics of the baseline.
I.e. Pre-development landscape or view and/or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view an/or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that are not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.
High scenic quality impacts would result.	Moderate scenic quality impacts would result	Low scenic quality impacts would result.	Negligible scenic quality impacts would result.

Cumulative effects

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they

may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility (visibility) of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The landscape Institute (1996)).

APPENDIX D: CRITERIA FOR SIGNIFICANCE OF IMPACT ASSESSMENT

Six standard rating scales are defined and used to assess and quantity the identified impacts. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on three criteria, namely:

- The relationship between impacts/issues and impact status (Box 1);
- The relationship between impacts/issues and spatial scale (Box 2);
- The relationship between impacts/issues and temporal scale (Box 3);
- The relationship between impacts/issues and probability (Box 4
- The relationship between impacts/issues and severity (Box 5);

These three criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment.	+
Neutral	No cost or benefit to the receiving environment.	N
Negative	A cost to the receiving environment.	-

Box 2: Spatial scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Box 3: Temporal scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years.	1
Medium	Medium term; Reversible over time; 5 – 15 years.	2
High	Long term; Approximate lifespan of the project: 16 - 30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Box 4: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Box 5: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table	2

Rating	Description	Quantitative Rating
	due to water abstraction.	
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value.	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example, the permanent change to topography resulting from a quarry.	4

Box 6: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	**High**	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	**No Impact**	Zero impact.	0
Negative	**Low**	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	- 1 – 5
	Medium	Impact is real, but not substantial in relation to	- 6 – 11

		other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required.	
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	- 12 - 16

APPENDIX E: Curriculum Vitae - Graham A Young

Graham is a registered landscape architect with interest and experience in landscape architecture, urban design and environmental planning. He holds a degree in landscape architecture from the University of Toronto and has practiced in Canada and Africa, where he has spent most of his working life. During his 30 year career he has received numerous Institute of Landscape Architects of South Africa and other industry awards. He has published widely on landscape architectural issues and has had projects published both locally and internationally in design journals and books. In addition to being a founding member of Newtown Landscape Architects he is currently a senior lecturer, teaching landscape architecture and urban design at post and under graduate levels, at the University of Pretoria. He has been a visiting studio critic at the University of Witwatersrand and University of Cape Town. A 'niche' specialty of his is Visual Impact Assessments for which he was cited with an ILASA Merit Award in 1999.

EXPERIENCE: **NEWTOWN LANDSCAPE ARCHITECTS cc.** ***Founding Member***

Current

Responsible for project management, landscape design, urban design, and visual impact assessment.

Senior Lecturer: Department of Architecture, University of Pretoria.

1991 - 1994
1988 - 1989

GRAHAM A YOUNG LANDSCAPE ARCHITECT - ***Sole proprietor***

Designed major transit and CBD based urban design schemes; designed commercial and recreational landscapes and a regional urban park; participated in inter-disciplinary consulting teams that produced master plans for various beachfront areas in KwaZulu Natal and a mountain resort in the Drakensberg.

1989 - 1991

CANADA - ***Free Lance***

Designed golf courses and carried out golf course feasibility studies (Robert Heaslip and Associates); developed landscape site plans and an end-use plan for an abandoned mine (du Toit, Allsopp and Hillier); conducted a visual analysis of a proposed landfill site.
.

1980 - 1988

KDM (FORMERLY DAMES AND MOORE) - *Started as a Senior Landscape Architect and was appointed Partner in charge of Landscape Architecture and Environmental Planning in 1984*. Designed commercial, corporate and urban landscapes; completed landscape site plans; developed end-use master plans for urban parks, college and technikon sites; carried out ecological planning studies for factories, motorways and a railway line.

1978 - 1980

DAYSON & DE VILLIERS - ***Staff Landscape Architect***

Designed various caravan parks; designed a recreation complex for a public resort; conducted a visual analysis for the recreation planning of Pilgrims Rest; and designed and supervised the installation of various private gardens.

EDUCATION:

Bachelor of Landscape Architecture, 1978, (BLArch), University of Toronto, Canada;
Senior Lecturer - Department of Architecture, University of Pretoria.

PROFESSIONAL:

Registered Landscape Architect – South African Council for Landscape Architectural Profession (2001);
Board of Control for Landscape Architects of South Africa (1987) – Vice Chairman 1988 to 1989;
Professional Member - Institute of Landscape Architects Southern Africa (1982) – President 1986 - 1988;
Member Planning Professions Board 1987 to 1989;
Member International Association of Impact Assessment;

AWARDS:

Intermediate Phase(S'kumbuto, Moshate and Uitspanplek), Freedom Park: ILASA Merit Award (2009)

Corniche Bay Resort, Mauritius: ILASA Merit Award (2009)

Torsanlorenzo International Prize, Landscape design and protection 2nd Prize Section B: Urban Green Spaces, for Intermediate Phase Freedom Park (2009)

Phase 1 and Intermediate Phase Freedom Park: Loerie Awards Gold Statue (2008)

Phase 1 and Intermediate Phase Freedom Park: Special Mention World Architecture Festival, Nature Category (2008)

Moroka Park Precinct, Soweto: ILASA Merit Award for Design (2005) and Gold Medal United Nations Liveable Communities (LivCom) Award (2007)

Isivivane, Freedom Park: ILASA Presidential Award of Excellence Design (2005)

Information Kiosk, Freedom Park: ILASA Merit Award for Design (2005)

Moroka – Mofola Open Space Framework, Soweto: ILASA Merit Award for Planning (2005)

Mpumalanga Provincial Government Complex: ILASA Presidential Award of Excellence (with KWP Landscape Architects for Design (2003)

Specialist Impact Report: Visual Environment, Sibaya Resort and Entertainment World: ILASA Merit Award for Environmental Planning (1999);

Gillooly's Farm, Bedfordview (with Dayson and DeVilliers): ILASA Merit Award for Design;

COMPETITIONS:

Johannesburg Inner City Park Design competition – with MMA architects (2009) Finalist and considered "the strongest concept" by the adjudication panel.

Pan African Parliament International Design competition – with MMA architects (2007) Finalist

Leeuwpan Regional Wetland Park for the Ekurhuleni Metro Municipality (2004) Landscape Architectural Consultant on Department of Trade and Industries Building (2002) – Finalist

Landscape Architecture Consultant on Project Phoenix Architectural Competition, Pretoria (1999): Winner;

Mpumalanga Legislature Buildings (1998): Commissioned;

Toyota Fountain (1985): First Prize - commissioned;

Bedfordview Bike/Walkway System - Van Buuren Road (1982): First Prize - commissioned;

Portland Cement Institute Display Park (1982): Second Prize

CONTRIBUTOR/AUTHOR:

Van Wyk, I. ***Green Building Handbook, South Africa, Vol. 2,*** Greenbuilding Media, Cape Town (2010).

- *Landscape Water Management*

Young, G and Barnard, J., ***Newtown Landscape Architects – A Retrospective 1994 – 2009,*** Newtown Landscape Architects cc, Johannesburg (2009).

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- *Visual Impact Assessment of a Peaking Power Plant, KwaZuluNatal*

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- Freedom Park Phase 1 and Intermediate Phase (NBGM), Pretoria, Gauteng

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- *Freedom Park Phase Intermediate Phase* (NBGM), Pretoria, Gauteng

Van Ueffelen, C. ***1000 X Landscapes***, Verlagshaus Braun, Germany (2008)

- *Freedom Park Phase 1 and Intermediate Phase* (NBGM), Pretoria, Gauteng
- *Riverside Government Complex* (NLAKWP), Nelspruit, Mpumalanga;
- *Moroka Dam Parks Pre*cinct, Soweto, Gauteng.

In ***Johannesburg: Emerging/Diverging Metropolis***, Mendrision Academy Press, Italy (2007)

- *Moroka Dam Parks* Precinct, Soweto, Gauteng.

Research panel: Oberholzer, B. ***Guideline for involving visual & aesthetic specialists in EIA processes: Edition 1.*** CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town. (2005)

Malan, C. and McInerney, P (eds) ***The Making of an African Building. The Mpumalanga Provincial Government Complex***, Johannesburg MPTS Architectural Library, Johannesburg (2001)

- *Riverside Government Complex* (KWPNLA), Nelspruit, Mpumalanga;

Numerous publications in industry journals.

REFERENCES:

Australian Heritage Commission (1999), *Protecting Local Heritage Places*, Australian Heritage Commission, Canberra.

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The Landscape Institute with the Institute of Environmental Management and Assessment (2002), *Guidelines for Landscape and Visual Impact Assessment Second Edition,* Spon Press, London

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Ittelson, W.H., Proshansky, H.M., Rivlin, L.g. and Winkel, G.H. (1974). *An Introduction to Environmental Psychology.* Holt, Rinehart and Winston, New York.

Lange, E. (1994), Integration of computerized visual simulation and visual assessment in environmental planning. *Landscape and Environmental Planning.* 30: p 99-112.

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Low, B & Rebelo, G (1998). *Vegetation of South Africa, Lesotho and Swaziland*, Department of Environmental Affairs & Toursim, Pretoria.

Ramsay, J. (October 1993). Identification and assessment of aesthetic values in two Victorian forest regions. *More than meets the eye: identifying and assessing aesthetic value.* Report of the Aesthetic Value Workshop held at the University of Melbourne.

Schapper, J. (October 1993). The importance of aesthetic value in the assessment of landscape heritage. *More than meets the eye: identifying and assessing aesthetic value.* Report of the Aesthetic Value Workshop held at the University of Melbourne.

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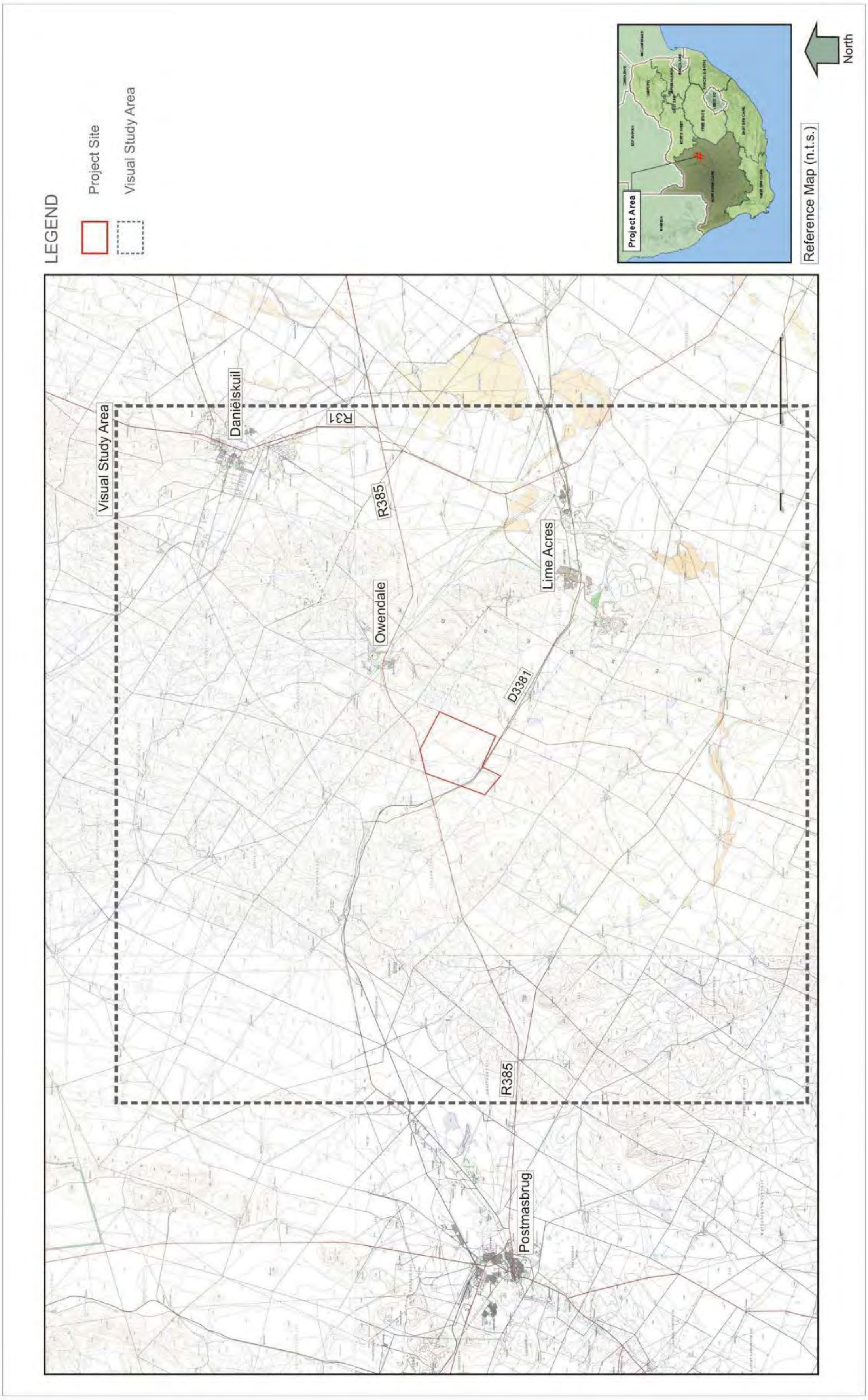


Figure 1: LOCALITY - Humansrus CSP

An example of a power plant using central receiver technology - image courtesy NREL.

LEGEND

Project Area

Existing Power Lines

Figure 2: LAYOUT - Humansrus CSP

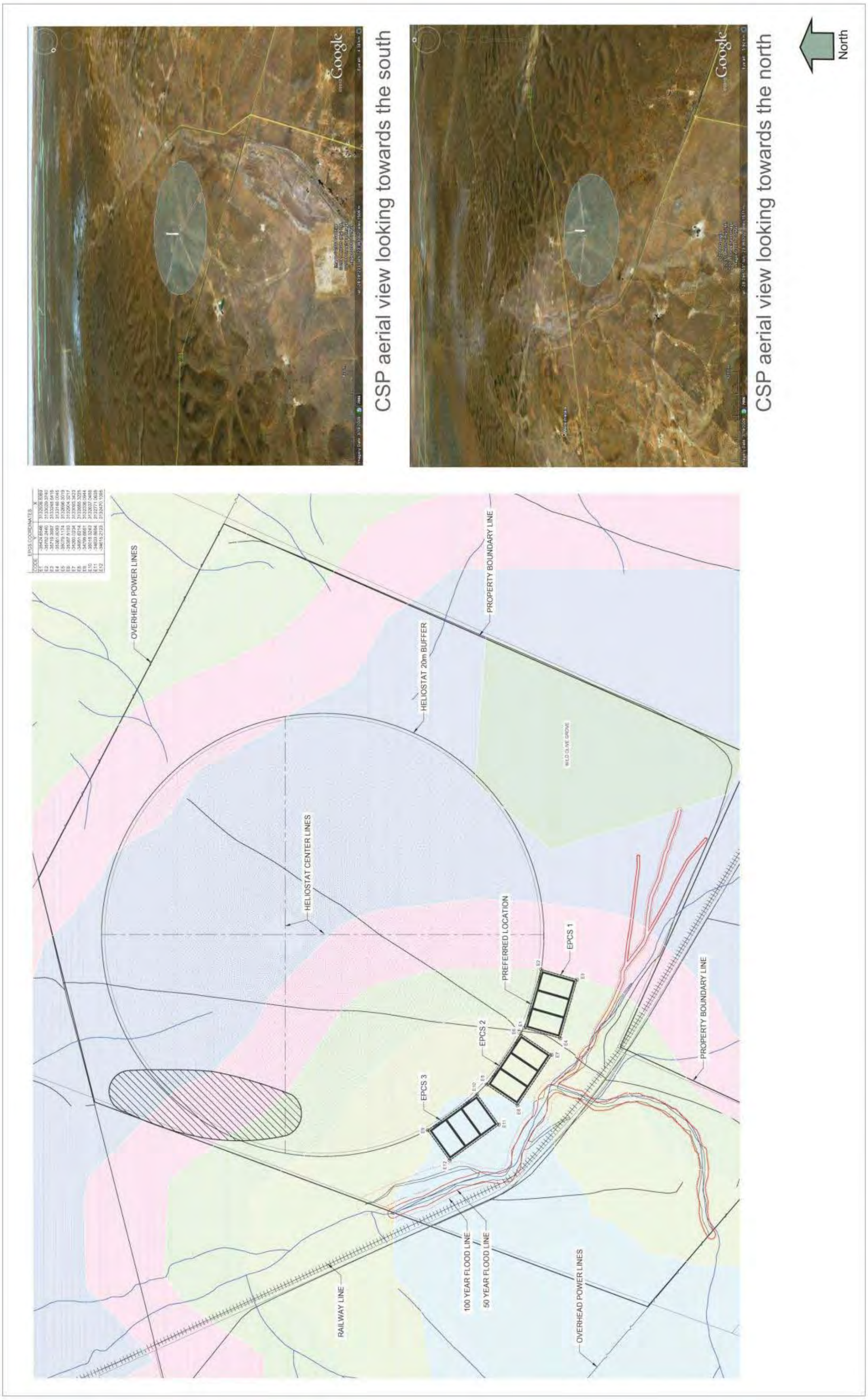


Figure 2a: LAYOUT - Humansrus CSP

View 1: From the R385 looking east towards the project site

View 2: From the R385 looking east towards the project site

Refer to Figure 3 for location of views

Figure 4: LANDSCAPE CHARACTER (View 1 & 2) - Humansrus CSP

May 2011

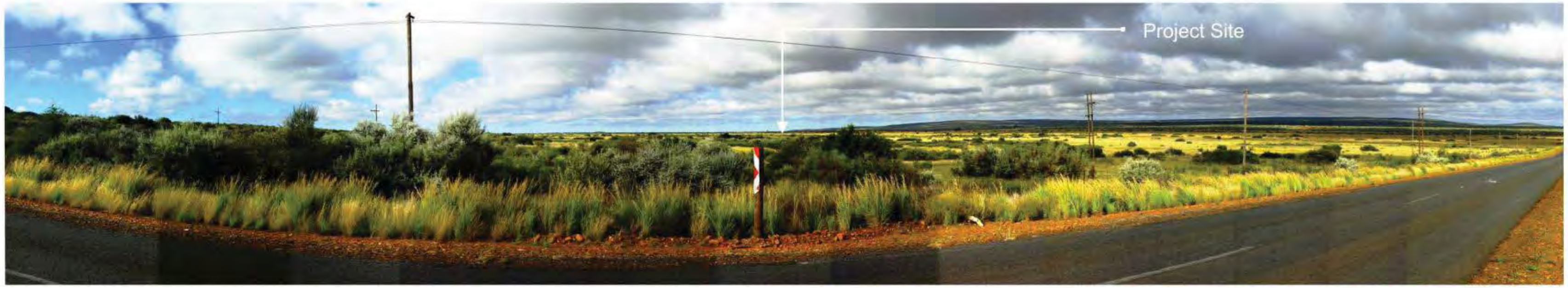
View 3: From the R385 looking east towards the project site

View 4: From the R385 looking east towards the project site at north western corner of the site

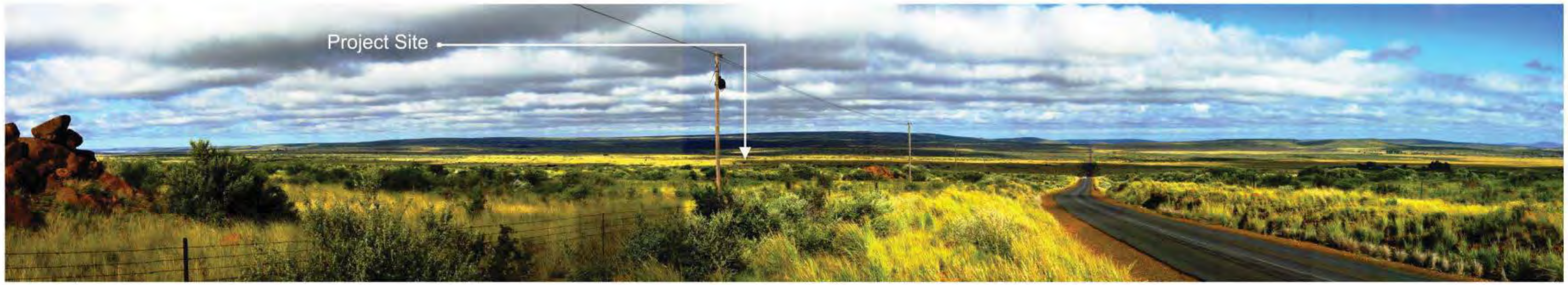
Refer to Figure 3 for location of views

Figure 5: LANDSCAPE CHARACTER (View 3 & 4) - Humansrus CSP

May 2011



View 5: From the R385 looking east towards the project site at north eastern corner of the site



View 6: From the R385 looking east towards the project site

Refer to Figure 3 for location of views

Figure 6: LANDSCAPE CHARACTER (View 5 & 6) - Humansrus CSP

May 2011

View 7: From the R385 at Owendale looking south west towards the project site

View 8: From the Lime Acers road looking north west towards the project site

Refer to Figure 3 for location of views

Figure 7: LANDSCAPE CHARACTER (View 7 & 8) - Humansrus CSP

May 2011

View 9: From the Lime Acres road looking north west towards the project site at the south eastern corner of the site

View 10: From the Lime Acres road looking north west from adjacent the project site

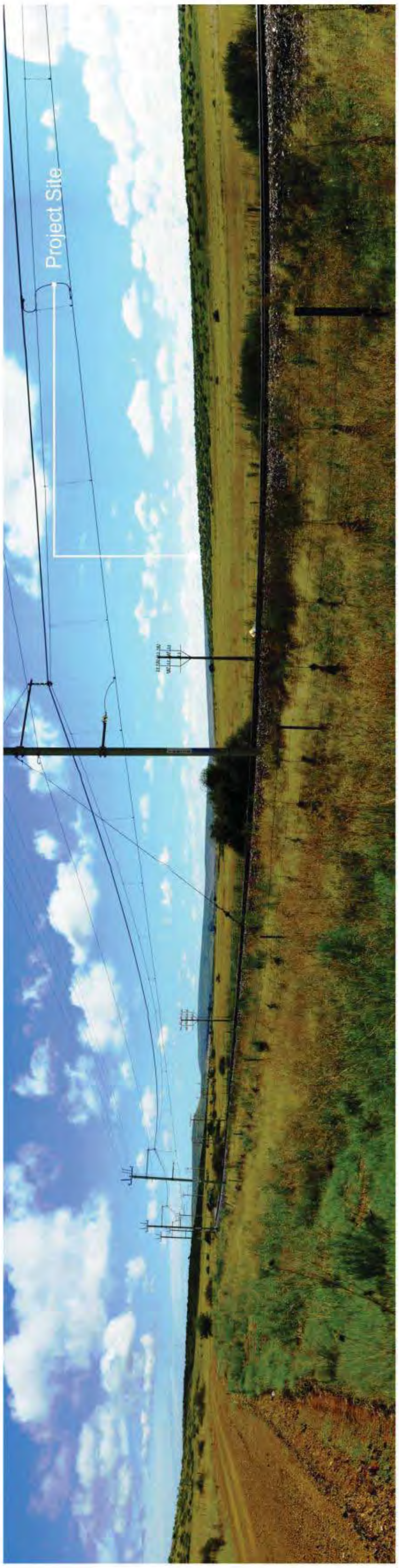
Refer to Figure 3 for location of views

Figure 8: LANDSCAPE CHARACTER (View 9 & 10) - Humansrus CSP

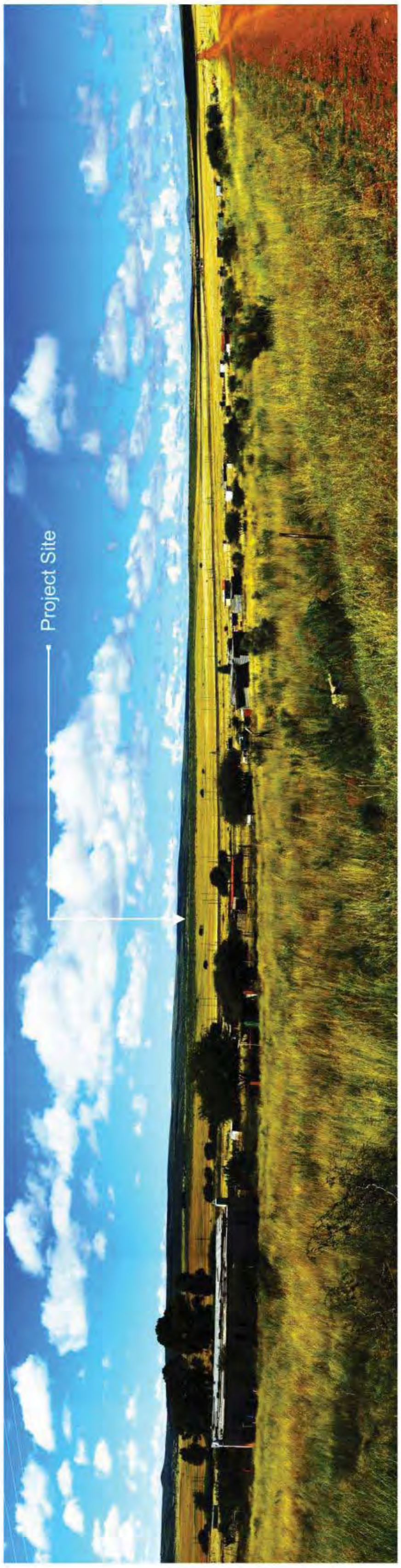
May 2011

Figure 9: LANDSCAPE CHARACTER (View 11 & 12) - Humansrus CSP

May 2011



View 11: From the Lime Acres road looking north east across the project site



View 12: From a farm road north of the R385 looking south east towards the project site

Refer to Figure 3 for location of views

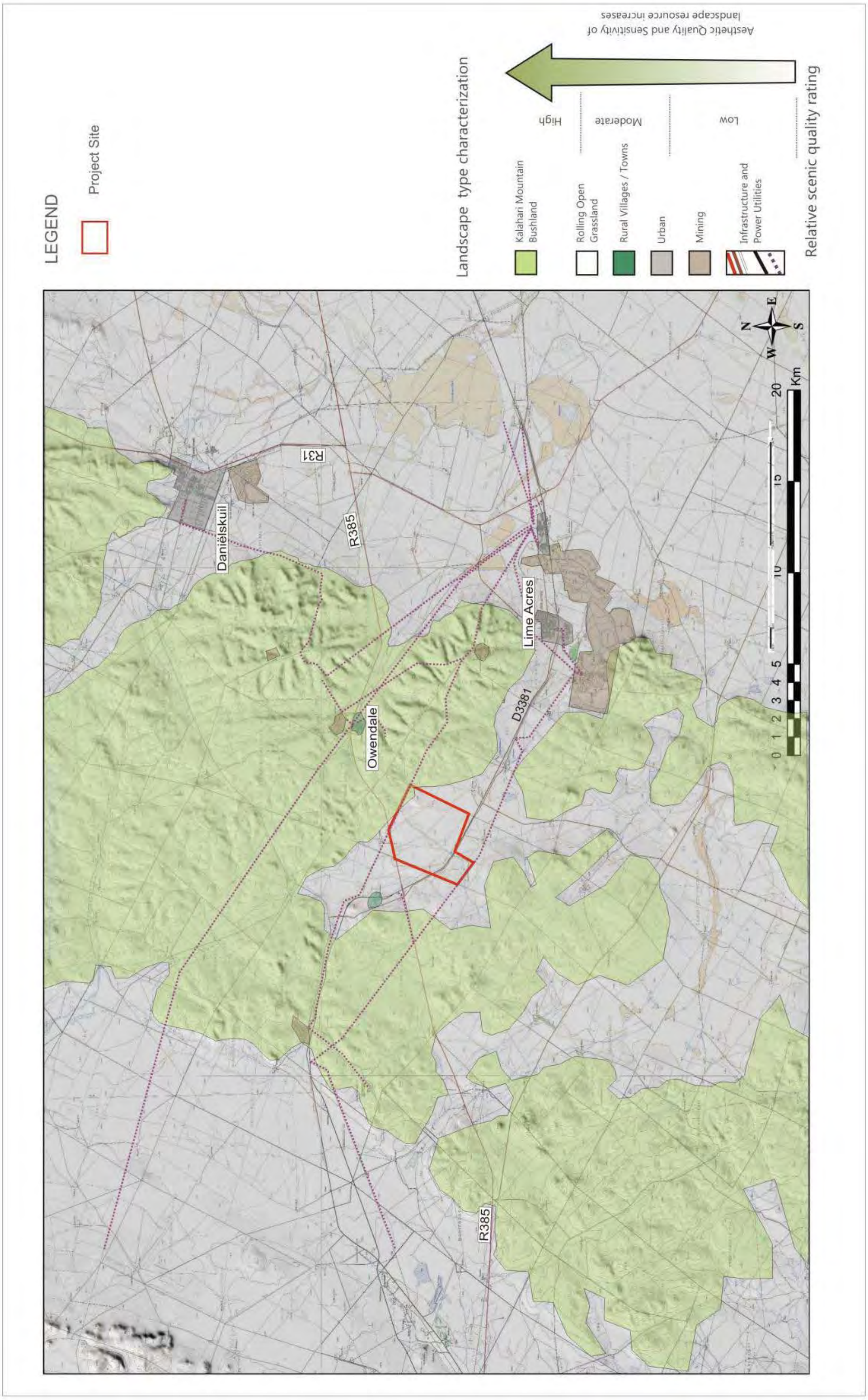


Figure 10: VISUAL RESOURCE - Humansrus CSP

May 2011

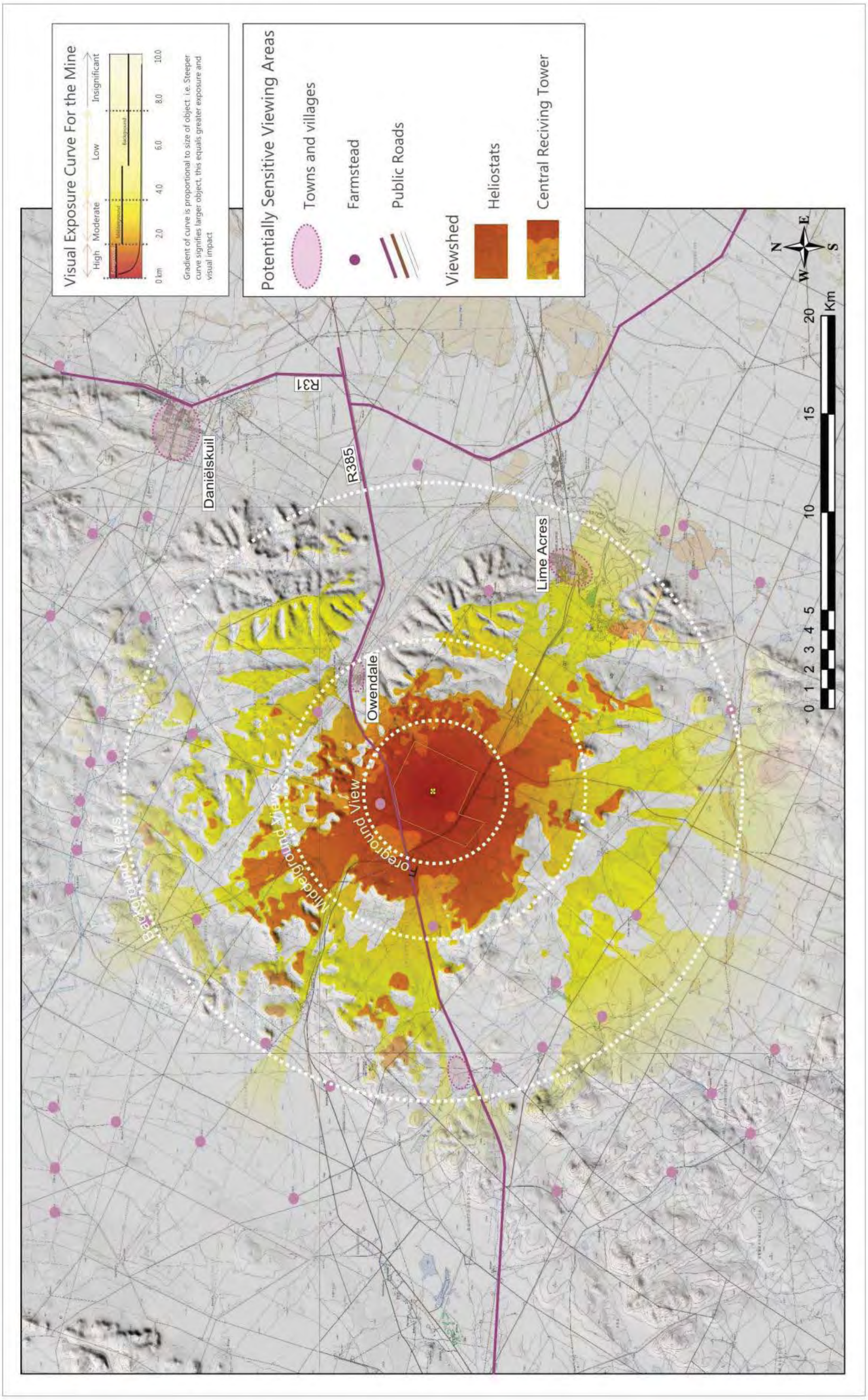


Figure 11: VIEWSHED AND SENSITIVE VIEWING AREAS - Humansrus CSP

May 2011

View 4: From the R385 looking east towards the project site at north western corner of the site BEFORE DEVELOPMENT

View 4: From the R385 looking east towards the project site at north western corner of the site AFTER DEVELOPMENT

Refer to Figure 3 for location of views

Figure 12: SIMULATION (View 4) - Humansrus CSP

View 6: From the R385 looking east towards the project site

View 6: From the R385 looking east towards the project site AFTER DEVELOPMENT

Refer to Figure 3 for location of views

Figure 13 LANDSCAPE CHARACTER (View 6) - Humansrus CSP

View 12: From a farm road north of the R385 looking south east towards the project site BEFORE DEVELOPMENT

View 12: From a farm road north of the R385 looking south east towards the project site AFTER DEVELOPMENT

Refer to Figure 3 for location of views

Figure 14: SIMULATION (View 12) - Humansrus CSP

View 11: From the Lime Acres road(D3381) looking north east across the project site BEFORE DEVELOPMENT

View 11: From the Lime Acres road (D3381)looking north east across the project site AFTER DEVELOPMENT

Refer to Figure 3 for location of views

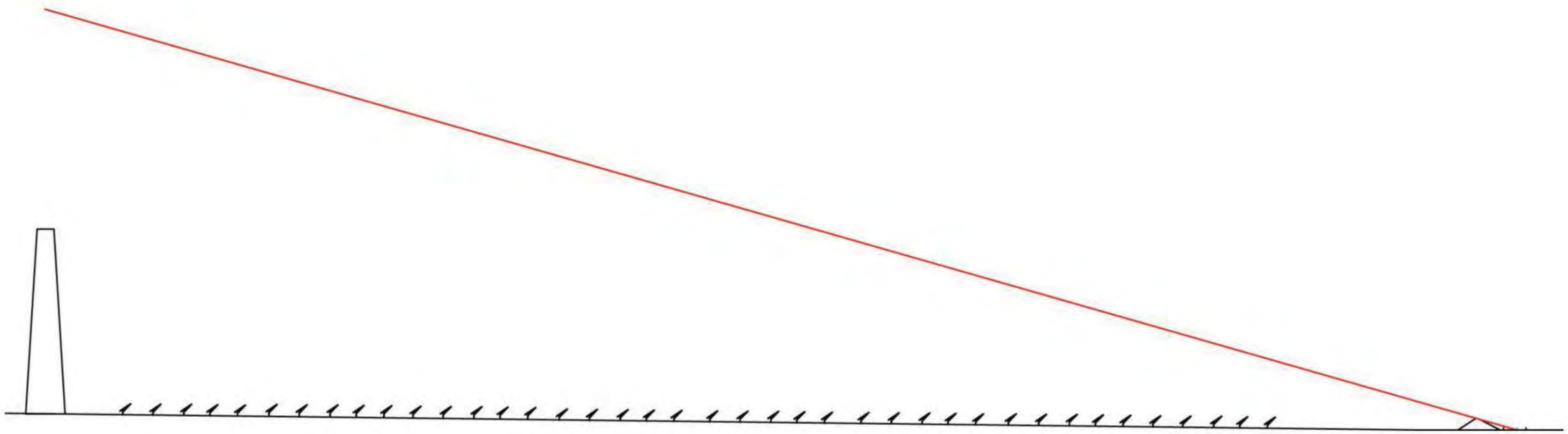
Figure 15: SIMULATION (View 13) - Humansrus CSP

Plan showing section line through mitigation measure

View 5: BEFORE mitigation measures are implemented

Refer to Figure 3 for location of views

Figure 16: MITIGATION MEASURES (View 5) - Humansrus CSP

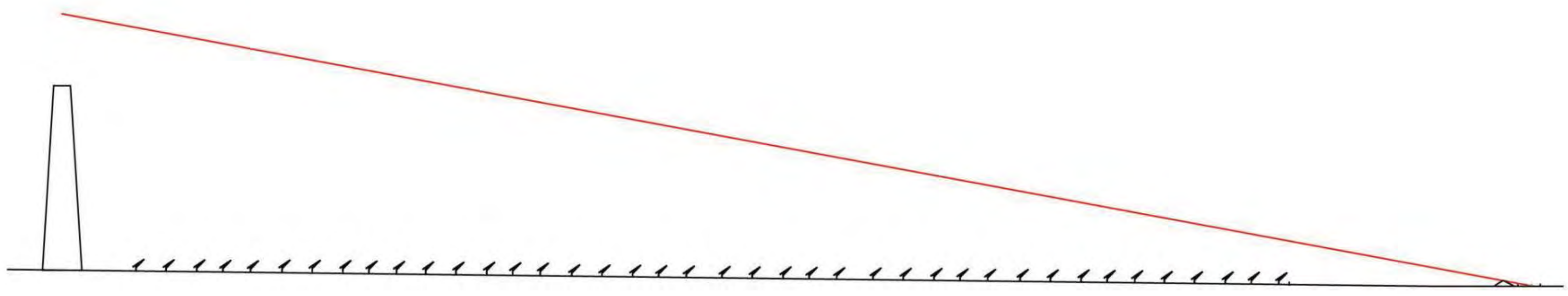


Section A-A through 10m high visual buffer

View 5: With 10m high berm as visual buffer

Refer to Figure 3 for location of views

Figure 17: MITIGATION MEASURES: VISUAL BUFFER (View 5) - Humansrus CSP

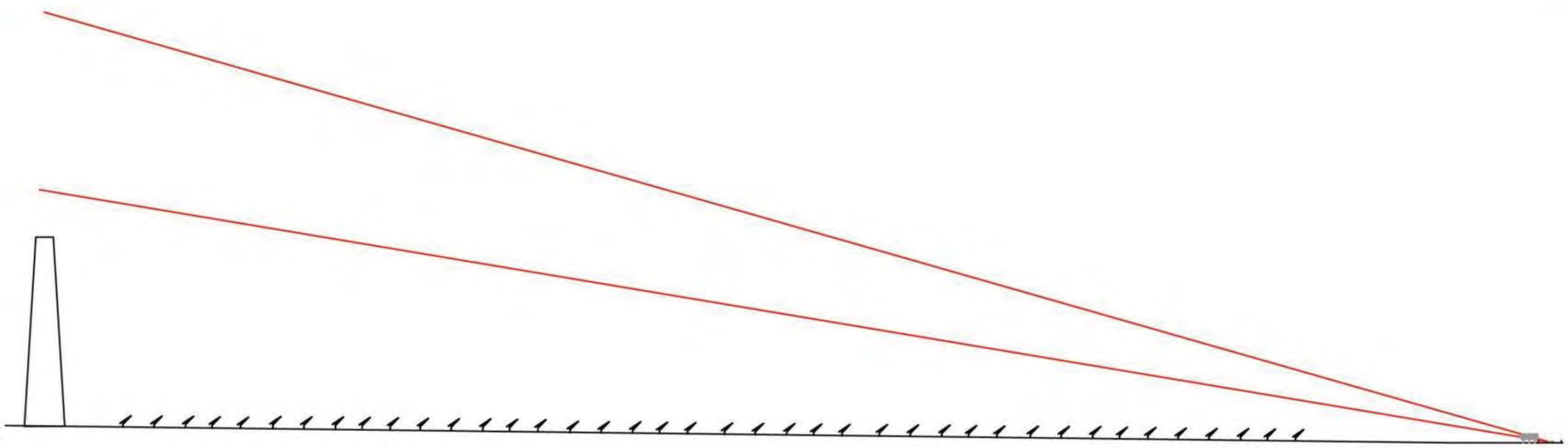


Section A-A through 5m high visual buffer

View 5: With 5m high berm as visual buffer

Refer to Figure 3 for location of views

Figure 18: MITIGATION MEASURES: VISUAL BUFFER (View 5) - Humansrus CSP



Section A-A through tree visual buffer

View 5: With Olea europa subs. africana trees as visual buffer

Refer to Figure 3 for location of views

Figure 19: MITIGATION MEASURES: VISUAL BUFFER (View 5) - Humansrus CSP

Appendix F

Avifauna Impact Assessment

Proposed Humansrus Solar Thermal Energy Power Plant

SPECIALIST AVIFAUNAL IMPACT ASSESMENT

EIA REPORT
September 2011

Andrew Pearson
Endangered Wildlife Trust
011 4861102
andrewp@ewt.org.za

Declaration of Independence

All specialist investigators specified above declare that:

- We act as independent specialists for this project.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.

Terms and Liabilities

- This report is based on a short term investigation using the available information and data related to the site to be affected. No long term investigation or monitoring was conducted.
- The Precautionary Principle has been applied throughout this investigation.
- The specialist investigator, and the Endangered Wildlife Trust, for whom he/she works, does not accept any responsibility for the conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from these assessments or requests made to them for the purposes of this assessment.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator withholds the right to amend this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report and all of the information contained herein remain the intellectual property of the Endangered Wildlife Trust.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Signed on the 21st September 2011 by Andrew Pearson in his capacity as specialist investigator for the Endangered Wildlife Trust's Wildlife and Energy Programme.

Executive Summary

Solar Reserve SA (Pty) Ltd is planning a 100 MW Solar Thermal Energy Power Plant (or otherwise known as a Concentrated Solar Power (CSP) plant) on the Farm 469, Hay RD (Humansrus), approximately 30 km east of Postmasburg, in the Northern Cape. Very few CSP plants have been constructed worldwide to date, and knowledge on the associated avifaunal impacts remains limited. Therefore, the level of confidence with which the various impacts are discussed and predicted is therefore relatively low.

The site consist mainly of uniform, arid vegetation types sites. Few permanent water bodies are on site. The proposed site falls within the Quarter Degree Grid Square (QDGS), 2823AD, and the South African Bird Atlas Project (SABAP) records 168 bird species of which 11 are Red Listed Species. Various other species relevant to the project were identified and include raptors, doves, pigeons and aerial foragers such as swallows and swifts.

Potential impacts of the project on avifauna were found to be of two types; those related to the CSP itself, and those relating to additional infrastructure. The former includes collision of birds with heliostats, burning of birds in focal points, collision with the central receiver tower, burning in the vicinity of the receiver tower as well as and habitat destruction and disturbance of birds. With regards to additional infrastructure, associated powerlines may result in electrocution and collision impacts on avifauna, while the development of various infrastructures will also cause habitat destruction and disturbance. The majority of all impacts discussed above, are likely to be of medium significance. The presence of open water ponds close to the CSP plant could drastically increase the potential for avifaunal impacts, especially when one considers the proximity of the site to already established water bird populations at the three CWAC sites.

It is unlikely that effective mitigation of impacts associated with the burning of birds as well as collision with heliostats, will be possible, but this will need to be confirmed once the plant is operational and some experience is gained. For this reason it has been recommended that a monitoring protocol, for the operational phase of the project, be incorporated in to the project EMP. This will insure that any bird mortalities are recorded and reported. The impacts of disturbance and habitat destruction can be mitigated by ensuring that the construction Environmental Management Plan incorporates guidelines as to how best to minimize this impact. Mitigation of collision with overhead powerlines will involve marking the relevant sections of line with appropriate marking devices.

Introduction

Solar Reserve SA (Pty) Ltd is planning a Solar Thermal Energy Power Plant (or otherwise known as a Concentrated Solar Power (CSP) plant). SSI was appointed as independent environmental consultants to conduct the Environmental Impact Assessment (EIA) process for the proposed development, and the Endangered Wildlife Trust (EWT) was subsequently appointed to conduct an avifaunal specialist study. Following the completion of the Scoping phase of the project, Worley Parsons RSA, took over as the independent Environmental Consultants, while the EWT was retained for the completion of the EIA phase. The proposed CSP plant is located on the Farm 469, Hay RD (Humansrus), approximately 4 km southeast of Groenwater and 30 km east of Postmasburg, in the Northern Cape (see Fig. 1). Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW which will require an area of approximately 800 ha. To the authors knowledge only two plants have been constructed to date, i.e. Solar One - an experimental 10 MW plant built in 1979 in Barstow, California and Solar Two – an improvement on Solar One at the same site. A 40 MW plant is also under development in Spain (Spain Solar Tres).

The proposed site falls within the Quarter Degree Grid Square (QDGS), 2823AD, and the South African Bird Atlas Project (SABAP) records 168 bird species of which 11 are Red Listed Species (Harrison *et al*, 1997). In addition, three Coordinated Waterbird Count (CWAC) areas, which are regarded as sites important for water birds either by virtue of the species present or the numbers in which they are represented, are within close proximity to the study area.

Figure 1: Google Earth image showing the relative position of the proposed CSP plant at Humansrus, depicted on the map with by the yellow star, as well as Postmasburg to the West and Kimberley to the South East.

Terms of Reference

The following terms of reference for the EWT avifaunal study were adopted:

- **Identification of sensitive sites:** The bird sensitive sections of the study area will be identified.
- **Describe affected environment and determine status quo:** The existing environment will be described and the bird communities most likely to be impacted will be identified. Different bird micro-habitats will be described as well as the species associated with those habitats.
- **Describe focal species:** Threatened bird species (as per red data book status), will be identified, and species most likely to be impacted upon will be identified.
- **Identification of impacts:** The potential impact on the birds will be identified.
- **Assess and rate the identified impacts.** The significance of the potential impacts will be rated according to a set of pre-determined criteria.
- **Assess alternatives.** A comparative assessment of the avifaunal impacts related to proposed project alternatives.
- **Propose and explain mitigation measures:** Practical mitigation measures will be recommended and discussed.

Methodology

The following section describes the process and criteria used to assess the site during the in terms of avifaunal impact.

- The study was initially conducted from a desk top level. Using various GIS layers, 1:50 000 topographical maps and Google earth images, key features within the study area were identified and a map of the site and surrounding area was created using ARCGIS 9.3.
- The various data sets discussed below under "sources of information" were collected.
- This data was examined to determine presence of sensitive Red Data species in the study area.
- Abundance of the species most sensitive to this project (not necessarily red listed species) was determined.
- A thorough site visit was conducted.
- Bird micro-habitats were then identified and described.
- Proximity of the site to water was assessed, as was the presence of small water features (e.g. dams or water troughs) within the site boundary.
- The impacts of the proposed project on birds were then predicted.
- Impact were assessed using a standard set of criteria (see Appendix A), as supplied by SSI environmental consultants.

Sources of Information

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison et al, 1997) obtained from the Avian Demography Unit (ADU) of the University of Cape Town, as a means to ascertain which species occur within the study area. A data set was obtained for these quarter degree square (Table 1).
- The SABAP 2 data for the relevant Pentads was also consulted.
- Data from the Co-ordinated Avifaunal Road count project (CAR – Young, Harrison, Navarro, Anderson & Colahan, 1997) for the "Mpumalanga Precinct".
- Data from the Co-ordinated Waterbird Count (CWAC) project was also consulted to determine whether any CWAC sites exist in the study area (Taylor, Navarro, Wren- Sargent, Harrison & Kieswetter, 1999).
- The Important Bird Areas of southern Africa (IBA) project data (Barnes 1998) was consulted to determine its relevance to this project.

- The conservation status of all bird species occurring in the aforementioned quarter degree square was determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes, 2000).
- Electronic 1:50 000 maps were obtained from the Surveyor General.
- High resolution satellite imagery from Google Earth was used to aid in the identification of micro-habitats

Scope, Limitations and Assumptions

This study made the assumption that the above sources of information are reliable. The following factors may potentially detract from the accuracy of the predicted results:

- In assessing the impacts of the associated infrastructure such as a new power line – the EWT is hugely experienced. However, with regard to the impacts of the CSP plant itself, this is largely new territory – quite possibly the case for all consultants on this project. With the exception of the one paper already cited, very little information on avifaunal impacts at existing solar plants could be found**. The level of confidence with which the various impacts are discussed is therefore relatively low**. However it must also be stated that many of the impacts of the CSP plant itself cannot readily be mitigated for in any case. For example if birds mistake the heliostats for water sources and are burnt in the focal points, mitigation for this would be very difficult.
- Unfortunately the Southern African Bird Atlas Project (Harrison et al 1997) data is now relatively outdated. This results in a low confidence in the report rates of the various species in the study area. Furthermore, updated data for the second bird atlas project (SABAP2), revealed a low number of counts for the relevant pentad.
- The site visit was conducted in May, over which time various species may not have been present in the study area.
- The SABAP data covers the period 1986-1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate.
- The final and exact position and nature of the associated infrastructure such as pipelines, power lines and roads was not available during the site visit.
- **Associated overhead powerlines, extending out of the site boundary, to connect with the Eskom Grid, may have large impacts; these however will fall within a separate EIA process, and were not assessed in this study.**
- Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behavior can never be entirely reduced to formulas that will hold true under all circumstances.

Review of potential avifaunal issues

Extensive review of the available literature on the internet relating to avifaunal interactions at solar energy power plants revealed very little, particularly in comparison to the literature available on avifaunal interactions with other forms of power generation. Possible reasons for this include the following:

- Little knowledge on these impacts exists since so few solar plants have been constructed to date.
- The two plants previously constructed were experimental sites, not commercial. All information related to the experiments would therefore have been private and not released into the public domain.
- The impacts of solar power plants of this type on avifauna are in fact relatively minor.

One paper entitled "Avian mortality at a solar energy power plant" (McCrary, McKernan, Schreiber, Wagner & Sciarrotta 1986) was discovered. This paper describes the results of their weekly monitoring over a two year period at Solar One. The main results of this study are summarized below:

- Forty visits (one week apart) to the facility over a two year period revealed 70 bird carcasses involving 26 species. It was estimated that between 10 and 30% of carcasses were removed by scavengers in between visits, so the actual number of mortalities may have been slightly higher. It is important to note that extensive agricultural lands and evaporation ponds (53 ha) were situated adjacent to the facility, which probably resulted in a higher abundance of many bird species than would otherwise have been the case.
- Fifty seven (81%) of the birds died through collision with infrastructure, mostly (>75%) colliding with the heliostats. Species killed in this manner included water birds, small raptors, gulls, doves, sparrows and warblers.
- Thirteen (19%) of the birds died through burning in the standby points. Species killed in this manner were mostly swallows and swifts.

Briefly, some of the anticipated avifaunal issues involved with the Humansrus Solar Thermal Energy project are now described below.

Issues relating to the CSP plant itself:

- Collision with the heliostats (mirrors):
  Reflective surfaces are particularly prone to collisions in the same way as household windows. The CSP plant will consist of hundreds or thousands of heliostat mirrors and can be expected to result in some collisions.
- Collision with the central receiver tower:
  Almost any infrastructure that stands proud in the landscape will result in a certain number of collisions by birds. In this case, the central receiver tower will stand approximately 200 m tall, a significant height, particularly in this landscape. A mitigating factor is that it will be a solid concrete tower and should be relatively visible to birds.
- Roosting on the central receiver tower:
  Birds could potentially use the top of the tower as a roosting site at night. It is likely that they would only come in to roost after the plant has been shut down in the evenings, and would leave the roost before the plant starts up in the morning.
- Burning when in vicinity of the central receiver:
  The central receiver will glow white hot when the plant is operational which might potentially result in birds in the vicinity being burnt.
- Burning when entering the "standby focal points":
  During testing, maintenance and daily start up procedures, the heliostats are focused in groups onto focal or standby points in the sky, usually at roughly the same height as the central receiver (approximately 200 m). In the case of the CSP plant, there will be numerous standby points. McCrary et al found that 19% of the birds that were found dead at Solar One were burned in standby points. Avian foragers such as swifts and swallows accounted for 46% of these mortalities. The more time a bird spends in the air the more chance there is of it flying into a standby point. The height at which species fly is also critical, species likely to fly at this height include the swifts, swallows, and martins.
- Loss of habitat:
  The CSP plant will take up an area of approximately 3 km squared. This would obviously be habitat previously available to the birds in the area.
- Disturbance:
  Resident bird species may be disturbed by construction, operational and maintenance activities associated with the CSP plant, particularly whilst breeding.
- Nesting of Sociable Weavers and other species on the plant infrastructure:
  Experience in this arid region has shown that Sociable Weavers are quick to nest on any manmade infrastructure and they may utilize infrastructure at the CSP site.

It is important to stress that most of the above impacts – and certainly the first five listed impacts – will probably only become significant when large numbers of birds are in the vicinity of the CSP plant. For example one swallow being burnt in a focal point would hardly be considered a significant impact. However, if a large flock of swallows congregated – perhaps due to a nearby roost site – a large number of birds could be burnt and the significance would be greatly amplified. For this reason, the more sensitive species in terms of the above impacts are likely to be the gregarious, flocking species.

Issues relating to the associated infrastructure:

The EWT believes that the impacts of the associated infrastructure such as overhead power lines on birds may in fact outweigh the impacts of the CSP plant itself, depending on the length of new infrastructure that needs to be constructed. The proximity of site to the existing power line and road infrastructure is therefore very important. The closer the final site is to existing infrastructure, the less new infrastructure will need to be built. Briefly, the impacts of the associated infrastructure are as follows:

<u>New power line:</u>

- Collision with associated power line infrastructure.
- Electrocution on associated power line infrastructure.
- Nesting on associated power line infrastructure.
- Disturbance through construction and maintenance activities of new power line.
- Habitat destruction through construction activities of new line.

<u>New road/s:</u>

- Disturbance of avifauna through construction and maintenance activities.
- Habitat destruction through construction activities.

<u>New pipe line/s:</u>

- Disturbance of avifauna through construction and maintenance activities.
- Habitat destruction through construction activities.

Issues or factors that may attract birds to the vicinity of the CSP plant thereby amplifying the above interactions/impacts:

In this arid, relatively uniform landscape, large congregations of birds are unlikely unless a strong attractant exists, such as water.

- Birds attracted to open water evaporation ponds:

  In this landscape, any source of water is hugely important for all animals - including birds. If the CSP plant involves any open water sources such as evaporation ponds, this will attract more birds into the immediate area thus heightening the risk of the above impacts occurring. McCrary *et al* (1986) found a number of water birds (teal, grebes, coots) that had collided with heliostats at Solar One and this is almost certainly related to the presence of large (53 ha) evaporation ponds nearby. This is supported by the fact that 45% of all species recorded in 150 ha around Solar One, were only recorded at the ponds. The importance of the evaporation ponds at Solar One to birds is further illustrated by the fact that 107 bird species were recorded in the vicinity of Solar One, whilst the avian community in similar habitat elsewhere is usually less than 20 species. It is clear then that the presence of open water ponds close to the CSP plant would drastically increase the potential for avifaunal impacts.

- Birds mistakenly attracted to heliostats:

  In these arid regions the daily activity schedule of many animals and birds revolves around securing their required daily intake of water. For example, Namaqua Sandgrouse (medium report rate in the study area) fly in flocks to water sources during mid to late morning. There is a possibility that birds such as these may mistake the heliostats for water sources when flying high above and descend to investigate. In the case of the Sandgrouse, they would typically circle several times once they have located a water source, before descending. If the heliostats are mistaken for water, these birds would most likely circle through one or more focal points and may well be burnt to death.

Regional Overview

The Northern Cape region is one of the most arid in southern Africa. In examining the region as a whole in terms of avifauna, it is important to relate the avifauna to the biomes and vegetation types present in the area. Harrison *et al* (1997) in "The Atlas of Southern African Birds" provide an excellent description of the various biomes represented in the region and the associated bird species. It is widely accepted within the ornithological community that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (in Harrison *et al* 1997). Therefore, this vegetation description focuses on factors which are relevant to bird distribution and is not a complete account of plant species. Of more relevance is the description of micro-habitat, given in following sections of this report

Nama karoo biome: This biome comprises mainly low shrubs and grasses, trees such as *Acacia karoo* and exotic species such as *Prosopis glandulosa* are restricted to watercourses. Compared to "succulent karoo", "nama karoo" has a much higher proportion of grass and tree cover. The "karoo" used loosely to mean both "nama" and "succulent karoo", supports a particularly high diversity of species endemic to southern Africa. Avifauna characteristically comprises ground dwelling species of open habitats. The tree lined watercourses allow penetration of several species typical of arid woodland such as the Kori Bustard and Karoo Korhaan. Several species are almost entirely confined to the "Nama karoo" such as the Red Lark and Sclaters Lark. Because rainfall in the "nama karoo" is in summer and the neighboring "succulent karoo" has winter rainfall, there is opportunity for species to migrate seasonally between the two. Two species suspected to do so (on the basis of atlas data) are the Ludwig's Bustard and Larklike Bunting.

Woodland biome: Woodland covers much of the northern and eastern parts of the country and is defined as having a distinct grassy under story and a woody upper story of trees and shrubs. Tree cover can range from sparse such as in the southern Kalahari, to almost closed. The more arid woodland types such as the Kalahari vegetation types are typically fine leaved and dominated by acacias and typically occur on nutrient rich, often alluvial soils in the western regions.

Central Kalahari is characterized by sparse to dense shrubland on deep Kalahari soils, grass cover is variable and dependant on rainfall. Southern Kalahari consists of open shrubland on deep Kalahari sands and again, grass cover is variable and dependant on rainfall. Avifauna of the Kalahari vegetation types is characteristic, with many species that occur in the moister woodlands avoiding the Kalahari, probably due to the absence of surface water. At the same time there are no species truly endemic to the Kalahari, most of them also spread to other woodland types. Two

species which have their ranges centered on the Kalahari however, are the Fawn-colored Lark and Kalahari Robin, representing possibly the closest to endemic species of the Kalahari.

A more site specific vegetation descriptions can be obtained from Mucina & Rutherford 2006, and the vegetation types occurring on site are identified in Figure 2 below. Six vegetation types are present in the surrounding areas of the site, namely Ghaap Plateau Vaalbosveld, Kuruman Mountain Bushveld, Kuruman Thornveld, Olifantshoek Plains Thornveld, Southern Kalahari Mekgacha, and Southern Kalahari Salt Pans. Two vegetation types Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld are present within the site itself, with the former representing the majority of the area.

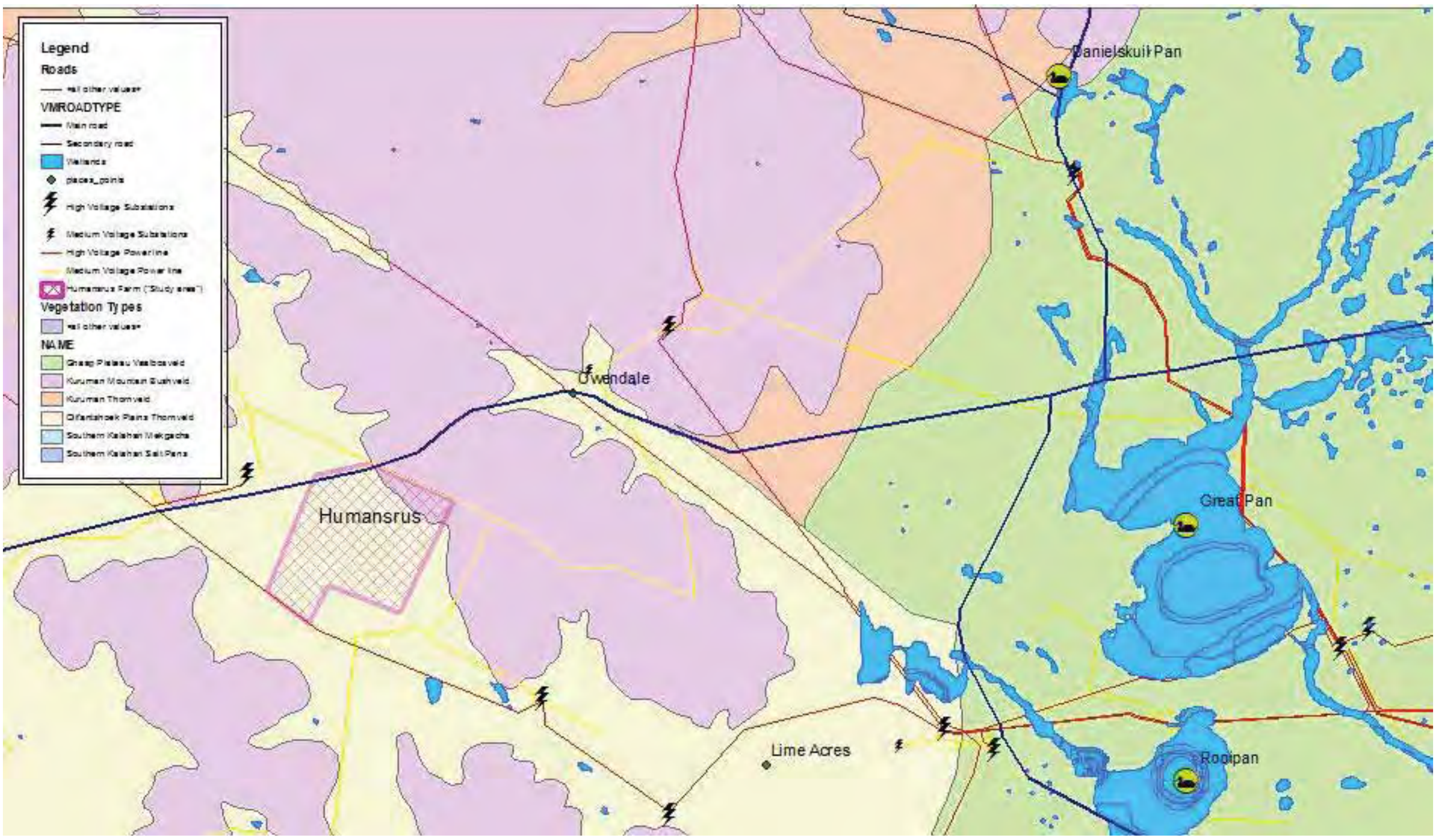


Figure 2: Vegetation Map of the site and surrounding areas, also showing CWAC sites, existing power lines, substations, roads, wetlands and places of human settlement.

Presence of Red Data bird species

Table 1 below shows report rates for the Red Data species in the study area (Harrison *et al* 1997). Report rates are an expression of the number of times a species is counted in a particular square expressed as a percentage of the number of times that square was counted. A total of 168 species have been recorded for the QDGS, which had been relatively well counted with 77 cards submitted. Eleven species recorded are listed in the red data book (Barnes, 2000)

Table 1: Red Data species recorded in the quarter degree square (2823AD) covering the study area (Harrison *et al* 1997).

Total species		168
# cards submitted		77
Species	**Cons. status**	**Report Rate (%)**
Tawny Eagle	VU	1
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
Kori Bustard	VU	1
White-backed Vulture	VU	17
Black Harrier	NT	1
Black Stork	NT	5
Secretarybird	NT	9
Greater Painted-snipe	NT	1
Greater Flamingo	NT	5

CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened.

An evaluation of CAR data revealed that there were no Co-ordinated Avifaunal Road-count routes through or near to the site. The site does not fall within an Important Bird Area (IBA) and there were no IBA's within close proximity to the site.

An evaluation of the SABAP 2 data revealed that of the four pentads in the study area, pentad number 2820_2325, was the only one that had been sufficiently counted. This is likely due to the

fact that the settlement of Lime Acres falls within this pentad. The data for this pentad did not reveal any additional information to that obtained from the SABAP 1 data.

Three CWAC sites were identified to the east of the study area, namely Danielskuil Pan, Great Pan, and Rooipan, and are shown in Figure 2.

Danielskuil Pan actually consists of two dams and a dam/pan with open shoreline, some shorebird habitat, and almost no fringing vegetation. Formerly, the dam/pan received water from local sewage works. Counts are available for 1996 and 1997, when mainly small numbers of 17 species were recorded, 16 species in summer (only South African Shelduck being missing) and only 3 in winter (SA Shelduck, Threebanded Plover and Cape Wagtail). The most numerous birds in summer were Whitefaced Duck, Blacksmith Plover (a good count of 47 birds in 1997), Curlew Sandpiper and Little Stint. Pollution by sewage and domestic refuse is an important threat; mild threats are fishing, and overhead powerlines. Data was not available for Great Pan, and neither for Rooipan, as both sites are classed as private, and individual cards are not available for public viewing. The species occurring at these sites are expected to be similar to those present at Danielskuil Pan, discussed above.

Bird Micro-habitats

An examination of the micro habitats available to birds within the study site was conducted. These are generally evident at a much smaller spatial scale than vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. The following micro-habitats were identified on site:

Drainage Lines and Wetlands

Figure 3: An example of a drainage line, with evidence of erosion, observed in the general study area.

Few wetland areas were observed on site. There is a “vlei” area situated parallel to the rail line at the south west of the site which appears to flow toward a small dam (see section below). The desktop study revealed the presence of Salt Pans and CWAC sites in the surrounding area (discussed above). Drainage lines and wetlands are an important form of habitat to numerous species. Drainage lines are often surrounded by natural grasslands, which may provide habitat for species such korhaans, cranes, larks and pipits. Various waterfowl, such as ducks and geese, may make use of these areas

Man-made Dams

Figure 4: A small dam observed, close to the western boundary of the farm.

Artificially constructed dams have become important attractants to various bird species in the South African landscape. Various waterfowl frequent these areas and crane species often use dams to roost in communally. Birds such as flamingos and African Spoonbills may make use of these areas. Therefore dams are a key element of this study, and should be classed as no-go areas for this project.

Grassland

Figure 5: Grassland observed on site

Grassy areas make up the majority of the site and fall within the areas classified as Olifantshoek Plains Thornveld. Grasslands represent a significant feeding area for many bird species such as Blue Crane, Secretarybird, Kori Bustard and Northern Black Korhaan. The grassland patches are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl, as well as small mammals such as Suricates (see Fig. 6). This in turn may attract large raptors because of both the presence and accessibility of prey.

Figure 6: A group of Suricates observed at their burrows, in grassland, near to the site.

Bushveld, Woodland and Thicket patches

Figure: 7: A woodland and Thicket patch observed on site

Small patches of Acacia thickets and bushes were observed, usually close to disturbed areas such as homesteads and kraals. As one moves to the periphery of the site, away from the flat grassy areas, the elevation rises and small trees and bushveld appear (depicted as "Kuruman Mountain

Bushveld" discussed above). These areas attract smaller passerine species such as Robins and Shrikes. Weavers and Sparrow-weavers use the tree as structures for nesting and Raptors such the Southern Pale Chanting Goshawk may use these areas for perching.

Figure 8: A photograph taken from an elevated point, east of the site, looking west towards the site, showing grassy areas of Olifantshoek Plains Thornveld at lower elevation, and Kuruman Mountain Bushveld at a higher elevation. The majority of the site is to be built in the flat lower lying area.

Water-trough points

Figure 9: A central water point for cattle on site. Note the short grazed grassy areas.

Through overgrazing and the clearance of vegetation by cattle at these feeding and watering points, a microhabitat favoured by certain species has been created. Small species such as robins and wagtails are attracted to the water trough itself to drink, while the open, short grassy areas are favoured by terrestrial species such as coursers and lapwings. Francolins and korhaans were also observed foraging in these areas during the site visit

Table 2 below shows the micro habitats that each Red Data bird typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis below represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where impacts on those species will be most significant.

Table 2: Preferred Micro-habitats and likelihood of occurrence on site of Red Data species recorded in the relevant QDGS.

Species	**Preferred Micro-habitat**	**Likelihood of occurrence on site**
Tawny Eagle	Woodland and Bushveld	Unlikely
Martial Eagle	Woodland, savannah and Shrublands	Possible
Lesser Kestrel	Arable lands and Grasslands	Likely
Blue Crane	Farm Dams, cultivated lands and grassland	Likely
Kori Bustard	Grasslands and Bushveld	Unlikely
White-backed Vulture	Savannah Woodlands and Bushveld	Possible
Black Harrier	Cultivated lands and Grasslands	Unlikely
Black Stork	Rivers and Kloofs	Unlikely
Secretarybird	Cultivated lands and Grasslands	Possible
Greater Painted-snipe	Dams and Wetlands	Unlikely
Greater Flamingo	Dams and wetlands	Possible

Focal species

After determining the red data species that are likely or may possibly be found on site, as well as identifying the microhabitats, the focal species for the study were identified. Table 3 below shows the report rates for selected species that have been recorded in the quarter degree squares covering the study area (Harrison *et al* 1997). Focal Red Data species have been included, as well as a selection of non Red Data species which are considered to have particular relevance to this study such as raptors, doves, pigeons and aerial foragers such as swallows and swifts. Those species observed during the site visit are also indicated.

Table 3: Report rates for selected Focal Red Data species and a selection of other species that are considered particularly relevant to the study (Harrison *et al* 1997)

Species	**Cons Status**	**Report Rate (2823AD)**
Martial Eagle	VU	6
Lesser Kestrel	VU	13
Blue Crane	VU	6
White-backed Vulture	VU	17
Secretarybird	NT	9
Greater Flamingo	NT	5
Grey Heron*		56
Cape Teal		57
Verreaux's Eagle		55
Booted Eagle		4
Black-shouldered Kite*		69
Jackal Buzzard		0
Pale Chanting Goshawk		39
Rock Kestrel		79
Greater Kestrel		12
Helmeted Guineafowl*		55
Red-crested Korhaan		1
Black Korhaan* (pre-split)		34
Crowned Lapwing*		90
Blacksmith Lapwing*		91
Pied Avocet		25
Black-winged Stilt		56
Spotted Dikkop*		3
Double-banded Courser*		8
Namaqua Sandgrouse		36
Rock (Speckled) Pigeon		65
Red-eyed Dove*		29
Cape Turtle Dove*		44

Laughing Dove*		96
Namaqua Dove		79
Barn Owl*		4
Spotted Eagle Owl		1
White-rumped Swift		57
Little Swift		58
European Swallow (Barn)		32
White-throated Swallow		10
Greater Striped Swallow		70
Rock Martin		79
Brown-throated Martin		9
Pied Crow*		56
Mountain Chat		81
Familiar Chat*		78
Ant-eating Chat*		86
Karoo Scrub-Robin		55
Kalahari Scrub-Robin*		55
Black-chested Prinia*		66
Cape Wagtail*		95
Common Fiscal*l		94
White-browed Sparrow-weaver*		84
Sociable Weaver		1
House Sparrow*		83
Scaly-feathered Finch*		12
Red-billed Quelea*		34
Yellow Canary*		92

CE = Critically endangered, E = Endangered, VU = Vulnerable, NT = Near threatened, * = recorded during site visit.

Evaluation of avifaunal impacts

Issues relating to the CSP plant itself:

Collision with the heliostats (mirrors):

This is likely to impact on birds, but the extent to which it will occur is unknown at this stage. In the South African context, this impact will only become fully known and understood, once such projects have been established, and their interaction with avifauna has been monitored for a period of time. The impact on bird populations worldwide through them colliding with windows of buildings has been well documented (see www.flap.org). At Solar One, 81% of bird mortalities were through collision with structures, with >75% of these collisions having occurred with the heliostat mirrors themselves (McCrary *et al* 1986).

Collision with the central receiver tower:

Bird collisions with tall infrastructure have also been well documented world wide. However, this typically occurs with migratory species in flocking behavior and has usually involved low visibility conditions such as fog. There are unlikely to be sufficient numbers of any particular bird species at the site of the CSP plant to constitute flocking behavior thereby resulting in this risk. It is however likely that the occasional bird will collide with the tower.

Roosting on the central receiver tower:

The tower will be a prominent structure in the landscape and may be an attractive roost for certain bird species. Although it will be too hot during operation, as it cools down during the evenings it may be a very attractive (particularly during winter) if it retains some warmth (although the temperature it retains remains to be seen). If it is well lit at night, this may attract insects, thereby attracting birds. If birds do roost on the tower, this is likely to simply be a nuisance for plant staff, as bird pollution will build up on any available surfaces.

Burning when in vicinity of the central receiver:

It seems unlikely to be a significant impact as birds would presumably be repelled by the heat before they get within burning range. Certain particularly fast flying species may be impacted on, such as the doves, swifts, martins and swallows identified in table 3. Research at Solar One did not detect any mortalities through this mechanism (McCrary *et al* 1986).

Burning when entering the "standby focal points":

This impact is likely to occur at the CSP plant. At this stage it is safe to say that some birds will in all likelihood be killed in the focal points. The significance of the impact will depend on just how many birds, and what species are killed. Furthermore, it seems unlikely that any mitigation for this impact will be possible. Monitoring at Solar One recorded that 19% of all bird mortalities were through burning in standby or focal points – mostly swifts and swallows (McCrary *et al* 1986).

Loss of habitat:

Approximately 800ha will be taken up by the CSP plant in total. The vegetation in this area will should not be fully cleared automatically. Rather, only the areas where infrastructure has to be constructed should be cleared. Obviously construction activities on site will flatten and impact on certain areas of vegetation even if it is not cleared. Similar habitat is abundant in the greater area and it is anticipated that the bird species will move to surrounding areas.

Disturbance:

Construction activities will no doubt disturb the birds in the area, particularly breeding birds – however due to the uniformity of the broader area, these birds can quite easily move off and find similar habitat nearby.

Nesting of Sociable Weavers and other species on the plant infrastructure:

The extent to which this occurs will need to be monitored closely. This is an impact of the birds on the plant rather than the plant on the birds. It is hoped that the constant moving and cleaning of the heliostats will make them unattractive nesting substrate for the birds. No nests were observed within the site boundaries, however, some nests (such as the one shown in Fig. 9 below) were observed in the surrounding areas.

Figure 9: A sociable weaver nest on a manmade structure observed in the surrounding area.

Table 4: Rating of significance of impacts associated with CSP itself.

Impact	Status	Temporal scale	Spatial scale	Probability	Severity	Significance
Collision with heliostats	-	3	1	2	4	10 (Medium)
Collision with central receiver tower	-	3	1	2	4	10 (Medium)
Roosting on central receiver tower	N	3	1	2	1	7 (Medium)
Burning in vicinity of central receiver tower	-	3	1	1	4	9 (Medium)
Burning in focal points	-	3	1	2	4	10 (Medium)
Habitat loss	-	4	1	4	3	11 (Medium)
Disturbance	-	1	1	2	2	7 (Medium)
Nesting	+	3	1	1	1	6 (Medium)

Issues relating to associated infrastructure:

New power lines:

Collision of large terrestrial birds with overhead power lines is likely to occur and is anticipated to be the most significant threat posed by associated infrastructure. This will be especially relevant to large overhead power lines extending beyond the site. Species most likely to be affected are korhaans and other large terrestrial species. The significance of this impact depends on the length of new line to be built. In this case it appears that new line will be required from the CSP plant to a substation connecting with the High Voltage Line running to the South West of the site. The exact routing of this new line was not available at the time of the site visit, and it is probable that this infrastructure will form part of a separate EIA process all together. Therefore, **only the impacts of overhead powerlines within the CSP site boundary have been assessed at this stage**.

Electrocution of birds on pylons will depend entirely upon the exact pylon structure that for the new line – detail of which was not available at the time of this study. Electrocution risk is determined by the phase-phase and phase-earth clearances on a pole structure which differ greatly between different structures. Again, if the structure used is dangerous to birds, the significance of this impact will vary with the length of the line.

Nesting of birds on pylons is in fact a positive impact on avifauna, but may impact negatively on the quality of electrical supply by causing electrical faults. In the case of Sociable Weaver nests, the nest material may pose problems to the pylons structural integrity through added weight, and there is an increased fire risk due to the fuel load of these massive nests.

Disturbance of avifauna through construction and maintenance activities associated with the power line is not likely to be significant.

Habitat destruction by construction activities is likely to occur, but not likely to be significant.

Table 5. Rating of significance of impacts associated with new power lines

Impact	Status	Temporal scale	Spatial scale	Probability	Severity	Significance
Collision of birds	-	3	1	2	4	10 (Medium)
Electrocution of birds	-	3	1	1	4	9 (Medium)
Nesting	N	3	1	2	1	7 (Medium)
Habitat destruction	-	3	1	3	2	9 (Medium)
Disturbance	-	2	1	3	2	8 (Medium)

New roads:

Disturbance of avifauna is likely to occur to some extent, but not likely to be too significant as there is already a gravel district road (along the rail line to the west of the site) as well as various tracks through the farm and it is unlikely that extensive new roads would be, again depending on the final layout of the CSP plant within the farm.

Habitat destruction caused by road construction will have some impact on avifauna, but as discussed elsewhere the habitat in this landscape is relatively uniform and so this impact is unlikely to be too significant.

Table 6. Rating of significance of impacts associated with new roads

Impact	Status	Temporal scale	Spatial scale	Probability	Severity	Significance
Habitat Destruction	-	4	1	3	3	11 (Medium)
Disturbance	-	2	1	3	2	8 (Medium)

New pipe lines:

This infrastructure is likely to have very similar impacts to the roads discussed above, except on a smaller scale. Should new pipelines be required for water supply to the CSP plant impacts of this on avifauna will be minor habitat destruction and minor disturbance.

Table 7. Rating of significance of impacts associated with new pipelines

Impact	Status	Temporal scale	Spatial scale	Probability	Severity	Significance
Habitat Destruction	-	2	1	2	2	7(Medium)
Disturbance	-	2	1	2	1	6 (Medium)

Comparison of Alternatives

For the purpose of the proposed EIA only the following types of alternative options will be considered:

- The design or layout of the activity
- The technology to be used in the activity
- The option of not implementing the activity (i.e. "No-go").

For the proposed CSP various plant design or layout positions on the proposed site will be assessed as alternatives. Three possible technology alternatives have been identified as development options and will be considered and assessed. The no-go alternative will also be assessed in order to reflect the potential impact if the proposed project will not be implemented.

No-go Alternative

The current status quo would be maintained by not implementing the proposed CSP Plant. The current farming activities will continue and the land use will not change. Presence and abundance of bird species, as described in the Avifaunal Scoping Report, would remain the same. Purely in terms of impacts on avifauna, this option would have the least impacts.

Location Options

The options for the proposed location of the CSP are limited to the remainder of the Farm 469 (Humansrus), Hay RD. However more than one design or layout option of the proposed plant on the selected site will be investigated. No alternative site locations have been assessed.

Technology Options

The three technology alternatives that are being considered relates to the water consumption of the plant and particularly the consumption of the cooling systems. The cooling system is the only variable in terms of water consumption. The three cooling system options are dry, wet and hybrid cooling. The estimated water consumption during the construction phase remains constant irrespective of the cooling option chosen. The consumption during operation however will be influenced by the selected cooling system. The dry system consumes approximately 90% less water than the wet system and moderately less than the hybrid cooling system and the availability of water will be a determining factor of the option to be selected.

It is unlikely that there will be any direct impacts on avifauna, relating to the type of cooling system chosen. However, as birds are dependent on water, the wet system may have more negative, indirect impacts on avifauna, through the possible depletion of water availability and wetland habitats. This of course is dependent on the source of the water used.

Site Layout options.

An avifaunal sensitivity map has been compiled (see figure 10 below), showing areas of medium-high, low-medium, and unknown sensitivities. Recommendations with regard to these sensitivity "zones" has been discussed below. It is recommended that infrastructure is not built or developed in the zone of medium to high sensitivity.

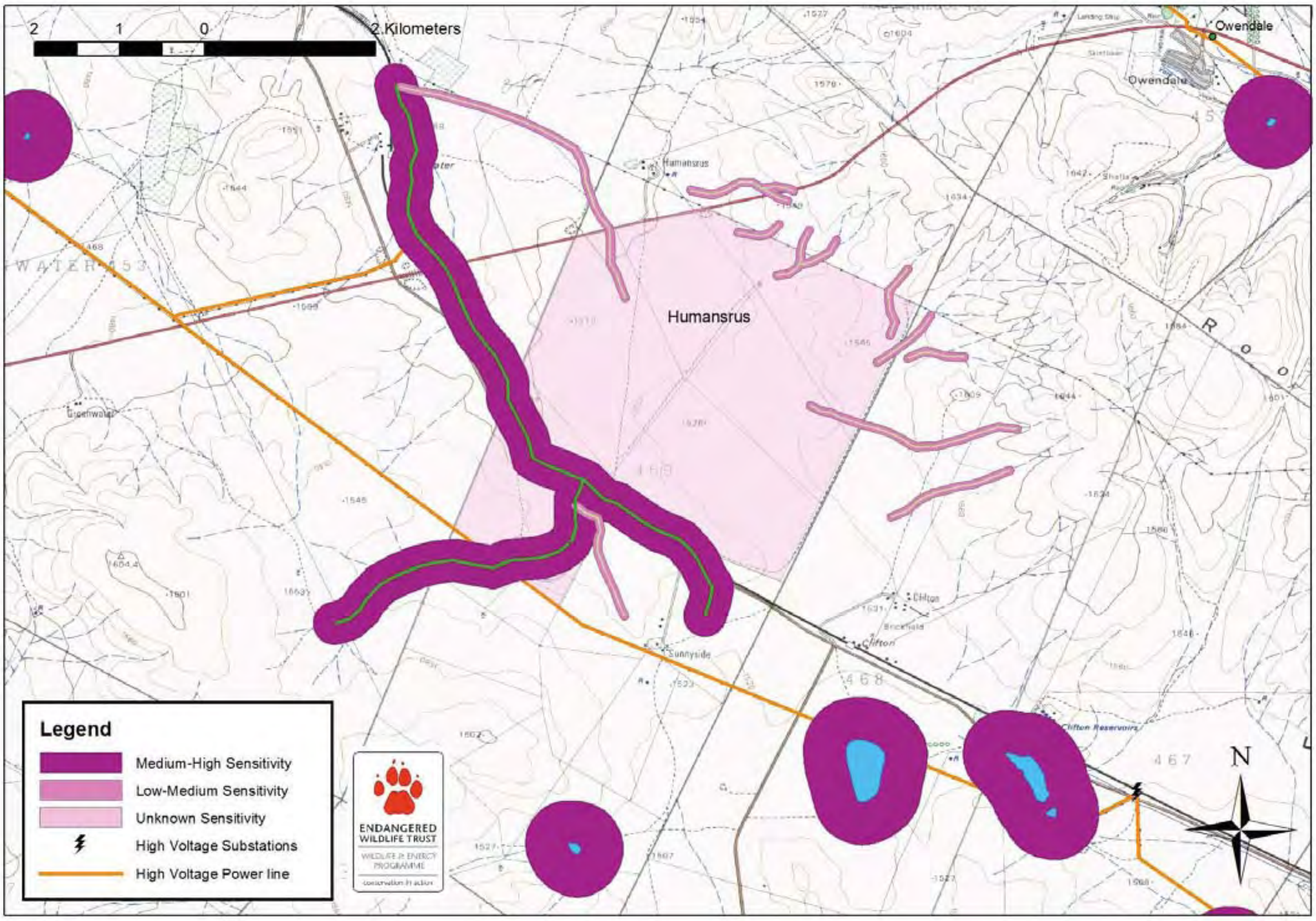


Figure 10: A map showing various avifaunal sensitivity zones within the proposed development site.

Medium-High sensitivity: These zones include 250m buffers around water bodies, such as dams and pans, as well as 100m buffer around a seasonal drainage line/wetland area, identified using GIS and confirmed during the site visit, to the south and west of the study site. No construction of CSP infrastructure in these areas (as indicated in the map above- Figure 26) should be permitted. However, upon consultation with EWT, construction of infrastructure may be possible, with caution, within certain areas of these zones. Should associated infrastructure, such as pipe-lines or power lines pass through these areas, mitigation as discussed elsewhere must be implemented. Importantly, should any over-head powerlines pass through these areas; they should be fitted with collision mitigation in the form of "bird flight diverters". The confidence with which these "Medium-High sensitive" areas were identified was moderate.

Medium- Low Sensitivity: These zones are likely to be of low sensitivity; however, in times of good rainfall, they may attract more birds and then can be regarded as having medium sensitivity. They

include 50m buffers around drainage line identified at a desk-top level, but were not apparent on the ground during the site visit. It is recommended, that where possible, infrastructure should avoid these areas.

Unknown Sensitivity: These are the remaining areas of the study site. These are designated "unknown" sensitivity for the following reasons: no obvious avifaunal features or patterns could be identified during the study; any of the identified focal species may at some point utilize or pass through these areas, and; the precautionary principle has been adopted. It is likely that the majority of these areas are *"Low"* sensitivity for birds. These unknown sensitivity areas are preferred for construction.

Conclusions and Mitigations

The site is in the arid Kalahari and Nama Karoo Biomes of the Northern Cape, with uniform vegetation of only two types (Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld) found on the study site. The uniformity of the site resulted in few microhabitats available for birds. There were no major water bodies or wetlands on site, with only one small dam and a narrow "vlei" area to the south west of the site. This area has been buffered and designated as medium-high sensitivity. The presence of three CWAC sites to the East of the study area, means that it is possible for waterfowl and other bird species associated with water, may be attracted to additional water sources (e.g. evaporation ponds) created by the CSP project. Of particular concern here is the Greater Flamingo. The level of confidence with which the various impacts are discussed is relatively low, primarily due to a lack of exposure to such projects within the South Africa. However, a prediction of the impacts of the proposed CSP plant on avifauna at Humansrus revealed the following key findings:

Impacts associated with CSP plant:

- Collision of birds with heliostats is likely to be of medium significance.
    - *Mitigation:* It is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Burning of birds in focal points will be of medium significance.
    - *Mitigation:* Again, it is unlikely that mitigation of this impact will be possible, but this will need to be confirmed once the plant is operational and some experience is gained.
- Habitat destruction and disturbance of bird will be of medium significance.

    - *Mitigation:* This can be mitigated by ensuring that the construction Environmental Management Plan incorporates guidelines as to how best to minimize this impact.

Impacts associated with new power lines:

- Collision of birds with overhead power lines is likely to be of medium significance.
    - *Mitigation:* This will be mitigated for by marking the relevant sections of line (i.e. those within the Medium-High Sensitivity zones, as depicted in figure 10 above) with appropriate marking devices. These sections of line, and the exact spans, will be finalised as part of the Environmental Management Programme (EMP) phase, once power-line routes are finalised and pylon positions are pegged.
- Electrocution of birds is likely to be of medium significance.
    - *Mitigation:* Any overhead power lines which are built within the site, and which are 132kV or lower, should use a "bird friendly" monopole structure, fitted with a bird perch, as per Eskom standard guidelines.

Impacts associated with new roads, pipe lines.

- Habitat destruction and disturbance of birds will be of medium significance.
    - *Mitigation:* This will be mitigated by ensuring that the construction EMP incorporates guidelines as to how best to minimize this impact.

A final recommendation is that a detailed monitoring protocol, for the operational phase of the project, be incorporated in to the final project EMP. The EWT should be consulted during the EMP phase, to assist in compiling such a monitoring program. The monitoring will involve regular inspections of the plant, to collect any bird carcasses. This will insure that any bird mortalities are recorded and reported, and may assist with the implementation of future, additional mitigation strategies.

Appendix 1

Significance Rating Methodology

Although specialists are given free reign on how they conducted their research and obtained information, they are requested to provide the reports in a specific layout and structure, so that a uniform specialist report volume can be produced. To ensure a direct comparison between various specialist studies, six standard rating scales are defined and used to assess and quantity the identified impacts. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on three criteria, namely:

- The relationship between impacts/issues and impact status (Box 1);
- The relationship between impacts/issues and spatial scale (Box 2);
- The relationship between impacts/issues and temporal scale (Box 3);
- The relationship between impacts/issues and probability (Box 4
- The relationship between impacts/issues and severity (Box 5);

These three criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment.	+
Neutral	No cost or benefit to the receiving environment.	N
Negative	A cost to the receiving environment.	-

Box 2: Spatial scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Box 3: Temporal scale of impacts

Rating	Description	Quantitative

		Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years.	1
Medium	Medium term; Reversible over time; 5 – 15 years.	2
High	Long term; Approximate lifespan of the project: 16 -30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Box 4: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Box 5: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction.	2
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value.	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be	4

Rating	Description	Quantitative Rating
	mitigated. For example, the permanent change to topography resulting from a quarry.	

Box 6: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	No Impact	Zero impact.	0
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	- 1 – 5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required.	- 6 – 11

	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	- 12 - 16

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Appendix G

Biodiversity Impact Assessment

Project code: SSI – HSP – 2012/01

Version 2011 11 02

Terrestrial Biodiversity Impact Assessment for the proposed Concentrated Solar Plant (CSP) on the Farm Humansrus 469, Northern Cape Province

compiled by

BEC

Bathusi Environmental Consulting

August 2011

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I PROJECT DETAILS

Client:	Worley Parsons RSA PTY (LTD) & SSI Engineers & Environmental Consultants
Report name:	Strategic Biodiversity Impact Assessment for the proposed Concentrated Solar Plant (CSP) on Farm Humansrus 469, Northern Cape Province.
Report type:	Biodiversity Impact Assessment Report
BEC Project number:	SSI - HSP – 2012/01
Authority Reference:	N/A
Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting

II RESERVED COPYRIGHT

III SPECIALIST INVESTIGATORS

The Natural Scientific Professions Act of 2003 aims to '*provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'.*

Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

Table 1: **Biodiversity Specialists for this project**

Floristic Investigator:	**Riaan Robbeson (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	*400005/03*
Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	*667.08/08*
Investigator:	**Dewald Kamffer (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions

Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*

IV DECLARATION OF INDEPENDENCE

All specialist investigators, project investigators and members of companies employed for conducting this biodiversity investigation declare that:

- We act as independent ecologists compiling this report
- We consider ourselves bound to the rules and ethics of the South African council for natural scientific professions;
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than financial compensation for work performed in a professional capacity in terms of the environmental impacts assessment regulations, 2005;
- We will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the general public;
- We do not have any influence over decisions made by the governing authorities;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the environmental impact assessment regulations, 2005;
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- We do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience; and
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.

____
Signature of principal ecologist:

Bathusi Environmental Consulting cc (CK1999/052182/23)
____
Name of company:

1st August 2011
____
Date:

V SURVEY DETAILS

Field surveys were conducted from the 30th May 2011 to the 3rd June 2011.

VI LEGISLATION

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(a) Details of (i) The person who prepared the report, and
(ii) The expertise of that person to carry our the specialist study or specialised process;

(b) A declaration that the person is independent in a form as may be specified by the competent authority;

(c) An indication of the scope of, and the purpose for which, the report was prepared;

(d) A description of the methodology adopted in preparing the report of carrying out the specialised process;

(e) A description of any assumptions made and any uncertainties or gaps in knowledge;

(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;

(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;

(h) A summary and copies of any comments that were received during any consultation process;

(i) Any other information requested by the competent authority.

Compliance with provincial, national and international legislative aspects is strongly advised during the planning, assessment, authorisation and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to, Table 2.

Table 2: **Legislative guidance for this project**	
Biodiversity Act (No. 10 of 2004)	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from

Table 2: **Legislative guidance for this project**

	bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
Conservation of Agricultural Resources Act 43 of 1983	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
Convention on International Trade in Endangered Species of Wild Life and Fauna	International agreement between governments, drafted because of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Environmental Conservation Act (No. 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
National Environmental Management Act (No. 107 of 1998)	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated and positive aspects enhanced.
National Environmental Management Act (No 10 of 2004)	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
National Forest Act, 1998 (No 84 of 1998)	Cutting, disturbing, damaging or destroying any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of the subsection published by the Minister in the Gazette. The sections include protected tree species, a particular tree, a group of trees or particular woodland to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire of dispose of any protected tree, except under a licence granted by the Minister.
Northern Cape Nature Conservation Act, No. 9 of 2009	Provides for the sustainable utilisation of wild animals, aquatic biota and plants, provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Amongst other regulations, the following may apply to the current project: • Boundary fences may not be altered in such a way as to prevent wild animals from freely moving into or off of a property; • Aquatic habitats may not be destroyed or damaged; and • The Act provides lists of protected species for the Province.
Protected Areas Act (No. 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

VII CONTENTS

VIII LIST OF TABLES

IX LIST OF FIGURES

1 EXECUTIVE SUMMARY

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, Solar Reserve is assessing the feasibility of constructing a Concentrated Solar Plant (CSP) with a maximum capacity of 100 MW. A technically feasible site was identified on the farm Humansrus 469, located approximately 4km southeast of Groenwater and 30km east of Postmasburg in the Northern Cape Province, comprising approximately 1,354ha, of which roughly 650ha will be utilized for the solar plant. Bathusi Environmental Consulting cc was appointed to conduct the relevant terrestrial biodiversity investigations. Riaan A. J. Robbeson (Pr.Sci.Nat.) conducted the floristic assessment while Dewald Kamffer (Pr.Sci.Nat) assessed the faunal components.

1.1 BIOPHYSICAL ATTRIBUTES

The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the southwestern part of the study area. In addition to the presence of these non-perennial streams, it appears as if wider floodplains are associated with many of the drainage lines in the region. No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

The general region comprises extensive untransformed habitat with limited areas characterised by agriculture and mining in particular. The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprises the Ib land type and is typically variable in relief and spatial heterogeneity, characterised by ridges and low mountains. The presence of these habitat types is important in terms of habitat variability and biodiversity attributes that characterise these parts. The Ae214, 215 and Ib237 land type units are present in the study area. Ae land types are typical of undulating plains and low-lying topography.

The geology of the area conforms to banded iron formations, with jaspilite, chert and riebeckite asbestos in the rocky/ stony parts of the study area. Low-lying sandy plains comprise red aeolian sand of Tertiary to Recent age with silcretre and calcrete. An informal/ small-scale, mine on the site excavates the semi-precious jaspilite.

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. The Kalahari savanna is a sandy, arid region in the western interior. Two regional vegetation types of the Kalahari savanna system are present within the study area, namely the Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld, Least Threatened) and Kalahari Mountain Bushveld (Kuruman Mountain Bushveld, Least Threatened).

1.2 FLORA

The SANBI database indicates the known presence of only 146 plant species within the ¼-degree grid (2823AD), which is regarded a poor reflection of the true floristic diversity of the regional vegetation that includes both grassland and savanna habitat types. Dwarf shrubs, shrubs and trees dominate the physiognomy in most areas, but open grassland plains are also present.

The site investigation revealed the presence of approximately 129 plant species on the site. Because of the winter survey period, this species composition is by no means regarded comprehensive. The savanna physiognomy of woodland and shrubland habitat of the site is indicated by the structural dominance of woody species. A diverse composition of grasses and forbs was noted in the grassland habitat types. A total of 41 plant families are represented by the floristic diversity of the site, dominated by Poaceae.

No Threatened plant species are known to occur in this particular ¼-degree grid, but four protected tree species are known to occur in the region, three of which was confirmed on the study area. Application for permits for the removal/ damage/ cutting or pruning of protected tree species as per National Forest Act, 1998 (No 84 of 1998) need to be submitted to the relevant authority prior to the commencement of construction activities. These species include:

Acacia erioloba	Less than 20
Boscia albitrunca	Single individual observed
Olea europaea subsp. *africana*	Many (>300)

Results of the photo analysis and site investigations revealed the presence of the following habitat types (with estimated floristic sensitivities):

- Closed Shrubveld (Medium-high floristic sensitivity);
- Drainage Line (High floristic sensitivity);
- Excavations (Low floristic sensitivity);
- Floodplains (High floristic sensitivity);
- Grassland Plains (Medium floristic sensitivity);
- Homestead (Low floristic sensitivity);
- Olea europaea Woodland (High floristic sensitivity); and
- Open Shrubveld (High floristic sensitivity).

The vegetation of the study area is largely representative of the regional vegetation types. The interplay between rocky areas and low-lying grasslands with intermittent drainage lines is typical of the region, resulting in clearly defined communities. Although not unique, slight variations do occur, which become important on a local scale, such as the Olea Woodland and localised rock sheets in the Floodplain habitat type. Olea woodland variations occur in small patches in the larger region, but it is by no means a frequent occurrence. The driving

force behind the development of this unit is thought to be anthropogenic in nature, fire frequency and intensity in particular that affected the occurrence of other woody species adversely while favouring *Olea europaea*. Rock sheets associated with shallow gravely soils in the close vicinity of drainage lines and floodplains are important in terms of the occurrence of succulent species.

Remaining parts of the study area is characterised by open shrubveld to the west, closed shrubveld to the east, as well as drainage lines with associated floodplains and grassland plains. These habitat types are well defined and clear boundaries exist, mostly driven by the presence/ absence of rocky/ stony soils and slopes. Grazing practices have resulted in slight deterioration of the status of particularly the grassland areas, resulting in the influx of low shrub species.

A large part of the study area comprises floristic habitat of medium sensitivity. The loss of these areas is not expected to result in severe impacts on the floristic environment when considered on a regional scale. However, it should be noted that the proposed footprint for the development is situated in close vicinity to floristic habitat types of high sensitivity, including the Drainage line, Floodplains and Olea Woodland habitat types. Impacts within these areas are therefore likely to occur unless strict mitigation measures are implemented.

The proposed footprint is indicated to exclude most of the sensitive habitat types. The close vicinity of these areas to the proposed development is an aspect that should receive attention during the EMP phase of the project where protection and conservation measures are developed to provide for protection of sensitive areas.

1.3 FAUNA

Please note that the avifaunal component was excluded from this assessment, as it will form the subject of a separate investigation.

Animals known to be present in the Q-grid of the study area were considered potential inhabitants of the study area (all species known from the Northern Cape Province were included to minimize the effect of sampling bias). The presence of 41 animal species was confirmed during the site investigation (Table 23), by means of visual sightings, tracts, faecal droppings, burrows, characteristic behaviour patterns as well as confirmation obtained from the landowner. Signs of, or individuals of, four butterflies, 10 reptiles and 25 mammals were confirmed for the study area. This includes the Red Data mammals South African Hedgehog (*Atelerix frontalis,* NT), Lesser Dwarf Shrew (*Suncus varilla,* DD) and Brown Hyaena (*Hyaena brunnea,* NT).

The forty-one animals confirmed to occur in the study area are regarded typical of an area the size of the study site in the Eastern Kalahari Bioregion, given the mixture of habitat types present in the study area. It must be noted that a study conducted during the raining

period (i.e. in the warm, wet season) would likely reveal other species that are unlikely to be found during the cold, dry season (migrant birds, summer-active invertebrates, amphibians and reptiles etc.); it might even include additional red data species.

Fifty-six Red Data animals are known to occur in the Northern Cape Province (mammals, reptiles, amphibians and invertebrates); 41 have a low probability of occurring in the study area, 10 have a moderate probability and two species have a high probability of occurring, namely *Tatera leucogaster* (Bushveld Gerbil, DD) and *Manis temminckii* (Pangolin, VU). Three species, *Mellivora capensis* (red), *Atelerix frontalis* (NT), *Suncus varilla* (DD) and *Hyaena brunnea* (NT) were confirmed for the study area.

Floristic habitat types are considered representative of faunal habitat types; the following sensitivities were ascribed:

- Closed Shrubveld (Medium-high faunal sensitivity);
- Drainage Line (High faunal sensitivity);
- Excavations (Low faunal sensitivity);
- Floodplains (High faunal sensitivity);
- Grassland Plains (Medium faunal sensitivity);
- Homestead (Low faunal sensitivity);
- Olea europaea Woodland (High faunal sensitivity); and
- Open Shrubveld (High faunal sensitivity).

Areas that have limited distribution within the larger region, as well as areas where unique biophysical attributes occur are regarded sensitive and should preferably be excluded from the proposed development, particularly all habitat types that have an aquatic origin. Sensitive habitat types include the Drainage line, Floodplains and Olea Woodland. When the proposed footprint for the development is evaluated, it is clear that only 12.1 ha (1.86%) of the proposed area comprises habitat of high faunal sensitivity (mainly Olea Woodland, 11.2 ha). This habitat type is limited in nature and is only infrequently represented in the region. The loss of this habitat, when considered on a regional scale is regarded to be of medium importance and while it is not regarded a red flag for the proposed development, the conservation of remaining habitat located immediately outside the proposed footprint should be ensured.

A total of 629.4 ha (97.3%) of the proposed footprint area comprises habitat of medium faunal sensitivity, including the Grassland Plains and Open Shrubveld habitat. An important aspect is the loss of migration potential in an east-west direction for animals that utilises the grassland and low shrubveld habitat. It is however conceivable that animals will adapt and utilise other available migration routes, particularly to the north of the site. The general region comprises extensive areas of similar habitat and this proposed development is not regarded to contribute significantly to habitat fragmentation and isolation on a regional scale. The loss of these habitat types is regarded to be of medium importance, particularly because of the extensive size of the proposed development.

The significance of impacts across the entire site is regarded to be of moderate significance. However, on closer inspection it is clear that certain impacts, particularly those of a direct nature, are expected to result in significant impacts in parts of the study area. Of particular importance is the significance of impacts on Red Data animals. Some species are unable to evacuate the area with disturbance and will likely be destroyed. The only sensible mitigation measure will be to remove these animals by means of an intensive search and rescue operation. The destruction of extensive areas on the property is also expected to result in significant impacts on fauna species present on the neighbouring areas that utilise this area on an infrequent basis.

Closed Shrubveld Habitat Type Impacts within this habitat type are regarded significant on a local scale; excluding this area from the development, as far as technically feasible, is recommended. It is indicated that a small portion of this habitat type will be affected. The loss of a small portion of this habitat type is not expected to result in significant impacts on a regional scale since this vegetation type is well represented to the north of this particular site, with a Least Threatened conservation status afforded by VEGMAP. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Drainage Line Habitat Type Any impact within this habitat type will be regarded as significant. Although the proposed footprint does not include any part of this drainage line, the proximity of the drainage line to the development area will require strict management and development measures to prevent impacts to this area. Drainage of water from the development area towards this habitat will result in deterioration of the status on the site as well as in wetland habitat further downstream. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Floodplains Habitat Type Any impact within this habitat type will be significant, excluding this area from the development represents the major mitigation measure. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint, but the proximity of these areas to the footprint will highly likely result in peripheral impacts affecting this area adversely. It should also be noted that this habitat type buffers the drainage line from the proposed development, keeping this buffer intact is therefore important in terms of preserving the drainage line. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Grassland Plains Habitat Type Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Olea Woodland Habitat Type A portion of this habitat type will be affected by the proposed development, the presence of protected tree species represents an important consideration. While the presence of these individuals does not represent a red flag to the development, careful planning and execution of development plans must be made to avoid impacts in adjacent parts of this habitat type. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Open Shrubveld Habitat Type Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

The major objectives of this Biodiversity Impact Assessment are to establish the presence/absence of ecologically sensitive areas or species within the proposed project area, briefly assess the potential impacts of the proposed development on the natural environment, provide pertinent comments on the suitability of the area for the proposed project and to make pertinent development recommendations based on results of the field assessments and available desktop knowledge.

The Terms of Reference for the floristic assessment are as follows:

- Obtain all relevant Précis and Red Data flora information;
- Conduct a photo analysis of the proposed area;
- Identify preliminary floristic variations;
- Survey preliminary habitat types to obtain a broad understanding of the floristic diversity;
- Assess the potential presence of Red List flora species according to information obtained from SANBI;
- Incorporate existing knowledge of the region into the assessment;
- Describe broad habitat variations present in the study area in terms of biophysical attributes and phytosociological characteristics;
- Compile a floristic sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects;
- Provide pertinent recommendations; and
- Present all results in a suitable format.

The Terms of Reference for the faunal assessment are as follows:

- Obtain available faunal distribution records and Red Data faunal information
- Survey the site to obtain a broad overview of available faunal habitat types;
- Assess the potential presence of Red Data fauna species;
- Incorporate existing knowledge of the region;
- Describe the status of available habitat in terms of faunal attributes, preferences and conservation potential;
- Compile a faunal sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects; and
- Present all results in a suitable format.

3 INTRODUCTION

Destructive activities in a natural environment require vigilance to ensure that the biological and cultural heritage of future generations is not adversely affected by activities of today. Concern is growing about the consequences of biodiversity losses, for ecosystem functioning, for the provision of ecosystem services and for human well being.

Why is Biodiversity Conservation Important? Biodiversity sustains life on earth. An estimated 40 percent of the global economy is based on biological products and processes. Biodiversity has allowed massive increases in the production of food and other natural materials, which in turn have fed the (uncontrolled) growth and development of human societies. Biodiversity is also the basis of innumerable environmental services that keep humans and the natural environment alive, from the provision of clean water and watershed services to the recycling of nutrients and pollination.

Current pressures on and losses of biodiversity are unfortunately threatening to undermine the functionality of natural ecological processes and adaptive responses of the environment. The last few centuries have witnessed brutal increases in the rate at which biodiversity is being altered by humanity. With uncontrolled growth of human population, consumption needs have increased exponentially as well as the drive to extract more economically valuable resources at ever-faster rates. Natural habitats that harbour some of the world's most valuable biodiversity are being lost at increasingly faster and over progressively wider areas, while managed lands are undergoing increasing simplification. Adopting 'biodiversity friendly' practices remains challenging within the entire developmental sphere, especially for smaller companies and peripheral players. This is partly because governments, while perhaps committed on paper to biodiversity, have found it difficult to create the right incentives and apply the necessary regulations in a way that could encourage all players to conserve biodiversity.

Humanity faces the challenge of supporting the needs of growing populations from a rapidly shrinking natural resource base. Achieving a balance while doing this will require a better understanding and recognition of conservation and development imperatives and this is only a step towards more strategic and integrated approach to land use planning and management that helps societies make better-informed decisions. Evidence illustrate how management tools, rehabilitation and restoration processes, together with improved scientific knowledge, can help conserve biodiversity; also highlighting that mutual benefits can result from stronger collaboration between the mining and conservation sectors. Good practice, collaboration and innovative thinking can advance biodiversity conservation worldwide while ensuring that the minerals and products that society needs are produced responsibly.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. The enactment of the National

Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

Savannah Environmental has appointed by Momentous Energy as an independent Environmental Assessment Practitioner (EAP), to undertake the necessary environmental studies to identify and assess all potential environmental impacts associated with the proposed project. Bathusi Environmental Consultants (BEC) has been appointed as independent ecological specialists to conduct a strategic biodiversity impact evaluation of the biological environment that will be affected by this proposed development. Dewald Kamffer (FSI) conducted the faunal assessment; Riaan Robbeson (BEC) conducted the floristic assessment, provided the ecological interpretation and compiled the ecological sensitivity analysis.

4 LIMITATIONS OF THIS INVESTIGATION

Although care was taken to ensure the proper investigation the study area, it is only reasonable to expect that not all areas could be investigated in detail and not all species could be located or identified during a single survey that was conducted during the winter period. Because rare and endemic species normally do not occur in great densities and because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible and results are ultimately based on estimations and specialist interpretation of limited data.

Results presented in this report are based on a snapshot investigation of the study area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the study area. No concrete conclusions may therefore be drawn concerning biological diversity or conservation strategies as far as this study area is concerned.

It is emphasised that information, as presented in this document, only have bearing on the site as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

5 PROJECT BACKGROUND

Solar energy use currently contributes a very small portion of the total energy supply in the Northern Cape Province. Approximately 0.2% of households use it for cooking, and 0.15% uses it for heating, but the Northern Cape has the highest solar energy use for lighting (1%) when compared to other provinces. In particular, the area of the Northern Cape bordering Namibia has the highest solar radiation intensity in southern Africa, and there is a national drive to increase the use of solar energy technologies (SoER, 2004).

Solar Reserve SA is planning a Concentrated Solar Power (CSP) plant on the Farm 469, Hay RD (Humansrus), situated approximately 4 km southeast of Groenwater and 30 km east of Postmasburg, in the Northern Cape, Kheis Local Municipality. Beal Environmental Consulting was appointed as independent environmental consultants to conduct the Environmental Impact Assessment (EIA) process for the proposed development. WPRSA / SSI were appointed as independent consultants to carry out the Public Participation process.

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW in the Northern Cape. This CSP plant will comprise of four main subsystems, namely:

- **Solar Field –** the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- **Molten Salt Circuit** which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- The **Power Block**; and
- **Auxiliary facilities and infrastructure** which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Bathusi Environmental Consulting cc was appointed to conduct the relevant terrestrial biodiversity investigations. Riaan A. J. Robbeson (Pr.Sci.Nat.) conducted the floristic assessment while Dewald Kamffer (Pr.Sci.Nat) assessed the faunal components.

6 APPROACH TO THIS ASSESSMENT

While a proper knowledge of the biodiversity of the region is not negotiable to the ultimate success of this project, an attempt was made to remove any subjective opinions that might be held on any part of the study area as far as possible. Inherent characteristics of a project of this nature implies that no method will be foolproof, mainly as a result of shortcomings in available databases and lack of site specific detail that could be obtained from limited detailed site investigations conducted over a short period of time. It is an

unfortunate fact that inherent sensitivities within certain areas are likely to exist that could not be captured or illustrated during the process. This is a limitation of every scientific study; it simply is not possible to know everything or to consider aspects to a level of molecular detail. However, the approach followed in this study is considered effective in presenting objective comments on the comparison of biodiversity sensitivity of parts in the study area.

In order to present an objective opinion of the biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of any area within the site in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects, namely:

- A desk-top assessment of all available biological and biophysical data;
- Augmentation of existing knowledge by means of site specific and detailed field surveys;
- Specialist interpretation of available data, or known sensitivities of certain regional attributes; and
- An objective impact assessment, estimating potential impacts on biological and biophysical attributes.

6.1 Background Information

The overall goal of this section of the biodiversity investigation is to establish a reference point for the biophysical and biological sensitivities of the study area by means of the Ecosystem Approach or Landscape Ecology. The Ecosystem Approach is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

For the purpose of this particular study, a local scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of

biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. In non-professionals' terms, it implies that if sensitive habitat types/ ecosystems (frequently associated with biodiversity elements of high sensitivity or conservation importance) are protected, species that are highly sensitive to changes in the environment will ultimately be protected. Species conservation is therefore largely replaced by the concept of habitat conservation. This approach is regarded effective since the protection of sensitive ecosystems will ultimately filter down to species level.

It is inevitable that the Landscape Ecology Approach will not function effectively in all cases since extremely localised and small areas of sensitivity do occur scattered in the study area, which cannot always be captured on available databases or might have been missed during the site investigations. In addition to the compilation of basic species lists and the identification and description of localised ecological habitat, it was also regarded important to identify areas of sensitivity on a local scale and, where possible, communities or species that are considered sensitive to influences arising from the proposed development.

This investigation therefore aims to:

- Determine the biological sensitivity of the receiving natural environment as it relates to the construction and operation of the plant and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity;
- Highlight flora and fauna species of conservation importance that are likely to occur within the study area;
- Estimate the level of potential impacts of the construction and operation of proposed power lines on the biological resources of the study area;
- Apply the Precautionary Principal throughout the assessment[1].

Available databases of biophysical attributes are implemented to identify regional areas of importance as it relates to biodiversity. Biophysical attributes that are known to be associated with biodiversity aspects of importance, conservation potential or natural status of the environment were implemented to compile the ecological sensitivity analysis of the study area. These attributes include the following:

- Areas of known biological importance (ENPAT);
- Geology and soil types;
- Areas of surface water (ENPAT);
- Degradation classes (ENPAT Land Cover Classes);
- Regional vegetation types (VEGMAP);
- Land cover categories (ENPAT);
- Regional conservation plans (where available); and
- Ridges and outcrops.

[1] (www.pprinciple.net/the_precautionary_principle.html).

6.2 FLORISTIC ASSESSMENT

The floristic assessment was conducted by R. A. J. Robbeson (Pr.Sci.Nat.).

6.2.1 *General Floristic Attributes*

The vegetation investigation is based on a variation of the Braun-Blanquet method whereby vegetation is stratified on aerial images with physiognomic[2] characteristics as a first approximation. These initial stratifications are then surveyed for floristic and environmental diversity during a site investigation and ultimately subjected to a desktop analysis to establish differences/ similarities between observed units.

In preparation for the site survey, physiognomic homogenous units are identified and delineated on digital aerial photos, using standard aerial photo techniques (downloaded from www.googleearth.com and georectified on Arcview 3.2). A site visit was conducted to examine the general floristic attributes and -diversity of the study area. Because of the seasonality of the surveys, only qualitative observations were made at sample points with limited floristic diversity noted.

A desktop analysis of sample data was conducted to establish differences/ similarities between delineated vegetation units, which were subsequently described in terms of species composition and dominance as well as driving (developmental) environmental parameters. Preliminary results and species lists that are provided should be interpreted with normal liabilities in mind.

It is not the intention to provide exhaustive and comprehensive lists of all species that occur on this site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation worthy species and habitat associated with these species are considered the highest priority, the presence of which is most likely to result in significant negative effects on the ecological environment.

6.2.2 *Red Data Flora*

The purpose of listing Red Data plant species is firstly to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Secondly, the potential occurrence of these species can then be assessed in terms of their habitat requirements in order to determine whether they have a likelihood of occurring in habitats that may be affected by the proposed infrastructure. Red Listed flora information, as presented by SANBI was used as a point of departure for

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[2] Physiognomy refers to the visual appearance of vegetation in terms of different growth classes, biomass, height, etc.

this assessment. A snapshot investigation of an area, such as this particular investigation, represents a severe limitation in terms of locating and identification potential Red Listed flora species. Particular emphasis was therefore placed on the identification and assessment of habitat deemed suitable for the potential presence of Red Listed.

It should be noted that Red List species are, by nature, usually rare and difficult to locate. Compiling a list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. Notwithstanding the application of the Precautionary Principle, there is always the likelihood that a species that is not included in a list might be unexpectedly present in an area.

Furthermore, regulations in terms of the National Forest Act provide a list of protected tree species for South Africa. The most important legislation is the following: *National Environmental Management: Biodiversity Act (act No 10 of 2004).*

6.2.3 Floristic Sensitivity

The aim of this exercise is to determine the inherent sensitivity of vegetation communities or habitat types by means of the comparison of weighted floristic attributes. Results of this exercise are not 'stand-alone' and will eventually be presented in conjunction with results obtained from the faunal investigation.

Each vegetation unit is subjectively rated on a scale of 1 to 10 (**Sensitivity Values**) in terms of the influence that the particular Sensitivity Criterion has on the floristic status of the plant community. Separate Values are multiplied with the specific Criteria Weighting, which emphasises the importance/ triviality that the individual Sensitivity Criteria have on the status of each community. **Ranked Values** are then added and expressed as a percentage of the maximum possible value (**Floristic Sensitivity Value**) and placed in a particular class, namely:

High	80% – 100%
Medium – high	60% – 80%
Medium	40% – 60%
Medium – low	20% – 40%
Low	0% – 20%

This method is considered effective in highlighting sensitive areas, based on observed floristic attributes rated across the spectrum of communities. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics, e.g. human impacts, size, fragmentation are important in assessing the status of the various communities.

High Sensitivity Index Values indicate areas that are considered pristine, unaffected by human influences or generally managed in an ecological effective manner. These areas are comparable to nature reserves and even well managed farm areas. Low Sensitivity Index Values indicate areas of lower ecological status or importance in terms of vegetation attributes, or areas that have been negatively affected by human impacts or poor management. Sensitivity Criteria employed in assessing the floristic sensitivity of separate units may vary between different areas, depending on location, type of habitat, size, etc.

6.3 Faunal Assessment

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.). This faunal assessment included qualitative surveys across major habitat types observed in the study area.

6.3.1 *Data analysis*

- All GPS acquired data is converted from text to shapefiles to allow GIS analyses.
- Shapefiles of environmental attributes such as geology, soil, hydrology and vegetation are incorporated in the analyses of available faunal habitats.
- Sensitivity maps are compiled, where relevant, subsequent to data analyses.
- Species lists are compiled for relevant taxa using fieldwork data, literature and data supplied by various other institutions and specialists.

6.3.2 *Red Listed fauna Probabilities*

Three parameters are used to assess the Probability of Occurrence of each Red Listed species:

- Habitat requirements (HR) - Red Listed animals have specific habitat requirements and the presence of these habitat characteristics in the study area is evaluated.
- Habitat status (HS) - The status or ecological condition of available habitat in the study area is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Listed species (especially wetland-related habitats where water quality plays a major role); and
- Habitat linkage (HL) - Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Listed species within the study area.

6.3.3 *Ecological Function*

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity or with

extensive grassland and drainage systems amongst one another are perceived to be more sensitive and will be those contributing to important faunal assemblages or overall preservation of faunal diversity.

The estimated Probability of Occurrence for Red Data fauna species is presented in five categories, namely:

- Very low;
- Low;
- Moderate;
- High; and
- Very high.

6.3.4 *Faunal Habitat Sensitivities*

Faunal habitat sensitivities are subjectively estimated based on the following criteria:

- Habitat status;
- Connectivity;
- Observed species composition & RD Probabilities; and
- Functionality.

and is place in one of the following classes:

- High;
- Medium-high
- Medium;
- Medium-low; or
- Low.

6.4 IMPACT EVALUATION

6.4.1 *Status of the Impact*

The impacts are assessed as either having a:

- Negative effect (i.e. at a cost to the environment);
- Positive effect (i.e. at a benefit to the environment); or
- Neutral effect on the environment.

6.4.2 *Spatial Scale of the Impact*

The spatial scale of the impact was assessed according to the following criteria:

(0) None - no impact;
(1) Low - site specific, within the boundaries of the site;
(2) Medium – local, extending beyond the boundaries of the site, (i.e. up to 5km);
(3) High – Regional, extends far beyond the site boundaries (i.e. >5km); or

(4) Very high – National and/ or international.

6.4.3 Temporal Scale of Impacts

The lifespan of the impact was assessed to be either:

(0) None – no impact

(1) Low – short term, quickly reversible (0 – 5 years);

(2) Medium - medium term, reversible over time (5 – 15 years);

(3) High - long term, approximate life span of project (16 - 30 years); or

(4) Very high – permanent, over 30 years, resulting in permanent and lasting changes.

6.4.4 Probability of Occurrence

The likelihood of the impact actually occurring was indicated as either:

(0) No impact;

(1) Improbable - possibility of the impact materializing is negligible (<10%);

(2) Probable – possibility that impact will materialise is likely, (10 – 49%);

(3) Highly probable - expected that impact will occur, (50 – 90%); or

(4) Definite - the impact will occur regardless of any prevention measures (>90%).

6.4.5 Severity of Impacts

The magnitude or severity of the impacts is indicated as either:

(0) None - Small (where the aspect will have no impact on the environment);

(1) Negligible/ minor – Systems are marginally affected by proposed development;

(2) Average - Medium or short-term impacts on the affected system. Mitigation is easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction;

(3) Severe - Medium to long term impacts on the affected system that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value; or

(4) Very Severe - An irreversible and permanent change to the affected system that cannot be mitigated. For example, the permanent change to topography resulting from a quarry.

6.4.6 Accumulative Impact

The impact of the development is considered together with additional developments of the same or similar nature and magnitude. The combined impacts may be:

- Negligible – i.e. the net effect is the same as the single development;
- Marginal – i.e. the impact of two developments of a similar nature is less than twice the impact of a single development; or
- Compounding – i.e. the impact of two developments is more than twice the impact of two single - developments.

6.4.7 Significance of the Impact

Based on a synthesis of the information contained in the points above, the potential impacts were assigned a significance weighting, which is formulated by adding the sum of the numbers assigned to Spatial Scale, Temporal Scale, Probability of Impacts and Severity of Impacts.

- None: 0 (There is no impact);
- Low: 1 - 5 (Impact is of a low order, mitigation measures are easy, inexpensive and simple);
- Medium: 6 - 11 (Impact is real, but not substantial, mitigation measures are costly);
- High: 12 - 16 (Impact is substantial and will occur even with the application of costly and complicated mitigation measures)

7 THE BIOPHYSICAL ENVIRONMENT

7.1 LOCATION

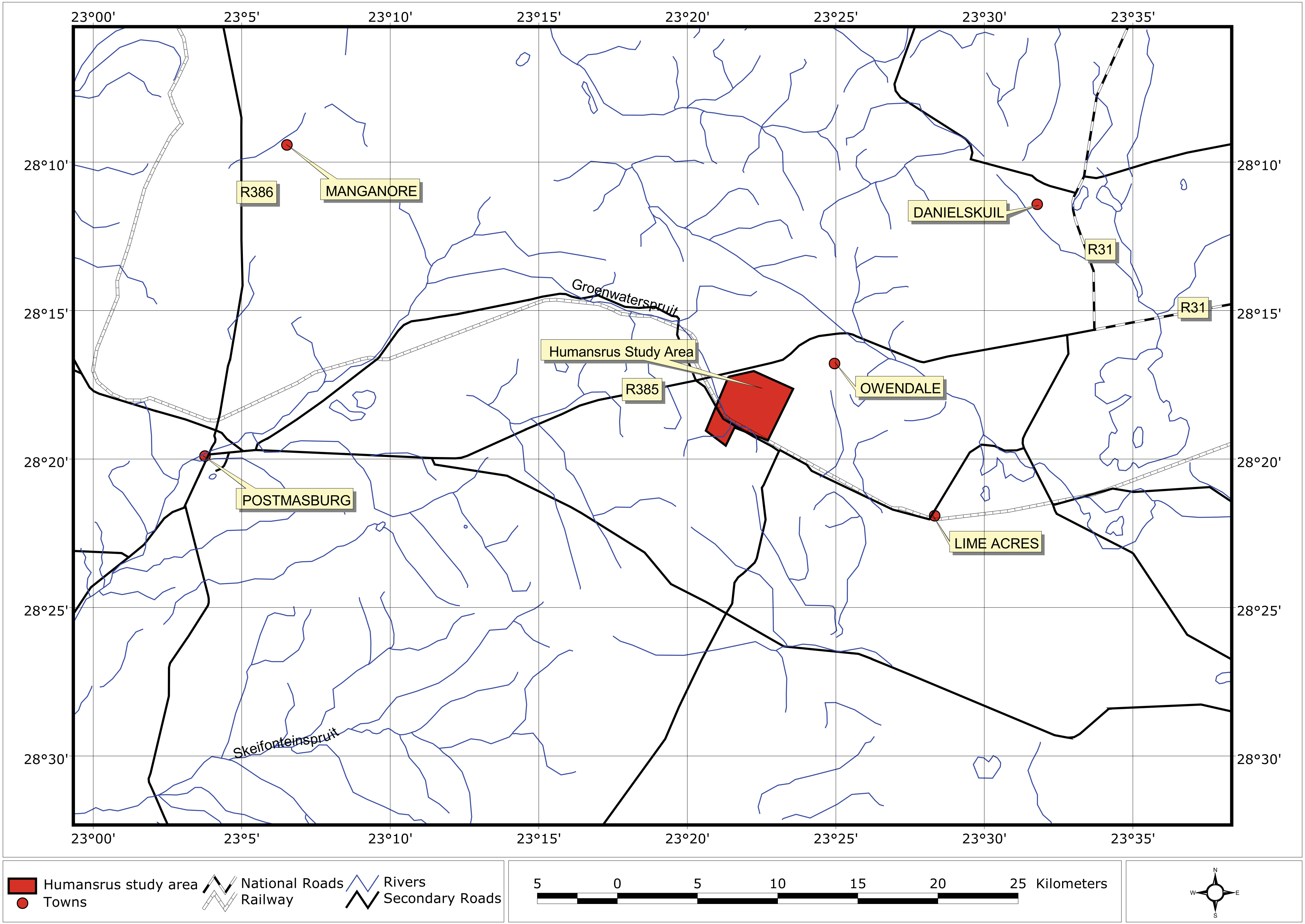
The regional setting of the proposed site is indicated in Figure 1, with georeferenced Google Earth images presented in Figure 2, downloaded from the Google Earth website and
This site is situated approximately 4km southeast of Groenwater and 30km east of Postmasburg, in the Northern Cape and falls within the jurisdiction of the Kheis Local Municipality. Existing overhead powerlines is situated on the northern and southern boundary of the farm and will be utilised to evacuated electricity into the grid.

7.2 SURFACE WATER

The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the southwestern part of the study area (Figure 2). In addition to the presence of these non-perennial streams, it would appear as if wider floodplains are associated with the drainage lines. The region is generally classified as relative dry and the ecological functionality of these areas would therefore be important on a local and regional scale on a temporary basis. The northern part of the study area is characterised by mountainous terrain and seasonal flow from these areas created floodplains at the foothills of the mountains. These areas are mostly characterised by wide, flat and sandy beds.

No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

Figure 1: Regional setting of the study area



23°00'
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MANGANORE
R386
DANIELSKUIL
R31
R31
Groenwaterspruit
Humansrus Study Area
R385
OWENDALE
POSTMASBURG
LIME ACRES
Skeifonteinspruit
Humansrus study area
Towns
National Roads
Railway
Rivers
Secondary Roads
5 0 5 10 15 20 25 Kilometers
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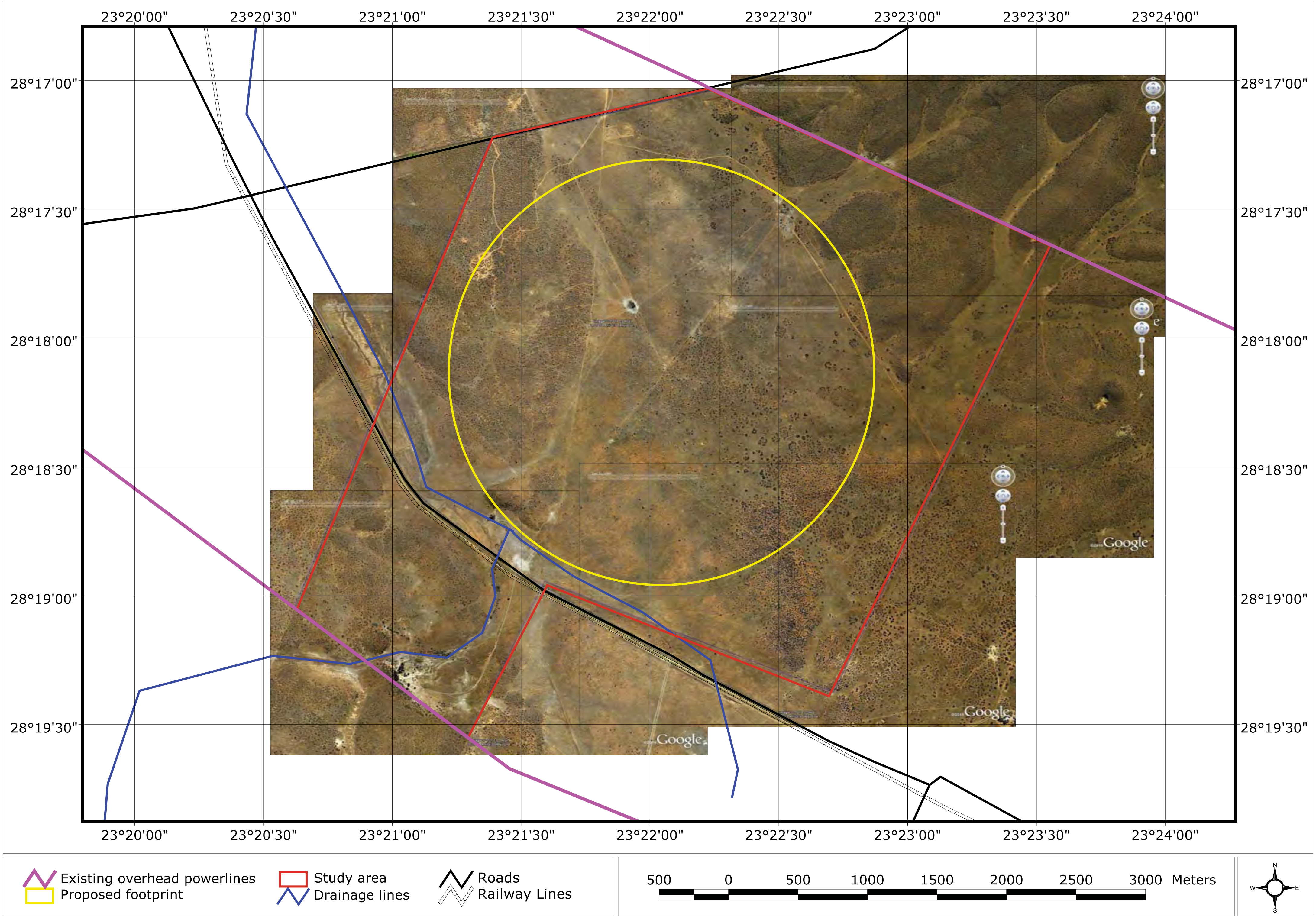
Figure 2: Google Earth image of the general region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Google
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Proposed footprint
Study area
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Railway Lines
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7.3 LAND COVER & LAND USE OF THE REGION

Land use often determines land cover; it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land. Most of the Province is dominated by vast open areas of natural vegetation; 69.7% of the total area is covered by shrubland and low fynbos. A further 14.2% of the Northern Cape is dominated by thicket vegetation and bushland. A total of 0.7% of the Province is classified as degraded whilst 0.2% has dongas and sheet erosion. Urbanisation in the Province is relatively low at 0.1% (SoER, 2004).

Land cover categories of the general region are presented in Figure 3. For the purpose of this assessment, land cover are loosely categorised into classes that represent natural habitat and land cover categories that resulted from habitat degradation and transformation on a local or regional scale. Areas that are characterised by high levels of transformation and habitat degradation is generally more suitable for development purposes as it is unlikely that biodiversity attributes of importance will be present or affected by development. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes.

The region of the study area comprises extensive untransformed habitat with limited areas characterised by development, agriculture, mining and other forms of habitat transformation. One of the shortfalls of the ENPAT database is that it does not reflect the status of natural habitat within the study area.

7.4 TOPOGRAPHY, RELIEF AND SLOPES

The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprising the Ib land type, is likely to be variable in relief and spatial heterogeneity. The presence of these habitat types is important in terms of habitat variability and ultimately biodiversity attributes that characterise these parts. Hills and ridges have generally been shown to have a rich biodiversity consisting of an important habitat for sensitive species as well as high plant diversity.

Topographical categories are presented in Figure 4.

Figure 3: Land Cover of the general region

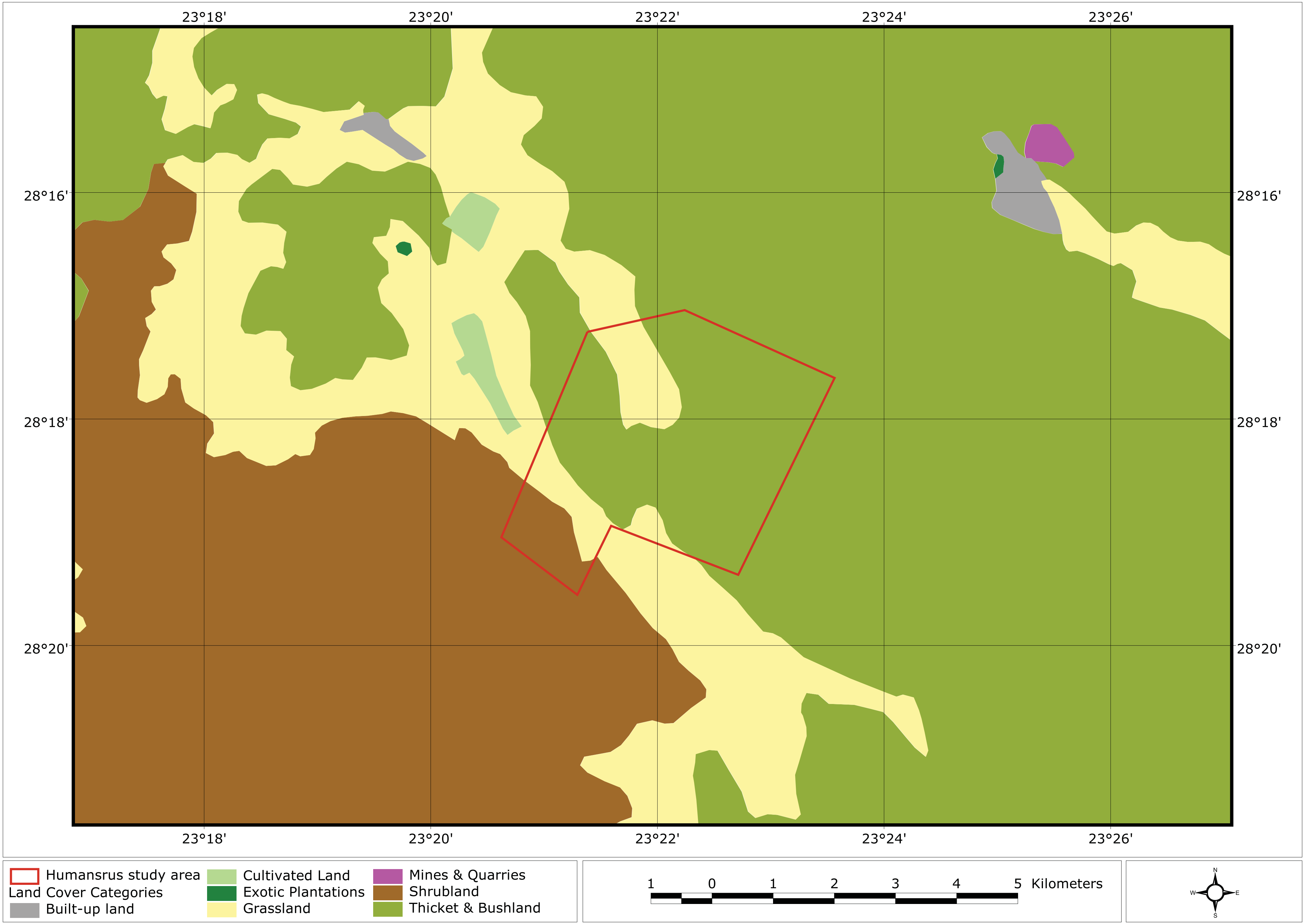
23°18'
23°20'
23°22'
23°24'
23°26'
28°16'
28°18'
28°20'
Humansrus study area
Land Cover Categories
Built-up land
Cultivated Land
Exotic Plantations
Grassland
Mines & Quarries
Shrubland
Thicket & Bushland
1 0 1 2 3 4 5 Kilometers
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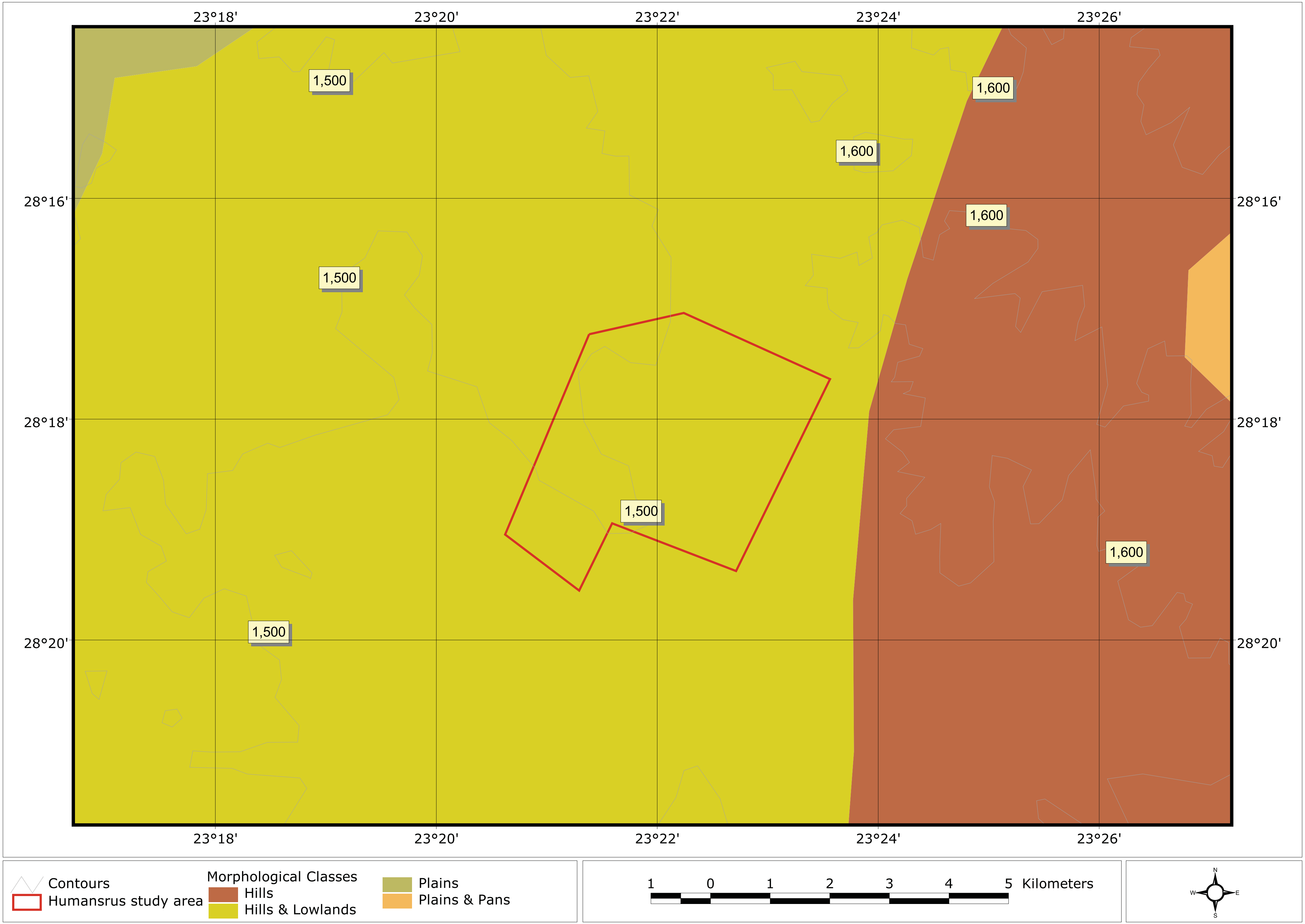
Figure 4: Topographical categories of the general region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1,600
1,600
Contours
Humansrus study area
Morphological Classes
Hills
Hills & Lowlands
Plains
Plains & Pans
1 0 1 2 3 4 5 Kilometers
N
S
E
W

7.5 DECLARED AREAS OF CONSERVATION

No declared area of conservation is present within the general surrounds of the study area. The study area does however fall within the Griqualand West Centre of Endemism.

7.5.1 *Griqualand West Centre of Endemism*

This area is named after Griqualand West, the region comprising the Hay District and parts of the Barkley West District in the Northern Cape Province. The region was so called because of the Griqua, a KhoeKhoe people, who lived there.

The mountainous western parts of the WC are covered by Kalahari Mountain Bushveld, and the eastern plateau area is covered by Kalahari Plateau Bushveld, both endemic to the centre (Low & Rebelo, 1996). *Tarchonanthus camphoratus* is a particularly common woody species in these two bushveld types. Typical mountain species include *Searsia tridactyla, Croton gratissimus* and *Buddleja saligna.* Pockets of Karoo-type vegetation increase towards the south and west, especially in overgrazed areas. Succulents of the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae are well represented in the centre.

The proximity of the GWC is signified by the pockets and tongues of wind-blown, orange-red Kalahari sand that have accumulated in some of the intermontane valleys. The vegetation of the GWC is still fairly intact, although extremely poorly conserved. Apparently, the Kalahari Plateau Bushveld is the only Savanna Biome vegetation type that is not represented in any sizeable nature reserve (Van Rooyen & Bredenkamp, 1996b). Bush encroachment, which is due to inappropriate management practices (mainly overgrazing by domestic livestock), is a major problem in many parts of the region.

Vascular Plants:

• Total number of species/ infraspecific taxa	± 1,800
• Endemic/ near endemic families	0
• Endemic/ near endemic genera	0
• Endemic/ near endemic species/ infraspecific taxa	>40 (2.2%)
• Percentage succulents among endemics	32.5%

Representative endemic/ near endemic succulents include:

- *Aizoon asbestinum;*
- *Euphorbia bergii*
- *Euphorbia inornata;*
- *Euphorbia planiceps;*
- *Euphorbia rectirama;*
- *Euphorbia wilmaniae*

- *Aloinopsis orpenii*
- *Aloinopsis wilmanii*
- *Ebracteola wilmaniae*
- *Lithops aucampiae subsp. aucampiae* var. *aucampiae*
- *Lithops aucampiae subsp. aucampiae* var. *koelemanii*
- *Lithops bromfeldii* var. *glaudinae*
- *Lithops lesliei* subsp. *burchelli*

7.6 LAND TYPES & GEOLOGY

Although it is not in the scope of this report to present a detailed description of the soil types of the area, a basic description will suffice for this assessment as a strong association between habitat types and land types are typically known to occur. The following land type units are encountered in the study area (Figure 5):

- Ae214/215 - A- land types generally represent flat or slightly undulating landscapes, on granite, shale and Karoo sediments, which mostly give rise to deep, freely drained soils. Yellow & red soils without a water table predominate, belonging in one or more of the Inanda, Kranskop, Magwa, Hutton, Griffon or Clovelly soil forms. The land does not qualify as a plinthic catena and one of the above soil forms occupy at least 40% of the area (red, high base status, >300mm deep, no dunes); and
- Ib237 - This land type is characteristic of the very rocky quartzite hills and ridges, with very little, shallow soil. These ridges have grassland on cooler, exposed sites and bush on warmer sheltered sites [land types with exposed rock (exposed country rock, stones or boulders) covering more than 80% of the area. The rocky portion may be underlain by soils, which would have qualified the unit for inclusion in another broad soil pattern was it not for the surface rockiness].

The geology of the area conforms to banded iron formations, with jaspilite, chert and riebeckite asbestos in the rocky/ stony parts of the study area. Low-lying sandy plains comprise red aeolian sand of Tertiary to Recent age with silcretre and calcrete.

7.7 REGIONAL ECOLOGY

7.7.1 Background

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. The term savanna is widely used to describe a vegetation type with a well-developed grassy layer and an upper layer of woody plants. The distribution of variations and smaller communities are correlated with many environmental factors, including geology, landform, climate, soil types, fire and a very specific faunal composition. South African savannas of nutrient-poor

substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity. A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper layer from dominating. This, coupled with fires and grazing, keeps the grass layer dominant.

Conservation of savanna is good in principle, mainly due to the presence of the Kruger and Kalahari Gemsbok National Parks within the biome. Similarly, in neighbouring countries, large reserves occur, such as Etosha, Gemsbok, Chobe and Hwange National Parks and the Central Kalahari Game Reserve. However, this high area conserved in South Africa, belies the fact that half of savanna vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved if sustainable stocking levels are maintained. The importance of tourism and big game hunting in the conservation of the area must not be underestimated.

African savannas are inhabited by 13,000 plant species, of which 8,000 are savanna endemics. Dry savannas, specifically, have more than 3,300 endemic species, a diversity equalling that of the South African grasslands and only exceeded by the Fynbos biome. In respect of animal biodiversity, the savannas are without peer. Dry South African savannas have more recorded species of amphibians (52 species), reptiles (177 species), birds (519 species) and mammals (171 species) than any other biome.

The Kalahari savanna is a sandy, arid region in the western interior. Within the Kalahari savanna system, seven major vegetation types have been described. Two of these vegetation types are present within the study area, namely the Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld) and Kalahari Mountain Bushveld (Kuruman Mountain Bushveld).

Flagship fauna species for the Savanna Biome include:

- Starbust Horned Baboon Spider (*Ceratogyrus bechuanicus);*
- Ground Hornbill (*Bucorvus leadbeateri*);
- Cape Griffon (*Gyps coprotheres*);
- Wild Dog (*Lycaon pictus*);
- Short-eared Trident Bat (*Cloeorotis percivali*); and
- White Rhinoceros (*Ceratotherium simum*).

The study area comprises two VEGMAP vegetation types (Figure 6), namely:

- Kuruman Mountain Bushveld; and
- Olifantshoek Plains Thornveld.

7.7.2 Kuruman Mountain Bushveld

This vegetation is characterised by rolling hills with gentle to moderate slopes and hill pediment areas with an open shrubveld with *Lebeckia macrantha* prominent in places with a well-developed grass layer. The conservation status of this unit is set at Least Threatened, but none of this vegetation type is formally conserved in statutory conservation areas. The transformation status is low, but some parts are heavily utilised for grazing purposes.

Species of conservation importance that are present in this vegetation type include the Griqualand West Endemics *Lebeckia macrantha, Justicia puberula, Tarchonanthus obovata, Euphorbia wilmaniae, Digitaria polyphylla, Sutera griquensis* and the Endemic *Euphorbia planiceps.* The following species are characteristic of this vegetation type:

Small Trees & Tall Shrubs
Searsia lancea, Diospyros austro-africana, Euclea crispa subsp*. crispa, Euclea undulata, Olea europaea* subsp*. europaea, Searsia pyroides* var*. pyroides, S. tridactyla, Tarchonanthus camphoratus* and *Tephrosia longipes*.

Low Shrubs
Searsia ciliata, Amphiglossa triflora, Anthospermum rigidum subsp*. pumilum, Gomphocarpus fruticosus* subsp*. fruticosus, Helichrysum zeyheri, Lantana rugosa* and *Wahlenbergia nodosa.*

Succulent Shrubs
Ebracteola wilmaniae and *Hertia pallens.*

Graminoids
Andropogon chinensis, A. schirensis, Anthephora pubescens, Aristida congesta, Digitaria eriantha, Themeda triandra, Triraphis andropogonoides, Aristida diffusa, Brachiaria nigropedata, Bulbostylis burchelli, Cymbopogon caesius, Diheteropogon amplectens, Elionurus muticus, Eragrostis chloromelas, E. nindensis, Eustachys paspaloides, Heteropogon contortus, Melinis repens, Schizachyrium sanguineum and *Trichoneura grandiglumis.*

Herbs
Dicoma anomala, D. schinzii, Geigeria ornativa, Helichrysum cerastioides, Heliotropium strigosum, Hibiscus marlothianus, Kohautia cynanchica, Rhynchosia totta and *Kyphocarpha angustifolia.*

Geophytic Herbs
Boophane disticha and *Pellaea calomelanos.*

7.7.3 Olifantshoek Plains Thornveld

This vegetation type comprises the pediment areas of the major mountains in the region as well as some of the ridges to the west. The vegetation comprises very wide and diverse units on plains with usually open tree and shrub layers with *Acacia luederitzii, Boscia albitrunca* and *Searsia tenuinervis*. The grass layer is typically poorly developed and sparse. Red aeolian sands characterise the substrate.

The conservation status of this vegetation type is set at Least Threatened, with only 0.3% statutorily conserved in the Witsand Nature Reserve. Only about 1% of the area has been transformed and erosion is low.

Species of conservation importance that are present in this vegetation type include the Kalahari and Griqualand West Endemics *Acacia luederitzii* var. *luederitzii, Lebeckia macrantha, Hermannia burchelli, Justicia puberula, Putterlickia saxatilis, Tarchonanthus obovata, Anthephora argentea, Sutera griquensis* and the Endemic *Amphiglossa tecta.* Important taxa for this unit include the following:

Trees
Acacia erioloba, Boscia albitrunca, Acacia mellifera subsp. *detinens* and *Terminalia sericea.*

Shrubs
Lessertia frutescens, Lycium hirsutum, Rhigozum obovatum, Searsia tridactyla, Tarchonanthus camphoratus, Aptosimum procumbens, Grewia retinervis, Hoffmannseggia burchelli, Lycium pilifolium and *Solanum tomentosa.*

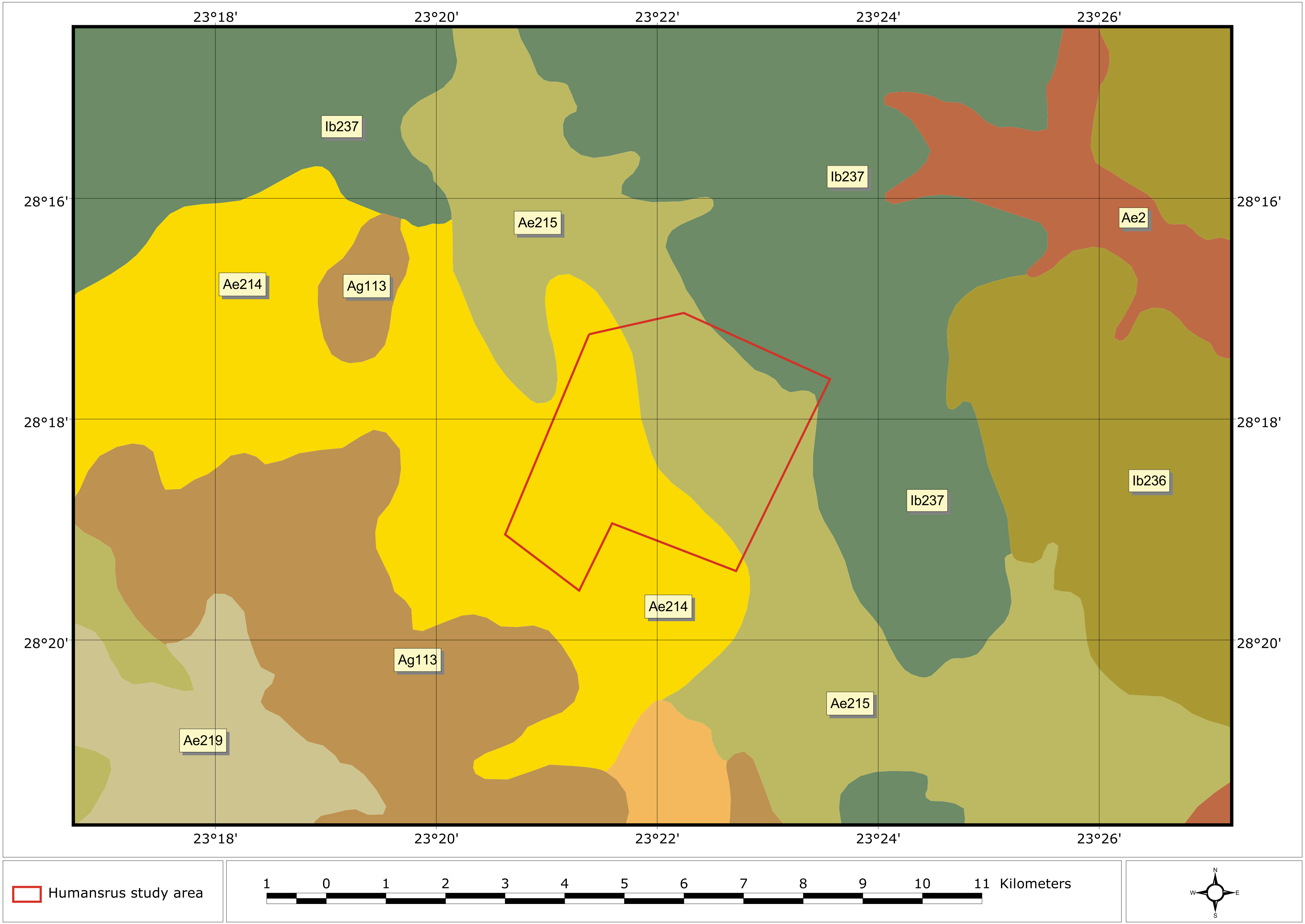
Succulent Shrubs
Lycium cinereum and *Talinum caffrum.*

Graminoids
Schmidtia pappophoroides, Stipagrostis uniplumis, Aristida congesta, Brachiaria serrata, Digitaria eriantha subsp. *eriantha* and *Melinis repens.*

Herbs
Acanthosicyos naudinianus, Gisekia pharnacioides, Hermannia tomentosa, Ipomoea magnusiana, Oxygonum delagoense, Pollichia campestris and *Tephrosia purpurea* subsp. *leptostachys.*
Succulent Herb
Piaranthus decipiens

Geoxylic suffrutex
Elephantorrhiza elephantina

Figure 5: Land Types of the general region


23°18'
23°20'
23°22'
23°24'
23°26'
28°16'
28°18'
28°20'
Ib237
Ib237
Ib237
Ae2
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Ae214
Ae214
Ag113
Ag113
Ib236
Ae219
Humansrus study area
1 0 1 2 3 4 5 6 7 8 9 10 11 Kilometers
N
S
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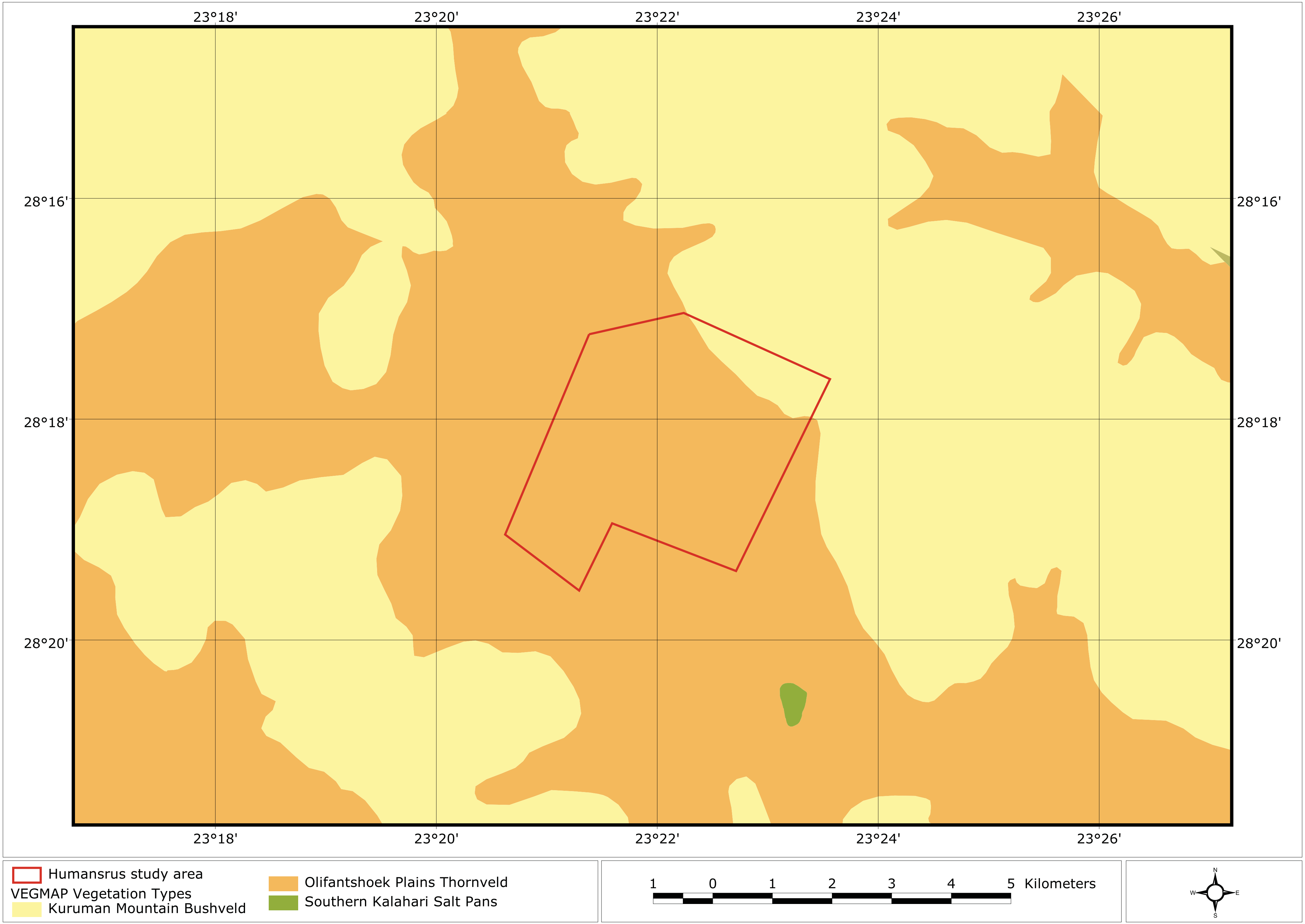
W

Figure 6: VEGMAP vegetation types of the region



23°18'
23°20'
23°22'
23°24'
23°26'
28°16'
28°18'
28°20'
Humansrus study area
VEGMAP Vegetation Types
Kuruman Mountain Bushveld
Olifantshoek Plains Thornveld
Southern Kalahari Salt Pans
1 0 1 2 3 4 5 Kilometers
N
W
E
S

8 FLORA OF THE STUDY AREA

8.1 REGIONAL DIVERSITY

The SANBI database indicates the known presence of only 146 plant species within this particular ¼-degree grid (2823AD). This relative low diversity is the result of poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity (POSA, 2009). As a rule, it is estimated that any grid where less than 300 species are known to occur is regarded a result of undersampling and does not reflect the floristic diversity of the particular area. The existing database is therefore not regarded an accurate reflection of the true floristic diversity of the region. A list of plant species of the 2823AD ¼-degree grid is presented in Appendix 1.

Notwithstanding the relative poor floristic knowledge of the region, the species composition of the general region adequately displays the varying physiognomy of the area that comprises both grassland and savanna habitat types (Table 3) with 22 dwarf shrub species (15.1%), 24 shrub species (16.4%), 5 trees species (3.4%) as well as 35 grass species (24.0% and 44 herb species (30.1%).

Table 3: **Growth forms of the region**

Growth Form	Number	Percentage
Climber	4	2.7%
Dwarf shrub	22	15.1%
Geophyte	6	4.1%
Graminoid	35	24.0%
Herb	44	30.1%
Parasite	1	0.7%
Shrub	24	16.4%
Succulent	5	3.4%
Tree	5	3.4%
Total	**146**	

8.2 FLORISTIC DIVERSITY OF THE SITE

The site investigation revealed the presence of approximately 144 plant species on the farm (Appendix 2). The diversity of this portion of land, in spite of the moderately degraded status of extensive parts of the site, is regarded diverse, reflecting not only on the species richness of the regional vegetation types, but also the effect of transformation and the influx of plant species not normally associated with the region.

The savanna physiognomy of parts of the area is indicated by the presence of several woody species in areas of natural vegetation. These woody species comprise a relative large proportion of diversity and their dominance in certain areas, particularly in wetter and

untransformed parts of the study area, is noted. Grasses (37 species, 25.7%), forbs (46 species, 31.9), shrubs (24 species, 16.7%), geophytes (14 species, 9.7% and succulents (14 species, 9.7%) comprise a high percentage of the species diversity (Table 4).

Table 4: **Growth forms of the study area**		
Growth Form	**Number**	**Percentage**
Forbs	46	31.9%
Geophytes	14	9.7%
Grasses	37	25.7%
Hydrophilics	1	0.7%
Sedges	3	2.1%
Shrubs	24	16.7%
Succulents	14	9.7%
Trees	5	3.5%
Total	**144**	

A total of 45 plant families are represented by the floristic diversity of the site, dominated by Poaceae (37, species, 25.7%) and Asteraceae (20 species, 13.9%) (Table 5).

It should be noted that the survey was conducted during the winter period and while the most of the plants on site was still in a suitable condition for identification purposes, a summer survey is likely to reveal additional flowering species that are not generally observed during the winter period.

Table 5: **Plant families of the study area**		
Family	**Number**	**Percentage**
Aizoaceae	1	0.7%
Amaranthaceae	2	1.4%
Amaryllidaceae	3	2.1%
Anacardiaceae	4	2.8%
Apocynaceae	1	0.7%
Asclepiadaceae	1	0.7%
Asteraceae	20	13.9%
Bignoniaceae	1	0.7%
Boraginaceae	1	0.7%
Cactaceae	2	1.4%
Campanulaceae	1	0.7%
Capparaceae	1	0.7%
Celastraceae	1	0.7%
Colchicaceae	1	0.7%
Commelinaceae	1	0.7%
Convolvulaceae	1	0.7%
Crassulaceae	2	1.4%
Cyperaceae	3	2.1%
Dipsacaceae	1	0.7%
Ebenaceae	2	1.4%

Table 5: **Plant families of the study area**		
Family	**Number**	**Percentage**
Ehretiaceae	1	0.7%
Euphorbiaceae	1	0.7%
Fabaceae	1	0.7%
Fabaceae	11	7.6%
Geraniaceae	2	1.4%
Hyacinthaceae	2	1.4%
Iridaceae	3	2.1%
Lamiaceae	2	1.4%
Liliaceae	9	6.3%
Lobeliaceae	1	0.7%
Malvaceae	2	1.4%
Mesembryanthemaceae	2	1.4%
Oxalidaceae	1	0.7%
Papaveraceae	1	0.7%
Pedaliaceae	1	0.7%
Poaceae	37	25.7%
Polygalaceae	1	0.7%
Polygonaceae	1	0.7%
Rhamnaceae	1	0.7%
Scrophulariaceae	4	2.8%
Selaginaceae	1	0.7%
Solanaceae	3	2.1%
Sterculiaceae	3	2.1%
Thymelaeaceae	2	1.4%
Tiliaceae	1	0.7%

8.3 Flora species of Conservation Importance

8.3.1 Red List Species

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001), amended to include additional categories to indicate species that are of local conservation concern. The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

The South African Red List contains three additional categories (Critically Rare, Rare and Declining) to highlight plant species that are not in danger of extinction, but are of local conservation concern because they are rare, or there are threatening processes affecting their populations. These categories have been developed to highlight those taxa classified as Least Concern according to the IUCN system, should be considered in conservation prioritization processes. It is important to emphasize that the South African categories

Critically Rare, Rare and Declining are intended for use in local conservation prioritization processes only. In submission to the IUCN Red List of Threatened Species, these taxa have to be categorized according to the IUCN system and therefore their global status will be Least Concern.

No Threatened plant species are known to occur in this particular ¼-degree grid. The near endemic species *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* was observed in the study area.

Aloe grandidentata is protected under CITES (Appendix II). Northern Cape Nature & Environmental Conservation Ordinance included the following genus and species that were observed during the surveys:

- All species of the genus Aloe (*Aloe grandidentata*);
- All species of the family Apocynaceae (*Pachypodium succulentum*);
- Certain species of the family Liliaceae (*Lachenalia* species); and
- All species of the family Mesembryanthemaceae (*Lithops aucampiae* subsp. *aucampiae* var. *aucampiae*, *Chasmatophyllum musculinum, Nananthus aloides*).

8.3.2 Protected Tree Species

According the Act (National Forests Act (Act no 84 of 1998)), the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

A taxon is 'Declining' when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

The following protected tree species do occur in the study area as well as surrounding areas (Table 6). Survey conditions were not particularly conducive for identifying Red Data species during the site investigation, but it is regarded highly unlikely that any Threatened flora species would occur on this site.

Table 6: **Protected tree species of the region**

Taxon	**Family**	**Abundance**	**Status**
Acacia erioloba	Fabaceae	Less than 20	Declining, confirmed presence
Acacia haematoxylon	Fabaceae	None observed	Declining, not confirmed
Boscia albitrunca	Capparaceae	Single individual observed	Declining, confirmed presence
Olea europaea subsp. *africana*	Oleaceae	Many (>300)	Declining, confirmed presence

An application for permits for the removal/ damage/ cutting or pruning of protected tree species as per National Forest Act, 1998 (No 84 of 1998) need to be submitted to the relevant authority prior to the commencement of construction activities.
Comments were made about the status and size of Wild Olive individuals in the Olea woodland. It should be noted that the accurate determination of the age of a tree is a specialist field and only rough estimates can be presented in this document. Aspects that were taken into account include the general appearance, stem diameter/ girth, environmental aspects, evidence and observations from other areas. A rough estimate of the age of these trees would be in the region of 50 -60 years.

The relatively dense stand of Olea individuals is likely to have resulted from changes in the fire regime that indicated the arrival of cattle farming to the area. Increased fire frequency likely caused other woody species to disappear, whilst favouring the growth of Olea. An important aspect to note is that most of the individuals are roughly the same size (and therefore age), representing an abnormal population structure. Normally there would be a few old (particularly large) individuals area present while numbers increase as size (age) decrease. This would suggest that the presence of these individuals could be attributed to a specific period in the past. It should be noted that this species do occur naturally in the region, albeit at lower densities. When compared to other part of the geographical distribution area of this species, the size and age of these individuals are not particularly unique.

However, taking the status of this community into consideration, the presence of these trees is regarded an important aspect of the biodiversity; application of the rules and guidelines of the Ecosystem Approach will dictate that as much as possible of this community be preserved.

8.4 ALIEN & INVASIVE PLANT SPECIES

The following invasive and weed species were noted on the study site (Table 7).

Table 7: **Invasive and weed plant species of the study area**

Species Name	**Growth Form**	**Family**	**Status/ Uses**
Acacia hebeclada	Fabaceae	Shrub	Indigenous invader, declared indicator of encroachment
Acacia mellifera	Fabaceae	Shrub	Declared indicator of encroachment, medicinal uses, poison source
Alternanthera pungens	Amaranthaceae	Forb	Weed, pioneer species
Argemone ochroleuca	Papaveraceae	Forb	Declared Invader - Category 1
Berkheya species	Asteraceae	Forb	Weed
Bidens pilosa	Asteraceae	Forb	Weed, edible parts
Cynodon dactylon	Poaceae	Grass	Indicator of disturbed areas, grazing potential
Cyperus esculentus	Cyperaceae	Sedge	Weed, edible parts
Datura stramonium	Solanaceae	Forb	Declared Invader - Category 1, weed
Echinopsis sphaciana	Cactaceae	Succulent	Declared Invader - Category 1

Table 7: **Invasive and weed plant species of the study area**			
Species Name	**Growth Form**	**Family**	**Status/ Uses**
Opuntia ficus-indica	Cactaceae	Succulent	Declared Invader - Category 1
Rhigozum trichotomum	Bignoniaceae	Shrub	Declared indicator of encroachment
Schinus molle	Anacardiaceae	Tree	Exotic, invasive, S. America
Schkuhria pinnata	Asteraceae	Forb	Medicinal uses, weed (S. America)
Solanum panduriforme	Solanaceae	Forb	Weed
Xanthium strumarium	Asteraceae	Forb	Category 1, weed (S. America)

8.5 MACRO HABITAT TYPES

Due to the relative high levels of transformation as well as low utilisation levels and the effect of frequent burning noted across most of the site, vegetation within the study area was found to be relatively degraded, albeit in a well-developed status. Because of intensive human activities, remaining natural vegetation within the study area is not regarded entirely representative of the regional vegetation type, i.e. pristine. Results of the photo analysis and site investigations revealed the presence of the following habitat types (Figure 7):

- Closed Shrubveld;
- Drainage Line;
- Excavations;
- Floodplains;
- Grassland Plains;
- Homestead;
- Olea europaea Woodland
- Open Shrubveld; and
- Road.

8.5.1 Closed Shrubveld

The Closed Shrubveld unit is situated in the northern section of the study area, comprising the hills and low ridges that form part of the Kuruman Mountain Bushveld regional vegetation type. The vegetation is dominated by a well-developed shrub layer with heights between 0.5 and 3m. The status of this unit is regarded pristine and little evidence of degradation and over-utilisation was observed within the study area. Although remarkably similar in species composition to the Open Shrubveld habitat type, the woody component is much more dominant; assumed to be an effect of low burning frequencies. The substrate is typically rocky, stony and slopes vary between 5 and 15%.

Although this habitat type comprises only approximately 115.8ha (8.1%) of the study area, it is well represented outside the study area towards the north. The VEGMAP database also indicates that very little of this vegetation type (Kuruman Mountain Bushveld) is transformed by human activities, representing a regional area of untransformed and pristine

vegetation type. It is therefore possible to assume that the faunal component that typifies this habitat type is similarly unaffected.

The species composition is typical of a pristine vegetation type, represented by a number of co-dominant species. The woody species *Acacia mellifera, Calobota cuspidosa, Ehretia rigida, Euclea crispa, Euryops multifidus, Grewia flava, Gymnosporia buxifolia, Lycium bosciifolium, Olea europaea, Searsia ciliata, S. lancea, S. pentheri* and Ziziphus mucronata occurs in this unit. A well-developed herbaceous layer includes the dominant grasses *Aristida congesta subsp. congesta, Brachiaria nigropedata, Digitaria eriantha, Echinochloa colona, Eragrostis lehmanniana, Fingerhuthia africana, Heteropogon contortus, Pogonarthria squarrosa* as well as the forbs *Aptosimum albomarginatum, Babiana hypogea, Bulbine abyssinica, Geigeria species, Kyphocarpa angustifolia* and *Sutherlandia frutescens.*

The floristic status of this habitat type is regarded pristine and a high floristic sensitivity is ascribed to these parts. Aspects that affect the sensitivity of this unit is the pristine nature, absence of any human activities that contribute to habitat degradation, fragmentation or isolation and a moderate likelihood of Red Data species being present.

8.5.2 Drainage Line

The drainage line is present in the southern part of the study area, originating further to the south. This habitat type occurs in terrain type 5 (Valley bottoms). The character of this habitat changes as it progresses first northwards and then to the north-west. The portion of the river located in the southern section of the property (south of the road) is characterised by a rocky streambed that takes its nature from the surrounding habitat types and topography. Areas surrounding the drainage line in this part of the property conform to the Open Shrubveld habitat type where soils are typically rocky/ stony and slopes are steeper than the surrounding Grassland Plains habitat type. It is also noted that the Floodplain habitat type is absent from this part of the drainage line. The vegetation of this part is characterised by the presence of trees and shrubs on the banks, while the streambed is largely devoid of soil and vegetation. The presence of rocks and boulders within the streambed results in pockets of standing water in which hydrophilic vegetation grows. Woody species associated with this part of the Drainage Line habitat type include *Olea europaea, Searsia lancea, Tarchonanthus camphoratus, and Ziziphus mucronata.*

The section of the drainage line north of the road is characterised by the relative flat surrounding Grassland Plains and Floodplains habitat type where a dam interrupts the flow of a period. The dam is partly filled with water and is characterised by species associated with standing water, such as *Falkia oblonga, Persicaria lapathifolia* and *Schoenoplectus corymbosus*. The soils in these parts are typically sandy/ loamy of nature and stones are mostly absent from the streambed. The streambed is characterised by low, eroded banks that becomes shallower further to the southeast. The vegetation of the streambed as well as the surrounding Floodplain habitat is characterised by short grassland and low herb

species. Species that are dominant in these habitat types include the grasses *Aristida congesta* subsp. *barbicollis, Cymbopogon plurinodis, Eragrostis obtusa, Eragrostis rigidior, Heteropogon contortus, Microchloa caffra* and *Themeda triandra.* Forbs that were noted within the Drainage line include *Androcymbium melanthioides, Arctotis arctotoides, Berkheya* species, *Falkia oblonga, Felicia* species, *Gazania krebsiana, Geigeria* species, *Indigofera* species, *Monsonia angustifolia, Scabiosa columbaria* and *Walafrida densiflora.*

Any habitat associated with water is regarded sensitive and this drainage line, with small variations along the progression across the study area is typical of this type of habitat where ecotonal areas are created by the interplay between topography and biophysical attributes of the area. This habitat comprises approximately 16.1 ha (1.1%) of the study area, but the importance and sensitivity is however underlined by the dependency of this habitat from surrounding areas that are the origin of water that ultimately feeds into the drainage line. The vegetation, although not in a pristine state because of high utilisation factors, is regarded sensitive, particularly because of the association with the adjacent Floodplain habitat type.

8.5.3 Excavations

Small portions of the study area are subjected to small-scale surface mining operations (Jaspilite). These areas are devoid of vegetation because of severe surface disturbances, either excavation or dumping of overburden materials. No sensitivity is ascribed to these areas, but it should be noted that surrounding habitat comprises relative untransformed shrubveld.

8.5.4 Floodplains

The wide levees adjacent to the Drainage line habitat type is characterised by low grassland vegetation where soils are relatively deep, but shallow rock sheets with gravely soils do occur scattered in this habitat type. This habitat is situated on terrain type 4 (footslopes) where slopes are low, comprising approximately 45.6 ha (3.2%) of the study area.

The nature of this habitat type is determined by drainage of water from higher lying areas towards the drainage line. Vegetation is characterised by low grasses that include the dominant species *Aristida congesta* subsp*. barbicollis, Cymbopogon plurinodis, Eragrostis obtusa, E. plana, E. species, Microchloa caffra* and *Themeda triandra,* as well as the forbs *Androcymbium melanthioides, Arctotis arctotoides, Argemone ochroleuca, Berkheya* species, *Bulbine narcissifolia, Euphorbia clavarioides, Felicia* species, *Gazania krebsiana, Geigeria* species, *Hibiscus species, Homeria* species, *Scabiosa columbaria* and *Walafrida densiflora.*

The presence of *Aristida congesta* subsp*. barbicollis, Cymbopogon plurinodis, E. plana, Argemone ochroleuca, Berkheya* species and *Walafrida densiflora* indicates a high utilisation factor.

A small variation is present that significantly increases the sensitivity ascribed to the unit. Small, localised rock sheets occur scattered and is characterised by open sheets of rock and shallow gravely soils along the edges. The vegetation occurring on these sheets is entirely different to that of the immediate surrounding grassland where deeper soils prevail. The grass *Microchloa caffra* is dominant along the edges and of particular note is the presence of three succulent species, namely *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* (single individual), cf. *Nananthus aloides* and cf. *Chasmatophyllum musculinum.*

While none of these species are included in a Threatened category. All of these species are categorised as Least Threatened, their presence is regarded an important addition to the biodiversity of the area, furthermore enhancing the sensitivity of this habitat type. While the vegetation of this habitat type is not regarded pristine, a high sensitivity is ascribed because of the presence of unique plant species that occur in small, unique habitat variations.

8.5.5 Grassland Plains

A large portion of the study area comprises open grassland plains (approximately 658.0 ha, 46.2%). These areas area characterised by the dominance of the herbaceous layer and the absence of trees and shrubs, although localised stands of *Searsia ciliata* occur scattered within this unit. Biophysical attributes include the presence of relative deep, yellow, yellow/ brown and red soils that mostly falls into a sandy category. Rocks are generally absent, but localised, small areas of stony soil do occur, but not as dominant as in the woodland and shrubveld habitat types. A characteristic feature of this unit is the flat slopes; woodland and shrubveld generally becomes dominant as soon as a slight incline occurs. These areas are therefore generally low-lying in the landscape. This habitat type is situated within the Olifantshoek Plains Thornveld regional vegetation type, but is not particularly representative thereof, it rather represents small grassveld variations of this regional vegetation type that is associated with the low-lying areas along the drainage lines. Although it comprises a large extent of the study area, it is moderately represented in the surrounding region.

The vegetation, because of the grassland nature, is heavily utilised and evidence is noted in the absence or dominance of the grass *Themeda triandra* within certain camps of the property, depending whether the camp is grazed or not. Grass species that occur within this unit include *Aristida congesta* subsp*. barbicollis, Aristida stipitata, Cymbopogon plurinodis, Digitaria monodactyla, Eragrostis lehmanniana, Eragrostis obtusa, Fingerhuthia africana, Heteropogon contortus, Microchloa caffra, Sporobolus nitens* and *Stipagrostis ciliata.* The herbaceous stratum is diverse and includes the dominant species *Arctotis arctotoides, Babiana hypogea, Berkheya* species*, Boophane disticha, Brunsvigia natalensis, Dicoma capensis, Felicia* species*, Gazania krebsiana, Geigeria* species*, Hermannia species* and *Jamesbrittenia aurantiaca*

Shrubs occur at low densities, including *Acacia hebeclada, A. mellifera, Euryops multifidus, Calobota cuspidosa, Lycium bosciifolium, Searsia ciliata* and *Tarchonanthus camphoratus.*

Within this unit, there are watering points for animals where other infrastructure also occurs, such as animal pens. The release of cattle and horses from other parts of the country where *Acacia erioloba* (Camel thorn) occurs around these parts has resulted in the germination of this protected tree species through germination of seeds contained in droppings. Similar to other protected tree species on the property, these trees should receive consideration in terms of required permits for removal.

8.5.6 Homestead

An old homestead is situated in the southern part of the study area (south of the road), characterised by farming infrastructure, fences, animal pens and buildings. Introduced plants are dominant and include tall trees, cacti and weeds. A low sensitivity is ascribed to these parts as the normal vegetation is entirely transformed.

8.5.7 Olea europaea Woodland

Approximately 35.1 ha (2.5%) of the site comprises a relative dense stand of *Olea europaea* trees. While this species occur normally in the woodland/ shrubland areas of the study area, this particular site is characterised by a particularly high cover abundance value of this species. Many of the other species normally associated with the woodland areas in the study area are not present, or occur at much lower cover abundance values. Biophysical habitat characteristics are similar to that of the Open Shrubveld with stony/ rocky soils, slight slopes.

The origin of this community of trees is not clear, but it would appear as if fire has played some part as a driving force. The difference between this and the Closed Shrubveld habitat type located further to the north, might be that this unit has received more frequent fires in the past; fire resistant properties of this species has resulted in it becoming more dominant than other species that were affected to a higher degree. It is also noted that the boundaries of this unit is not particularly defined, but rather a gradient between this and the Open Shrubveld habitat type. Where the boundaries are defined, it is bordering the Grassland Plains, similar to the Open Shrubveld. This provides further evidence that this unit has developed from the Open Shrubveld.

Evidence from aerial images also indicates that this particular physiognomy is not repeated frequently in the surrounding region. Areas of potentially similar physiognomy are observed, always located on the interface of open shrubveld and grassland habitat. In association with the dominant tree species *Olea europaea* the following woody species are present: *Acacia mellifera, Calobota cuspidosa, Ehretia rigida, Euryops multifidus, Searsia ciliata, S. lancea, S. pentheri* and *Tarchonanthus camphoratus.* The grass layer is well

developed with *Aristida meridionalis, Cymbopogon plurinodis, Digitaria eriantha, Elionurus muticus, Enneapogon scoparius, Eragrostis lehmanniana, Eragrostis obtusa, Eragrostis rigidior, Fingerhuthia africana, Heteropogon contortus, Microchloa caffra, Stipagrostis ciliata* and *Themeda triandra*. The forbs *Arctotis arctotoides, Babiana species, Bulbine* species, *Felicia species, Gazania krebsiana, Geigeria species* and *Jamesbrittenia aurantiaca* occur frequently.

A single individual of the protected tree *Boscia albitrunca* (Shepard's Tree) was observed within this unit. The floristic status of this unit is regarded relative pristine; little evidence of grazing is noted. The density of the protected tree *Olea europaea* renders this unit fairly unique in the region and a high sensitivity is therefore ascribed.

8.5.8 Open Shrubveld

This unit comprises approximately 528.8 ha (37.2%) of the study area, representing the second largest habitat. Evidence from aerial images indicates that this physiognomy is repeated in the region, representing the regional vegetation type (Olifantshoek Plains Thornveld). The biophysical attributes of this community include stony/ rocky soils, situated on slightly elevated areas from nearby grassland and drainage habitat types. The physiognomy is dominated by shrubs that developed because of the rockiness of the substrate, but not to the extent that a closed/ dense canopy is formed like the Closed Woodland habitat further to the north. The prominence of a well-developed and diverse herbaceous layer prevents the shrubs from dominating.

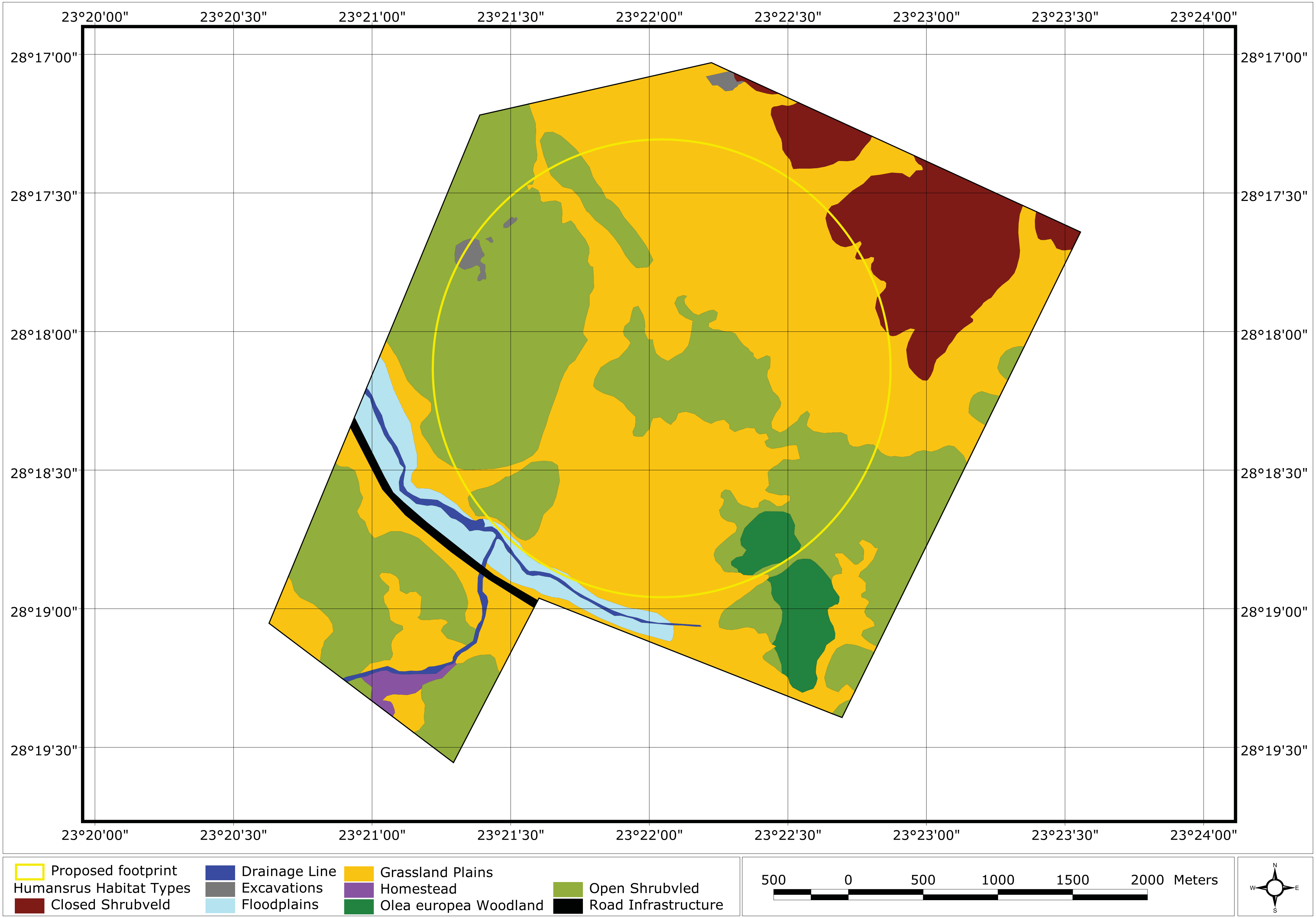
The species composition of this unit is similar to that of the Closed Woodland habitat type, but woody species occur at much lower densities. Prominent woody species include *Acacia mellifera, Calobota cuspidosa, Ehretia rigida, Euclea undulata, Euryops multifidus, Gymnosporia buxifolia, Olea europaea, Searsia ciliata, Tarchonanthus camphoratus* and *Ziziphus mucronata.* The grass layer is diverse and includes species such as *Aristida congesta* subsp. *barbicollis, Cymbopogon plurinodis, Digitaria eriantha, Elionurus muticus, Enneapogon scoparius, Eragrostis obtusa, Fingerhuthia africana, Heteropogon contortus, Sporobolus nitens, Stipagrostis ciliata, Themeda triandra* and *Trichoneura grandiglumis*. Frequently observed herb species include *Aptosimum albomarginatum, Babiana species, Euphorbia clavarioides, Gazania krebsiana, Geigeria species, Gnidia* species, *Hibiscus* species, *Kalanchoe* species, *Rhynchosia totta* and *Walafrida densiflora.*

This community is well represented in the general region and, while the vegetation is relatively pristine, no particularly sensitive attribute is common to this unit. A medium-high floristic status is ascribed, but a medium floristic sensitivity results.

8.5.9 Road

The study area is divided by an east-west road.

Figure 7: Floristic habitat types of the study area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Closed Shrubveld
Drainage Line
Excavations
Floodplains
Grassland Plains
Homestead
Olea europea Woodland
Open Shrubvled
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8.6 Floristic Sensitivity

Floristic sensitivity calculations are presented in Table 8 and illustrated in Figure 8.

Table 8: Floristic sensitivity estimations for the respective habitat types

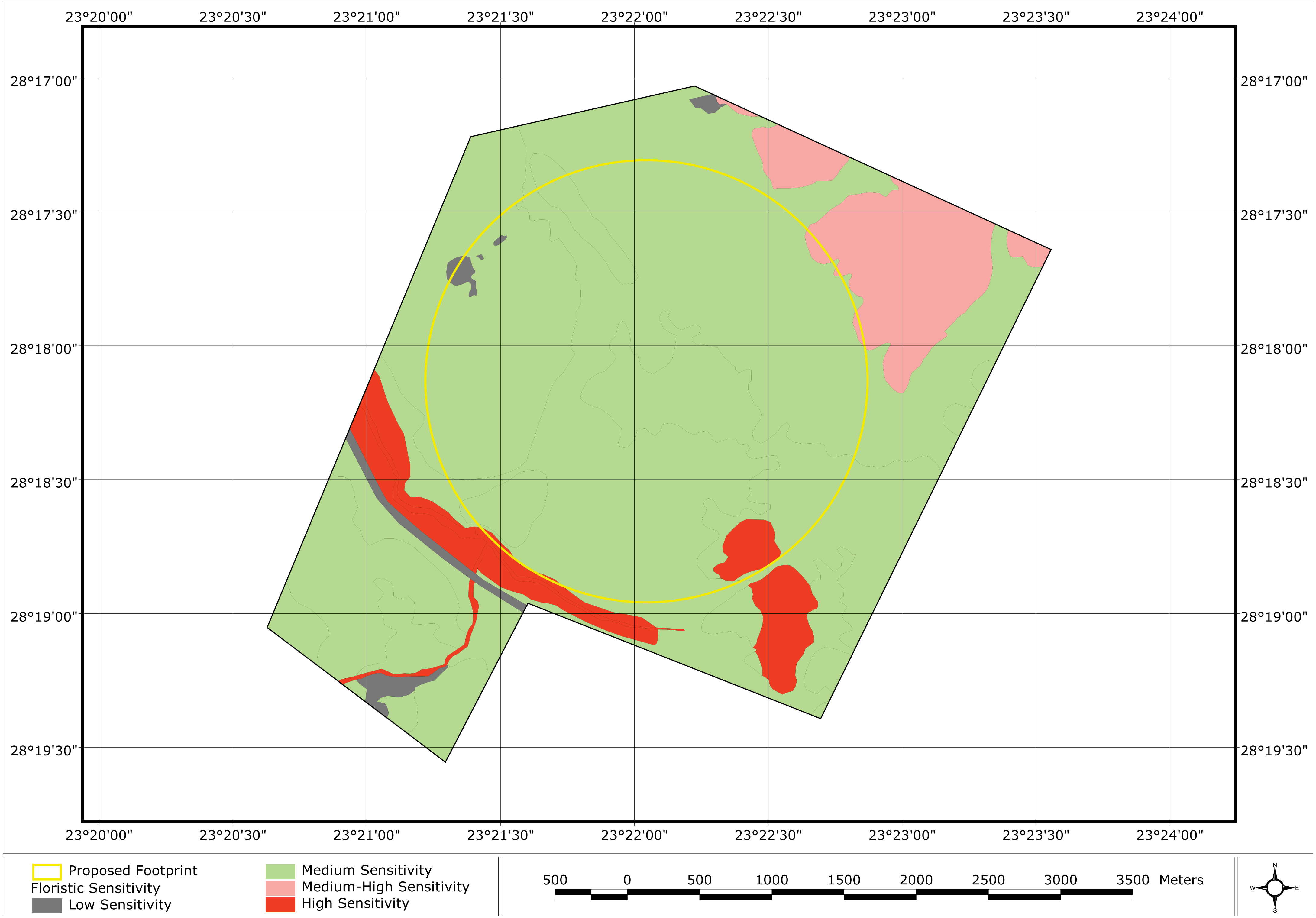
Criteria	RD species	Landscape sensitivity	Status	Species diversity	Functionality/ fragmentation	TOTAL	SENSITIVITY INDEX	SENSITIVITY CLASS
Community	**Criteria Ranking**							
Closed Shrubveld	3	10	10	10	10	250	78%	medium-high
Drainage Line	6	10	8	9	10	263	82%	high
Excavations	0	5	1	0	1	49	15%	low
Floodplains	8	10	8	9	9	280	88%	high
Grassland Plains	3	5	7	8	8	176	55%	medium
Homestead	0	3	2	2	2	52	16%	low
Olea woodland	4	10	10	10	10	260	81%	high
Open Shrubveld	3	5	8	8	10	188	59%	medium

The extent of habitat sensitivities within the respective alternatives is presented in Table 9.

Table 9: Extent of floristic habitat sensitivities within the study area

Habitat Sensitivity	Extent	Percentage
Low	24.0ha	1.7%
Medium	1,186.8ha	83.4%
Medium-high	115.8ha	8.1%
High	96.8ha	6.8%

Figure 8: Flora habitat sensitivities of the study area



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Proposed Footprint
Floristic Sensitivity
Low Sensitivity
Medium Sensitivity
Medium-High Sensitivity
High Sensitivity
500 0 500 1000 1500 2000 2500 3000 3500 Meters
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W
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8.7 Discussion

The vegetation of the study area is largely representative of the regional vegetation types. The interplay between rocky areas and low-lying grasslands with intermittent drainage lines is typical of the region, resulting in clearly defined communities. The vegetation of the study area is therefore not considered unique on a regional scale. Slight variations do however exist and these variations become important on a local scale, such as the Olea Woodland and localised rock sheets in the Floodplain habitat type. The high density of Olea trees, as well as slightly higher structure of this habitat type, renders it fairly unique. It should be noted that it does occur in small patches in the larger region, but it is by no means a frequent occurrence. The driving force behind the development of this unit is thought to be anthropogenic in nature, fire frequency and intensity in particular. Rock sheets associated with shallow gravely soils in the close vicinity of drainage lines is important in terms of the occurrence of succulent species.

Remaining parts of the study area is characterised by open shrubveld to the west, closed shrubveld to the east, as well as drainage lines with associated floodplains and grassland plains. These habitat types are well defined and clear boundaries exist, mostly driven by the presence/ absence of rocky/ stony soils and slopes. Grazing practices have resulted in slight deterioration of the status of particularly the grassland areas, resulting in the influx of low shrub species.

While no Red Data plant species were observed in the study area, the presence of three protected trees are confirmed, namely the prominent *Olea europaea,* a small number of *Acacia erioloba* and a single individual of *Boscia albitrunca.* The near endemic *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* was observed in the study area. Suitable habitat for this species is located outside the proposed footprint for the site. Due to the cryptic nature of this species, it is nonetheless recommended that a detailed walkthrough of all moderately suitable habitat be conducted prior to the commencement of construction activities.

A large part of the study area comprises floristic habitat of medium sensitivity (approximately 1,128.7 ha, 83.4%). These habitat types are well represented in the surrounding region and the loss thereof is not expected to result in severe impacts on the floristic environment when considered on a regional scale. However, it should be noted that the proposed footprint for the development is situated in close vicinity to floristic habitat types of high sensitivity, including the Drainage line, Floodplains and Olea Woodland habitat types. Impacts within these areas are therefore likely to occur unless strict mitigation measures are implemented.

The high sensitivity ascribed to the Olea Woodland habitat type is mainly the result of a unique physiognomy created by the dominant *Olea europaea* trees. Because the species composition of this unit does not vary significantly from surrounding shrubveld habitat, the

loss of a portion of this habitat type (11.2 ha) is not regarded a significant impact. The loss of a relative high number of protected tree species should be viewed in light of the presence of this species across the region.

The proposed footprint is indicated to exclude most of the other sensitive habitat types. The close vicinity of these areas to the proposed development is an aspect that should receive attention during the EMP phase of the project where protection and conservation measures are developed to provide for protection of these areas.

9 FAUNA OF THE STUDY AREA

Please note that the avifaunal component was excluded from this assessment, as it is addressed in a separate investigation.

9.1 REGIONAL FAUNAL DIVERSITY

Only specific faunal groups are used during the species-specific element of this faunal assessment because of restrictions concerning database availability. Data on the Q-degree level is available for the following faunal groups:

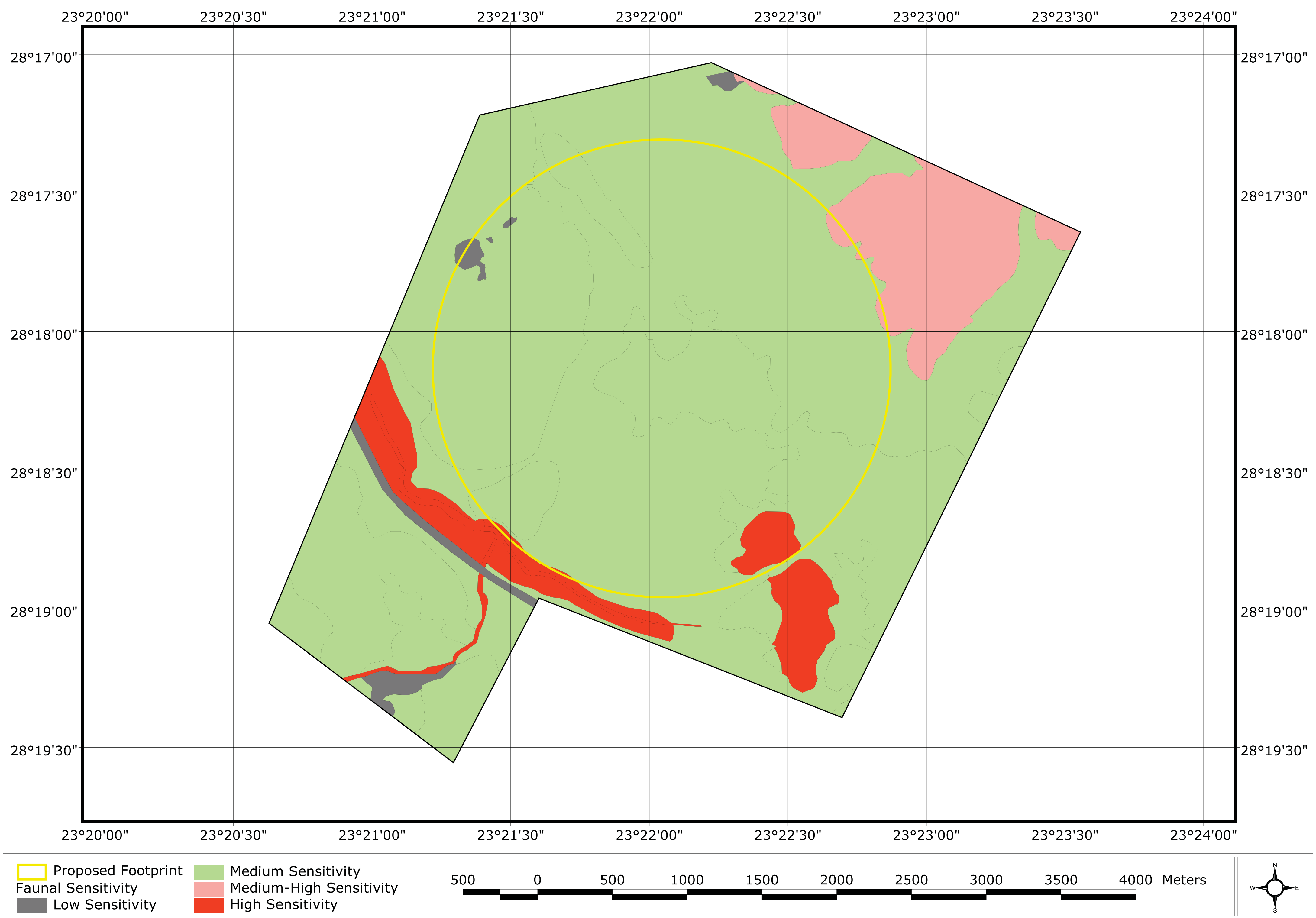
- Invertebrates: Butterflies (South African Butterfly Conservation Assessment – http://sabca.adu.org.za)
- Amphibians: Frogs (Atlas and Red Data Book of the South Africa, Lesotho and Swaziland)
- Reptiles: Snakes and other Reptiles (South African Reptile Conservation Assessment - http://sarca.adu.org.za)
- Mammals: Terrestrial Mammals (Red Data Book of the Mammals of South Africa: A Conservation Assessment.)

Animals known to be present in the Q-grid of the study area are considered potential inhabitants of the study area (all species known from the Northern Cape Province were included to minimize the effect of sampling bias). The likelihood of each species' presence in the study areas was estimated based on known ecological requirements of species; these requirements were compared to the ecological conditions found in the study area and surrounding faunal habitat.

9.2 FAUNAL DIVERSITY OF THE SITE

The presence of 41 animal species was confirmed during the site investigation (Table 23), by means of visual sightings, tracts, faecal droppings, burrows, characteristic behaviour patterns as well as confirmation obtained from the landowner. Signs of, or individuals of, four butterflies, 10 reptiles and 25 mammals were confirmed for the study area. This includes the Red Data mammals South African Hedgehog (*Atelerix frontalis,* NT), Lesser Dwarf Shrew (*Suncus varilla,* DD) and Brown Hyaena (*Hyaena brunnea,* NT).

The forty-one animals confirmed to occur in the study area are regarded typical of an area the size of the study site in the Eastern Kalahari Bioregion, given the mixture of habitat types present in the study area. It must be noted that a study conducted during the raining period (i.e. in the warm, wet season) would likely reveal other species that are unlikely to be observed or present during the cold, dry season (migrant birds, summer-active invertebrates, amphibians and reptiles etc.); it might even include additional Red Data species.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Proposed Footprint
Faunal Sensitivity
Low Sensitivity
Medium Sensitivity
Medium-High Sensitivity
High Sensitivity
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Table 10: Animal species occurring on the study area				
Class	**Order**	**Family**	**Genus-Species**	**Common Name**
Insecta	Lepidoptera	Nymphalidae	*Junonia hierta*	Yellow Pansy
			Vanessa cardui	Painted Lady
		Pieridae	*Belenois aurota*	Brown-veined White
			Colias electo	Lucerne Butterfly
Amphibia	Anura	Pipidae	*Xenopus laevis*	Common Platanna
		Pyxicephalidae	*Cacosternum boettgeri*	Boettger's Caco
Reptilia	Testudines	Pelomedusidae	*Pelomedusa subrufa*	Marsh Terrapin
	Squamata	Boidae	*Python natalensis*	Southern African Python
		Colubridae	*Dasypeltis scabra*	Common Egg Eater
			Dispholidus typus	Boomslang
			Pseudaspis cana	Mole Snake
			Lycophidion capense	Cape Wolf Snake
		Elapidae	*Naja nivea*	Cape Cobra
		Viperidae	*Bitis arietans*	Puff Adder
		Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink
		Agamidae	*Agama atra*	Southern Rock Agama
Mammalia	Insectivora	Erinaceidae	*Atelerix frontalis*	South African Hedgehog
		Soricidae	*Suncus varilla*	Lesser Dwarf Shrew
	Primates	Cercopithecidae	*Papio ursinus*	Chacma Baboon
	Lagomorpha	Leporidae	*Lepus capensis*	Cape Hare
	Rodentia	Sciuridae	*Xerus inauris*	Cape Ground Squirrel
		Pedetidae	*Pedetes capensis*	Springhare
		Hystricidae	*Hystrix africaeaustralis*	Porcupine
		Bathyergidae	*Cryptomys hottentotus*	Common Mole-rat
		Muridae	*Aethomys chrysophilus*	Red Veld Rat
	Carnivora	Canidae	*Otocyon megalotis*	Bat-eared Fox
			Vulpes chama	Cape Fox
			Canis mesomelas	Black-backed Jackal
		Viverridae	*Suricata suricatta*	Suricate
		Hyaenidae	*Hyaena brunnea*	Brown Hyaena
		Protelidae	*Proteles cristatus*	Aardwolf
		Felidae	*Felis silvestris*	African Wild Cat
			Caracal caracal	Caracal
		Felidae	*Panthera pardus*	Leopard
	Tubulidentata	Orycteropodidae	*Orycteropus afer*	Aardvark
	Hyracoidea	Procaviidae	*Procavia capensis*	Rock Hyrax
	Artiodactyla	Bovidae	*Tragelaphus strepsiceros*	Kudu
			Damaliscus pygargus phillipsi	Blesbok
			Antidorcas marsupialis	Springbok
			Raphicerus campestris	Steenbok
			Sylvicapra grimmia	Common Duiker

9.3 Red Data Fauna Assessment

Fifty-six Red Data animals are known to occur in the Northern Cape Province (mammals, reptiles, amphibians and invertebrates) (Table 9). This includes 12 listed as Data Deficient (DD), 21 as Near Threatened (NT), 12 as Vulnerable (VU), 5 as Endangered (EN) and 5 as Critically Endangered (CR). It is estimated that 41 of the 56 animals are listed have a low probability of occurring in the study area, 10 have a moderate probability and two species have a high probability of occurring. Three species, *Mellivora capensis* (red), *Atelerix frontalis* (NT), *Suncus varilla* (DD) and *Hyaena brunnea* (NT) were confirmed for the study area (Table 8).

This assessment is based on:

- the size of the study area;
- the location of the study area within a largely untransformed environment; and
- the presence of relatively pristine habitat such as those associated with grassland, woodland, wetlands and outcrops.

Table 11: **Red Data Assessment for the study area**			
Species Details			**Probability Assessment**
Biological Name	**English Name**	**Status**	
	Butterflies		
Athene lindae	Linda's Hairtail	Vulnerable	low
	Amphibians		
Cacosternum karooicum	Karoo Caco	Data Deficient	low
Pyxicephalus adspersus	Giant Bullfrog	Near Threatened	moderate
Strongylopus springbokensis	Namaqua Stream Frog	Vulnerable	low
	Reptiles		
Bitis schneideri	Namaqua Dwarf Adder	Vulnerable	low
Cordylus cataphractus	Armadillo Girdled Lizard	Vulnerable	low
Cordylus lawrenci	Lawrence's Girdled Lizard	Near Threatened	low
Dermochelys coriacea	Leatherback Turtle	Critically Rarea	low
Gerrhosaurus typicus	Namaqua Plated Lizard	Near Threatened	low
Goggia microlepidota	Small-scaled Dwarf Leaf-toed Gecko	Near Threatened	low
Homopus signatus	Speckled Cape Tortoise	Near Threatened	low
Lamprophis fiskii	Fisk's House Snake	Vulnerable	low
Phelsuma ocellata	Namaqua Day Gecko	Near Threatened	low
Typhlosaurus lomii	Lomi's Blind Legless Skink	Vulnerable	low
	Mammals		
Acinonyx jubatus	Cheetah	Vulnerable	low
Atelerix frontalis	South African Hedgehog	Near Threatened	confirmed
Bathyergus janetta	Namaqua Dune Mole-rat	Near Threatened	low
Bunolagus monticularis	Riverine Rabbit	Critically Rare	low
Chrysochloris asiatica	Cape Golden Mole	Data Deficient	low
Chrysochloris visagiei	Visagie's Golden Mole	Critically Rare	low
Cistugo lesueuri	Leseur's Wing-gland Bat	Near Threatened	moderate
Cistugo seabrai	Angolan Wing-gland Bat	Vulnerable	low
Crocidura cyanea	Reddish-grey Musk Shrew	Data Deficient	moderate

Crocidura fuscomurina	Tiny Musk Shrew	Data Deficient	low
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	Data Deficient	low
Crocuta crocuta	Spotted Hyaena	Near Threatened	low
Cryptochloris wintoni	De Winton's Golden Mole	Critically Rare	low
Damaliscus lunatus lunatus	Tsessebe	Endangered	low
Diceros bicornis bicornis	Black Rhinoceros - arid ecotype	Critically Rare	low
Elephantulus intufi	Bushveld Elephant-shrew	Data Deficient	low
Equus zebra hartmannae	Hartmann's Mountain Zebra	Endangered	low
Erimitalpa granti	Grant's Golden Mole	Vulnerable	low
Graphiurus platyops	Rock Dormouse	Data Deficient	low
Hippotragus equinus	Roan Antelope	Vulnerable	low
Hyaena brunnea	Brown Hyaena	Near Threatened	confirmed
Lycaon pictus	African Wild Dog	Endangered	low
Manis temminckii	Pangolin	Vulnerable	high
Mellivora capensis	Honey Badger	Near Threatened	moderate
Miniopterus schreibersii	Schreiber's Long-fingered Bat	Near Threatened	moderate
Mirounga leonina	Southern Elephant Seal	Endangered	low
Myosorex varius	Forest Shrew	Data Deficient	low
Mystromys albicaudatus	White-tailed Rat	Endangered	low
Otomys slogetti	Sloggett's Rat	Data Deficient	low
Panthera leo	Lion	Vulnerable	low
Paratomys littledalei	Littledale's Whistling Rat	Near Threatened	moderate
Petromys typicus	Dassie Rat	Near Threatened	low
Poecilogale albinucha	African Weasel	Data Deficient	moderate
Rhinolophus capensis	Cape Horseshoe Bat	Near Threatened	low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	Near Threatened	moderate
Rhinolophus darlingi	Darling's Horseshoe Bat	Near Threatened	moderate
Rhinolophus denti	Dent's Horseshoe Bat	Near Threatened	moderate
Rhinolophus fumigatus	Ruppel's Horseshoe Bat	Near Threatened	low
Suncus varilla	Lesser Dwarf Shrew	Data Deficient	confirmed
Tatera leucogaster	Bushveld Gerbil	Data Deficient	high
Xerus princeps	Mountain Ground Squirrel	Near Threatened	low

9.3.2 Brown Hyaena (*Hyaena brunnea*)

This species is found in southern Africa from Namibia in the north-west to Mozambique in the east and utilises a variety of relatively arid habitats from open desert to tree savanna. Brown Hyaena is an extremely efficient scavenger with an omnivorous diet. It is primarily a nocturnal animal, but is able to migrate great distances. The status of this species is Near Threatened on the IUCN Red List; it is generally considered widespread yet rare (the total population is estimated to be between 5,000 and 8,000).

9.3.3 South African Hedgehog (Atelerix frontalis)

This species occurs in a variety of habitats, excluding desert and high-rainfall areas. It eats various food items including insects, millipedes, earthworm, mice, lizards, fungi as well as certain fruit types. It is mainly nocturnal, resting up in dry vegetation or the burrows of other species during daytime. The status of this species is Near Threatened on the IUCN Red List.

9.3.4 Lesser Dwarf Shrew (Suncus varilla)

This species is widespread in South Africa, extending into East Africa, occurring in a broad range of habitats. Dwarf shrews eat insects and other small invertebrates; they are commonly associated with old termite mounds (as was the case in the study area) which provide food and shelter. The species is listed as Data Deficient on the IUCN Red List. This species was observed in old termite mounds, which were present across the study area. They, typically, were not present in high numbers; only two individuals were located.

9.3.5 Other Red Data Species

Another two Red Data species are considered highly likely to occur in the study area based on habitat preferences and availability of habitat, namely:

- *Tatera leucogaster* (Bushveld Gerbil, DD)
- *Manis temminckii* (Pangolin, VU)

9.4 FAUNAL HABITAT TYPES

The close relationship between vegetation units and specific faunal composition has been noted in several scientific studies. For the purpose of this investigation, floristic units are therefore considered representative of the faunal habitat types (Refer Figure 9). The following characteristics of untransformed habitat types are regarded pertinent.

9.4.1 *Closed Shrubveld*

- Significant shelter for medium and large mammals.
- Food provision for browsers, but little in terms of grazing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Include unique habitat characteristics (rockiness and steeper slopes) that are absent from the other faunal habitat types in the study area.
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.4.2 *Drainage Line*

- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes some unique habitat characteristics (wetland-related habitat characteristics) that are absent from other faunal habitat types in the study area.
- Is a scarce faunal habitat type within the study area, and probably in the region, represented by less than 12ha within the study area.
- Represents an important migration route for aquatic, amphibian and terrestrial animals within the study area as well as on a local scale.

9.4.3 *Floodplains*

- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Include some unique habitat characteristics (wetland-related habitat characteristics) that are absent from the other faunal habitat types in the study area.
- Is a scarce faunal habitat type (within the study area, probably in the region) represented by less than 44ha within the study area.

9.4.4 Grassland Plains

- Habitat largely untransformed, but some degradation due to management and over-grazing.
- Lack of significant shelter for medium and large mammals.
- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes very few unique habitat characteristics (that may be considered scarce in the region of the study area).
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.4.5 *Olea europaea* Woodland

- Food provision for both grazers and browsers.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Significant shelter for medium and large mammals present.
- Includes some unique habitat characteristics (closed woodland and *Olea europaea* specific characteristics) that are absent from the other faunal habitat types in the study area.
- Represents a scarce faunal habitat type (within the study area as well as in the general region); represented by less than 36ha within the study area.
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.4.6 Open Shrubveld

- Habitat type not transformed, but some degradation due to management and over-grazing.
- Lack of significant shelter for medium and large mammals.
- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes very few unique habitat characteristics (that may be considered scarce in the region of the study area).
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.5 Faunal Habitat Sensitivity Assessment

During the field assessment, the study area was investigated and assessed in terms of the following biodiversity attributes:

- Habitat status: level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity: the number of different faunal habitat types (both on micro- and macro-scale) found within the proposed site and bordering areas;
- Habitat linkage: the degree to which the faunal habitat of the proposed site is linked to other natural areas enabling movement of animals to and from the habitat found on site;
- Red Data species: the degree to which suitable habitat for the red data species likely to be found in the study area (larger study area) is located on each site; and
- Sensitive faunal habitat: the relative presence of faunal sensitive habitat type elements such as surface rock associated with outcrops and hills as well as wetland elements.

Table 12: **Faunal Habitat Sensitivities for the study area**

Community	Status	Diversity	Linkage	RD Likelihood	Habitat Sensitivity	Average	Sensitivity Class
Closed Shrubveld	8	7	7	7	8	74%	medium-high
Drainage Line	8	8	10	8	9	86%	high
Excavations	1	1	2	1	1	12%	low
Floodplains	8	9	9	8	8	84%	high
Grassland Plains	6	5	6	5	6	56%	medium
Homestead	1	1	1	1	1	10%	low
Olea woodland	8	9	7	8	8	80%	high
Open Shrubveld	6	5	6	6	6	58%	medium

Calculated faunal habitat sensitivities are similar to the floristic habitat sensitivities, for an illustration thereof, the reader is referred to Figure 8. The extent of habitat sensitivities within the study area is presented in Table 11.

Table 13: **Extent of faunal habitat sensitivities within the study area**

Habitat Sensitivity	Extent	Percentage
Low	24.0ha	1.7%
Medium	1,186.8ha	83.4%
Medium-high	115.8ha	8.1%
High	96.8ha	6.8%

9.6 DISCUSSION

The study area includes faunal habitat types of varying sensitivities, ecological system characteristics and functionalities. Based on habitat status (levels of degradation and transformation), habitat scarcity and general habitat sensitivity the faunal habitat types present in the study area were assigned various levels of faunal habitat sensitivity with regards to the proposed activity. Areas that have limited distribution within the larger region, as well as areas where unique biophysical attributes occur are regarded sensitive and should preferably be excluded from the proposed development, particularly all habitat types that have an aquatic origin. Sensitive habitat types include the Drainage line, Floodplains and Olea Woodland. These habitat types comprise a small portion of the entire study area, namely 6.6% (89.8 ha) in total.

When the proposed footprint for the development is evaluated, it is evident that only 12.1 ha (1.86%) of the proposed area comprises habitat of high faunal sensitivity (mainly Olea Woodland, 11.2 ha). This habitat type is limited in nature and occurs infrequently in the region. However, it is estimated that the faunal component of this habitat type is not likely to be significantly dissimilar to surrounding areas of shrubveld and woodland. The presence of a higher stratum of trees than surrounding woodland habitat is the main structural characteristic that differentiates this from other habitat types. Surrounding woodland and shrubland areas will therefore likely provide in the requirements of fauna species observed in this habitat. The loss of this habitat, when considered on a regional scale is regarded to be of medium importance and while it is not regarded a red flag for the proposed development, the conservation of remaining habitat located immediately outside the proposed footprint should be ensured.

A total of 629.4 ha (97.3%) of the proposed footprint area comprises habitat of medium faunal sensitivity, including the Grassland Plains and Open Shrubveld habitat. An important aspect is the loss of migration potential in an east-west direction for animals that utilises the grassland and low shrubveld habitat. It is however conceivable that animals will adapt and utilise other migration routes that is available to the north of the site. The general region comprises extensive areas of similar habitat and this proposed development is not regarded to contribute significantly to habitat fragmentation and isolation on a regional scale. The loss of these habitat types is regarded to be of medium importance, particularly because of the extensive size of the proposed development.

10 ECOLOGICAL INTERPRETATION

Results of the respective floristic- and faunal habitat sensitivity assessments are interpreted to present an estimation (Table 12) that would reflect the expected impact of the construction and operation of the proposed CSP site on the biological environment. While the estimations of habitat sensitivity, as presented in preceding chapters do provide an indication in terms of the extent and locality of important habitat, an interpretation of the surrounding habitat sensitivity is also implemented in these estimations.

Table 14: **Ecological Sensitivity of the study area**

Community	**Floristic Sensitivity**	**Faunal Sensitivity**	**Ecological Sensitivity**
Closed Shrubveld	medium-high	medium-high	**medium-high**
Drainage Line	high	high	**high**
Excavations	low	low	**low**
Floodplains	high	high	**high**
Grassland Plains	medium	medium	**medium**
Homestead	low	low	**low**
Olea woodland	high	high	**high**
Open Shrubveld	medium	medium	**medium**

Ascribed floristic and faunal sensitivities are similar in nature providing further evidence how the faunal status of an area reflects the floristic status. Since these sensitivities are similar, the reader is referred to Figure 8 for an illustration of the habitat sensitivities within the study area.

11 BIODIVERSITY IMPACT ASSESSMENT

Results of the floristic and faunal investigations were interpreted holistically in order to assess the potential impact on the ecological environment. The impact assessment is aimed at presenting a description of the nature, extent significance and potential mitigation of identified impacts on the biological environment. These tabular assessments are presented in Section 11.4 in the form of an Impact Rating Matrix for each identified impact within the respective habitat types.

Please note that only habitat types that exhibit attributes of Medium or higher sensitivities will be evaluated in this section. Impacts in areas of lower than Medium sensitivity are regarded acceptable and the implementation of generic mitigation measures is expected to result in minimising potential impacts within these areas. Habitat types that will be evaluated include:

- Closed Shrubveld;
- Drainage Line;
- Floodplains;
- Grassland Plains;
- Olea Woodland; and
- Open Shrubveld.

11.1 IDENTIFICATION OF IMPACTS

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status.

Impacts resulting from the proposed development on ecological attributes of the study area are largely restricted to the physical impacts on biota or the habitat in which they occur. Direct impacts include any impacts on populations of individual species of concern, including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof is immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. In addition, the extent of the effect is frequently large scale, mostly regional. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts.

Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

Eleven impacts were identified that are relevant to the proposed development and are placed in three categories, namely:

- **Direct impacts:**
  - Direct impacts on threatened flora species;
  - Direct impacts on protected tree species;
  - Direct impacts on threatened fauna species;
  - Loss, or disruption of mammal migration routes on a local scale;
  - Direct impacts on sensitive/ pristine habitat types of the study area;
  - Direct impacts on common fauna species occurring on the study area;
- **Indirect Impacts:**
  - Faunal interactions with structures, servitudes and personnel;
  - Impacts on surrounding habitat/ species, including ecosystem functioning;
- **Cumulative Impacts:**
  - Impacts on SA's conservation obligations & targets (VEGMAP vegetation types);
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation, pollution (air, soils, surface water).

Other, more subtle impacts on biological components, such as changes in local, regional and global climate, effects of noise pollution on fauna species, increase in acid rain, ground water deterioration, etc., are impacts that cannot be quantified to an acceptable level of certainty and is mostly subjective in nature as either little literature is available on the topic or contradictory information exist. These impacts are therefore omitted from this assessment.

11.2 NATURE OF IMPACTS

11.2.1 *Direct Impacts on Threatened Flora Species*

This is regarded as a direct impact since it results in the physical damage or destruction of Red Data species or areas that are suitable for these species, representing a significant impact on the biodiversity of a region. Threatened plant species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human activities is one of the greatest reasons for these species having a threatened status. Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.
One of the greatest limitations in terms of mitigating or preventing this particular impact, is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. To allow for an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited to some extent.

The likelihood of Red Data flora species occurring within the study area is regarded relatively low. Available data did not indicate the known presence of Red Data plants in the region. However, habitat types present on the property is in an optimum condition and Red Data plant species might be present. Since this survey was conducted during the winter, no definitive comments could be made about the absence of Red Data plants on the study area.

11.2.2 Direct Impacts on Protected Tree Species

When the proposed footprint is evaluated, it is clear that a number of protected tree species will be removed during construction. While *Acacia erioloba* and *Boscia albitrunca* occur in low numbers on the property, *Olea europaea* is present as shrubs in most of the woodland and shrubveld habitat types and as relatively dense stands of trees in the Olea Woodland. Impacts within this area in particular will result in direct and significant impacts on this protected tree. It is not regarded as a cause to stop the proposed development, since the species occurs in commonly across most of the region. In addition, most of the habitat where this species occurs is captured within areas where human related impacts are unlikely to happen, thereby ensuring adequate protection for the species.

However, this species is under increasing threat that causes a continuous decline in numbers and it has been placed in a Declining Category; it is a legal requirement to report the presence of this species to relevant authorities in order to monitor their numbers as well as impacts on the status of the species.

The presence of protected tree species on the property has been established and impacts on a number of these trees will occur.

11.2.3 Direct Impacts on Threatened Fauna Species

The presence of three Red Data fauna species on this property has been confirmed and any surface disturbance therefore represents a direct and significant impact on these species. While some of them are highly mobile and will ultimately be able to avoid impacts that result from the proposed development, some like the Lesser Dwarf Shrew will not be able to avoid effects of microhabitat destruction, such as the termite mounds, which they occupy. A direct approach can be implemented in order to relocate these animals to adjacent suitable habitat. Similar to Red Data plants, the presence of Red Data animal species is seen as a significant attribute to the biodiversity of an area. Any impact is therefore viewed as significant. Additional aspects that will be affected include migration patterns and suitable habitat for breeding and foraging purposes.

The presence of Red Data fauna species within the study area is confirmed.

11.2.4 Loss, or Disruption of Migration Routes

The region is characterised by untransformed and large expanses of relatively pristine woodland and grassland habitat types that will likely be occupied by a high diversity of animal species. Evidence of this snapshot investigation has confirmed this and it is therefore possible to assume that the animals that utilises these habitat types migrate across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors or habitat. The loss of an area as large, as this property, will affect the migration pattern of a number of species that are present in the immediate region. While larger animals are able to avoid unsuitable habitat, smaller animals might not be able to cross or avoid these areas.

The size of the proposed development implies that much of the natural habitat that is present on the study area will become unsuitable for a number of species that might utilise this area on a frequent or infrequent nature.

11.2.5 Direct Impacts on Sensitive/ Pristine Habitat Types

The loss/ change of pristine habitat types or habitat that are regarded sensitive as a result of restricted presence in the larger region (atypical habitat) represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of

significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities and faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region.

Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

Parts of the study area are regarded as highly sensitive.

11.2.6 Direct Impacts on Common Fauna Species

The likelihood of this direct impact occurring is relatively low due to the ability of most animal species to evacuate an area that becomes unsuitable. The presence of a relative diverse faunal species composition on this property has been established. Considering the low levels of habitat transformation and degradation of the surrounding region, most animal species are likely to evacuate towards adjacent areas of natural habitat during the development. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact, some species are not able to relocate, such as ground living and small species. The proposed development will result in severe impacts on these species.

While some fauna species are able to avoid areas of disturbance, some species are simply not able to relocate such vast distances. The proposed development will therefore result in destruction of these animals. It is unlikely that their conservation status will be affected, but any direct and sever impact on animals is considered significant.

11.2.7 Faunal Interactions with Structures, Servitudes & Personnel

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. While the structures are visible, injuries and death of animals could potentially occur because of accidental contact. An aspect that is of concern is the presence of vehicles on access and infrastructure roads, leading to road kills, particularly amongst nocturnal animals that abound in the study area.

The presence of personnel within the development area during construction and maintenance periods will inevitably result in some, but normally limited, contact with animals. While most of the larger animal species are likely to move away from humans, encounters with snakes and scorpions remain likely. Similarly, the presence of humans

within areas of natural habitat could potentially result in killing of animals by means of snaring, poaching, poisoning, trapping, etc.

The nature of the proposed development is expected to result in limited indirect impacts on the fauna species.

11.2.8 Impacts on Surrounding Habitat/ Species & Ecosystem Functioning

Surrounding areas and species present in the direct vicinity of the study area could potentially be affected by indirect impacts resulting from construction and operational activities. This indirect impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processed;
- Effects on pollinators; and
- Increased invasion by plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the drainage line, is regarded important. It is well known that the status of a catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines, such as the one on this property, might be insignificant on a regional scale, but the combined status of numerous such small drainage lines will determine the quality of larger rivers further downstream.

The nature of this impact dictates that potential impacts are likely to spread from the development area into bordering areas of high sensitivity.

11.2.9 Impacts on SA's Conservation Obligations & Targets

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types and while any impact that results in irreversible transformation of natural habitat is regarded significant, no significant disruption of ecosystem functioning is assumed in least threatened vegetation types, which still have more than 80% of their original extent untransformed.

Loss of parts of the natural vegetation is expected to result in an insignificant, indirect impact on the conservation status of the regional vegetation types; which is regarded Least Concern.

11.2.10 Increase in Local & Regional Fragmentation/ Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by extremely low levels of transformation and habitat fragmentation. Impacts from the proposed development are unlikely to increase regional or local levels of fragmentation and habitat isolation significantly.

11.2.11 Increase in Environmental Degradation

Cumulative impacts associated with this type of development could lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

The nature of the proposed development dictates that the biological environment is unlikely to be affected since no effluents, spillages or chemical are likely to be produced or transported. However, the general region is characterised by low levels of degradation, this impact therefore becomes more important since it represents the 'thin end of the wedge'.

11.3 Assessment of Impacts

In estimating the significance and likelihood of impacts of the proposed development on the biological environment, cognisance is taken of all biophysical, floristic and faunal attributes that characterise the study area as well as the immediate region. It represents a subjective interpretation of the biophysical attributes, estimated sensitivities of habitat types that are present on the study area as well as taking cognisance of the larger region and how the proposed project will affect the biodiversity issues on a larger scale. Impacts are assessed prior to as well as subsequent to the implementation of all recommended mitigation measures.

11.3.1 Impact Assessment Prior to Implementation of Mitigation Measures

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Closed Shrubveld Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	3	Negligible	10	medium
Direct impacts on Protected Trees	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on RD fauna	Negative	2	4	3	3	Negligible	12	high
Disruption of Migration Routes	Negative	1	4	2	2	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	1	4	3	2	Negligible	10	medium
Direct impacts on common fauna species	Negative	1	4	4	2	Negligible	11	medium
Faunal Interactions w structures	Negative	1	4	2	1	Negligible	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Negligible	12	high
Impacts on conservation targets	Negative	3	4	1	1	Negligible	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	medium
Average Impact Status							10.1	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Drainage Line Habitat Type								
Direct impacts on RD flora	Negative	2	4	2	3	Negligible	11	medium
Direct impacts on Protected Trees	Negative	2	4	1	2	Negligible	9	medium
Direct impacts on RD fauna	Negative	3	4	2	3	Negligible	12	high
Disruption of Migration Routes	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	4	Negligible	12	high
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	1	1	Negligible	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	3	4	3	3	Negligible	13	high
Impacts on conservation targets	Negative	3	4	2	2	Negligible	11	medium
Increase in fragmentation & isolation	Negative	2	4	1	2	Negligible	9	medium
Increase in environmental degradation	Negative	3	4	2	3	Negligible	12	high
Average Impact Status							10.6	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Floodplains Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	3	Negligible	10	medium
Direct impacts on Protected Trees	Negative	2	4	1	1	Negligible	8	medium
Direct impacts on RD fauna	Negative	3	4	2	3	Negligible	12	high
Disruption of Migration Routes	Negative	2	4	2	3	Negligible	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	4	Negligible	12	high
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	3	4	3	3	Negligible	13	high
Impacts on conservation targets	Negative	2	4	2	2	Negligible	10	medium
Increase in fragmentation & isolation	Negative	2	4	2	2	Negligible	10	medium
Increase in environmental degradation	Negative	2	4	2	3	Negligible	11	medium
Average Impact Status							10.5	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Grassland Plains Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	3	Marginal	10	medium
Direct impacts on Protected Trees	Negative	1	4	4	1	Marginal	10	medium
Direct impacts on RD fauna	Negative	2	4	4	4	Marginal	14	high
Disruption of Migration Routes	Negative	3	4	3	2	Marginal	12	high
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	2	Marginal	10	medium
Direct impacts on common fauna species	Negative	2	4	4	2	Marginal	12	high
Faunal Interactions w structures	Negative	2	4	3	1	Marginal	10	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Marginal	10	medium
Impacts on conservation targets	Negative	2	4	2	1	Marginal	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Marginal	9	medium
Average Impact Status							10.6	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Olea Woodland Habitat Type								
Direct impacts on RD flora	Negative	3	4	1	3	Marginal	11	medium
Direct impacts on Protected Trees	Negative	2	4	4	3	Marginal	13	high
Direct impacts on RD fauna	Negative	2	4	4	3	Marginal	13	high
Disruption of Migration Routes	Negative	3	4	2	2	Marginal	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	3	Marginal	12	high
Direct impacts on common fauna species	Negative	2	4	2	3	Marginal	11	medium
Faunal Interactions w structures	Negative	2	4	3	1	Marginal	10	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Marginal	12	high
Impacts on conservation targets	Negative	2	4	1	1	Marginal	8	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Marginal	9	medium
Average Impact Status							11.0	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Open Shrubveld Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	3	Marginal	10	medium
Direct impacts on Protected Trees	Negative	2	4	4	2	Marginal	12	high
Direct impacts on RD fauna	Negative	2	4	4	4	Marginal	14	high
Disruption of Migration Routes	Negative	2	4	3	2	Marginal	11	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	2	Marginal	11	medium
Direct impacts on common fauna species	Negative	2	4	4	2	Marginal	12	high
Faunal Interactions w structures	Negative	2	4	2	1	Marginal	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Marginal	10	medium
Impacts on conservation targets	Negative	2	4	2	1	Marginal	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium
Increase in environmental degradation	Negative	2	4	2	2	Marginal	10	medium

Average Impact Status	10.8	medium

11.3.2 Impact Assessment After Implementation of Mitigation Measures

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Closed Shrubveld Habitat Type								
Direct impacts on RD flora	Negative	1	2	1	1	Negligible	5	low
Direct impacts on Protected Trees	Negative	1	2	2	1	Negligible	6	medium
Direct impacts on RD fauna	Negative	2	2	1	1	Negligible	6	medium
Disruption of Migration Routes	Negative	1	2	1	1	Negligible	5	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	1	1	Negligible	5	low
Direct impacts on common fauna species	Negative	1	2	1	1	Negligible	5	low
Faunal Interactions w structures	Negative	1	2	1	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	1	Negligible	5	low
Impacts on conservation targets	Negative	3	4	1	1	Negligible	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	medium
Average Impact Status							6.5	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Drainage Line Habitat Type								
Direct impacts on RD flora	Negative	2	2	2	1	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	1	0	0	Negligible	2	low
Direct impacts on RD fauna	Negative	1	2	1	2	Negligible	6	medium
Disruption of Migration Routes	Negative	1	1	1	1	Negligible	4	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	1	2	Negligible	6	medium
Direct impacts on common fauna species	Negative	1	1	1	1	Negligible	4	low
Faunal Interactions w structures	Negative	1	1	2	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	2	Negligible	6	medium
Impacts on conservation targets	Negative	2	2	1	2	Negligible	7	medium
Increase in fragmentation & isolation	Negative	1	1	1	1	Negligible	4	low
Increase in environmental degradation	Negative	1	1	1	1	Negligible	4	low

Average Impact Status							5.0	low

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Floodplains Habitat Type								
Direct impacts on RD flora	Negative	2	2	1	2	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	1	0	0	Negligible	2	low
Direct impacts on RD fauna	Negative	1	2	1	2	Negligible	6	medium
Disruption of Migration Routes	Negative	1	1	1	1	Negligible	4	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	2	2	Negligible	7	medium
Direct impacts on common fauna species	Negative	1	2	1	1	Negligible	5	low
Faunal Interactions w structures	Negative	1	1	2	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	2	Negligible	6	medium
Impacts on conservation targets	Negative	1	2	1	1	Negligible	5	low
Increase in fragmentation & isolation	Negative	1	1	1	1	Negligible	4	low
Increase in environmental degradation	Negative	1	1	1	1	Negligible	4	low
Average Impact Status							5.0	low

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Grassland Plains Habitat Type								
Direct impacts on RD flora	Negative	2	4	0	1	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	4	4	1	Negligible	10	medium
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on pristine/ sensitive habitat	Negative	1	4	2	1	Negligible	8	medium
Direct impacts on common fauna species	Negative	1	4	4	2	Negligible	11	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	1	Negligible	9	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	medium

Average Impact Status	9.3	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Olea Woodland Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	1	Negligible	8	medium
Direct impacts on Protected Trees	Negative	2	4	4	2	Negligible	12	high
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	1	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	2	Negligible	11	medium
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Negligible	10	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	3	1	Negligible	10	medium
Increase in environmental degradation	Negative	2	4	1	1	Negligible	8	medium
Average Impact Status							9.5	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
Issues related to Biodiversity - Open Shrubveld Habitat Type								
Direct impacts on RD flora	Negative	2	4	1	2	Negligible	9	medium
Direct impacts on Protected Trees	Negative	2	4	4	1	Negligible	11	medium
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	1	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on common fauna species	Negative	2	4	3	1	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	1	1	Negligible	8	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	1	1	Negligible	8	medium

Increase in environmental degradation	Negative	2	4	1	1	Negligible	8	medium
Average Impact Status							9.1	medium

11.4 SUMMARY OF IMPACTS

Table 15: **Summary of impacts within respective habitat types**		
Habitat Type	**Impact without mitigation**	**Impact with mitigation**
Closed Shrubveld Habitat Type	10.1 (medium)	6.5 (medium)
Drainage Line Habitat Type	10.6 (medium)	5.0 (low)
Floodplains Habitat Type	10.5 (medium)	5.0 (low)
Grassland Plains Habitat Type	10.6 (medium)	9.3 (medium)
Olea Woodland Habitat Type	11.0 (medium)	9.5 (medium)
Open Shrubveld Habitat Type	10.8 (medium)	9.1 (medium)

11.5 DISCUSSION

The significance of impacts across the entire area is regarded medium. However, on closer inspection it is revealed that certain impacts, particularly those of a direct nature, are expected to result in significant impacts in localised parts of the study area. This is mainly the result of the environment and biodiversity that characterises the area being in a relatively pristine state, as well as the destructive effect that clearing of land will have on biodiversity attributes of the study area.

Of particular importance is the significance of impacts on Red Data animals. Some species are unable to evacuate the area with disturbance and will likely be destroyed. The only sensible mitigation measure will be to remove these animals by means of an intensive search and replace activity. The destruction of extensive areas on the property is also expected to result in significant impacts on fauna species present on the neighbouring areas that utilise this area on an infrequent basis.

The implementation of generic mitigation measures is expected to result in a reduction of the impacts, mostly to a medium significance. Site specific and detailed mitigation measures in certain areas of the property will reduce the significance of impacts within high sensitivity areas to an acceptable level.

Closed Shrubveld Habitat Type Impacts within this habitat type are regarded significant on a local scale, excluding this area from the development, as far as technically feasible, is recommended. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint. The loss of a small portion of this habitat type is not expected to result in significant impacts on a regional scale since much of this habitat are present to the north of this particular site, while the regional vegetation type is also afforded a Least Threatened status (VEGMAP). The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Drainage Line Habitat Type Any impact within this habitat type will be regarded as significant on a local and regional scale. Although the proposed footprint does

not include any part of this drainage line, the proximity of the drainage line to the development area will require strict management and development measures to prevent impacts to this area. Drainage of water from the development area towards this habitat will result in deterioration of the status on the site as well as in wetland habitat further downstream. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Floodplains Habitat Type Any impact within this habitat type will be significant on a local scale, excluding this area from the development represents the major mitigation measure. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint, but the proximity of these areas to the footprint will highly likely result in peripheral impacts affecting this area adversely. It should also be noted that this habitat type buffers the drainage line from the proposed development, keeping this buffer intact is therefore important in terms of preserving the drainage line. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level. This habitat type is suitable for the cryptic near endemic species *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae.* Due to the cryptic nature of this species, it is nonetheless recommended that a detailed walkthrough of all moderately suitable habitat be conducted prior to the commencement of construction activities.

Grassland Plains Habitat Type Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Olea Woodland Habitat Type A portion of this habitat type will be affected by the proposed development; the presence of protected tree species represents an important consideration. While the presence of these individuals does not represent a red flag to the development, careful planning and execution of development plans must be made to avoid impacts in adjacent parts of this habitat type. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

Open Shrubveld Habitat Type Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant

impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

12 RECOMMENDED MITIGATION MEASURES

12.1.1 *General Aspects*

Mitigation Measure 1 - Exclude all areas of the Drainage line and Floodplain habitat types from the proposed development. This should be done during the planning phase of the project;

Mitigation Measure 2 - Exclude as much of the Closed shrubveld habitat type from the proposed development as technically feasible. This should be done during the planning phase of the project;

Mitigation Measure 3 - Allow for a suitable buffer in order to provide some protection of sensitive areas against peripheral impacts, wetland related habitat types in particular. Al areas that were ascribed a High Ecological Sensitivity should be buffered against potential impacts. Guidelines of the wetland specialist should be implemented in this regard;

Mitigation Measure 4 - Appoint an Environmental Control Officer (ECO) prior to start of construction. Responsibilities should include, but not be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 5 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Environmental monitoring should be conducted at least twice per year (Summer, Winter);

Mitigation Measure 6 - Limit construction, maintenance and inspection activities to dry periods in order to curb occurrence/ augmentation of erosion in areas of existing erosion, destabilizing of substrate in areas of high slopes, drainage lines, etc;

Mitigation Measure 7 - Ensure off site storage of hazardous materials, chemicals, fuels, oils, etc. in order to prevent accidental spillage, contamination or pollution;

Mitigation Measure 8 - Develop emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas;

Mitigation Measure 9 - Construction sites/camps need a detailed ecological assessment prior to construction;

Mitigation Measure 10 - Limit damage to protected tree species in the Olea woodland as far as possible. Adapt layout plans to avoid any excessive damage to this habitat type;

Mitigation Measure 11 - All individuals/ stands of Protected trees must be clearly and visibly marked prior to the start of construction or maintenance procedures;

Mitigation Measure 12 - Implement strict erosion monitoring and management procedures in all areas where slopes are present.

12.1.2 Fences & Demarcation

Mitigation Measure 13 - Demarcate construction areas by semi-permanent means in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

Mitigation Measure 14 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

Mitigation Measure 15 - Marking of plants should be done by means of semi-permanent (removable) marker tape;

12.1.3 Fire

Mitigation Measure 16 - Prevent all open fires;

Mitigation Measure 17 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

12.1.4 Roads & Access

Mitigation Measure 18 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 19 - Vehicular traffic shall not be allowed in permanently wet areas, no damage shall be caused to wet areas. Where necessary, alternative methods of construction shall be used to avoid damage to wet areas.

Mitigation Measure 20 - Prohibit construction of new access roads. Use should be made of existing roads, ensuring proper maintenance/ upgrade. Alternative methods of construction/ access to sensitive areas is recommended;

Mitigation Measure 21 - The Contractor shall select a suitable level area free of rock and large bushes as lay down area;

Mitigation Measure 22 - The Contractor shall select an area a suitable distance from any sensitive environmental feature as a construction camp;

12.1.5 Workers & Personnel

Mitigation Measure 23 - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 24 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

Mitigation Measure 25 - Use of branches of trees and shrubs for fire making purposes is strictly prohibited;

12.1.6 *Vegetation Clearance & Operations*

Mitigation Measure 26 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 27 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area;

Mitigation Measure 28 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 29 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 30 - Cut vegetation (grass and shrubs) only if required. No clearing of vegetation or soil by grading machinery shall be undertaken;

Mitigation Measure 31 - The establishment and regrowth of alien vegetation must be controlled after the removal of grass;

Mitigation Measure 32 - All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);

Mitigation Measure 33 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 34 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 35 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 36 - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 37 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 38 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 39 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

Mitigation Measure 40 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act, No. 43 of 1983 and should be addressed on a continuous basis;

12.1.7 Animals

Mitigation Measure 41 - No animal may be hunted, trapped, snared or killed for any purpose whatsoever;

Mitigation Measure 42 - Conduct a search and rescue operation in all affected areas to remove animals from old termite mounds prior to the commencement of construction activities (vegetation clearing and ground levelling). Reptiles and small mammals that utilises these micro-habitat should be captured and released in suitable nearby areas;

Mitigation Measure 43 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 44 - Dangerous animals should be handled by a competent person;

Mitigation Measure 45 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction; and

Mitigation Measure 46 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

12.1.8 Protected Trees/ Conservation Important Species

Mitigation Measure 47 - Conduct a suitable assessment of the abundance and structure of protected tree species on the property to assist the client with regards to the submission of relevant applications;

Mitigation Measure 48 - Obtain necessary and required approval per application for damage/ removal/ cutting/ pruning of Protected tree species from Department of Forestry, as per National Forests Act (Act No. 84 of 1998) under Government Notice GN 1012 of 2004 and GN 767 of 2005 as well as NCDENC;

Mitigation Measure 49 - Cutting/ pruning/ damaging of any Protected tree species should not be allowed at any circumstances, unless a permit has been obtained for this purpose; and

Mitigation Measure 50 - Conduct a detailed walkthrough of moderately suitable habitat for *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae.* Implement a removal and relocation programme if required.


Photo 1: Example of the Open Shrubveld habitat type


Photo 2: Example of the Drainage Line habitat type, upper parts in southern section of the study area


Photo 3: Example Grassland Plains habitat type.


Photo 4: Example of the Olea Woodland habitat type

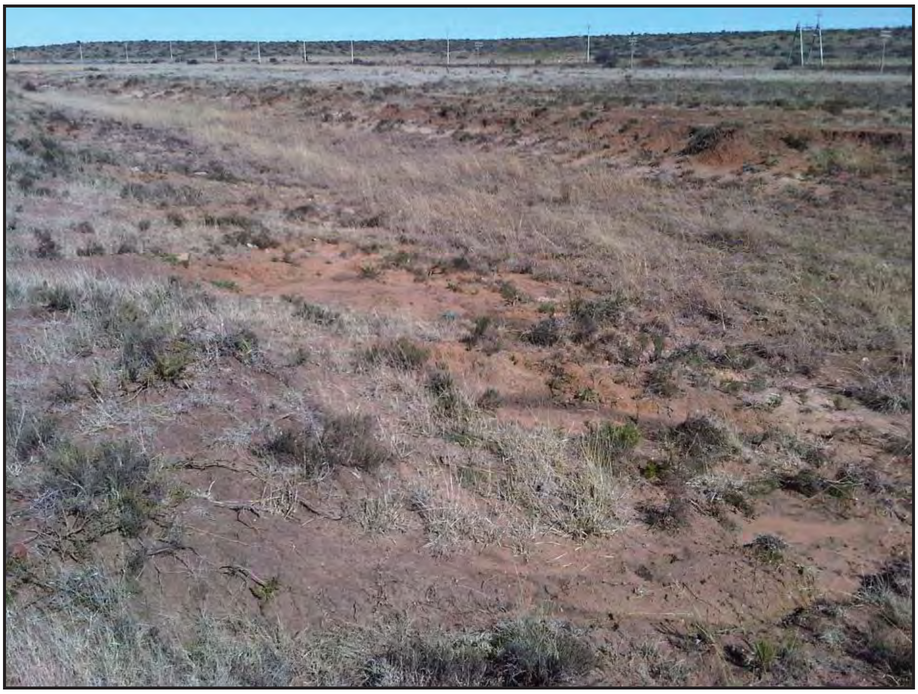

Photo 5: Example of the Drainage Line habitat type

Photo 6: Example of the Floodplains habitat type

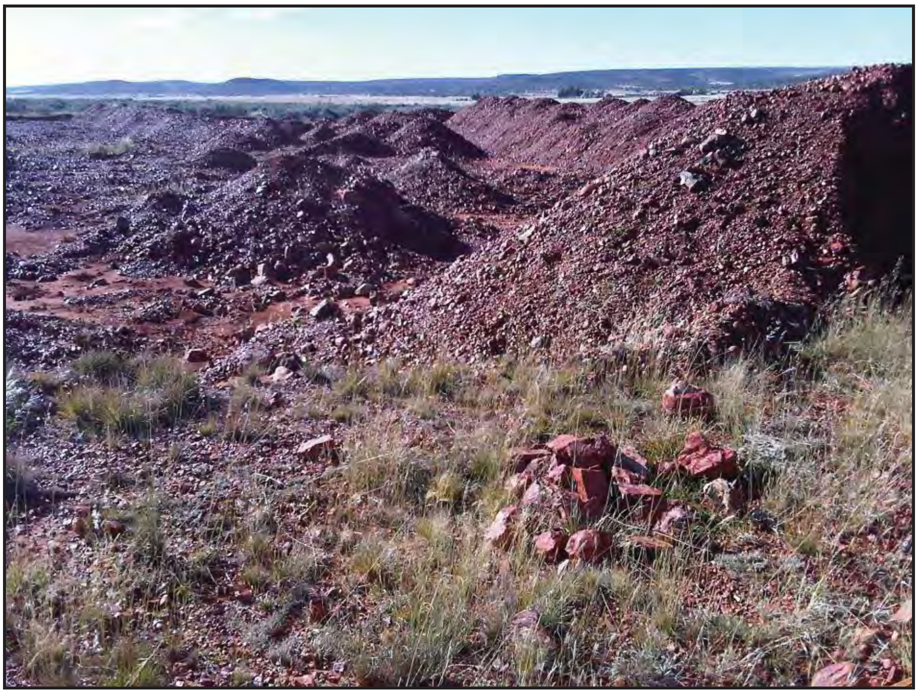
Photo 7: Example of informal mining operations on the property


Photo 8: Example of Closed Shrubveld habitat type

Species	Family	Threat status	Growth forms
Acacia haematoxylon	Fabaceae	LC	Shrub
Acacia hebeclada subsp. *hebeclada*	Fabaceae	LC	Shrub
Acacia tortilis subsp. *heteracantha*	Fabaceae	LC	Tree
Anthephora pubescens	Poaceae	LC	Graminoid
Antizoma angustifolia	Menispermaceae	LC	Climber
Aristida adscensionis	Poaceae	LC	Graminoid
Aristida congesta subsp. *congesta*	Poaceae	LC	Graminoid
Aristida meridionalis	Poaceae	LC	Graminoid
Aristida stipitata subsp. *spicata*	Poaceae	LC	Graminoid
Aristida vestita	Poaceae	LC	Graminoid
Asparagus suaveolens	Asparagaceae	LC	Shrub
Asplenium cordatum	Aspleniaceae	LC	Geophyte
Atriplex semibaccata var. *appendiculata*	Chenopodiaceae	LC	Dwarf shrub
Barleria bechuanensis	Acanthaceae	LC	Herb
Boscia albitrunca	Capparaceae	LC	Tree
Brachiaria marlothii	Poaceae	LC	Graminoid
Caesalpinia gilliesii	Fabaceae	NE	Shrub
Calobota cuspidosa	Fabaceae		Shrub
Chascanum pinnatifidum var. *pinnatifidum*	Verbenaceae	LC	Herb
Cheilanthes eckloniana	Sinopteridaceae	LC	Geophyte
Cheilanthes hirta var. *hirta*	Sinopteridaceae	LC	Geophyte
Chenopodium hederiforme var. *dentatum*	Chenopodiaceae	LC	Herb
Chloris virgata	Poaceae	LC	Graminoid
Cirsium vulgare	Asteraceae	NE	Herb
Cleome angustifolia subsp. *diandra*	Capparaceae	LC	Herb
Coccinia sessilifolia	Cucurbitaceae	LC	Climber
Convolvulus boedeckerianus	Convolvulaceae	LC	Herb
Cucumis heptadactylus	Cucurbitaceae	LC	Herb
Cynodon dactylon	Poaceae	LC	Graminoid
Datura inoxia	Solanaceae	NE	Herb
Deverra burchellii	Apiaceae	LC	Shrub
Digitaria eriantha	Poaceae	LC	Graminoid
Diospyros austro-africana var. *microphylla*	Ebenaceae	LC	Shrub
Ehretia alba	Boraginaceae	LC	Shrub
Enneapogon desvauxii	Poaceae	LC	Graminoid
Enneapogon scoparius	Poaceae	LC	Graminoid
Eragrostis bicolor	Poaceae	LC	Graminoid
Eragrostis echinochloidea	Poaceae	LC	Graminoid
Eragrostis homomalla	Poaceae	LC	Graminoid
Eragrostis lehmanniana var. *lehmanniana*	Poaceae	LC	Graminoid
Eragrostis mexicana subsp. *virescens*	Poaceae	NE	Graminoid
Eragrostis pallens	Poaceae	LC	Graminoid
Eragrostis pilgeriana	Poaceae	LC	Graminoid
Eragrostis porosa	Poaceae	LC	Graminoid
Eragrostis procumbens	Poaceae	LC	Graminoid
Eragrostis trichophora	Poaceae	LC	Graminoid
Eragrostis truncata	Poaceae	LC	Graminoid

Species	Family	Threat status	Growth forms
Eriocephalus ericoides subsp. *griquensis*	Asteraceae	LC	Shrub
Erucastrum strigosum	Brassicaceae	LC	Herb
Eucalyptus camaldulensis	Myrtaceae	NE	Tree
Euclea crispa subsp. *ovata*	Ebenaceae	LC	Shrub
Euphorbia duseimata	Euphorbiaceae	LC	Dwarf shrub
Euphorbia mauritanica var. *mauritanica*	Euphorbiaceae	LC	Succulent
Geigeria filifolia	Asteraceae	LC	Herb
Glossochilus burchellii	Acanthaceae	LC	Herb
Gnidia polycephala	Thymelaeaceae	LC	Dwarf shrub
Gymnosporia buxifolia	Celastraceae	LC	Shrub
Helichrysum cerastioides var. *cerastioides*	Asteraceae	LC	Herb
Helichrysum zeyheri	Asteraceae	LC	Dwarf shrub
Heliophila suavissima	Brassicaceae	LC	Dwarf shrub
Heliotropium ciliatum	Boraginaceae	LC	Herb
Hermannia comosa	Malvaceae	LC	Herb
Hermannia eenii	Malvaceae	LC	Herb
Hermannia erodioides	Malvaceae	LC	Herb
Hermannia jacobeifolia	Malvaceae	LC	Dwarf shrub
Hermbstaedtia fleckii	Amaranthaceae	LC	Herb
Hermbstaedtia odorata var. *aurantiaca*	Amaranthaceae	LC	Herb
Hertia ciliata	Asteraceae	LC	Succulent
Heteropogon contortus	Poaceae	LC	Graminoid
Hyparrhenia hirta	Poaceae	LC	Graminoid
Hypertelis salsoloides var. *salsoloides*	Molluginaceae	LC	Dwarf shrub
Indigofera alternans var. *alternans*	Fabaceae	LC	Herb
Indigofera denudata	Fabaceae	LC	Shrub
Ipomoea oenotheroides	Convolvulaceae	LC	Succulent
Jamesbrittenia atropurpurea subsp. *atropurpurea*	Scrophulariaceae	LC	Dwarf shrub
Jamesbrittenia aurantiaca	Scrophulariaceae	LC	Herb
Jamesbrittenia tysonii	Scrophulariaceae	LC	Dwarf shrub
Juncus rigidus	Juncaceae	LC	Herb
Justicia puberula	Acanthaceae	LC	Dwarf shrub
Kedrostis foetidissima	Cucurbitaceae	LC	Climber
Kohautia cynanchica	Rubiaceae	LC	Herb
Kyphocarpa angustifolia	Amaranthaceae	LC	Herb
Lactuca inermis	Asteraceae	LC	Herb
Laggera decurrens	Asteraceae	LC	Herb
Lantana rugosa	Verbenaceae	LC	Shrub
Lessertia affinis	Fabaceae	LC	Herb
Leucas capensis	Lamiaceae	LC	Dwarf shrub
Limeum argute-carinatum var. *argute-carinatum*	Molluginaceae	LC	Herb
Lopholaena cneorifolia	Asteraceae	LC	Succulent
Lycium horridum	Solanaceae	LC	Dwarf shrub
Melinis repens subsp. *repens*	Poaceae	LC	Graminoid
Melolobium microphyllum	Fabaceae	LC	Dwarf shrub
Menodora africana	Oleaceae	LC	Dwarf shrub
Mirabilis jalapa	Nyctaginaceae	NE	Herb
Monechma divaricatum	Acanthaceae	LC	Shrub
Nemesia lilacina	Scrophulariaceae	LC	Herb
Oenothera indecora	Onagraceae	NE	Herb

Species	Family	Threat status	Growth forms
Olea europaea subsp. *africana*	Oleaceae	LC	Tree
Ornithoglossum dinteri	Colchicaceae	LC	Geophyte
Osteospermum spinescens	Asteraceae	LC	Shrub
Oxalis depressa	Oxalidaceae	LC	Geophyte
Oxalis lawsonii	Oxalidaceae	LC	Geophyte
Pachypodium succulentum	Apocynaceae	LC	Succulent
Panicum stapfianum	Poaceae	LC	Graminoid
Parkinsonia aculeata	Fabaceae	NE	Shrub
Pavonia burchellii	Malvaceae	LC	Dwarf shrub
Pelargonium multicaule subsp. *multicaule*	Geraniaceae	LC	Dwarf shrub
Peliostomum leucorrhizum	Scrophulariaceae	LC	Dwarf shrub
Pentarrhinum insipidum	Apocynaceae	LC	Climber
Pentzia quinquefida	Asteraceae	LC	Shrub
Plantago lanceolata	Plantaginaceae	LC	Herb
Platycarphella parvifolia	Asteraceae		Herb
Pogonarthria squarrosa	Poaceae	LC	Graminoid
Pollichia campestris	Caryophyllaceae	LC	Herb
Pteronia cylindracea	Asteraceae	LC	Shrub
Rosenia humilis	Asteraceae	LC	Shrub
Salvia disermas	Lamiaceae	LC	Herb
Salvia stenophylla	Lamiaceae		Herb
Salvia verbenaca	Lamiaceae	LC	Herb
Schmidtia kalahariensis	Poaceae	LC	Graminoid
Searsia lancea	Anacardiaceae	LC	Tree
Searsia pendulina	Anacardiaceae	LC	Shrub
Searsia pyroides var. *pyroides*	Anacardiaceae	LC	Shrub
Searsia tridactyla	Anacardiaceae	LC	Shrub
Selago albida	Scrophulariaceae	LC	Dwarf shrub
Selago mixta	Scrophulariaceae	LC	Herb
Senecio carnosus	Asteraceae	LC	Herb
Sericorema sericea	Amaranthaceae	LC	Herb
Sesamum triphyllum var. *triphyllum*	Pedaliaceae	LC	Herb
Solanum namaquense	Solanaceae	LC	Dwarf shrub
Sporobolus fimbriatus	Poaceae	LC	Graminoid
Stachys spathulata	Lamiaceae	LC	Herb
Stipagrostis ciliata var. *capensis*	Poaceae	LC	Graminoid
Stipagrostis uniplumis var. *uniplumis*	Poaceae	LC	Graminoid
Tarchonanthus camphoratus	Asteraceae	LC	Shrub
Tecoma stans var. *stans*	Bignoniaceae	NE	Shrub
Themeda triandra	Poaceae	LC	Graminoid
Thesium lacinulatum	Santalaceae	LC	Dwarf shrub
Tragus racemosus	Poaceae	LC	Graminoid
Triraphis purpurea	Poaceae	LC	Graminoid
Typha capensis	Typhaceae	LC	Herb
Viscum rotundifolium	Viscaceae	LC	Parasite
Wahlenbergia androsacea	Campanulaceae	LC	Herb
Withania somnifera	Solanaceae	LC	Dwarf shrub
Zinnia peruviana	Asteraceae	NE	Herb
Zygophyllum pubescens	Zygophyllaceae	LC	Dwarf shrub

15 APPENDIX 2 – FLORISTIC DIVERSITY OF THE SITE

Species	Family	Growth form	Status/ Uses/ Properties
Acacia erioloba	Fabaceae	Tree	Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood
Acacia hebeclada	Fabaceae	Shrub	Indigenous invader, declared indicator of encroachment
Acacia karroo	Fabaceae	Tree	Edible parts, dyes and tans, medicinal uses, firewood
Acacia mellifera	Fabaceae	Shrub	Declared indicator of encroachment, medicinal uses, poison source
Albuca cf longipes	Liliaceae	Geophyte	None
Aloe grandidentata	Liliaceae	Succulent	None
Alternanthera pungens	Amaranthaceae	Forb	Weed, pioneer species
Aptosimum albomarginatum	Scrophulariaceae	Forb	None
Arctotis arctotoides	Asteraceae	Forb	None
Argemone ochroleuca	Papaveraceae	Forb	Declared Invader - Category 1
Aristida congesta subsp. *barbicollis*	Poaceae	Grass	None
Aristida congesta subsp. *congesta*	Poaceae	Grass	None
Aristida meridionalis	Poaceae	Grass	None
Aristida species	Poaceae	Grass	None
Aristida stipitata	Poaceae	Grass	None
Asparagus species	Liliaceae	Shrub	None
Babiana hypogea	Iridaceae	Geophyte	Edible parts
Babiana species	Iridaceae	Geophyte	None
Berkheya species	Asteraceae	Forb	Weed
Bidens pilosa	Asteraceae	Forb	Weed, edible parts
Boophane disticha	Amaryllidaceae	Geophyte	Poisonous, medicinal uses
Boscia albitrunca	Capparaceae	Tree	Protected Tree (National Forest Act, 1998)
Brachiaria nigropedata	Poaceae	Grass	None
Brachiaria serrata	Poaceae	Grass	None
Brunsvigia bosmaniae	Amaryllidaceae	Geophyte	None
Brunsvigia natalensis	Amaryllidaceae	Geophyte	None
Bulbine abyssinica	Liliaceae	Succulent	None
Bulbine narcissifolia	Liliaceae	Succulent	Medicinal uses
Bulbine species	Liliaceae	Succulent	None

Species	Family	Growth form	Status/ Uses/ Properties
Calobota cuspidosa	Fabaceae	Shrub	None
Cenchrus ciliaris	Poaceae	Grass	Palatable grazing species, Decreaser
Ceratotheca triloba	Pedaliaceae	Forb	Medicinal properties
Chaenostoma halimifolium	Scrophulariaceae	Forb	None
Chasmatophyllum musculinum	Mesembryanthemaceae	Succulent	None
Chloris virgata	Poaceae	Grass	None
Colchicum melanthioides	Colchicaceae	Geophyte	None
Crassula species	Crassulaceae	Succulent	None
Cyanotis speciosa	Commelinaceae	Forb	Medicinal properties
Cymbopogon plurinodis	Poaceae	Grass	Unpalatable grazing
Cynodon dactylon	Poaceae	Grass	Indicator of disturbed areas, grazing potential
Cyperus esculentus	Cyperaceae	Sedge	Weed, edible parts
Cyperus species	Cyperaceae	Sedge	None
Datura stramonium	Solanaceae	Forb	Declared Invader - Category 1, weed
Dicoma capensis	Asteraceae	Forb	Medicinal uses
Dicoma schinzii	Asteraceae	Forb	Medicinal uses
Digitaria eriantha	Poaceae	Grass	Weaving, palatable
Digitaria monodactyla	Poaceae	Grass	None
Digitaria tricholaenoides	Poaceae	Grass	None
Echinochloa colona	Poaceae	Grass	None
Echinopsis sphaciana	Cactaceae	Succulent	Declared Invader - Category 1
Ehretia rigida	Ehretiaceae	Shrub	None
Elionurus muticus	Poaceae	Grass	None, unpalatable
Enneapogon scoparius	Poaceae	Grass	None
Eragrostis curvula	Poaceae	Grass	Edible parts, indicator of degraded areas
Eragrostis echinochloidea	Poaceae	Grass	None
Eragrostis lehmanniana	Poaceae	Grass	Weaving
Eragrostis obtusa	Poaceae	Grass	Indicator of poor habitat conditions
Eragrostis plana	Poaceae	Grass	Weaving, unpalatable, indicator of degraded areas
Eragrostis racemosa	Poaceae	Grass	Palatable grazing
Eragrostis rigidior	Poaceae	Grass	None
Eragrostis species	Poaceae	Grass	None

Species	Family	Growth form	Status/ Uses/ Properties
Eriocephalus species	Asteraceae	Shrub	None
Eriocephalus spinescens	Asteraceae	Shrub	None
Euclea crispa	Ebenaceae	Shrub	Medicinal uses
Euclea undulata	Ebenaceae	Shrub	Firewood
Euphorbia clavarioides	Euphorbiaceae	Succulent	None
Euryops multifidus	Asteraceae	Shrub	None
Falkia oblonga	Convolvulaceae	Forb	None
Felicia species	Asteraceae	Forb	None
Fingerhuthia africana	Poaceae	Grass	Moderate grazing potential
Gazania krebsiana	Asteraceae	Forb	None
Geigeria species	Asteraceae	Forb	None
Gnidia species	Thymelaeaceae	Forb	None
Gnidia species	Thymelaeaceae	Shrub	None
Gomphocarpus fruticosus	Asclepiadaceae	Shrub	Medicinal uses
Grewia flava	Tiliaceae	Shrub	Edible parts, weaving
Gymnosporia buxifolia	Celastraceae	Shrub	None
Helichrysum argyrosphaerum	Asteraceae	Forb	None
Helichrysum species	Asteraceae	Forb	None
Heliotropium ciliatum	Boraginaceae	Forb	None
Hermannia althaefolia	Sterculiaceae	Forb	None
Hermannia coccocarpha	Sterculiaceae	Forb	None
Hermannia species	Sterculiaceae	Forb	None
Heteropogon contortus	Poaceae	Grass	None
Hibiscus species	Malvaceae	Forb	None
Homeria pallida	Iridaceae	Geophyte	None
Indigofera species	Fabaceae	Forb	None
Jamesbrittenia aurantiaca	Scrophulariaceae	Forb	None
Kalanchoe species	Crassulaceae	Succulent	None
Kyphocarpa angustifolia	Amaranthaceae	Forb	None
Lachenalia species	Hyacinthaceae	Geophyte	None
Lactuca capensis	Asteraceae	Forb	None
Ledebouria cooperi	Liliaceae	Geophyte	None

Species	Family	Growth form	Status/ Uses/ Properties
Ledebouria revoluta	Liliaceae	Geophyte	Edible parts
Ledebouria species	Liliaceae	Geophyte	None
Leonotis ocymifolia var. *raineriana*	Lamiaceae	Forb	Medicinal uses, colours & dyes
Leucas capensis	Lamiaceae	Forb	None
Lobelia species	Lobeliaceae	Forb	None
Lotononis species	Fabaceae	Forb	None
Lycium bosciifolium	Solanaceae	Shrub	None
Malva species	Malvaceae	Forb	None
Massonia species	Hyacinthaceae	Geophyte	None
Melinis nerviglumis	Poaceae	Grass	Increaser I
Melolobium canescens	Fabaceae	Shrub	Non
Melolobium species	Fabaceae	Shrub	None
Microchloa caffra	Poaceae	Grass	None
Monsonia angustifolia	Geraniaceae	Forb	None
Nananthus aloides	Mesembryanthemaceae	Succulent	None
Opuntia ficus-indica	Cactaceae	Succulent	Declared Invader - Category 1
Oxalis species	Oxalidaceae	Geophyte	None
Pachypodium species	Apocynaceae	Succulent	None
Persicaria lapathifolia	Polygonaceae	Hydrophilic	Indicator of moist conditions
Pogonarthria squarrosa	Poaceae	Grass	Unpalatable, indicator of poor habitat conditions
Polygala hottentotta	Polygalaceae	Forb	None
Pteronia pallens	Asteraceae	Shrub	None
Rhigozum trichotomum	Bignoniaceae	Shrub	Declared indicator of encroachment
Rhynchosia totta	Fabaceae	Forb	None
Ruschia species	Aizoaceae	Succulent	None
Sarcocaulon species	Geraniaceae	Succulent	None
Scabiosa columbaria	Dipsacaceae	Forb	Medicinal uses
Schinus molle	Anacardiaceae	Tree	Exotic, invasive, S. America
Schkuhria pinnata	Asteraceae	Forb	Medicinal uses, weed (S. America)
Schmidtia pappophoroides	Poaceae	Grass	None
Schoenoplectus corymbosus	Cyperaceae	Sedge	None
Searsia lancea	Anacardiaceae	Tree	Edible parts, tanning

Species	Family	Growth form	Status/ Uses/ Properties
Searsia pentheri	Anacardiaceae	Shrub	None
Searsia tridactyla	Anacardiaceae	Shrub	None
Solanum panduriforme	Solanaceae	Forb	Weed
Sonchus species	Asteraceae	Forb	None
Sporobolus africanus	Poaceae	Grass	Palatable, indicator of degraded areas
Sporobolus nitens	Poaceae	Grass	None
Sporobolus pectinatus	Poaceae	Grass	None
Stipagrostis ciliata	Poaceae	Grass	None
Sutherlandia frutescens	Fabaceae	Forb	Medicinal uses
Sutherlandia frutescens	Fabaceae	Shrub	Medicinal uses
Tagetes minuta	Asteraceae	Forb	Essential oils, colours & dyes
Tarchonanthus camphoratus	Asteraceae	Shrub	Medicinal uses
Themeda triandra	Poaceae	Grass	Palatable grazing
Trichoneura grandiglumis	Poaceae	Grass	None
Wahlenbergia species	Campanulaceae	Forb	None
Walafrida densiflora	Selaginaceae	Forb	None
Xanthium strumarium	Asteraceae	Forb	Category 1, weed (S. America)
Zaluzianskya species	Scrophulariaceae	Forb	None
Ziziphus mucronata	Rhamnaceae	Shrub	Edible parts, medicinal uses

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Appendix H

Waste Assessment

WorleyParsons

resources & energy

EcoNomics

SOLAR RESERVE

SOLARRESERVE

Basis of Design Report

Brine Evaporation Ponds for the Humansrus Solar Reserve Project

257000-PW0 – 1

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Solar Reserve

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Incorporating KV3 ENGINEERS

WorleyParsons

resources & energy

EcoNomics

SOLAR RESERVE

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PROJECT 257000-PW0 - BASIS OF DESIGN REPORT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	Author	A Reviewer	N/A	2011-10-24	N/A	

CONTENTS

1. BACKGROUND

1.1 INTRODUCTION

SolarReserve SA (Pty) LTD (hereafter referred to as SRSA), Kensani Capital Investments and Intikon Energy have entered into a Joint Development Agreement for the proposed development of a Central Receiver Power plant. The development is situated in the Northern Cape on the Farm 469 Humansrus near Postmasburg. The proposed development will fall under the Tsantsabane Local and Siyanda District Municipal Area. Electricity generated will be fed into the national power grid. The nature of the proposed development is two-fold and will entail the construction of a Central Receiver Tower or Concentrated Solar Power plant (hereafter referred to as CSP Plant) and a Photovoltaic Plant (hereafter referred to as PV Plant) on the same property.

The purpose of this report will be primarily for documenting of the basis of design for the final waste disposal facility for the CSP plant. The final waste product from the entire plant will be an effluent (brine) that will be handled in a zero discharge method i.e. the final effluent will be evaporated by means of an evaporation pond. The information in this report will be used for the planning and licensing of the said facility.

1.2 SCOPE OF WORK

WorleyParsons RSA is required under this appointment to provide the basis of design and positioning of the evaporation ponds for the CSP plant for planning and licensing purposes. The basis of design has to be in line with the requirements of the Local and the National Environmental Authorities.

The basis of design included the following tasks:

1. Waste Classification,
2. Pond sizing and positioning,
3. Liner Design, and
4. Design report and quantities estimation

2. DESCRIPTION OF THE SITE

2.1 LOCATION AND GENERAL DESCRIPTION

The site is located 30 km from Postmasburg and about 165 km from Kimberley along the R 385 road just north west of Lime Acres and south west of Danielskuil at georeference Latitude 28º 17' S and Longitude 23° 22' E. The location of the development can be seen in Figure 1.

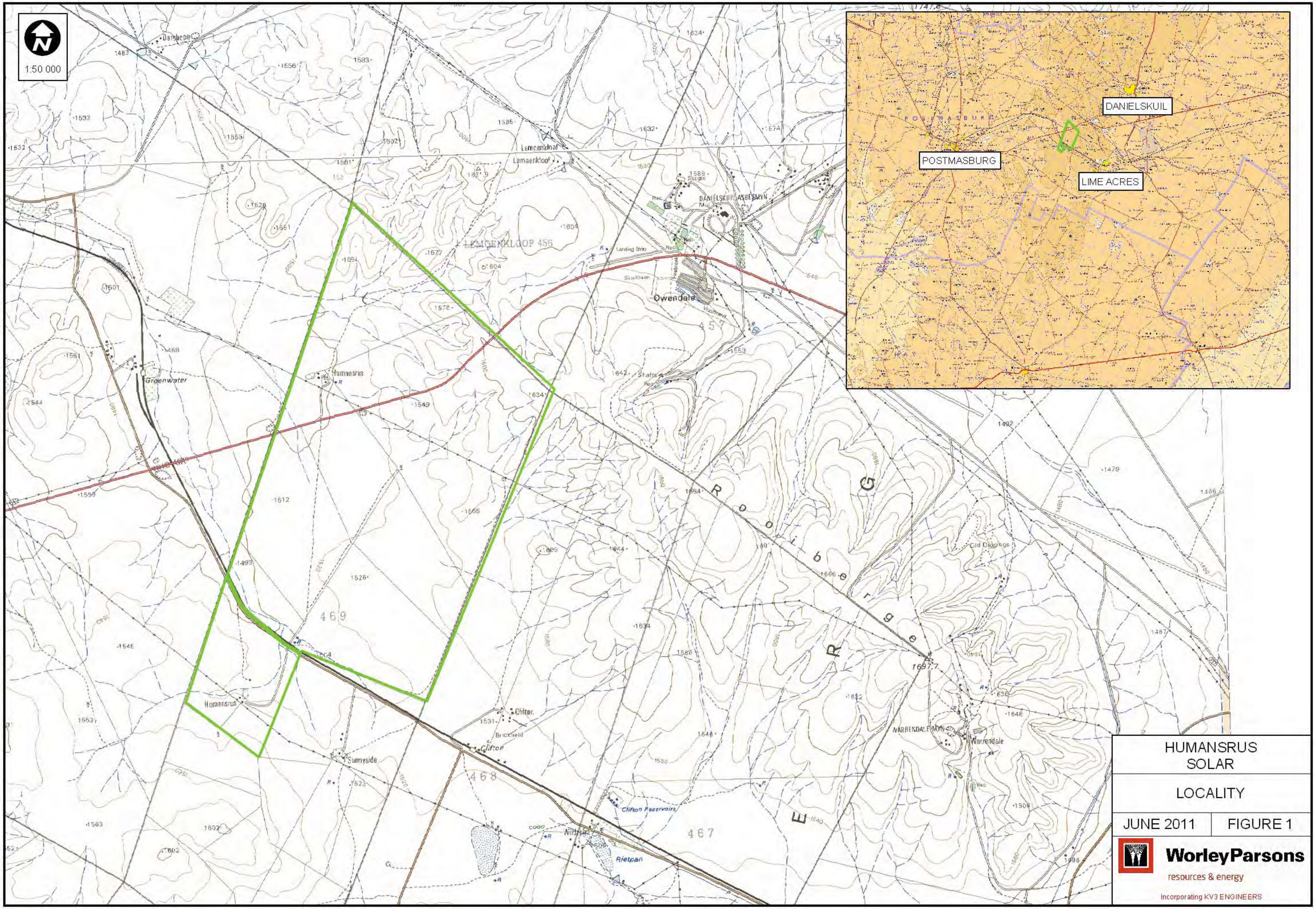
2.2 TOPOGRAPHY AND DRAINAGE

The site is relatively flat and slopes down from the north – east corner to the south – west corner. A small rock outcrop exists to the north of the site. There are some non-perennial lines in the south west corner of the site which is dry most of the year. Water will only flow briefly and during heavy and intense storms. This drainage system exists behind an outcrop of jasperlites and dolerites, the flow of this system is highly intermittent and a response to occasional intense rainfalls.

2.3 VEGETATION AND LAND USE

The site is historically agricultural land for use as grazing for domestic animals. The site is mainly grasslands with small shrubs and a few small trees.

Figure 1: Locality Map Humansrus Solar Reserve



HUMANSRUS SOLAR

LOCALITY

JUNE 2011 | FIGURE 1

WorleyParsons
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Incorporating KV3 ENGINEERS

2.4 CLIMATIC DATA

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000 indicate that January is the hottest month with an average maximum daily temperature of 32ºC and June the coldest with an average maximum daily temperature of 18ºC. During June and July the average minimum daily temperature drops to below 3ºC. The data also indicates that the absolute maximum temperature recorded during the period was 40.9ºC and the lowest -8.1ºC.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in Table 2 below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 1: Monthly Precipitation for the Humansrus

Average monthly precipitation in mm at Measuring Station Coordinates: S28º18' E023º22'												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean:	64.7	76.3	77.8	42.5	15	5.2	3.6	5.6	11.2	22.2	31.3	45.9	401.1
Standard Deviation:	46	50.9	49.7	35.2	18.6	10.1	8.2	11.2	17.0	24.1	28.4	36.5	107.9

2.5 HYDROLOGY AND SOILS

The area is covered with sands that have a high porosity and infiltration capacity and can be classified as soils with a deep Hutton profile (See MacVicar et al., 1997). Infiltration is likely to be rapid, and surface water will exist for a short time only. Surface water flows that may be generated in the hills to the north and east infiltrate rapidly into the substrata near the edges of the break in slope, creating opportunities for infiltration to groundwater greater than would be possible from rainfall directly onto the surface.

For the detailed hydrology report please refer to **Annexure A**: Surface Hydrology Scoping Report, One World, 5 August 2011.

2.6 GEOLOGY

The geology of the study area is the eastern flank of the Dimoten Syncline striking in a general north-south direction. The Preliminary Assessment of the Groundwater Resources Report completed by SRK Consulting Engineers indicates that significant parts of the study area are covered by recent

deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersected argillaceous, loose and well weathered material up to 30 mbgl, however this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales and banded ironstone, which were deposited after a period of erosion forming an unconformity in this specific area. The upper part of this Formation consists of a 1–3 m thick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic andesitic lavas of the Ongeluk Formation. This Makganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the CSP plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus. The area between these faults has apparently been displaced downwards to form a graben structure.

For more information please refer to **Annexure B**: Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Groundwater Assessment, SRK Consulting, July 2011.

2.7 HYDROGEOLOGY

Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers. This type of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operates in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shale and mudstone, which rather deform than fracture under stress.

Some unconfined interganular aquifers (also known as primary aquifers) also occur in and near the main drainage channel of the area at Groenwater station north-west of Humansrus. H ere the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. A ll these result in a poor ly developed primary aquifer that is very vulnerable to droughts.

For more information please refer to **Annexure B**: Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Groundwater Assessment, SRK Consulting, July 2011.

2.8 AQUIFER VULNERABILITY

Aquifer vulnerability as determined by evaluating seven parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible away from the high risk areas in the north and east. Best position will be in the south-western parts of the farm where the aquifer vulnerability is the lowest.

For more information please refer to **Annexure B**: Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Groundwater Assessment, SRK Consulting, July 2011.

2.9 WASTE CLASSIFICATION

The Counsel for Scientific and Industrial Research (CSIR) was approached to do the waste classification for the brine that is going to be disposed of on site. The following is the findings from the study the CSIR conducted.

According to the 2nd edition of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (1998) most waste disposal scenarios assume a solid with no significant head of liquid on the liners of the disposal site.

The sample originates from borehole water and is assumed to contain mostly major cations and anions and little if any heavy and trace metals. Only results for these were available.

The main concern for consideration should be the protection of ground and surface waters. Impacts could include human health (drinking), aquatic ecosystems, and commercial users (e.g. irrigation).

2.9.1 Classification of samples.

The Brine sample did not delist for either the 1 or 100 ha scenarios. Even though the suitability of the classification criteria of the minimum requirements to liquid wastes is not ideal the classification shows that the liquid as such is still hazardous (moderate hazard, Hazard rating 3).

The brine is an inorganic process wastes or residues and was classified as class 6 (Poisonous (toxic) substances) according to the SABS 0228 code.

2.9.2 Comparison with wastewater standards.

The elements analyzed and found in brine were compared with the general and special limits for wastewater discharge published in terms of the National Water Act (Act no. 36 of 1998)(NWA). The nitrate/nitrite content does meet the general limit and the fluoride exceeds the limit only by 0.6 mg/l as F, but the main concern is the total salt load. When the maximum loads allowed is compared with the calculated TDS content it is clear that disposal of the Brine as a wastewater will not be allowed. Using the estimated values the Brine exceeds the maximum level allowed by 3 to 4 times. Such levels will also contribute to “shock loads” where the salinity of the surface water can change significantly. Typically the published limits only allow an increase in dissolved solids content of approximately 300 to 450 mg/l.

Total dissolved solids is not necessarily toxic, but can affect natural aquatic systems negatively with effects on individual species, the overall community present in the system and on microbial and ecological processes. Though an index like the sodium absorption ratio (SAR) is a complex issue, high salt content in surface or groundwater increases the likelihood of negative effects if the water is used for irrigation.

2.9.3 Comparison with domestic use guidelines.

Human health factors in case of drinking are typically aesthetic for example in the case of chloride and sodium above 200 mg/l, where taste and corrosion is the most serious concern.

However sulphate levels of above 400 mg/l can cause diarrhea as well as a bitter taste as do magnesium at levels above 200 mg/l. At 10 mg/l as N the Nitrate/nitrite level of 10 mg/l as N can cause blue baby syndrome (Methaemoglobinaemia) in infants.

Total dissolved solid content levels of more than 3000 mg/l contribute to corrosion and taste problems, but can also have clear short-term health effects as it disturbs the human body’s salt balance. Similarly potassium can cause serious problems for infants and individuals with renal problems.

Fluoride is also present at the threshold level of 1.5 mg/l as F for dental mottling and softening of enamel in continuous users.

For more information please refer to **Annexure C**: Opinion Report for the Classification and Disposal of Evaporation Pond Brine Effluent from the Humansrus Solar Reserve, CSIR, August 2011.

3. CONCEPT DESIGN

3.1 DESIGN CRITERIA

The design criteria considered for the concept design and positioning of the evaporation pond for the CSP plant were as follows:

- The Hybrid Cooled zero discharge system will be used for the CSP plant,
- The Hybrid Cooled zero discharge system will produce an average daily flow of effluent (brine) to the evaporation ponds of 164 m^3/day ,
- A design safety factor of 15% was used for the sizing of the evaporation pond,
- The effluent (brine) total dissolved solids (TDS) was taken as 5000 mg/l,
- The specific gravity of the effluent (brine) was taken as 1.28 ton/m^3,
- Annual rainfall for the area was used at 400 mm/annum,
- S-pan evaporation for the area was noted between 2200 mm/annum and 2600 mm/annum, the worst case scenario was used at 2200 mm/annum,
- The evaporation pond must be designed in such a way that maintenance can take place without disrupting the normal processes of the CSP plant,
- The evaporation ponds must fall outside the 1:50 year flood line positions of the non – perennial lines on site,
- The effluent (brine) is classified with a hazardous rating of 3 and therefore the ponds will be lined with a triple liner and double drainage system as required by the Department of Water Affairs (DWA).

3.2 DESIGN CALCULATIONS

The evaporation pond was designed using the above mentioned design criteria. The full calculation sheet is attached in **Annexure D.**

3.3 DESIGN LAYOUT

The preferred location for the evaporation pond is positioned in the south – west corner of the site. Access to the pond will be created by the centre line of the heliostat circle that runs in a vertical and horizontal line from the power block. The access road will have a gravel surface. The effluent will be piped or channelled to the evaporation pond as the south – west corner of the site is at a l ower position and therefore a gravity feed can be achieved. The evaporation pond was designed in three compartments that would enable maintenance on any of the three compartments without disrupting the normal operations of the CSP plant. The three compartments will have a small emergency overflow to each of the other compartments. The flow to each of the compartments will be controlled via a splitter box at the top end of the evaporation ponds. A limited amount of silt is to be expected to enter the ponds as no surface water will enter the system. Oil will be separated out of the effluent stream before it reaches the evaporation ponds.

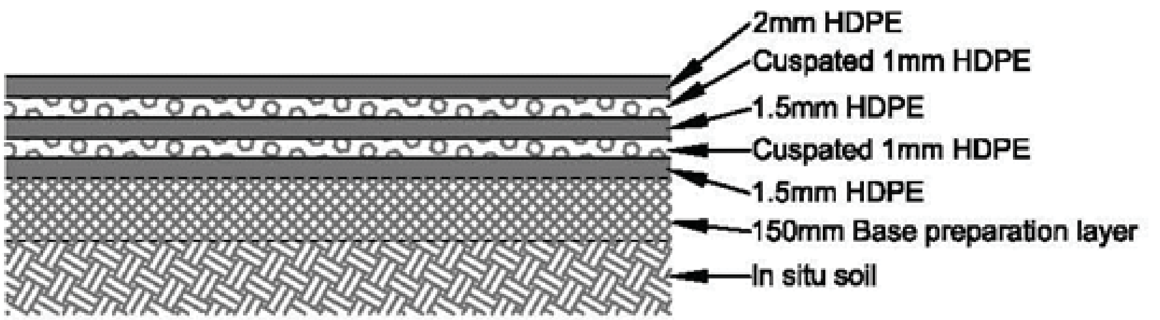
3.4 EVAPORATION POND DESIGN

The evaporation pond will be separated into three compartments. E ach compartments is sized at 112 m (b) x 200 m (l), giving a total size of 6.7 ha. The three compartments will have an overflow linking each compartment to the other. A 4 m access road will be constructed around each compartment in order to allow access for a small vehicle to move around the compartments. The side slopes of the evaporation pond will be 1 (h) : 2 (l) on the inside slope of the pond and 1 (h) : 3 (l) on the outside slope. The total depth of the evaporation pond is 1.2 m that includes a 300 mm freeboard and a 105 mm allowance for crystalline salt build up. The crystalline salt build for the evaporation pond was calculated at 233 m^3/annum. Over a 30 year life span of the CSP plant this calculates to approximately 105 mm depth in each compartment of the evaporation pond. The evaporation pond compartments will be used all three at the same time, however the pond size was designed that one of the compartments can be shut off for maintenance. This allowance for maintenance was calculated using the highest rainfall month.

3.5 LINER DESIGN

A meeting was held with DWA and the liner requirement recommended by the department is a triple liner system with two drainage layers. The site will be lined with a 2 mm High Density Polyethylene (HDPE) liner as a primary liner and two 1.5 mm HDPE liners that would serve as a secondary and tertiary liner. The three layers of this liner should have a cuspated drainage layer in between that drains toward a leakage detection system. The following figure shows the recommended liner detail.

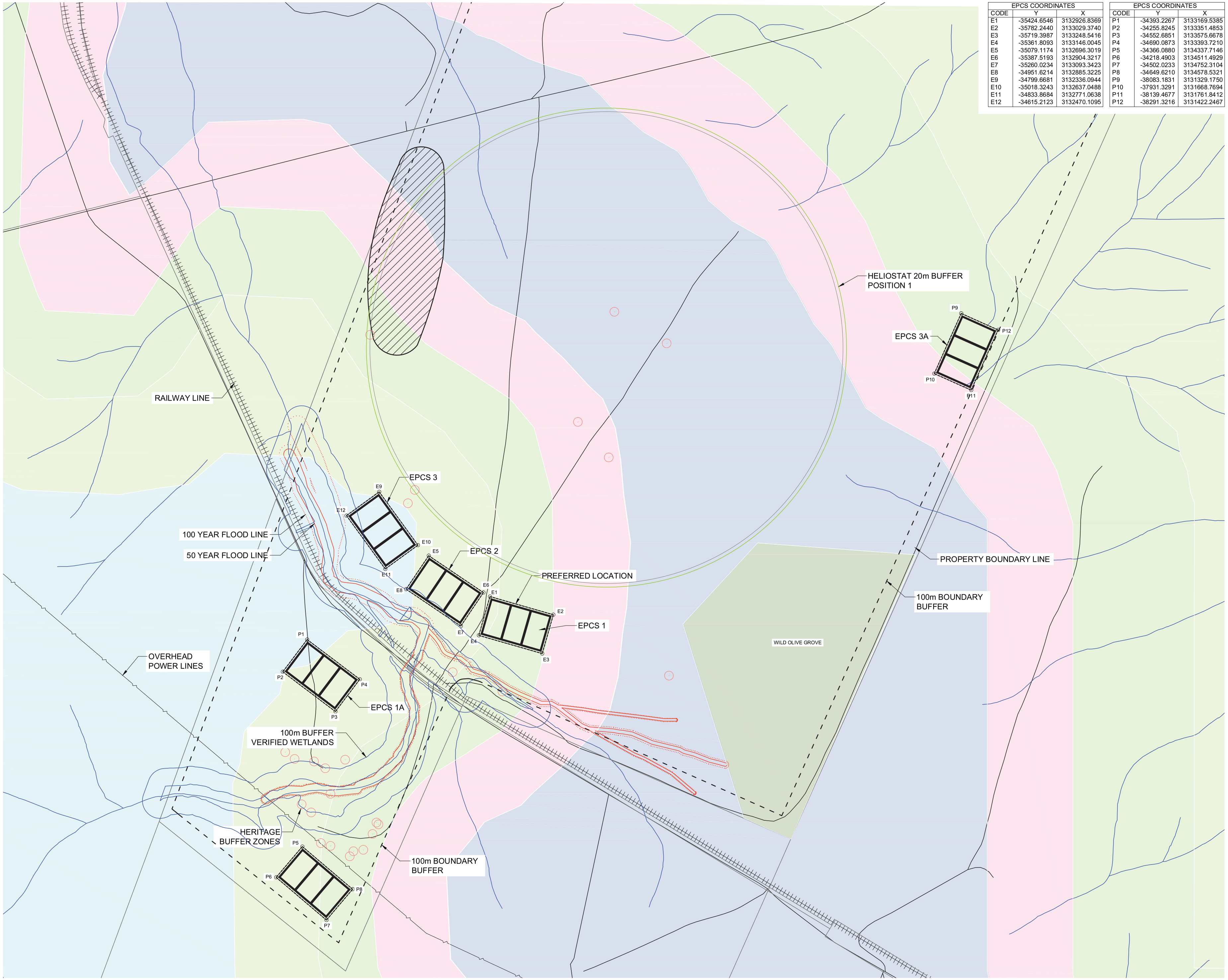
Figure 2: Evaporation Pond Liner Detail



3.6 EVAPORATION POND POSITIONING (CANDIDATE SITE SELECTION)

All care was taken to position the ponds where it could cause the least amount of damage to the environment in the case of a liner failure or unexpected event. From the initial studies (annexure B and annexure C) it was indicated that the south – west corner of the site was preferable to construct an evaporation pond due to the aquifer vulnerability being the lowest in that area. However six possible pond locations were selected over the entire site in order to ensure that the most suitable could be selected without disrupting the development of the CSP or PV project options. The candidate sites for the evaporation pond were numbered EPCS 1 through to EPCS 6. There are two possible site layouts for the CSP and PV options. The two options for the CSP and the PV and the candidate site positioning can be seen in the following figures 3 and 4 respectively. The first candidate site for the evaporation pond (EPCS1) is the preferred location in terms of a technical perspective as it is the closest to the vertical centre line of the heliostat rings and therefore the closest to the access road. A detailed geo-hydrological study was conducted in order to confirm the locations suitability for the establishment of the evaporation pond.

Figure 3: CSP, PV and Evaporation Pond Candidate Site Positioning



EPCS COORDINATES		
CODE	Y	X
E1	-35424.6546	3132926.8369
E2	-35782.2440	3133029.3740
E3	-35719.3987	3133248.5416
E4	-35361.8093	3133146.0045
E5	-35079.1174	3132696.3019
E6	-35387.5193	3132904.3217
E7	-35260.0234	3133093.3423
E8	-34951.6214	3132885.3225
E9	-34799.6681	3132336.0944
E10	-35018.3243	3132637.0488
E11	-34833.8684	3132771.0638
E12	-34615.2123	3132470.1095

EPCS COORDINATES		
CODE	Y	X
P1	-34393.2267	3133169.5385
P2	-34255.8245	3133351.4853
P3	-34552.6851	3133575.6678
P4	-34690.0873	3133393.7210
P5	-34366.0880	3134337.7146
P6	-34218.4903	3134511.4929
P7	-34502.0233	3134752.3104
P8	-34649.6210	3134578.5321
P9	-38083.1831	3131329.1750
P10	-37931.3291	3131668.7694
P11	-38139.4677	3131761.8412
P12	-38291.3216	3131422.2467

SCALE FOR REDUCED PLAN
0 10 20 30 40 50
50MM ON ORIGINAL DRAWING

NOTES

AQUIFER VULNERABILITY
- LOW (2)
- MEDIUM (3)
- MEDIUM (4)
- HIGH (6)
- VERY HIGH (9)

GENERAL
- WILD OLIVE GROVE
- JASPER MINING
- POWER LINE
- RAILWAY
- 50 YEAR FLOOD LINE
- 100 YEAR FLOOD LINE
- RIVER / STREAM

EPCS = EVAPORATION POND CANDIDATE SITE
SURVEY SYSTEM: Lo 23° / WG 23

All dimensions to be checked on site before any work is put in hand. Refer any discrepancies to the engineer.

FOR APPROVAL

AMENDMENT

NO.	DATE	CHECKED	DONE BY	DESCRIPTION
-	-		-	-

WorleyParsons
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P.O.BOX 36155
MENLO PARK, 0102
TEL:(012) 425 6300
FAX:(012) 460 1336

DESIGNED	DRAWN	CHECKED
R.R	J.B.	C.L.

CONSULTING ENGINEER DATE

CLIENT DATE

CLIENT

SOLARRESERVE

PROJECT

EVAPORATION POND CANDIDATE SITE POSITIONING

DRAWING DESCRIPTION

PROPOSED LAYOUT PLAN - HELIOSTAT POSITION 1

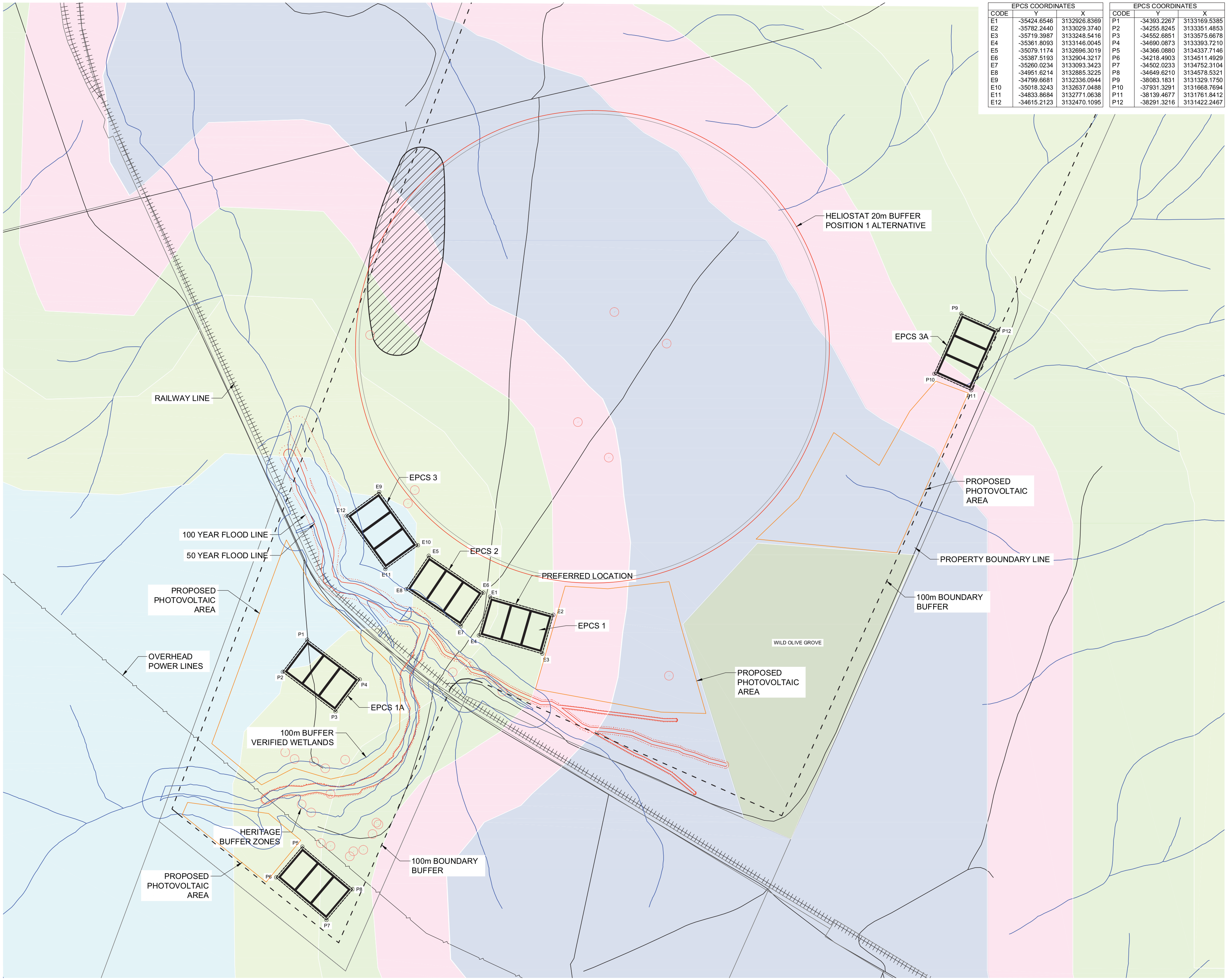
SCALE 1:10 000
ORIGINAL DWG SIZE A1

DATE OCTOBER 2011

DRAWING NUMBER

FIGURE 3

Figure 4: CSP, PV and Evaporation Pond Candidate Site Positioning Alternative



EPCS COORDINATES

CODE	Y	X
E1	-35424.6546	3132926.8369
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E7	-35260.0234	3133093.3423
E8	-34951.6214	3132885.3225
E9	-34799.6681	3132336.0944
E10	-35018.3243	3132637.0488
E11	-34833.8684	3132771.0638
E12	-34615.2123	3132470.1095

EPCS COORDINATES

CODE	Y	X
P1	-34393.2267	3133169.5385
P2	-34255.8245	3133351.4853
P3	-34552.6851	3133575.6678
P4	-34690.0873	3133393.7210
P5	-34366.0880	3134337.7146
P6	-34218.4903	3134511.4929
P7	-34502.0233	3134752.3104
P8	-34649.6210	3134578.5321
P9	-38083.1831	3131329.1750
P10	-37931.3291	3131668.7694
P11	-38139.4677	3131761.8412
P12	-38291.3216	3131422.2467

SCALE FOR REDUCED PLAN

0 10 20 30 40 50

50MM ON ORIGINAL DRAWING

NOTES

AQUIFER VULNERABILITY

- LOW (2)
- MEDIUM (3)
- MEDIUM (4)
- HIGH (6)
- VERY HIGH (9)

GENERAL

- WILD OLIVE GROVE
- JASPER MINING
- POWER LINE
- RAILWAY
- 50 YEAR FLOOD LINE
- 100 YEAR FLOOD LINE
- RIVER / STREAM

EPCS = EVAPORATION POND CANDIDATE SITE
SURVEY SYSTEM: Lo 23° / WG 23

All dimensions to be checked on site before any work is put in hand. Refer any discrepancies to the engineer.

FOR APPROVAL

AMENDMENT

NO	DATE	CHECKED	DONE BY	DESCRIPTION
-	-		-	-

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DESIGNED	DRAWN	CHECKED
R.R	J.B.	C.L.

CONSULTING ENGINEER　DATE

CLIENT　DATE

CLIENT

SOLARRESERVE

PROJECT

EVAPORATION POND CANDIDATE SITE POSITIONING

DRAWING DESCRIPTION

PROPOSED LAYOUT PLAN - HELIOSTAT POSITION 1 ALTERNATIVE

SCALE 1:10 000
ORIGINAL DWG SIZE A1

DATE OCTOBER 2011

DRAWING NUMBER

FIGURE 4

3.7 DESIGN ALTERNATIVES

3.7.1 Atomizers

Atomizers mechanically disperse the effluent over the evaporation ponds increasing evaporation timeframes and reducing evaporation pond sizing. This is accomplished utilizing atomizing heads, cyclones and pumps to spray the brine over the evaporation pond. This technology was not considered during concept design due to the site having sufficient space for a conventional evaporation pond. This technology will also bring additional complexity to the operation of the evaporation pond in terms of personnel and mechanical and electrical installations.

3.7.2 Crystallisation

The brine is released into a vessel where the pressure falls, the remaining water boils off and the salts crystallize. The salt cake, which is a fraction of the original waste stream, is then disposed of in landfill. This technology was not favoured due to the high cost and complexity of implementation for such systems as well as the disposal requirements of the salt cakes adding to the complexity of managing the waste products. Evaporation still remains the most suitable option.

3.7.3 Other Technologies

Other technologies exist that could be used for the final treatment of this type of effluent (brine). These technologies were not considered for this project as they have not been applied in South Africa. The other technologies that exist are:

i. **Deep well injection** - Deep well injection is presently applied worldwide for disposal of industrial, municipal and liquid hazardous wastes. In recent years this technology has been given serious consideration as an option for brine disposal from land based desalination plants. Deep well injection has been applied successfully for brine disposal from several membrane plants in Florida; however this method of brine disposal has not been used in South Africa.

ii. **Solar ponds** - Development of salt gradient solar ponds as a renewable energy source began in Israel more than thirty years ago. Although limited in scope, successful power generation by this technology has been demonstrated primarily in arid and semi-arid parts of the world. Recent technical papers have also appeared, describing experimental studies in

Italy and Switzerland, in which solar ponds are coupled with thermal desalination systems. In these experimental studies, the pond is used as a heat source for small multistage flash evaporator units.

Reference: Glater, J, and Cohen, Y, "Brine Disposal from Land B ased Membrane Desalination Plants: A Critical Assessment," (2003).

4. BASIS OF DESIGN DRAWINGS

The design drawings are supplied in **Annexure E** of the report. The following drawings are included:

DRAWING NUMBER	TITLE
257000 PW0 - D01	Basis of Design Details

5. CAPITAL COST ESTIMATE

A conservative (30%) estimate was made for the capital cost output for the construction of the evaporation pond. The following table shows the estimate:

Table 2: Capital cost estimate

Evaporation pond

Item	Unit	Qty	Rate	Total
Bulk Earthworks	m^3	67000	R 35.00	R 2 345 000.00
Restricted Earth Works	m	500	R 110.00	R 55 000.00
Concrete overflows	m^3	48.15	R 3 600.00	R 173 340.00
				R 2 573 340.00

Pond Lining

Item	Unit	Qty	Rate	Total
Earthworks (base preparation)	m^3	10500	R 45.00	R 472 500.00
HDPE liner (2mm)	m^2	70000	R 50.00	R 3 500 000.00
HDPE liner (1.5mm)	m^2	70000	R 45.00	R 3 150 000.00
HDPE liner (1.5mm)	m^2	70000	R 45.00	R 3 150 000.00
Cuspated HDPE	m^2	140000	R 25.00	R 3 500 000.00
Geo-textile	m^2	24000	R 25.00	R 600 000.00
160 perforated pipe installed	m	500	R 850.00	R 425 000.00
53mm Aggregate	m^3	250	R 800.00	R 200 000.00
				R 14 997 500.00

Summary

Total	R 17 570 840.00
P&G's 15%	R 2 635 626.00
Contingencies 10%	R 2 020 646.60
Total	**R 22 227 112.60**

Therefore the capital cost estimate (30%) for the construction of the evaporation pond is **R 22 227 112.60** (excluding 14% VAT).

6. SUMMARY

- The site is located 30 km from Postmasburg and about 165 km from Kimberley along the R 385 road.
- The site is relatively flat and slopes down from the north – east corner to the south – west corner.
- The site is historically agricultural land for use as grazing for domestic animals. The site is mainly grasslands with small shrubs and a few small trees.
- The climate of the area is typical of a semi-desert with very hot summers and cold winters.
- The area is covered with sands that have a high porosity and infiltration capacity and can be classified as soils with a deep Hutton profile.
- Significant parts of the study area are covered by recent deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness
- Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers.
- The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone.
- The classification criteria of the minimum requirements to liquid wastes show that the liquid is hazardous (moderate hazard, Hazard rating 3).
- The evaporation pond was designed in three compartments that would enable maintenance on any of the three compartments without disrupting the normal operations of the CSP plant.
- The three compartments will have a small emergency overflow to each of the other compartments.
- Each compartments is sized at 112 m (b) x 200 m (l), giving a total size of 6.7 ha.

- A 4 m access road will be constructed around each compartment in order to allow access for a small vehicle to move around the compartments.

- The side slopes of the evaporation pond will be 1 (h) : 2 (l) on the inside slope of the pond and 1 (h) : 3 (l) on the outside slope.

- The total depth of the evaporation pond is 1.2 m that includes a 300 mm freeboard and a 105 mm allowance for crystalline salt build up. The crystalline salt build for the evaporation pond was calculated at 233 m^3/annum. Over a 30 year life span of the CSP plant this calculates to approximately 105 mm depth in each compartment of the evaporation pond.

- The site will be lined with a 2 mm High Density Polyethylene (HDPE) liner as a primary liner and two 1.5 mm HDPE liners that would serve as a secondary and tertiary liner. The three layers of this liner should have a cuspated drainage layer in between that drains toward a leakage detection system.

- The capital cost estimate (30%) for the construction of the evaporation pond is **R 22 227 112.60** excluding 14% VAT.

ANNEXURE A SURFACE HYDROLOGY SCOPING REPORT

ONEWORLD
sustainable investments

Humansrus CSP: Surface Hydrology Scoping Report

FINAL REPORT

5 August 2011

Appreciating your financial, social and ecological assets

Submitted by:	Submitted to:
OneWorld Sustainable Investments	SSI
Postal address: PO Box 8359 Roggebaai 8012 South Africa Physical address: 4 Church Square Spin Street Cape Town South Africa	Physical address:
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Executive Summary

The proposed Concentrating Solar Power plant (CSP) proposed at the farm 469 Humansrus in the Northern Cape Province will cover an area of about 572 ha and use about 822 m^3 of water per day or 300,000 m^3 per year during operations.

It appears unlikely that the proposed plant will have a significant effect on surface water at local scales. A small ephemeral wetland (0.2 ha), located close to the boundary of the proposed field of heliostats, is unlikely to be affected.

Further investigation by the project proposer is required into the foundations of the heliostat field. The current conceptual layout of the heliostat field covers some areas of bare rock, stony ground and reverse-angle slopes, which could affect the construction and viability of heliostats at those locations.

A solution on the source of water for the operation of the CSP needs to be identified. Depending on which source (or mix of sources) of water is identified, further investigation is required and this should be the subject of the following EIA process:

- The likelihood and quantum of a mix of sources of water required for the proposed project and the likely regional impact of this competition for water;
- The potential size and location of a well field and the likelihood of impacts on other groundwater users (communities, farmers, industrial users, ecosystems);
- Possible alternative technologies for reducing the water consumption required by the proposed CSP;
- The proposer of the project may have to consider more intensely the production costs of power given the anticipated costs of water, based on the development costs of a well-field and the likely price of water obtained from an upgraded Vaal-Gamagara water supply scheme; and
- The priority basis of supply of water from the Vaal-Gamagara water supply scheme.

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Table of Contents

1 Overview

This report is a scoping review of potential hydrological impacts of the client Concentrating Solar Thermal plant proposed for Farm 469 (Humansrus) near Postmasburg, Northern Cape. This report was prepared as part of an assessment contracted to OneWorld Sustainable Investments by SSI of Johannesburg. In execution of this Scoping Report, the author visited the site on Wednesday 11 May, 2011.

1.1 Previous Expertise of the Author of This Report

This hydrological scoping report was undertaken and compiled by Arthur Chapman in his capacity as a hydrologist working for OneWorld Sustainable Investments in Cape Town. He has an M.Sc in hydrology and 21 years experience as a hydrologist, with a background in assessing the impacts of land-use change on runoff, hydrological modelling and environmental impact assessments. These assessments range from those of similar CSP projects (at Upington and two near Groblershoop, Northern Cape); assessments of the impacts of mines on water resources (the Hillendale and Fairbreeze heavy sands project of the then Iscor at Mtunzini) and Ogies; a review of the hydrological assessments for possible nuclear power plants in the Western Cape; calculation and estimations of the impacts of afforestation on surface and ground water resources in South Africa and internationally (Uruguay) and the impacts of invasive alien plant invasion on surface water resources. He is also consulting to international clients on the impacts of climate change in Southern Africa across a range of different sectors that includes water resources, human health and energy supply.

2 Introduction

SolarReserve have proposed a concentrating solar thermal plant (CSP) in the Northern Cape on the farm 469 Humansrus near Postmasburg, adjacent to the road R385 that links Postmasburg and Kimberley. The site is located 30 km from Postmasburg and about 165km from Kimberley along the R385 road (see Figure 1), just north west of Lime Acres and south west of Danielskuil at georeference Latitude 28º 17' S and 23° 22' E.

The proposed CSP at Humansrus is that of the "power tower" concept, modelled on that of Solar One and Solar Two, built and proved in Southern California. The essence of the design is a field of heliostats concentrating sunlight onto a central tower located at the top of a "power tower" (see project design information given by SSI). The concentrated sunlight heats the central tower, which heats a molten salt flowing through a primary circuit. Part of the flow of molten salt is conveyed through a heat exchanger which transfers heat into a secondary circuit of water and the resulting steam drives a turbine and generator. The steam cycle will use mostly dry cooling, although the design is not yet fixed. Occasional mist-spray cooling might be required when ambient air temperatures become too high for efficient and effective cooling of the steam circuit.

The generating capacity of the plant it not yet known at of time of writing. A principle of operation is that one quarter of the captured energy is transmitted straight into the grid and the other three quarters goes into heat storage (molten salt stored in tanks) for use during night times and periods of occluded sunlight. While the specific operational requirements of the proposed CSP have yet to be determined, the plant will start generating power each day when insolation is

sufficient to provide heating for its primary thermal circuit, and it will when there is insufficient energy insolation to store and transmit power. Between these times (at night and during cloudy conditions, it will use the stored heat to generate electricity.

3 Scope and Limitations

The scope of this assessment is to investigate the possible impacts of a CSP located at the Humansrus on the hydrological functioning at the local, regional and national scale. The terms of reference for this scoping report are as follows, and not limited to:

- An introduction to the study (see above);
- An overview of the study area hydrology (status quo);
- A description of the potential impacts (including cumulative impacts) on hydrology in the general area and the province;
- Any assumptions, limitations and / or constraints associated with the study; and
- Recommendations on any further studies that may be required during or after the EIA process.

While this scoping report is confined to surface water resources, it does integrate and comment on groundwater resources, in that interactions of surface water demands with potential groundwater supplies are important, given the general aridity of the region and need for water by the proposed facility.

3.1 Description of Proposed CSP Layout

The whole proposed installation, which includes the central power tower and the field of heliostats, is estimated at being roughly 2.7 km in diameter or covering 5.7 km^2 (572 ha). The heliostat field will contain between 14,500 and 17,000 heliostats, with the power tower located off-center and closer to the northern boundary of the round heliostat field. When the heliostats are not functioning (night time), they will likely be inverted, a position in which they can be cleaned. Dust on the reflecting surface i.e. mirror will significantly reduce reflectivity and will influence efficiency of the CSP plant – making a dust control suppression plan vital during operations. The heliostat surfaces will be cleaned regularly by means of high pressure spray of demineralised water from a vehicle moving amongst them.

The area in the immediate vicinity of the central tower is likely to paved or have a concrete flooring, as will the area around other supporting infrastructure (salt storage tanks, buildings, roads and some of the electricity distribution infrastructure). The area under the heliostats may be chipped stone or the natural veld with short shrubby vegetation or maintained as bare soil. Infiltration in this area is unlikely to be affected. Runoff from rainfall on the impervious areas is likely to infiltrate without significant surface flow being generated downslope (for reasons of high porosity and infiltrability in the Kalahari Sands.

The understood requirement for water for the operation of the facility is 300,000 $m^3.a^{-1}$ or about 822 m^3d^{-1}.

4 Climate, Geology and Landscape

4.1 Physical Layout

The proposed site for the CSP is illustrated in Figure 1 below. Within this core area, no surface drainage features such as stream channels, are observable. The area is covered with sands that have a high porosity and infiltration capacity and can be classified as soils with a deep Hutton profile (See MacVicar et al., 1997). Infiltration is likely to be rapid, and surface water will exist for a short time only. Surface flows that may be generated in the hills to the north and east infiltrate rapidly into the substrata near the edges of the break in slope, creating opportunities for infiltration to groundwater greater than would be possible from rainfall directly onto the surface.

To the west, the ground rises slightly more steeply with a slope of about 1:50 or 2-3%. This higher ground, that is a significant part of the western part of the CSP footprint, is not evident from the 1:50,000 topographic map, which is somewhat misleading as to land shape. The ground is stony and also has a large floating rock component (boulders not attached to the parent rock system). A small jaspillite mine or quarry is located on this feature (See Figure 1 – which identifies the feature). Questions need to be asked about its suitability as a base for installing heliostats. In the south-western part of the proposed heliostat field, bare rock is exposed and this is unlikely to be a suitable foundation for structures. Part of the proposed heliostat field is also located on reverse slopes (slopes that are orientated away from the likely location of the central tower). These features are likely to pose significant difficulties to the design and construction of the CSP, in the opinion of the author.

There is only one identifiable drainage channel, located on the west side of site, adjacent and parallel to the railway line. Ephemeral, , it is dry most of the time. Water flows only very briefly during heavy and intense storms. This drainage system exists behind an outcrop of jasperlites and dolerites, the flow of this system is highly intermittent and a response to occasional intense rainfalls.

4.2 Climate

The area is also known as the Green Kalahari, with a hot and dry climate. During the summer months (January) the temperatures can reach up to a maximum of 42°C. Rainfall patterns reveal that during an average year about 330 $mm.a^{-1}$ precipitation occurs, (determined from Smithers and Schulze, 2002) however during wetter years rainfall of over 600 mm has been recorded, whilst exceptionally dry years the annual precipitation merely reached 200 mm. Most of the rainfall received in the area is of convective origin and occurs in summer (Preston-Whyte and Tyson, 1988). Storms are relatively brief, but peak rainfall intensities over 5, 10 and 15 minutes differ little from other parts of South Africa which receive greater annual rainfall (Smithers and Schulze, 2002).

About 5 days a month in January daily maximum temperatures reach over 35°C, with minimum relative humidities at midday dropping to 20%-30% and even lower. Frost can be severe (defined as when air temperatures at the standard thermometer measuring height of 1.3 m drops below 0°C.

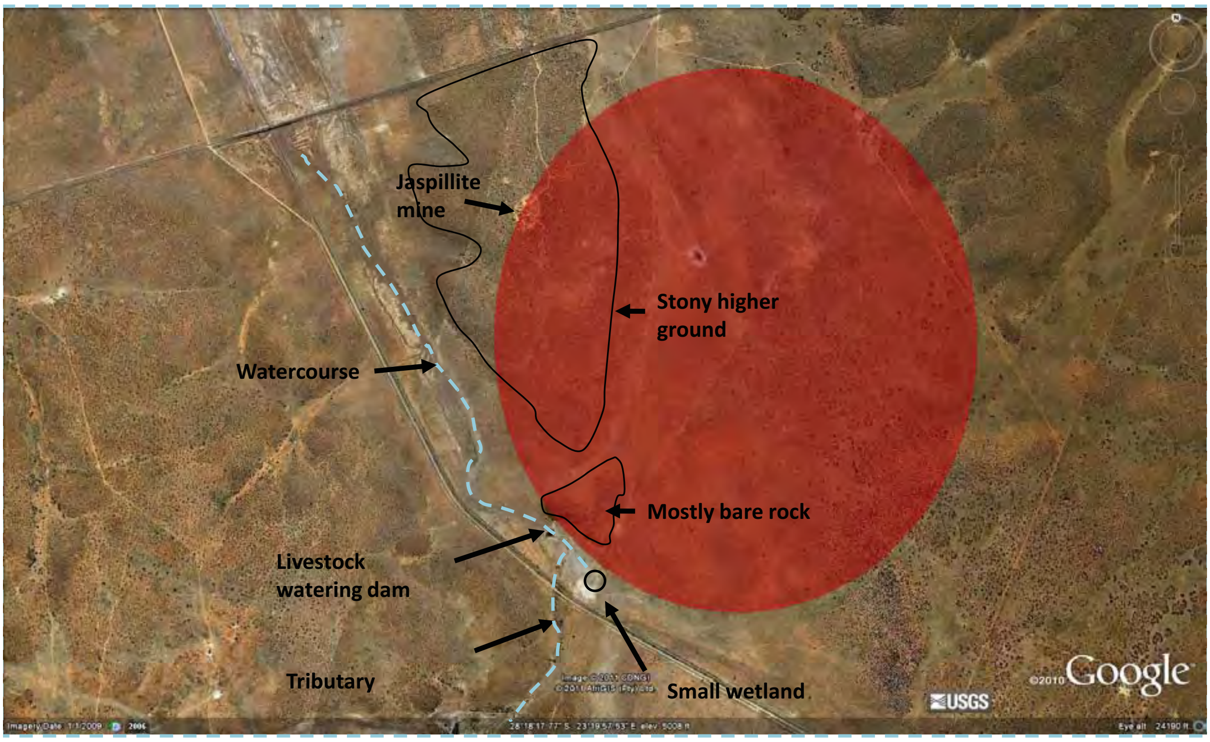

Figure 1 The proposed site of the CSP on the Humansrus farm, showing natural hydrological features (Source: Background Image: Google Earth).

Air temperatures at ground level may be several degrees lower than air temperature at thermometer measuring height. The climatological definition of a frost is 2.2°C at standard thermometer measuring height). Minimum temperatures can go as low as -7°C, but these occasions The January (14:h00) atmospheric saturation deficit averages about 40 mb (Tyson, 1986). The humidity mixing ratio (a measure of moisture content independent of temperature) for January is about 7 $g.kg^{-1}$, compared to 15 $g.kg^{-1}$ in more humid parts of the country (Preston-Whyte and Tyson, 1988. This is a measurement of the quantity of moisture in the air, measured as the number of grams of water vapour per kg of air. The quantity is controlled primarily by moisture availability, air temperature and air pressure). The dry atmosphere and good optical clarity are only a few of the reasons why this area in particular is excellent for CSP project development. Insolation of nearly 2,900 $kWh.m^{-2}.yr^{-1}$ when 1,800 $kWh.m^{-2}.yr^{-1}$ is roughly the minimum required to operate this type of CSP.

4.3 Geology and Landscape

The area is part of the Postmasburg Group, which is made up of the sub-components of the Griquatown Iron formation in the eastern higher ground, Makganyene Formation and recent Kalahari Sand Cover (Polteau, 2005). Red haematitic jaspilites are interbedded with the diamictites currently being quarried by the land owner. Diabases are intruded into the Makganyene

formation and outcrop along the central ridge. The combination of tightly packed ancient sediments, volcanic and diabase intrusions and lack of obvious faulting is likely to make evaluation of groundwater reserves difficult.

The site of the proposed CSP is mostly covered in Recent Kalahari Sands in the core of the proposed CSP site and has a slope of about 1:75 or about 1.3%, sloping downwards to the north-west. The slightly sloping ground may give distal heliostats a better, more unobstructed view of the central tower because they will be slightly higher than the more proximal ones. A reviewer of this document has noted that sloping ground is bad for CSP development and that a maximum of 3°incline can be tolerated or accommodated in the design. Total height of the individual heliostats is estimated at 15m.

5 Overview of the Hydrology of the Study Area

Pan evaporation in the area is estimated at between 2,200 and 2,600mm.a^{-1}, considerably more than the rainfall (Middleton and Bailey, 2009). The region is therefore in permanent water deficit and standing surface water, if it does not infiltrate, soon evaporates. Regional runoff can range from 0-25 mm.a^{-1} (Middleton and Bailey, 2009). Surface water generated by rainfall is confined to intense convective storms and quickly subsides. Streams in the vicinity are emphemeral. Those stream channels visited by the author had small amounts of standing water, probably a result of the very recent rainfalls, and no flows were evident Surface water storage (i.e. dams) is highly inefficient due to the high evaporation rate. Annual recharge to groundwater in the area is about 3-10 mm.a-1 (see Beekman et al., 1996).

5.1 Overview of Groundwater

The primary water source on the farm Humansrus is groundwater. There are four boreholes near the site on the farm Humansrus – north of the road (R365). According to the land-owner (Mr Scholz), the newest borehole was sunk to a depth of 107 metres and intersects the main aquifer between 97-107m below ground level and has been pump tested to a maximum of 32 l.s^{-1}. While this seems high; this quantity is also maximum pump capacity and maximum production could be even higher. The sustainability of this rate of extraction is not known (and is possibly unlikely). Another borehole in close proximity to the homestead was drilled to a depth of 50 m and it is estimated that it can supply water at 2 l.s^{-1}. (6,000 l.hr^{-1}). The quality of the groundwater is not yet known – and pending the results of the geo-hydrological investigation. The water is being used in its natural, untreated state, and TDS records revealed a range of between 0-1500 mg.l^{-1} (Middleton and Bailey, 2009).

Middleton and Bailey (2009) provided a broad estimation for groundwater availability in this area ranging between 10,000-75,000 m^3.km^{-2}.a^{-1}. Working from a utilisation rate of 822 m^3.d^{-1}, a well field of between 4 – 30 km^2 would be required to service fully the daily water needs of the facility, as a very broad estimate. A far more thorough and detailed investigation of the hydrogeological system is required before any decisions can be made on use of abstracted groundwater for CSP operations.

Given that diabase intrusions that are present on the proposed CSP site (shown for example outcropping in the area of bare rock identified in Figure 1), groundwater resources may be compartmentalised to some extent. Exploitation of the groundwater resource for CSP operational purposes will require significant investigation.

5.2 Wetlands and other Water Features

There is a small wetland near the south-western boundary of the CSP footprint, about 0.2 ha in area (See Figure 2). Colloquially known as a *pan* or *vlei*, it is shallow, had no standing water at the time of the visit but its spongy soils were damp (it had rained the night before). It appears to have a low biotic diversity. Covered mostly be a single tough type of grass about 0.6m heigh, it appears unpalatable to livestock (it has not been grazed, unlike surrounding grasslands) and is also unused by small birds. From observation, water retention is highly likely of short duration. Based on these observations and that at a regional scale other much larger pans near the Limeacres and Finsch mines had observable open water at the time of the author's visit, it is suggested that this small ephemeral wetland is of little consequence, even at local spatial scales.

The high evaporation rate and general low rainfall signifies that there is very little surface water in the area. What little surface water that exists after a storm soon evaporates or infiltrates to groundwater. At the time of the site visit (11 May 2011), the northern Cape region was at the end of the end of a particularly wet phase (caused partly by the La Niña conditions in the Pacific Ocean, which is known to cause above average rainfalls over large parts of South Africa, although not always). Despite the high rainfall, very little surface water was observed anywhere. A small dam exists about 200 m further down the drainage systems on the western boundary of the farm did have a small amount of water and is used as a water source by large livestock (See Figure 4). This dam is usually dry for most of the year. Water flowing into this dam appears to mostly come from a tributary arising off the main drainage channel to the west, on the other side of the railway line,.

Sedibeng Water is the water authority for the area in terms of water supply. The proposed site is located in the Northern Cape Proclaimed Service Area of Sedibeng Water. Proclamation means that the relevant water authority is the only party authorised to supply and manage water within its area of jurisdiction, unless agreed otherwise and excepting individual properties that manage their own water, as noted in this excerpt from the Water Supply Act (Act108, 1997) – that every Water Board:

> "*must consider every request by a water services institution for the provision of water services within its service area and may only refuse such request if, for sound technical and financial reasons, it would not be viable to provide those water services*" (Clause 32(c));

Economic growth and development is dependent on various inputs – water being one of these inputs are rated as vital to any development. The Northern Cape is characterised as a semi-arid area, which places enormous strain on existing water resources. The Sedibeng Water Authority needs to ensure that a constant supply of water is provided to its multitude of users i.e. mines, municipalities agriculture, utilities such as Eskom and Spoornet etc. The groundwater resource is not deemed sufficient at this point in time as it has not been investigated to its full extent in order to meet regional water needs. The Vaal-Gamagara Water Scheme, which is managed by the water

utility, Sedibeng Water, serves the purpose of conveying good quality water over substantial distances from the Vaal River.

Figure 2 The small ephemeral wetland (*vlei*) on the Humansrus western boundary (about 0.2 ha), looking south-east.

5.3 Water Institutions

Sedibeng Water, which began its life as a Water Board supplying water to the Welkom gold mining industry in 1979, is one of fifteen Water Boards in South Africa mandated in the National Water Act (Act 36 of 1998) to manage and supply water to users in regions across South Africa. Sedibeng Water operates in the northern parts of the Free State Province, as well as parts of North-West Province and Northern Cape Province. Sedibeng Water has some of the highest bulk tariffs of all water boards because of the distances over which it must supply water.

Figure 3 Natural drainage line, looking north-west, viewed from just below the wetland shown in Figure 2. The treeline indicates the livestock-watering dam wall.

The Vaal-Gamagara pipeline, which is now managed by Sedibeng Water, was originally built to serve the Sishen Iron Ore mine near Kathu in 1953 and was not managed at that time by Sedibeng Water. However at the start of mining operations, large volumes of good quality water was discovered at the Sishen mine, which needed to be pumped out of the ore body. This effluent was used as the primary source of water for the mining operations, and also supplied the areas of Kathu, Hotazel and beyond, utilising the pipeline installed. Due to this factor, a surplus of water in terms of supply from the Vaal Gamagara pipeline was created, allowing increased consumption at other sites along the pipeline, such as Postmasburg, supporting economic development

Figure 4 Livestock watering dam on the drainage line on the western boundary of Humansrus farm. The treeline indicates the livestock-watering dam wall.

It is estimated that mines now use about 60% of the total volume of water supplied by the pipeline (I. M. Hasenjager, pers.comm.). The Vaal-Gamagara Water Supply Scheme therefore is of very significant economic importance in the Northern Cape.

Water is abstracted from the Vaal River just downstream from its confluence with the Harts and is purified (near Delportshoop). The water is pumped about 20 km to Kneukel (near the Ulco cement works), where another pump station transports the water 117 km to the Tredwil pump station and Clifton reservoir near Lime Acres (these four reservoirs have a combined capacity of 27,000 m^3 and which serve as short-term balancing supplies – this storage facility could supply water for a day in an emergency if there was a power failure at the main pump stations and water filtration plants at Delportshoop, Kneukel and Tredwil). From this point the water is transported along the railway line to Postmasburg where after it turns north to Kathu, Hotazel ending at Black Rocks. The pipeline diameters vary between 700 mm at the source (Vaal River near the confluence with the Harts River) to 200 mm towards its terminus (Black Rocks). The pipeline branches out to supply water to surrounding areas such as Olifantshoek (including the Kalahari East pipeline) and Beesthoek. The design capacity of the pipeline is 36.37 $Ml.d^{-1}$ or 1.5 $Ml.hr^{-1}$ (1,500 m^3,hr^{-1}). The pipeline has a maximum allocation from the Vaal River of 13.7 million $m^3.a^{-1}$ but sometimes operates at less than full capacity During drought, water restrictions are imposed on abstractions

and allocations to users are curtailed on the basis of a priority classification, as well as the short-term yield characteristics of the Vaal River.

A few kilometres from the works near Lime Acres the pipeline passes near the south west side of the site. Due to the proximity of the pipeline to the proposed Humansrus CSP it is assumed that if the line has available capacity, an extraction point can be made. The landowner at Humansrus has also planned an off-take for some farm water supplies, indicating that the potential for the CSP operations to obtain water from this source is a possibility Despite the finds of water further north, the pipeline is fully committed at present (I. M. Hasenjager, Pers. Comm). Even with the construction of the new Kumba Iron Ore mine south of Postmasburg and mine dewatering supplying further water into the Vaal-Gamagara water scheme, the pipeline is already capacity (See also the section below under Potential Impacts and Cumulative Impacts for further comment on the Vaal-Gamagara water scheme).

5.4 *Permits and Licenses*

If the CSP uses groundwater during operations, water abstraction and use licences will be required. It is likely that a supply from the Vaal-Gamagara Water Scheme will not need to be licensed – the general policy under the National Water Act (Act 36 of 1998) is that water from a local authority, a water board, an irrigation board or another bulk water supplier does not require registration of use. This policy is subject to verification. An application to use water from the Vaal-Gamagara pipeline must however be submitted to Sedibeng Water.

6 Potential Impacts and Cumulative Impacts on Hydrology

The proposed project is unlikely to have a significant direct impact on local surface hydrology, such as interfering with surface drainage, or preventing infiltration to groundwater in ways which could affect other local or regional groundwater users. No wetlands of local or regional consequence are deemed by the author to exist in or near the proposed facility, as noted earlier.

The project may have an impact on hydrology at regional scales. A water use rate of 822 $m^3.d^{-1}$ requires that water be imported, whether via an off-take from the Vaal-Gamagara water scheme pipeline, or from local and regional groundwater resources, or both. This potential impact required further investigation in the Environmental Impact Assessment

The Vaal-Gamagara pipeline is fully committed in terms of water delivery (I.M. Hasenjager, Sedibeng Water, pers. comm.). Although it is expected that new water resources will come online in the near future as a result of mining dewatering operations i.e. newly proposed Kumba Mine near Postmasburg, the Vaal Gamagara pipeline will not have the capacity to carry the newly proposed resource as the pipeline is already fully committed. A case is however currently being made by Sedibeng Water in support of expanding the capacity of the new pipeline along the track of the existing pipeline. However due to the rock terrain it has also been indicated that the construction of the proposed pipeline extension will be a costly exercise – increasing the cost of water delivery to the users significantly (of the order R40-R50 m^{-3}.M. Hasenjager, pers. comm.).

7 Assumptions, Limitations and Constraints

Some assumptions have been made regarding the nature of the CSP. Full design specifications are not yet available but the basic nature of the system is apparent and this document works from that level of information. This document limits itself to addressing surface water issues, but comments on groundwater components because the requirement for water means that both sources (of supplied bulk water and groundwater) will be required in constructing and operating the CSP. No particular constraints have been identified.

8 Consultations and Consultation Process

In the pursuit of the development of this report, the study author consulted:

- Mr Allan Scholtz, the farm owner at Humansrus (visit – 11 May 2011);
- Members of the Groenwater Gemeenskap Rural Development Tribal Authority (Chief J.K. Marotobolo and Councilor Esther Diraditsile);
- Mr Hasenjager (Manager: Business Development and Acting Regional Manager Northern Cape, Sedibeng Water); and
- Various web resources and documents with respect to regional hydrology and climatology.

9 Recommendations for Further Studies during the EIA process

The following should be further researched during the EIA process:

- The likelihood and quantum of a mix of sources of water required for the proposed project and the likely regional impact of this competition for water;
- The potential size and location of a well field and the likelihood of impacts on other groundwater users (communities, farmers, industrial users, ecosystems);
- Possible alternative technologies for reducing the water consumption required by the proposed CSP;
- The proposer of the project may have to consider more intensely the production costs of power given the anticipated costs of water, based on the development costs of a well-field and the likely price of water obtained from an upgraded Vaal-Gamagara water supply scheme; and
- The priority basis of supply of water from the Vaal-Gamagara water supply scheme.

Please note that the Humansrus CSP is competing for water in a region of increasing water scarcity (that arises from increasing demand). The ability of Sedibeng Water to supply the CSP's needs (at current estimated use rates) is likely to be one of the important decision points in any roll out of the project.

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ANNEXURE B PRELIMINARY GROUND WATER ASSESSMENT REPORT

Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

Report Prepared for

SSI Engineers and Environmental Consultants

Report Number SRK 436964/Draft1

Report Prepared by

srk consulting

July 2011

Humansrus Solar Thermal Energy Power Plant Scoping Report: Preliminary Assessment of the Groundwater Resources

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Table of Contents

List of Tables

List of Figures

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by SSI Engineers and Environmental Consultants, the Department of Water Affairs and local property owners in the Humansrus area. SRK has exercised due care in reviewing the supplied information. Whilst SRK has compared the available data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the available data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Glossary of Terms

Aquifer: A water-bearing geological formation capable of supplying economic quantities of groundwater to wells, boreholes and springs.

Aquitard: A saturated geological unit with a relatively low permeability that retards, but does not prevent the movement of water; while it may not readily yield water to boreholes and springs, it may act as a storage unit.

Aquiclude: A geological unit with a very low permeability that severely restricts groundwater movement. GRU boundaries are commonly formed by aquicludes, e.g. dykes.

Contamination: The introduction of any substance into the environment by the action of man.

Fractured-rock Aquifer: Aquifers where groundwater occurs within fractures and fissures in hard-rock formations.

Groundwater: Refers to the water filling the pores and voids in geological formations below the water table.

Groundwater Flow: The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the slope of the water table and the transmissivity of the geological formations.

Groundwater Recharge: Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic Zone).

Groundwater Resource: All groundwater available for beneficial use, including by man, aquatic ecosystems and the greater environment.

Groundwater Resource Units: (GRU's) Represent provisional zones defined for the purposes of assessing and managing the groundwater resources of a region, in terms of large-scale abstraction from relatively shallow (depth < 300m) production boreholes. They represent areas where the broad geohydrological characteristics (i.e. water occurrence and quality, hydraulic properties, flow regime, aquifer boundary conditions etc.) are anticipated to be similar. Sometimes also called Groundwater Resource Units (GRU's).

Intergranular Aquifer: Aquifers where groundwater is contained in original intergranular interstices of sedimentary and weathered formations.

Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing and/or intergranular porosity; may be highly productive and able to support large abstractions for public supply and other purposes; water quality is generally very good.

Minor Aquifer System: Fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability; aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.

Non-Aquifer: A groundwater body that is essentially impermeable, does not readily transmit water and/or has a water quality that renders it unfit for use.

Non-Aquifer Systems: formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities; water quality may also be such that it renders the aquifer unusable; groundwater flow through such rocks does take place and needs to be considered when assessing the risk associated with persistent pollutants.

Permeability: The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as $m^3/m^2 \cdot d$ or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with *hydraulic conductivity*, which relates specifically to the movement of water.

Pollution: The introduction into the environment of any substance by the action of man that is, or results in, significant harmful effects to man or the environment.

Recharge: The addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.

Saline Water: Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids.

Saturated Zone: The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere

Specific Yield: Ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity from that mass.

Storativity (S): The volume of water released from storage per unit of aquifer storage area per unit change in head.

Unconfined Aquifer: An aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.

Unsaturated Zone: That part of the geological stratum above the water table where interstices and voids contain a combination of air and water; synonymous with *zone of aeration* or *vadose zone*.

Water Table: The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

List of Abbreviations

DWA	Department of Water Affairs (previously DWAF)
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity (Salinity of water)
GA	General Authorisation
m	metres
mamsl	Metres above mean sea level
mbgl	Metres below ground level
mS/m	Milli-siemens per metre
m^3/a	Cubic metres per annum
mm	millimetres
m^3/m	Cubic metres per month
SRK	SRK Consulting
mg/ℓ	Milligrams per litre
Ma	Million years
STEP Plant	Solar Thermal Energy Power Plant

1 Introduction

During June 2011 SRK Consulting was requested by Mr. Frank Benedek of SSI Engineers and Environmental Consultants to submit a cost proposal for a detailed groundwater resource assessment and provide specialist input to the Waste Management Licence Application, Environmental Impact Assessment and the Water Use Licence required for a proposed Concentrated Solar Power Plant (STEP Plant) on the farm Humansrus near Postmasburg in the Northern Cape Province.

The development is proposed for the Farm 469, (here after referred to as the Farm Humansrus) the Hay Rd, is located in the Northern Cape Province approximately 30 km east of Postmasburg along the R31 route to Kimberley (**Figure 1**). Farms and small communities in the area are totally dependent on groundwater whilst the larger communities like Postmasburg, Daniëlskuil and Lime Acres use groundwater as well as surface water from the Vaal-Gamagara pipe line, which crosses Humansrus farm.

1.1 Scope of Work

The following scope of work and deliverables were provided:

1. To provide a detailed description of the site topography, geological and geo-hydrological characteristics of the study area;
2. Depiction and characterization of the groundwater regime in a regional geological and geohydrological context indicating the overall characteristics of the geological settings and aquifer parameters, and identification of immediate groundwater users;
3. Data obtained from hydrocensus survey as well as the data obtained from the NGDB to be mapped.
    1) A desktop study to be undertaken for the analysis of data obtained from the National Department of Water Affairs' National Groundwater Database (NGDB);
    2) Site visit for purposes of the hydrocensus; and
    3) Consultation with relevant landowners to obtain additional borehole data, if available.
4. Determination of pre-project groundwater quality by means of baseline groundwater quality monitoring and sampling;
5. Assess the potential impacts (direct, indirect and cumulative) of the proposed development and the significance thereof on groundwater resources and downstream water users in the general area.
6. Description of groundwater management measures related to all project phases;
7. Groundwater monitoring protocols and a report containing groundwater monitoring data and analysis;
8. A groundwater model illustrating the above mentioned analysis will be required.

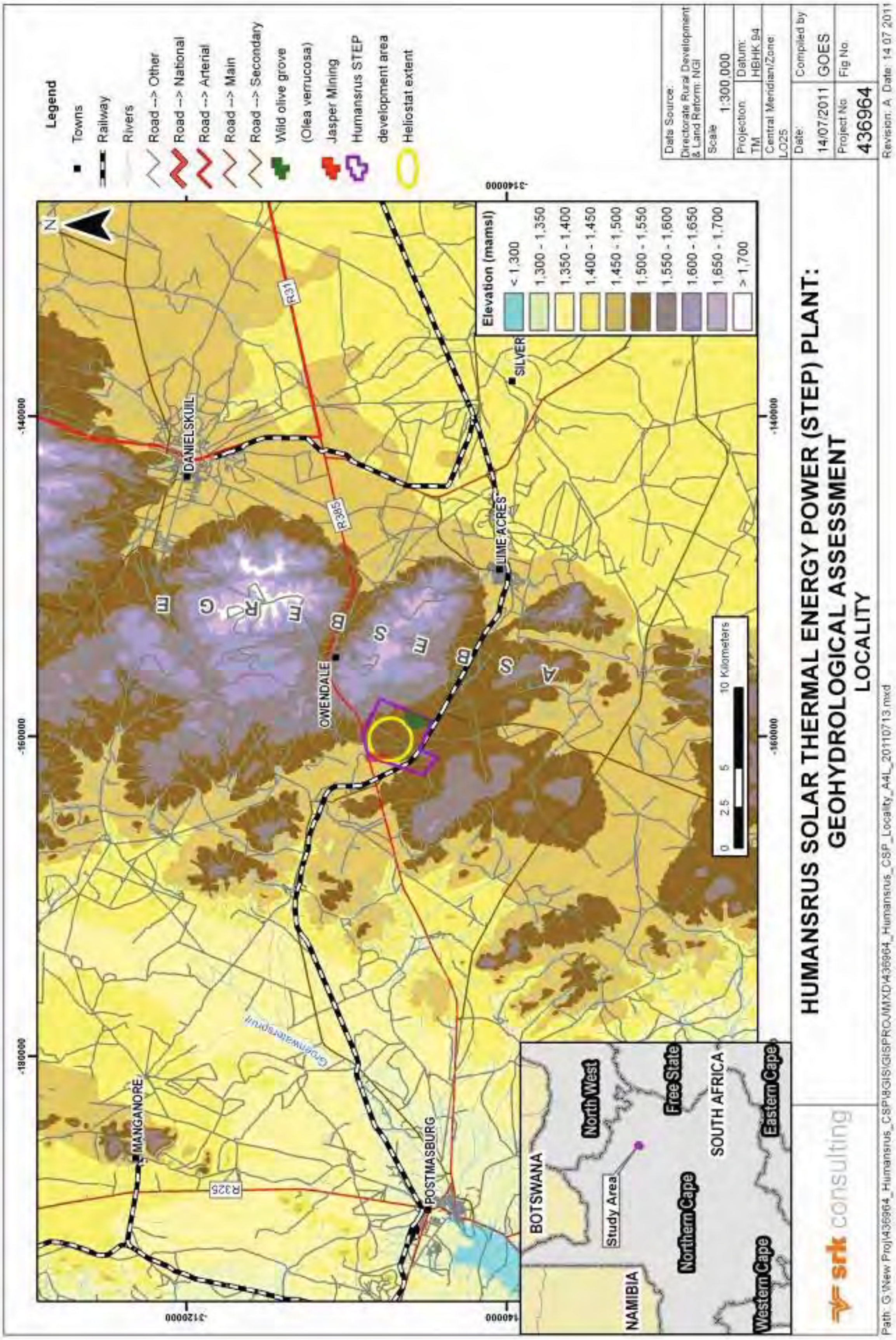


Figure 1: Locality of the Humansrus Solar Energy Thermal Power Plant site

9. Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:
    1) Discuss and evaluate the findings of each of the various specialist studies;
    2) Integrate findings to identify workable solutions;
    3) Recommend appropriate mitigation measures, where required, and
    4) Formulate final recommendations.
10. Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.
11. Recommendations on any further studies / additional scope of work that may be required during or after the EIA process.

1.2 Deliverables

Project deliverables:

1. Groundwater resource assessment report;
2. Groundwater Scoping Report (for the EIA/Waste Management Licence); and
3. Groundwater EIA Report (for the EIA/Waste Management Licence).

1.3 Methodology

The methodology employed for the investigation up to scoping level was as follows:

- All existing groundwater related information was collated and reviewed for the property and its surrounds. This included information from existing reports, the Department of Water Affairs' National Groundwater Database (NGDB), Water Authorisation and Registration Management System (WARMS database) and published maps;
- A detailed hydrocensus was carried out on existing boreholes, shallow wells and springs on the property, as well as a representative number of private boreholes, wells and springs that occur on the surrounding properties. During this field survey water levels, current abstraction, type of equipment, water usage, and basic chemistry based on field testing and any other information that was available from the owners/operators were measured and recorded;
- Groundwater management units (GMUs) were delineated for the site and the recharge, exploitation potential, and water balance of the groundwater resources in each GMU were derived. For this purpose the GIS grids generated for the DWA National Groundwater Resource Assessment, Phase 2 was used. The quality of the groundwater resources in each GMU was also assed. All data were captured into an ArcGIS 10 database and the aquifers defined and groundwater flow directions, aquifer boundaries, e.g. structural and lithological were defined;
- The current and anticipated groundwater uses were compared to the exploitation potential of the aquifers in the GMUs;
- Potential groundwater bearing structures and formations were mapped on satellite imagery and aerial photographs using the ArcGIS desktop software. The geological data of the area

were obtained and georeferenced for use in the GIS. The boreholes and other relevant groundwater information were superimposed on GIS generated maps for analysis; and

- The data were analyses and collated for the Scoping Report.

1.4 Work Programme

A hydrocensus of the boreholes on the Farm Humansrus and adjacent farms was conducted on 14 and 15 July 2011. All available geohydrological information (borehole depth, yield, groundwater intersections, groundwater use and estimated abstraction, etc.) was collected from the respective owners during this visit. Boreholes were visited and the relevant geohydrological data (like groundwater levels, quality, equipment, etc.) were measured and recorded. Simultaneously the local geology was noted and red flag areas identified.

2 Project Description

SolarReserve SA (Pty) Ltd (here after referred to SRSA) plans to construct a Solar Thermal Energy Power Plant (here after referred to as a STEP Plant) on the Humansrus farm. The STEP Plant generates power by concentrating the heat from the sun on a receiver where after the salt (heat transfer medium) is heated for the generation of electricity. Unlike wind and photovoltaic technology, the technology implemented by the proposed STEP Plant has the ability to store energy, which means that electricity can be delivered as and when needed dependent solely on demand and not climatic factors.

STEP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) arranged within a circle shaped heliostat field with an estimated land coverage of 3 km^2. The tower is erected slightly off-centre in the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver on top of the tower. The concentrated sunlight within the receiver, heats molten salt to over 550ºC, which then flows into a salt thermal storage tank.

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower;
- The salt complex is pumped from the cold salts thermal storage tank to the central receiver. The salt complex is transported through the central receiver tower by means of extremely thin tubes;
- The molten salt complex is heated up to approximately 566ºC and is circulated in the central receiver tower;
- The molten salt concentration is then transported to the hot salt thermal storage tank;
- Energy is transferred by means of a heat exchanger or steam generator to generate steam for the turbine;
- The highly pressurised steam is then passed through a steam turbine to generate electricity;
- The salt complex cools down to an approximate 288ºC in the steam generator; and

- After this process is completed, the molten salt concentrate is transported to the cold salt thermal storage tank – in order for the electricity generation cycle to commence once more.

The STEP Plant comprises four main subsystems which will be summarised below:

1. Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats;
2. Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
3. The Power Block; and
4. Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Three (3) different plant setups are under investigation for the Humansrus site of which 3 (Hybrid Cooled Zero Discharge System) is the preferred setup. The annual water demands of the different setups are as follow:

1. Dry Cooled Zero Discharge System - 169,200 m^3
2. Dry Cooled Non Zero Discharge System - 211,900 m^3
3. Hybrid Cooled Zero Discharge System - 246,200 m^3

3 Baseline Data

3.1 Physiography and Climate

The Farm Humansrus is located in a north-west – south-east running valley with two semi-parallel ranges of hills occurring on the western and eastern sides of the farm (**Figure 1**). This valley is controlled by faults on the two flanks with the eastern hills formed by hard, weather-resistant banded ironstone and jaspilite. The eastern hills form part of the Asbestos Hills stretching from Kuruman in the north to Prieska in the south.

The elevation of the study area varies between 1 460 mamsl in the far north-west and 1 630 mamsl on the eastern side of Humansrus. Hills on the western side of the valley are more gentle with only a few points where the elevation reaches >1,600 mamsl. The central valley on Humansrus farm is elevated between 1,500 and 1,540 mamsl.

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000 are summarized in **Table 1** below. The data indicate that January is the hottest month with an average maximum daily temperature of 32^{o}C and June the coldest with an average maximum daily temperature of 18^{o}C. During June and July the average minimum daily temperature drops to <3^{o}C.

Table 1: Temperature data for Kimberley (South African Weather Service)

KIMBERLEY CLIMATIC AVERAGES 1960-2000													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP	32.6	31.2	28.9	25	21.5	18.4	18.8	21.4	25.7	28	30.1	32.1	26.2
MIN TEMP	17.7	17.3	15.2	10.7	6.2	2.8	2.5	4.7	8.8	11.9	14.5	16.5	10.7
AVE TEMP	25.2	24.3	22	17.9	13.9	10.6	10.6	13.1	17.3	19.9	22.3	24.3	18.5
KIMBERLEY CLIMATIC ABSOLUTES 1960-2000													
HIGHEST TEMP	40.4	39.9	37.8	34.9	31.3	26.6	26.8	31.2	36.6	37.6	39.2	40.9	40.9
LOWEST TEMP	6.5	5.6	2	-2.8	-5.7	-7.9	-8.1	-7.8	-5.5	-0.5	2.5	3.8	-8.1

The data also indicates that the absolute maximum temperature recorded during the period was 40.9^{o}C and the lowest -8.1^{o}C.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in **Table 2** below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 2: Precipitation statistics for the Humansrus area (Source: South African Rain Atlas)

Average monthly precipitation in mm) at Measuring Station Coordinates: S28^{o}18' E023^{o}22'													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean:	64.7	76.3	77.8	42.5	15	5.2	3.6	5.6	11.2	22.2	31.3	45.9	401.1
Standard Deviation:	46	50.9	49.7	35.2	18.6	10.1	8.2	11.2	17.0	24.1	28.4	36.5	107.9

The data indicate that 84% of the precipitation occurs during the months November to April. This phenomenon is characteristic of a summer rainfall area. March is the wettest month with an average precipitation of ~78 mm, whilst July is the driest with <4 mm.

The rainfall distribution for this area is indicated in **Figure 2** over page. Rainfall generally decreases from the site (Humansrus) to the west, south and south east. The highest precipitation occurs in the mountainous area west and south west of Danëlskuil, where the MAP exceeds 520 mm. The lowest precipitation occurs at two isolated localities south east of Danëlskuil and Lime Acres respectively. These areas have a MAP of less than 360 mm.

3.2 Geology

The geology of the study area, which is located on the eastern flank of the Dimoten Syncline striking in a general north-south direction, is depicted in **Figure 3** on page 9. The geological map indicates that significant parts of the study area are covered by Recent deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersected argillaceous, loose and well weathered material up to 30 mbgl, however this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales and banded ironstone, which were deposited after a period of erosion forming a unconformity in this specific area. The upper part of this Formation consists of a 1–3 m thick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic andesitic lavas of the Ongeluk Formation. This Makganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the STEP Plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus (see **Figure 3**). The area between these faults has apparently been displaced downwards to form a graben structure.

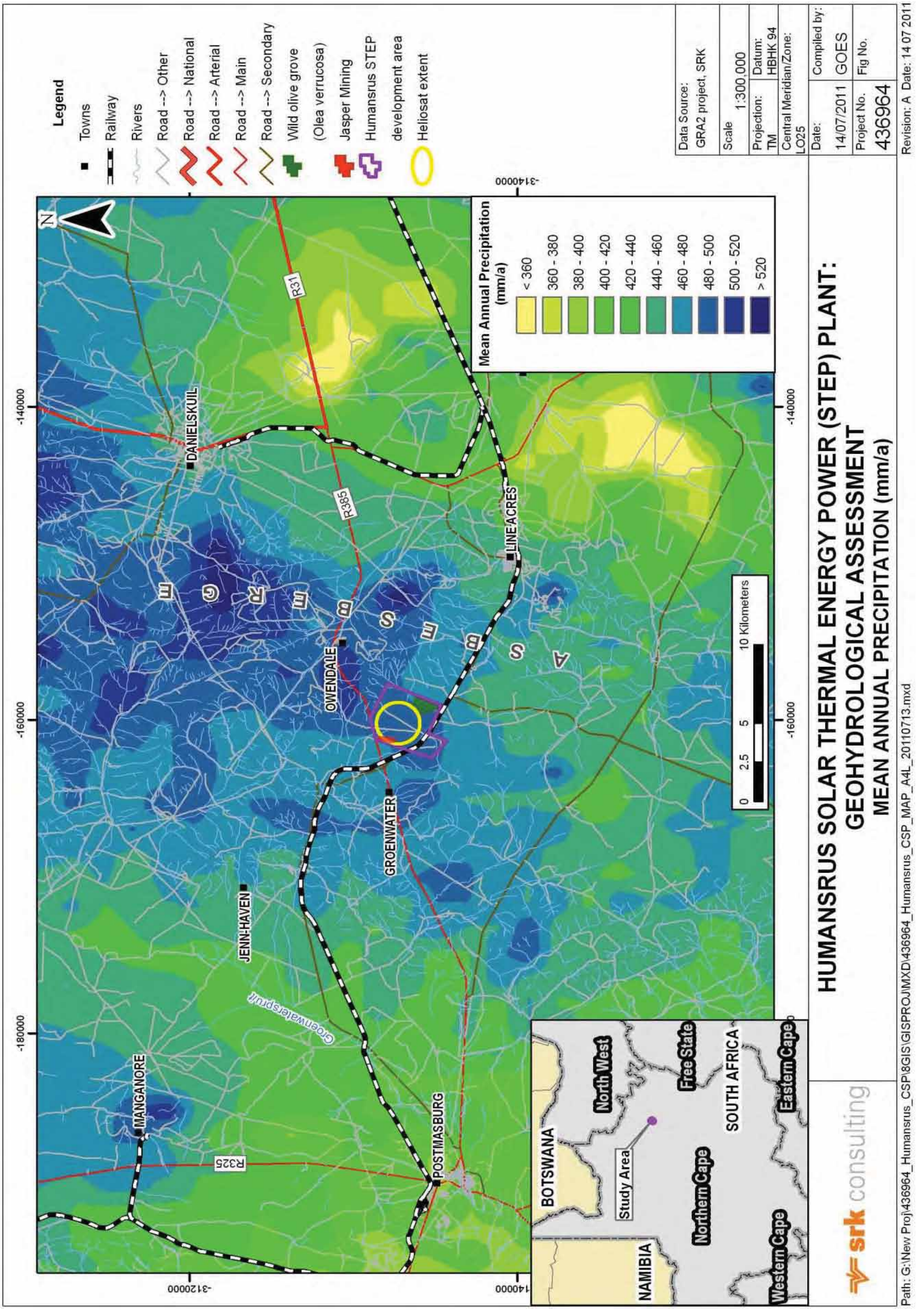


Figure 2: Rainfall distribution in the Humansrus area

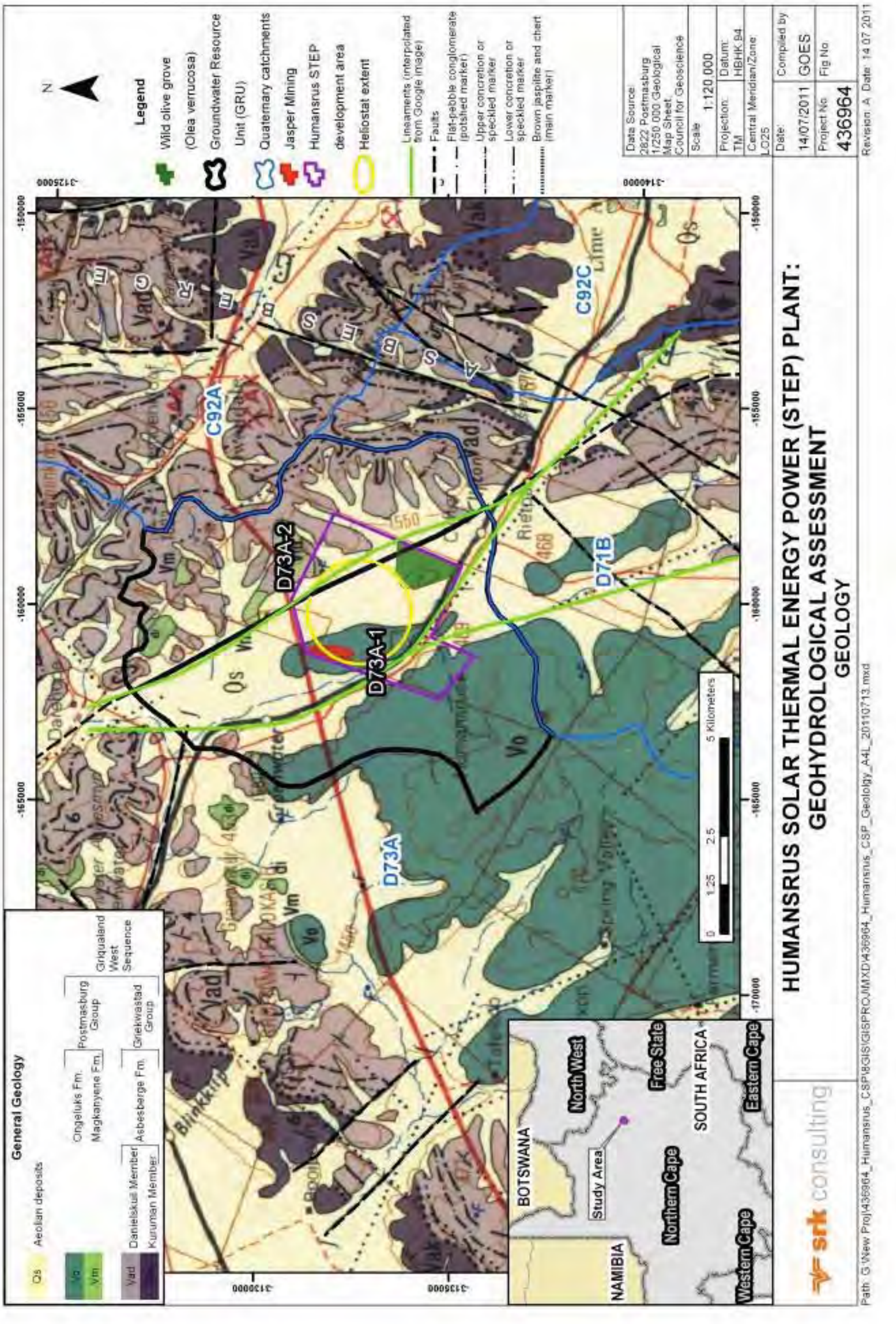


Figure 3: Geology of the Humansrus area (after Council for Geoscience)

3.3 Hydrogeology

3.3.1 Aquifer Type

Groundwater in this area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers (**Figure 4**). This type of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operates in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shale and mudstone, which rather deform than fracture under stress.

Some unconfined interganular aquifers (also known as primary aquifers) also occur in and near the main drainage channel of the area at Groenwater station north-west of Humansrus. Here the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. All these result in a poorly developed primary aquifer that is very vulnerable to droughts.

3.3.2 Hydrocensus Results

The hydrocensus results are summarized in **Table 3** (page 12) with the localities of these boreholes indicated in **Figure 5**. Forty-one (41) boreholes and one (1) spring were surveyed on the Farm Humansrus and its surrounds.

Four anomalously high yielding boreholes were located in the area, i.e. boreholes HS2, GR10, GR11 and GR12. These boreholes are located on the two graben-faults in the area with boreholes GR10, GR11 and GR12 on the western fault and borehole HS2 on the eastern fault. Borehole HS2 intersected highly fractured lava and tillite, as evident from drill cuttings around the borehole. It was reportedly yield tested by Mr Scholtz at 40 ℓ/s. However, during removal of the test pump, it got stuck in the borehole at 60 mbgl, probably as a result of the borehole collapsing due to an insufficient length of casing been inserted. This borehole cannot be used and a new borehole needs to be drilled adjacent to it for production purposes, if required. Borehole HS4, which is also located on or close to the eastern fault, has only a maximum immediate yield of 1 ℓ/s. It is believed that this relative shallow borehole (54 m) was not drilled deep enough to intersect the main fault and hence the relative low yield. Borehole GR11 is a replacement borehole drilled for borehole GR10 and is ~5 m from the latter. This borehole and borehole GR12, were previously used to irrigate ~25 ha of lucerne.

The average borehole yield of the surveyed boreholes is 4.6 ℓ/s. This value is skewed by a few extraordinary high yielding boreholes. Therefore the median borehole yield of 1.4 ℓ/s gives a much better indication of the borehole yield that can be expected from a successful borehole drilled in this area. Boreholes drilled to intersect the graben faults could be much higher yielding, possibly 20 ℓ/s to as high as 40 ℓ/s.

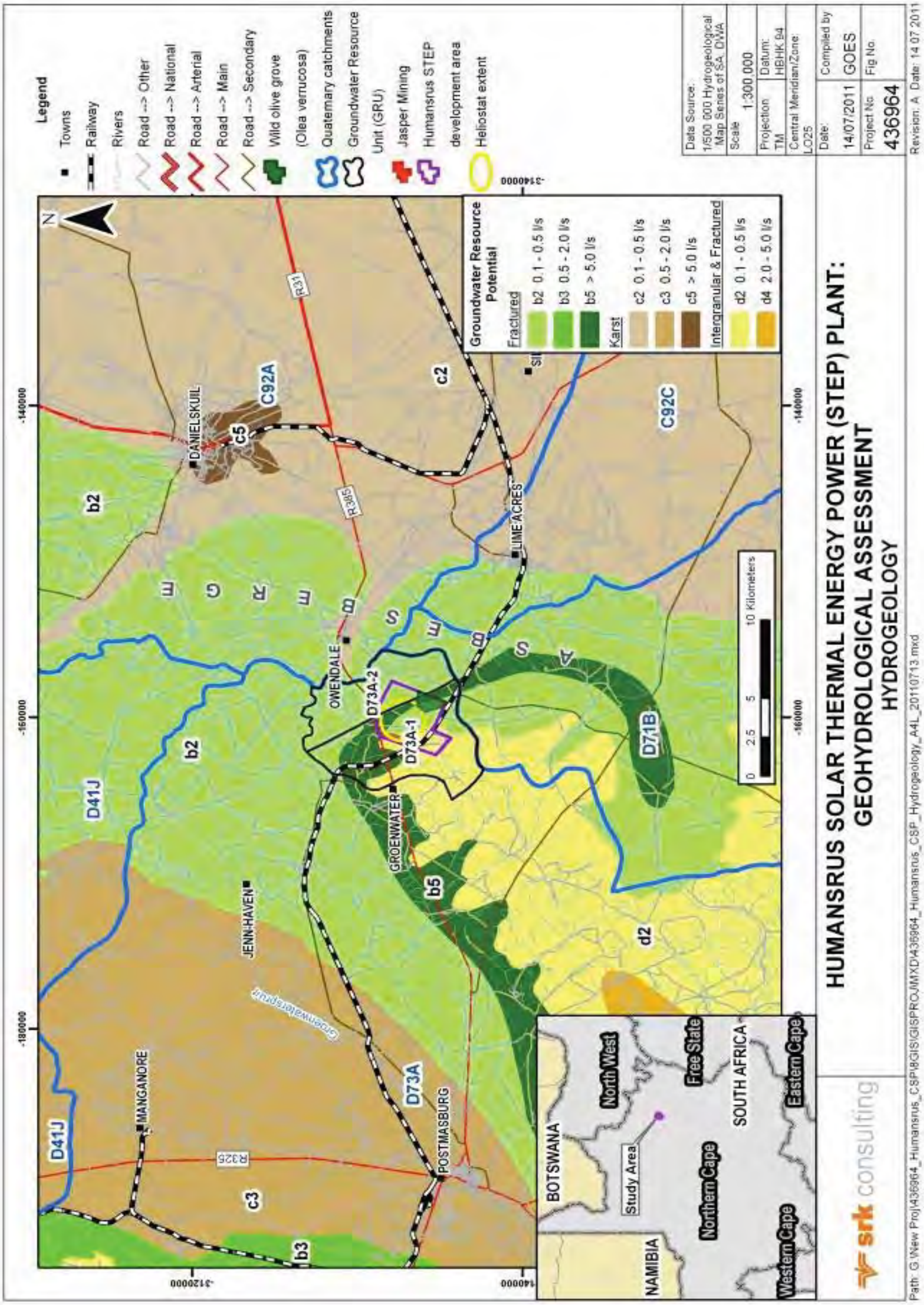


Figure 4: Aquifer type and yield potential in the Humansrus area (after the DWA 1:500 000 scale hydrogeological map series data)

Table 3: Summary of hydrocensus results of the Humansrus area.

Bh Nr	Date	Latitude	Longitude	Eleva-tion (mamsl)	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Pump intake (mbgl)	Use	pH	EC (mS/m)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Land reform												
GR1	15-Jul-11	-28.29228	23.31879	1499	73	4.0	19.00	None		Domestic			G47253, Pump removed
GR10	15-Jul-11	-28.28773	23.34227	1476		20.0	5.87	None					
GR11	15-Jul-11	-28.28773	23.34225	1477	60	20.0	7.05	None					Replacement bh for GR10
GR12	15-Jul-11	-28.27770	23.33874	1467	28	10.0	2.12	None					
GR13	15-Jul-11	-28.25558	23.32697	1458	0		0.00	None		Irrigation	7.22	132	Spring
GR14	15-Jul-11	-28.25672	23.33109	1461	9			WP 100mm cylinder	5	Domestic, Stock	7.70	33	Closed
GR15	15-Jul-11	-28.27567	23.33025	1488	91		19.49	None					
GR16	15-Jul-11	-28.26194	23.35528	1495	73		18.79	WP 75mm cylinder		Stock	7.45	43	
GR17	15-Jul-11	-28.25250	23.35111	1493	52			WP 60mm cylinder		Stock	7.37	61	
GR2	15-Jul-11	-28.29878	23.31550	1496	60			50mm Mono		Domestic			Pump out of order, Closed
GR3	15-Jul-11	-28.28208	23.31056	1485	64	3.5	29.11	40mm Submersible	55	Domestic	7.90	97	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	15-Jul-11	-28.27552	23.31678	1479	32	0.3	27.59	None					Tested by SRK in 2007, Likely partially collapsed
GR5	15-Jul-11	-28.27740	23.30551	1463	50	4.1	17.33	None					Tested by SRK in 2007
GR7	15-Jul-11	-28.27743	23.30550	1464	78	1.4	17.07	None					Drilled by SRK 2008, Blow yield
GR8	15-Jul-11	-28.27703	23.33501	1470	11			Handpump					Closed
GR9	15-Jul-11	-28.27719	23.33510	1471	15		4.00	40mm submersible					Out of order
Farm:	Humansrus - Owner: Mr. Allen Scholtz												
HS1	14-Jul-11	-28.27903	23.36406	1491	50	1.8	27.27	40mm Submersible	45	Domestic, Stock	7.15	52	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	14-Jul-11	-28.27681	23.36466	1467	107	40.0	28.02	None					Water strike at 98 mbgl Fractured lava and tillite
HS3	14-Jul-11	-28.28088	23.36538	1493	36	0.2		None					Roots at 10 mbgl
HS4	14-Jul-11	-28.29156	23.37531	1530	54	1.0		WP 90mm cylinder	42	Stock	7.90	54	Bees in borehole
HS5	14-Jul-11	-28.32079	23.35028	1525	54	1.8	18.27	WP 90mm cylinder	42	Stock			Out of order, Water flows in @ 10 mbgl
HS6	14-Jul-11	-28.28322	23.39720	1627	210	0.5		None					Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk												
SE1	14-Jul-11	-28.32690	23.36535	1519	84	3.6		WP 65mm cylinder	45	Stock			Baseplate closed
SE10	14-Jul-11	-28.32897	23.37159	1515	60	2.5		None					Collapsed at 6.8 mbgl
SE2	14-Jul-11	-28.32920	23.36567	1521	24	0.3		WP 65mm cylinder	24	Stock			Baseplate closed
SE3	14-Jul-11	-28.32963	23.36553	1522	33	0.5	17.00	WP 65mm cylinder	30	Domestic, Stock			
SE4	14-Jul-11	-28.32989	23.36586	1522	35	1.0		40mm Submesible	30	Domestic, Stock	7.23	90	Baseplate closed
SE5	14-Jul-11	-28.32921	23.36266	1516	35	1.9		WP 100mm cylinder	18	Stock			Baseplate closed
SE6	14-Jul-11	-28.33779	23.35252	1567	150	0.3	73.44	WP 65mm cylinder	81	Stock	7.70	70	Water strike at 75 mbgl
SE7	14-Jul-11	-28.32590	23.34681	1534	15	0.1	12.35	Solarpump	14	Stock	7.90	59	Alt Nr GW9
SE8	14-Jul-11	-28.32722	23.34662	1537	30	0.0		None					Dry
SE9	14-Jul-11	-28.32923	23.37240	1516	60	4.2		None					Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk												
CN1	15-Jul-11	-28.32497	23.39030	1506			31.71	WP 60mm cylinder	39	Domestic			
CN2	15-Jul-11	-28.32503	23.38942	1535				50mm Mono	42	Domestic, stock	6.85	32	Closed, Pump yield = 0.9 ℓ/s
CN3	15-Jul-11	-28.32493	23.38938	1535		0.3	29.65	None					
CN4	15-Jul-11	-28.32333	23.38965	1541			32.46	WP 60mm cylinder	36	Stock			
CN5	15-Jul-11	-28.32609	23.38891	1534		0.7	25.79	None					Was equipped with 40mm Subm., Intake @ 45m
CN6	15-Jul-11	-28.32919	23.38791	1528			19.31	None					
CN7	15-Jul-11	-28.32916	23.38609	1523		0.9	12.22	None					Blocked 0.2m below water level
CN8	15-Jul-11	-28.32973	23.38429	1526				None					Blocked at 16.7 mbgl, Dry
CN9	15-Jul-11	-28.33991	23.38789	1517			9.27	WP 60mm cylinder	21	Stock	7.25	51	
CN10	15-Jul-11	-28.34507	23.38803	1514			9.18	WP 60mm cylinder	24	Stock	7.20	59	
					Average	4.6					7.4	64.1	
					Median	1.4					7.4	59.0	

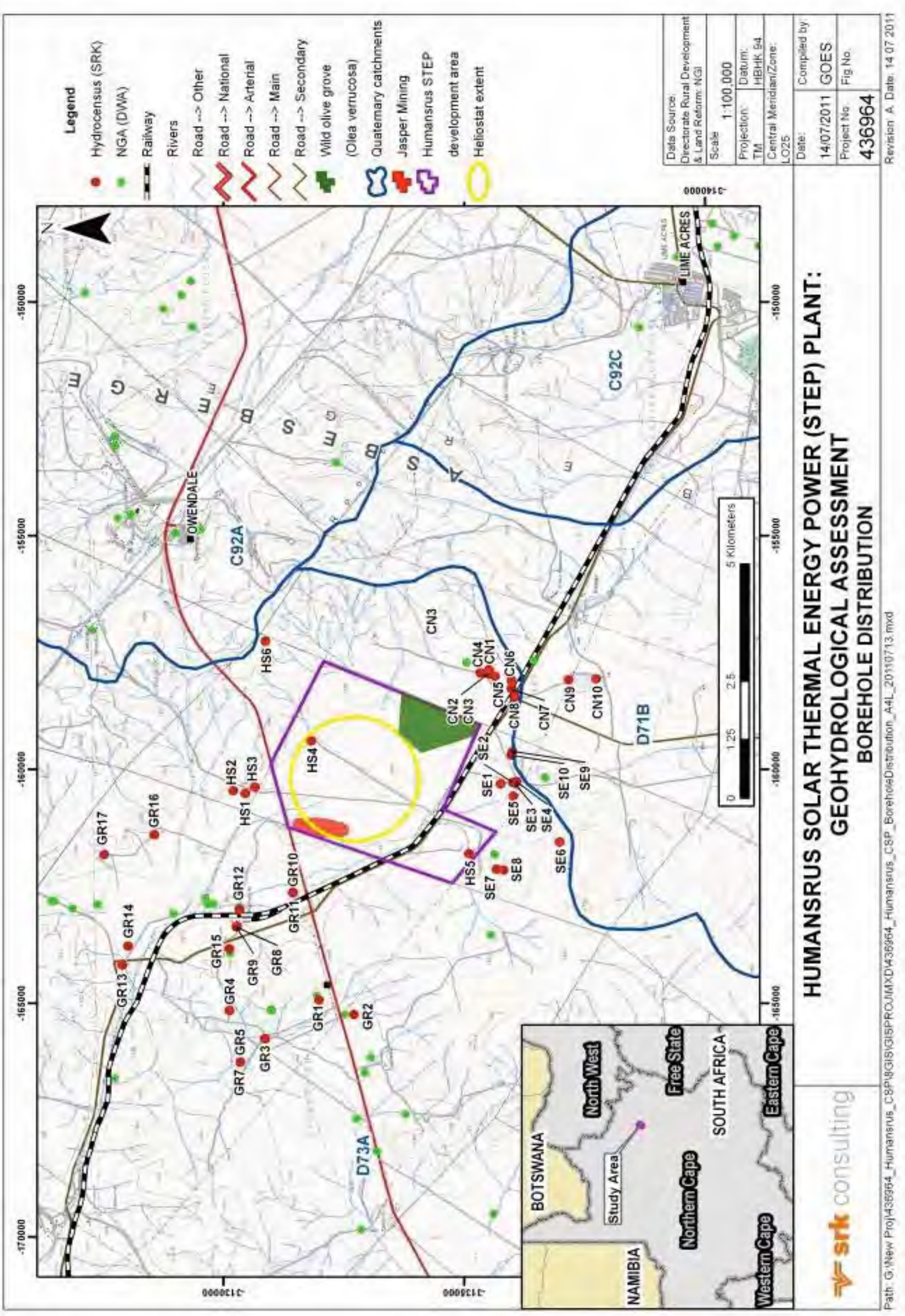


Figure 5: Localities of surveyed boreholes in the Humansrus area

3.3.3 Current Abstraction

The estimated abstraction from the Farm Humansrus and the surrounding areas is summarised in **Table 4** page 15. In the case of electric pumps, the estimates are based on pump yields and daily operating hours as reported by the owners. For windpumps a 24 h/d operation at 12% of the maximum yield was assumed (which is determined by the cylinder size). This assumption is based on the author's personal experience in the Karoo area. Based on these assumptions a total abstraction of approximately 104 000 m^3/a is calculated for the study area. Nearly 66% (~68 000 m^3/a) of this volume is abstracted in the Groenwater rural area, of which ~54% is for domestic use and 46% (31 500 m^3/a) spring flow at GR13.

No large scale irrigation currently takes place in the area and most of the abstracted groundwater is used for stock watering and domestic use. However, groundwater was previously abstracted from boreholes GR11 and GR12 at a rate of ~180 000 m^3/a to irrigate 25 ha of lucerne. This abstraction continued for several years and was only ceased after this portion of Groenwater was bought by the Department of Rural Affairs and Land Reform (pers. Comm. Mr. Scholtz).

3.3.4 Groundwater Resource Potential

The Humansrus area falls within the Quaternary Drainage Region D73A (see **Figure 3** and **Figure** 5) for which the amount of water available under General Authorisation is listed under Zone A of the Groundwater Taking Zones, where no water may be taken from this drainage regions except as set out under Schedule 1[1] and small industrial users[2] (DWAF, 2004). Therefore, if the water demand is to be satisfied from the groundwater resources a Water Use Licence Application will have to be submitted.

Two (2) Groundwater Resource Units (GRU's) were defined for this area. These are based on surface drainage, measured groundwater elevations and lineaments such as faults and dykes. The boundaries of these GRU's are indicated in **Figure 3**. The GRA2 grid datasets (DWAF, 2005) were used to derive the MAP, effective recharge and groundwater resource potential for these GRU's. As boreholes cannot intersect all the available recharge in an area, an exploitability factor (DWAF, 2005) was used to calculate the volume of groundwater that can actually be abstracted through boreholes. Current abstraction based on the hydrocensus data was subtracted from this value to determine the current Groundwater Exploitation Potential. These calculated values are summarised in **Table 5** on page 16.

[1] Not taking more than 10 cubic metres from groundwater on any given day.
[2] •"Small industrial users" mean water users who qualify as work creating enterprises that do not use more than twenty cubic metres per day (i.e. 20 000 litres/day) and identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented, under the following categories:-

a) 1: food processing;
b) 2: prospecting, mining and quarrying;
c) 3: manufacturing;
d) 5: construction

Table 4: Estimated groundwater abstraction in the Humansrus area

Bh Nr	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Use	Estimated Annual Abstraction (m^3)	Comments
Farm:	**Groenwater**				**TOTAL**	**68,223**	
GR1	73	4.0	19.00	None	Domestic	11,000	Pump removed, Abstraction was ~11,000 m^3/a
GR10		20.0	5.87	None			
GR11	60	20.0	7.05	None			Previous abstraction 120,000 m^3/a
GR12	28	10.0	2.12	None			Previous abstraction 60,000 m^3/a
GR13	0		0.00	None	Irrigation	31,500	Spring - rough estimate - difficult to measure flow
GR14	9			WP 100mm cylinder	Domestic, Stock	3,406	Closed
GR15	91		19.49	None			
GR16	73		18.79	WP 75mm cylinder	Stock	1,514	
GR17	52			WP 60mm cylinder	Stock	1,135	
GR2	60			50mm Mono	Domestic	7,900	Pump out of order, Previously pumped at ~7,900 m^3/a
GR3	64	3.5	29.11	40mm Submersible	Domestic	11,038	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	32	0.3	27.59	None			Tested by SRK in 2007, Likely partially collapsed
GR5	50	4.1	17.33	None			Tested by SRK in 2007
GR7	78	1.4	17.07	None			Drilled by SRK 2008, Blow yield
GR8	11			Handpump		730	Closed
GR9	15		4.00	40mm submersible			Out of order - not used anymore
Farm:	**Humansrus**				**TOTAL**	**17,082**	
HS1	50	1.8	27.27	40mm Submersible	Domestic, Stock	10,512	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	107	40.0	28.02	None			Water strike at 98 mbgl Fractured lava and tillite
HS3	36	0.2		None			Roots at 10 mbgl
HS4	54	1.0		WP 90mm cylinder	Stock	6,570	Bees in borehole
HS5	54	1.8	18.27	WP 90mm cylinder	Stock		Out of order, Water flows in @ 10 mbgl
HS6	210	0.5		None			Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	**Sunnyside**				**TOTAL**	**10,549**	
SE1	84	3.6		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE10	60	2.5		None			Collapsed at 6.8 mbgl
SE2	24	0.3		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE3	33	0.5	17.00	WP 65mm cylinder	Domestic, Stock	1,135	
SE4	35	1.0		40mm Submesible	Domestic, Stock	1,971	Baseplate closed
SE5	35	1.9		WP 100mm cylinder	Stock	3,406	Baseplate closed
SE6	150	0.3	73.44	WP 65mm cylinder	Stock	1,135	Water strike at 75 mbgl
SE7	15	0.1	12.35	Solarpump	Stock	631	Alt Nr GW9
SE8	30	0.0		None			Dry
SE9	60	4.2		None			Collapsed at 8 mbgl
Farm:	**Clifton**				**TOTAL**	**8,089**	
CN1			31.71	WP 60mm cylinder	Domestic	1,135	
CN2				50mm Mono	Domestic, stock	3,548	Closed, Pump yield = 0.9 ℓ/s
CN3		0.3	29.65	None			
CN4			32.46	WP 60mm cylinder	Stock	1,135	
CN5		0.7	25.79	None			Was equipped with 40mm Subm., Intake @ 45m
CN6			19.31	None			
CN7		0.9	12.22	None			Blocked 0.2m below water level
CN8				None			Blocked at 16.7 mbgl, Dry
CN9			9.27	WP 60mm cylinder	Stock	1,135	
CN10			9.18	WP 60mm cylinder	Stock	1,135	
					TOTAL FOR STUDY AREA	**103,942**	

Table 5: Groundwater exploitation potential of the Humansrus area

Groundwater Resource Unit	Area (m^2)	Area (km^2)	No. of cells	MAP (mm/a)	Recharge Factor (%)	Average Mean Annual Recharge		Groundwater Exploitation Potential (m^3/a)		Volume of Water stored in Aquifer (m^3/a)	5m Drawdown Storage Volume (m^3/a)
						(m^3/a)	(mm/a)	Wet Season	Dry Season		
Quaternary Catchment											
D73A	1,558,947,048	1,558.95	63,737	407	2.10%	23,021,400	8.6	19,554,500	15,472,300	333,785,000	25,459,600
Groundwater Resource Units (GRU's)											
D73A-1	42,490,000	42.49	4,249	476	2.00%	627,462	9.4	437,116	325,853	9,097,502	693,916
D73A-2	27,820,000	27.82	2,782	487	2.00%	410,826	9.9	340,868	268,020	5,956,520	454,336
TOTAL						***1,038,287***		***777,984***	***593,873***	***15,054,022***	***1,148,252***
Humansrus CSP Development Area											
Development Area	13,560,000	13.56	1,356	488	2.10%	200,244	10.1	170,089	134,581	2,903,322	221,452

The GRA2 data indicate that the Humansrus GRU (D73A-1) has an estimated average mean recharge of approximately 627 000 m^3/a, i.e. 2% of the MAP of 476 mm. The mean annual recharge in the Humansrus area is shown in **Figure 6** page 17. The groundwater exploitation potential was calculated to vary from 326 000 m^3/a for dry seasons to 437 000 m^3/a for wet seasons, i.e. a mean of approximately 381 000 m^3/a. The volume of groundwater that is potentially stored in the aquifers of the Humansrus GRU has been calculated as approximately 9.1 million m^3.

Based on information supplied by SSI, the maximum water demand of any of the three types of STEP Plants that is under consideration, is 246 200 m^3/a for the Hybrid Cooled Zero Discharge Plant.

Hourly water demand ranges from 41.5 m^3/h (11.53 ℓ/s) under full load to 8.35 m^3/h (2.32 ℓ/s) during off times. *Note: For this study, as a worst case scenario, this maximum demand figure was used for comparison to the sustainable amount of water available for exploitation*.

Comparing this maximum water demand (worst case scenario) to the exploitation potential of the Humansrus GRU (D73A-1), it is evident that this demand is well within (65%) the long term yield capacity of the aquifers of the GRU.

3.3.5 Depth to Water Table and Inferred Groundwater Flow Directions

Depth to water table at Humansrus varies from 18 to 28 mbgl.

The hydrocensus data and data from the NGDB were used to plot the groundwater elevations on the topgraphical map, from which the groundwater flow directions were inferred (**Figure 7**). The groundwater elevations normally mimics the surface elevation contours and generally flows from higher lying to lower lying areas. The inferred flows are from the surrounding high lying flanks of the valley towards the centre lower lying floor of the valley at Humansrus and then along the valley towards the north-west. These groundwater elevations indicate that the southern part of the surveyed area (i.e. the farm Clifton and part of the farm Sunnyside) falls outside the Humansrus GRU in another drainage region (D71B).

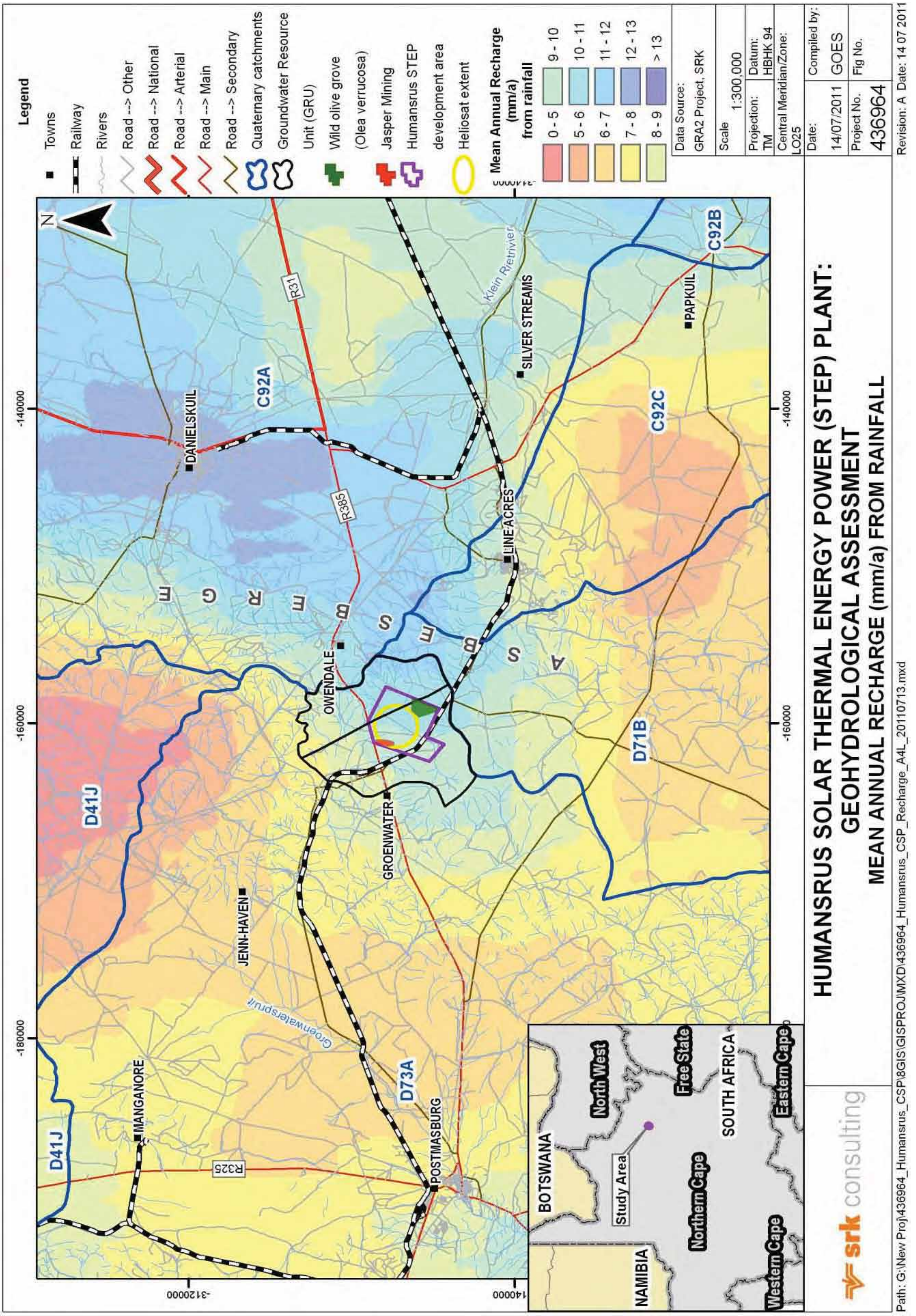


Figure 6: Mean annual recharge in the Humansrus area

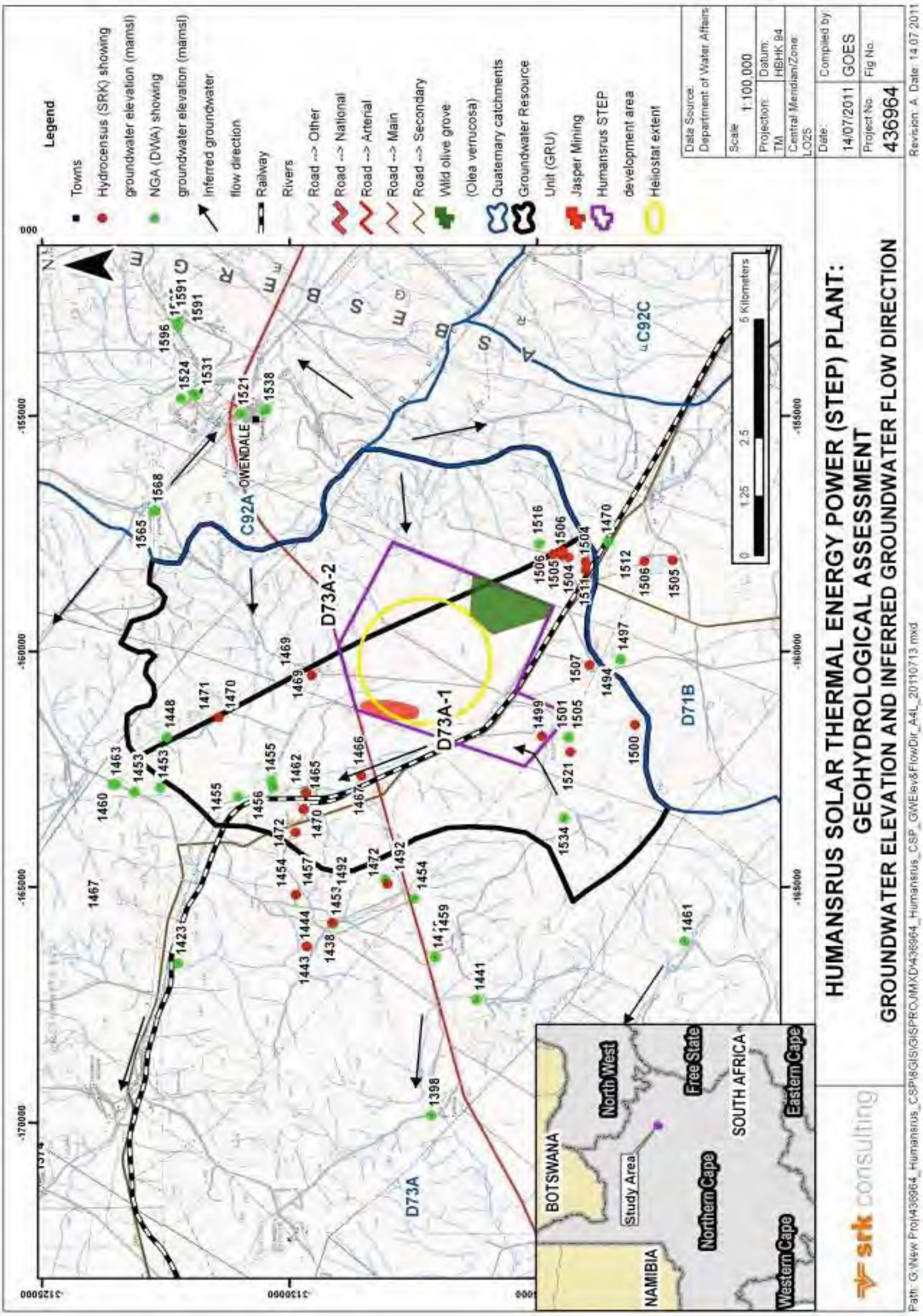


Figure 7: Groundwater elevations and inferred flow directions in the Humansrus area

3.3.6 Groundwater Quality

The groundwater salinity (expressed as Electrical Conductivity in mS/m) of the Humansrus area is shown in **Figure 8** (page 20). The groundwater quality varies throughout the area with the best quality of groundwater occurring in the recharge areas, i.e. the jaspilite and banded ironstone hills in the eastern and northern parts of the study area. However, the groundwater quality throughout the area is generally good and based on the field measured Electrical Conductivity's (EC), which ranged between 32 and 132 mS/m (mean EC = 59 mS/m), suitable for human consumption[3]. Noticeable anomalies in the field measured EC's were recorded near potential pollution sources (e.g. stock pens) in areas with shallow water levels. This indicates that the aquifers are easily polluted by surface pollution sources due to a rapid recharge and relative quick vertical infiltration.

The average EC and pH values of the surveyed boreholes are 66.8 and 7.5 respectively and correlate well with the median values. This means that there are not highly anomalous values for these parameters which skew the average values. Borehole GR14 and the spring GR13 are in the same area with largely different EC values. The relative high EC measured at the spring can likely be attributed to surface pollution from animals drinking at this open water source. Boreholes GR14 and CN2 are drilled in the Daniëlskuil Member (jaspilite) of the Asbestos Hills Formation and yield groundwater with very low EC values. The Asbestos Hills Formation in this area is characterized by a very good groundwater quality.

3.3.7 Aquifer Vulnerability

Figure 9 shows aquifer vulnerability as determined by evaluating seven parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible away from the high risk areas in the north and east. Best position will be in the south-western parts of the farm where the aquifer vulnerability is lowest.

[3] $\leq$150 mS/m is acceptable for long term human consumption (SABS, 2006)

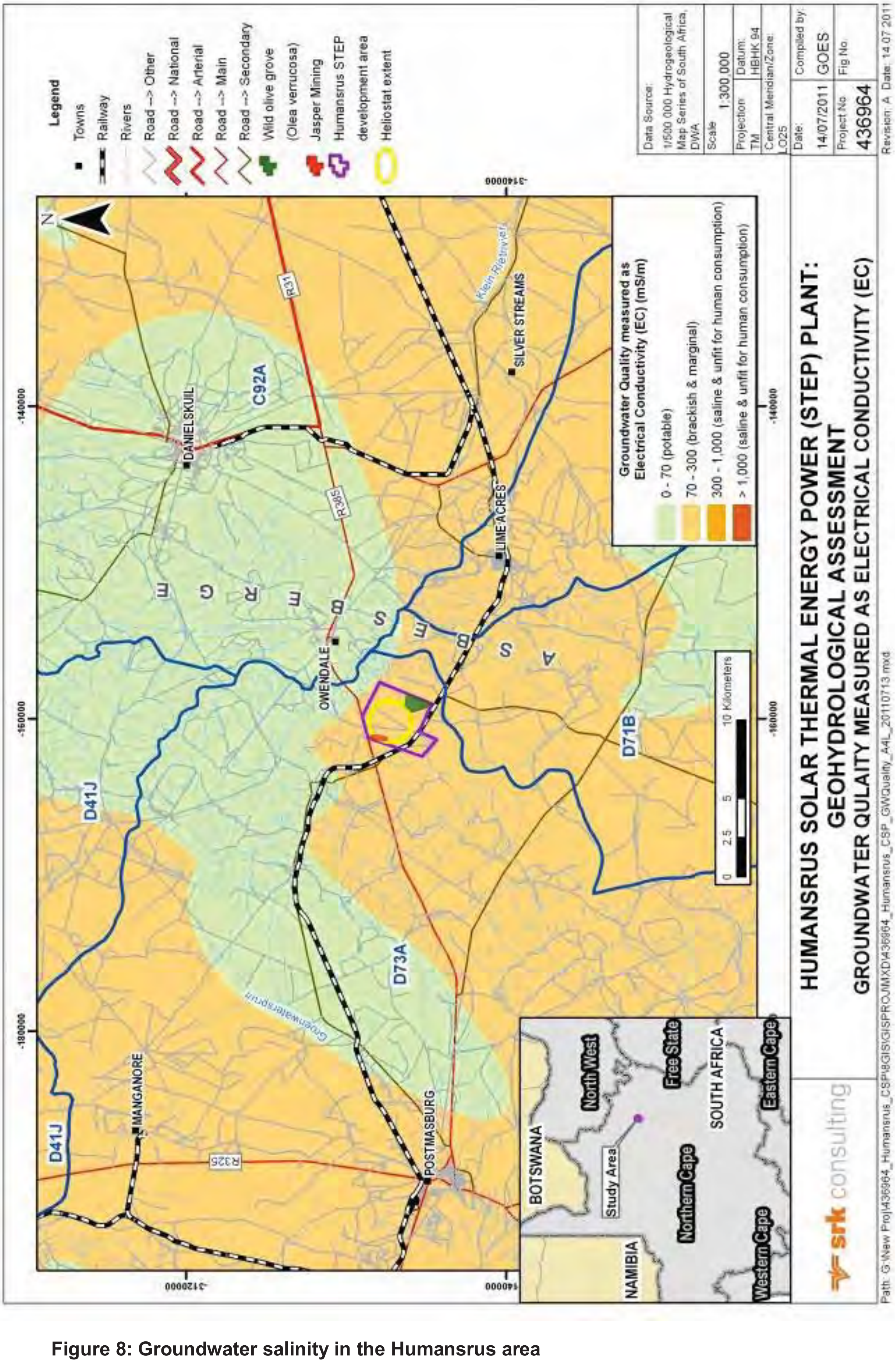


Figure 8: Groundwater salinity in the Humansrus area

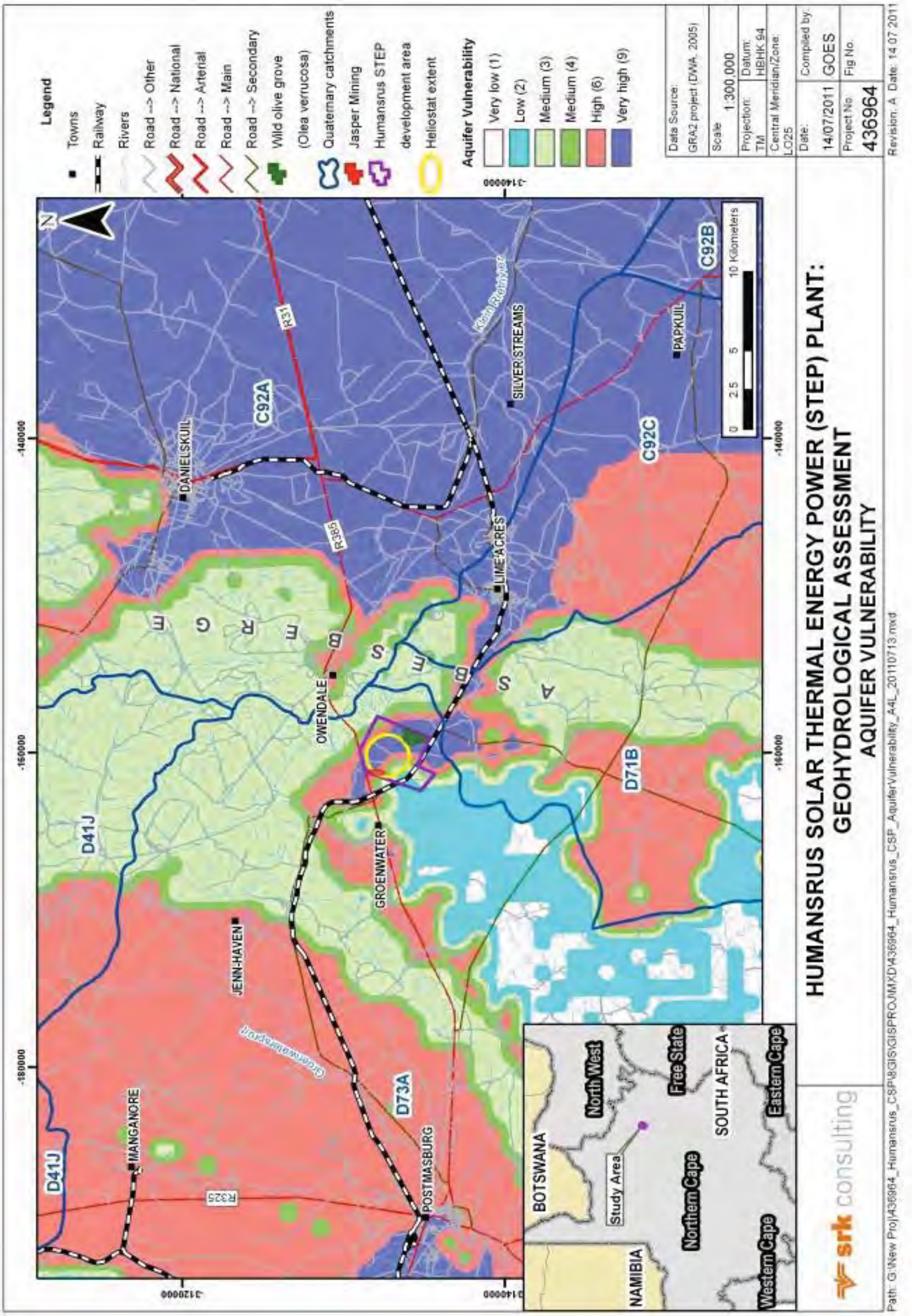


Figure 9: Aquifer vulnerability map of the Humansrus area

4 Conclusions

Based on the information discussed in this report the following can be concluded regarding the groundwater conditions at Humansrus:

- Local geological observations during the hydrocensus and lineament mapping from Google Earth images indicate that the valley at Humansrus farm is a result of graben faulting;
- Maximum immediate yields of boreholes drilled along these two graben faults are very high, but otherwise borehole yields seldom exceed 4 ℓ/s;
- The high yielding borehole HS2 drilled on the eastern graben fault intersected highly fractured lava and tillite in the fault zone and had a reported tested yield of 40 ℓ/s. This borehole is blocked at 60 mbgl by a pump that got stuck and cannot be used;
- Two boreholes (GR11 and GR12) located along the western graben fault at Groenwater were previously utilized for irrigation purposes and groundwater was abstracted at a rate of 180 000 m^3/a without an apparent significant negative impact on the aquifer;
- Relative little groundwater is abstracted from this area and groundwater is mainly used for stock watering and domestic purposes;
- Most of the calculated groundwater abstraction occurs in the Groenwater rural area with the Groenwater spring the main contributor;
- Groundwater quality measured as salinity (EC) in the surveyed area is generally good to very good with a mean EC of 59 mS/m. The EC only deteriorates near pollution sources such as stock pens, pit latrines and soak away pits. The best quality groundwater occurs near the recharge areas of the Asbestos Hills Formation in the eastern parts of the Humansrus valley;
- Groundwater exploitation figures for the area indicate that the expected maximum water demand of 246 200 m^3/a for the STEP Plant is only ~65% of the Exploitation Potential of the Humansrus GRU (D73A-1). Therefore, satisfying the STEP Plant's water demand from the local groundwater resources should not have an unacceptable negative influence on groundwater resources of the area;
- The General Authorisation for taking of groundwater from Drainage Region D73A is zero, except for schedule one and small scale industrial purposes. Therefore, if the water demand is to be satisfied from the groundwater resources, a Water Use Licence Application will have to be submitted to the DWA;
- The best areas for future production boreholes for the STEP Plant are the two graben faults at Humansrus with the eastern fault the prime choice;and
- From aquifer vulnerability point of view the proposed area for the STEP Plant is favourable as long as possible sources of groundwater pollution are kept away from the two graben faults, especially the north-eastern and eastern parts of the farm. Best area for the evaporation pond will be the south-western part of the farm where aquifer vulnerability is low. The groundwater level in this area is ~18 mbgl with argillaceous material expected in the upper part of the geological profile which will give some protection from surface pollution.

5 Recommendations

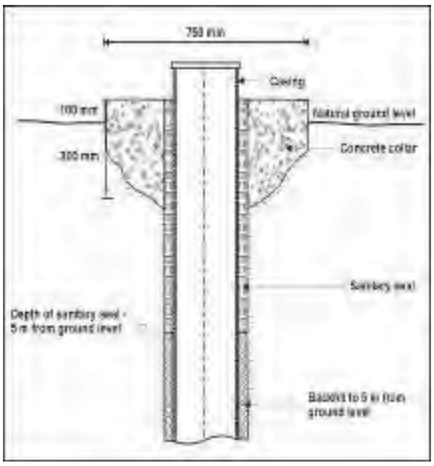
Based on the conclusion of this preliminary report the following is recommended:

1. The Solar Power Tower and evaporation ponds must be placed close to the centre of the valley at Humansrus as far away as possible from the two graben faults;
2. Heliostats can be placed all over the area as these do not pose a groundwater pollution hazard;
3. Future production boreholes must be concentrated on the two graben faults with the eastern fault the primary choice;
4. All existing boreholes must be properly sealed at the surface to prevent surface pollution of the groundwater. This measure will also prevent bees from invading the borehole;
5. A more detailed hydrogeological impact assessment including drilling of test boreholes and test pumping of existing and the test boreholes must be carried out;
6. At least three (3) shallow monitoring boreholes (two downstream and one upstream) must be drilled and pump tested near the evaporation ponds to obtain aquifer parameters for the numerical model and contamination transport model. These boreholes can be used for monitoring purposes in future;
7. The reportedly high yielding borehole HS2, which is unusable due to a pump stuck in it, should be replaced with a new production borehole drilled adjacent to it. The new borehole must be pump tested according to the DWA requirements. This will provide invaluable information regarding aquifer parameters of the fault zone for use in the groundwater numerical model;
8. Existing borehole HS4 must also be yield tested to obtain aquifer parameters in an area with a much lower aquifer potential; and
9. In order to safeguard the groundwater supplies from contamination and equipment from theft and damage, two zones of protection must be established around each production borehole.

Inner protection Zone

The inner protection zone is an area of at least 50 m x 50 m, centred on the actual borehole. The following measures must be applied in this protection zone:

- No pit latrines, VIP's, soak-aways or septic tanks – to prevent effluent from percolating into the aquifer and borehole;
- No storage of fuel, lubricants or other hazardous substances without a leak prove;
- Production boreholes for domestic use must be equipped with a sanitary seal – to prevent contaminated surface water and spilled fuel from percolating down the casing into the borehole;
- The concrete collar around borehole casing must be at least 100 mm higher than the floor or surface level



to prevent spilled fuel, water from leakages, wash water, etc to enter the borehole;

- No ponding of surface water must be allowed, i.e. the area must be sloped for surface water to drain away from this zone;
- Vegetation, other than trees and large bushes, should be maintained in this zone – Note: Roots of bushes and trees growing near boreholes often grows into the borehole where it can cause considerable problems;
- The borehole and pumping equipment must be housed in a lockable pump house. For this purpose a removable cage manufactured out of galvanised steel mesh and corrugated steel sheets is recommended. This cage, rather than a brick building, is recommended as it can be readily removed in case the borehole is damaged or if it needs to be re-developed and cleaned.
- The production boreholes, as well as other monitoring boreholes in the area, must be properly sealed to prevent entry of reptiles, insects, birds and small rodents.
- The entire area should be properly fenced with a lockable gate to prevent unauthorised entry and to exclude animals. The gate must be positioned and of such a type that allows easy vehicle access.
- A signboard must be erected on the gate warning people of the dangers and that unauthorised entry is not allowed.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted hydrogeological and environmental practices.

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ANNEXURE C WASTE CLASSIFICATION REPORT

CSIR Consulting and Analytical Services

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23 August 2011

Gerrie le Roux
Environmental & Waste Management Division
WorleyParsons RSA

FAX NO: 012 460 9978

Dear Gerrie

REPORT: OPINION REPORT FOR THE CLASSIFICATION AND DISPOSAL OF BRINE EFFLUENT FROM THE HUMANSRUS SOLAR RESERVE INTO EVAPORATION PONDS

Attached is the report on the hazardous nature of the brine effluent stream for the Humansrus Solar Reserve Stream 29. The report recommends that the Brine stream be treated by evaporation in a evaporation facility. As the waste stream is a bulk liquid the risks of disposing it as a waste or effluent is unacceptable.

I trust you find the report in order. Please let me know if you have any queries or comments.

Yours sincerely,

Mr Calie Adlem
Laboratory Manager: Inorganic Chemistry
Environmental Laboratory
CONSULTING AND ANALYTICAL SERVICES

CSIR

CONSULTING AND ANALYTICAL SERVICES

REPORT

on

OPINION REPORT FOR THE CLASSIFICATION AND DISPOSAL OF BRINE EFFLUENT FROM THE HUMANSRUS SOLAR RESERVE TO AN EVAPORATION POND

for

GERRIE LE ROUX
ENVIRONMENTAL & WASTE MANAGEMENT DIVISION
WORLEYPARSONS RSA

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by

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Pretoria
23 August 2011

EXECUTIVE SUMMARY

WorleyParsons RSA supplied the CSIR with results and information about Brine produced from the Humansrus Solar Reserve plant. The CSIR is to assess the risk associated with disposal options. WP will carry out the conceptual and detailed design required for the relevant disposal option.

Only the brine effluent identified as stream 29 intended for disposal to the evaporation ponds for the Humansrus Solar Reserve need to be considered.

Only some major cations and anions were found in the Brine. The brine cannot be discharged to surface water, nor released into the environment or disposed off as general waste.

The Brine exceeds the wastewater discharge limits significantly with regard to salt content.

The Brine generated does not delist and still qualify as a hazardous waste (Hazard rating 3)

The Brine can pose health problems and other end-user problems due to the types and levels of salt present.

The Brine as a bulk liquid waste will add significantly to the leachate of a typical waste disposal site. Further treatment for example evaporation is preferable to normal disposal.

Due to the pressure a bulk volume of leachate will exert on the liner of a disposal site which typically has limited volumes of leachate and any design must accommodate liners that can prevent damage and unacceptable leakage or loss.

The Brine requires a specifically engineered solution for treatment that can handle a bulk liquid with high levels of dissolved solids. The "Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 2nd edition, 1998" does not provide a practical solution since it focuses on the classifying and handling mostly of solid wastes and not liquid waste as such. The waste must preferably be handled in a specifically designed treatment facility such as the recommended evaporation and crystallization process recommended for such wastes.

HAZARDOUS WASTE CLASSIFICATION

TERMS OF REFERENCE

WorleyParsons RSA supplied the CSIR with results and information about Brine produced from the Humansrus Solar Reserve plant. The CSIR is to assess the risk associated with disposal options and write an opinion classification report about the disposal options. WorleyParsons (WP) will carry out the conceptual and detailed design of an evaporation pond based on their information and the classification opinion report.

INTRODUCTION

The assessment will be carried out using a risk approach. The finding will inform the design requirements for a disposal site/evaporation pond. Analytical and process information was supplied by WP and will be used for this assessment. No additional analyses will be carried out.

The brine is inorganic in nature and originates from borehole water.

KEY CONSIDERATIONS

According to the 2nd edition of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (1998) most waste disposal scenarios assume a solid with no significant head of liquid on the liners of the disposal site.

The sample originates from borehole water and is assumed to contain mostly major cations and anions and little if any heavy and trace metals. Only results for these were available.

The main concern for consideration should be the protection of ground and surface water in the vicinity of the plant and site. Impacts could include human health (drinking), aquatic ecosystems, and commercial users (e.g. irrigation).

<u>Only the brine effluent identified as stream 29 intended for disposal to the evaporation ponds for the Humansrus Solar Reserve need to be considered.</u>

METHODOLOGY

Analytical data. The Analytical data provided was evaluated against the wastewater discharge specifications (National Water Act no. 36 of 1998) and the relevant sections of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, DWAF, (2nd edition 1998).

WP supplied the analytical data but no information about a possible classification or size of disposal site/evaporation dam. The CSIR can accept no responsibility for the

representative nature or the accuracy of the analytical and load data for the brine that must be assessed.

Processing of results from leach tests and inorganic scans. The results of the extracts were processed to a limited extent to class the cations in context of the salts associated with nitrate and fluoride content. No other associated minerals are listed in the Minimum Requirements.

The acceptable risk (AR) values supplied in the "Minimum Requirements" supplied by the Department of Water Affairs and Forestry (DWAF) were used as a reference. These values were compared with the estimated environmental concentration (EEC) for the elements detected.

The EEC value was obtained by processing the results from the leaching tests using a spreadsheet. Load and two areas of disposal were used to calculate the final EEC. The load of the waste was reported as 4917.6 tons/month. The estimated hourly load of 6.82 ton/hour was used. In order to calculate the EEC values for the brine sample disposal at a 1 and 100 ha site was used. No other sites or scenarios were considered.

The EEC value was compared with the AR value and the waste classified to a hazard rating (HR) depending on the result. The original HR is supplied by DWAF. If the EEC value is lower than the AR value, the waste can delist to "General Waste". The detail results are attached as Appendix A.

Calculations used for processing of analytical results. Calculations were carried out using the following formulas and the results are shown in Appendix A.

Calculations

Teratogenicity, mutagenicity, carcinogenicity, AR values and hazard rating of the elements were found in the "Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 2nd edition, 1998" (DWAF). The calculations used to present the data in appendices A was carried out using formulas from the "Minimum Requirements".

<u>Example of calculation</u>.

Brine stream 29
Size of site = 1 ha
Volume concentrate = 4917.6 t/month

<u>Sodium Fluoride</u>
Analysis = 0.003546 g/kg
HR = 4
AR = 4300 ppb

Not a teratogen, mutagen or carcinogen.

EEC = (Analysis*volume per month/size of site)*0.66
= (0.003546 g/kg*4 917 600kg/month/1 ha)*0.66
= 11476 ppb

Thus AR<EEC

Waste do not delist
Site = H:h

If an element is hazardous as well as a teratogen, mutagen or carcinogen the EEC had to be lower than the AR before it will delist to be disposed in a G:B$^+$ site instead of a H:H site.

> NOTE: A product or residue is classified as a hazardous waste even if only one toxic element do not delist according to DWAF's criteria. However, the final authority for classification of the product or residue lies solely with the Department of Environmental Affairs (DEA) .

RESULTS AND DISCUSSION

Classification of samples. The Brine sample did not delist for either the 1 or 100 ha scenarios. Even though the suitability of the classification criteria of the minimum requirements to liquid wastes is not ideal, the classification shows that the liquid as such is still hazardous (moderate hazard, Hazard rating 3).

Table 1 shows the two scenarios used for classification of the brine stream. Listed are the load and two areas for disposal. The two columns to the right show the resultant classification and the type of site required for the disposal of the waste stream.

More detailed classifications are attached as Appendix A.

Table 1. The classification of the Brine

Residue	Load (kg/month)	Disposal area (ha)	Hazard rating	Site classification
Brine	4917600	1	Hazardous, moderate (3)	H:h
Brine	4917600	100	Hazardous, moderate (3)	H:h

The brine is an inorganic process wastes or residues and was classified as class 6 (Poisonous (toxic) substances) according to the SABS 0228 code.

Comparison with wastewater standards. In Table 2 the elements analyzed and found in brine were compared with the general and special limits for wastewater discharge published by DWA (National Water Act, Act 36 of 1998). The nitrate/nitrite

content does meet the general limit and the fluoride exceeds the limit only by 0.6 mg/l as F, but the main concern is the total salt load. When the maximum loads allowed is compared with the calculated TDS content it is clear that disposal of the Brine as a wastewater will not be allowed. Using the estimated values the Brine exceeds the maximum level allowed by 3 to 4 times. Such levels will also contribute to "shock loads" where the salinity of the surface water can change significantly. Typically the published limits only allow an increase in dissolved solids content of approximately 300 to 450 mg/l.

Total dissolved solids is not necessarily toxic, but can affect natural aquatic systems negatively with effects on individual species, the overall community present in the system and on microbial and ecological processes.

Though an index like the sodium absorption ratio SAR is a complex issue high salt content in surface or groundwater increases the likelihood of negative effects if the water is used for irrigation.

Table 2. Comparison of wastewater discharge criteria with the composition of the Brine.

Parameter	Brine	General limit	Special limit
Nitrate/nitrite as mg/l N	8.4	15	1.5
Electrical conductivity (mS/m)*	4321 mg/l as TDS (calc)	Max of 150 mS/m = 900 mg/l as TDS	Max of 100 mS/m = 600 mg/l as TDS
Fluoride mg/l	1.6	1	1
pH	7.6 (raw water)	5.5-9.5	5.5-7.5

* TDS equivalent of standard limit estimated by a calculation of the EC with a factor of 6.5

Comparison with domestic use guidelines. Human health factors in case of drinking is typically aesthetic for example in the case of chloride and sodium above 200 mg/l, where taste and corrosion is the most serious concern.

However sulphate levels of above 400 mg/l can cause diarrhea as well as a bitter taste as do magnesium at levels above 200 mg/l. At 10 mg/l as N the Nitrate/nitrite level of 10 mg/l as N can cause blue baby syndrome (Methaemoglobinaemia) in infants.

Total dissolved solid content levels of more than 3000 mg/l contribute to corrosion and taste problems, but can also have clear short-term health effects as it disturbs the human body's salt balance. Similarly potassium can cause serious problems for infants and individuals with renal problems.

Fluoride is also present at the threshold level of 1.5 mg/l as F for dental mottling and softening of enamel in continuous users.

Table 3. Available analyses for Brine stream 29 in mg/l

PARAMETER	RESULT
Sodium as Na	204
Potassium as K	136
Calcium as Ca	267
Magnesium as Mg	258
M-Alkalinity as $CaCO_3$	1554
Chloride as Cl	363
Sulfate as SO_4	509
Nitrate as NO_3	37 (8.4 as N)
Fluoride as F	1.6
pH	7.6
Silica (reactive) as SiO_2	36
TDS (calc.)	4321

DISPOSAL CONSIDERATIONS.

Only a few major cations and anions were found in the Brine. The brine needs to be treated and stored with a suitable technology like an evaporation pond. It cannot be discharged to surface water or disposed as normal waste.

The Brine exceeds the wastewater discharge limits significantly especially with regard to salt content.

The Brine generated does not delist and still classify as a hazardous waste (Hazard rating 3)

The Brine can pose health problems and other end-user problems due to the types and levels of salt present.

The Brine is a bulk liquid waste that will add significantly to the leachate of a typical waste disposal site and therefore require disposal into an evaporation pond to allow evaporation rather than disposal to a "typical" landfill scenario..

Due to the head (pressure) leachate will present on the liner of a disposal site a normal design for a waste disposal site (which typically has limited volumes of leachate with solids) and its liners may not be sufficient to prevent leakage and a breach of its integrity.

The Brine requires a specifically engineered solution for treatment that can handle a liquid with high levels of dissolved solids. As such the typical approach in the "Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 2nd edition, 1998" does not seem relevant and the design of the treatment plant must be carried out by the relevant experts. One of the recommended treatment methods for this type of waste is evaporation and concentration.

Based on the above, the brine must be disposed by applying a suitable solution specific to bulk liquids containing high levels of salts and not by wastewater discharge or disposal to a normal waste disposal site.

REFERENCES

1. Toxicity Characteristic Leaching Procedure. 1986. Federal Register, 51(114). Washington, DC: Environmental Protection Agency.

2. Minimum requirements for the handling, classification and disposal of hazardous waste, 2nd edition. 1998. Department of Water Affairs and Forestry.

3. Act no 36 of 1998, Revision of general authorizations in terms of section 39 of the national water act, 1998, [section 21(f) and (h).

4. South African Water Quality guidelines, volume 1, 4 and 6, Department of Water Affairs and Forestry, 1996, 2nd edition.

APPENDIX A

Waste classification of Brine stream 29 from the Humansrus Solar Reserve plant

Waste classification report

Stream 29									Volume (kg) =		4917600	
Brine									Size (ha) =		1	
	DL	Measured	Teratogen	Mut/Car	Hazard	ARL	Disposal all.	Total load wst	EEC	RHR	Waste class	Site needed
Metals	= *	g/kg	Y=Yes	Class	Rating	Ppb	g/ha/m	kg/ha	ppb			
Ca(fluoride)		0.00328			3	1000	1515	46189.02	10645.62	3	Hazardous waste	H:h
K(fluoride)		0.004893		2/3	3	100	151	3086.167	15880.15	3	Hazardous waste	H:h
Na (nitrate)		0.05069		3/4	4	1000	1515	2988.755	164520.28	4	Hazardous waste	H:h
Na (fluoride)		0.003536		3/4	4	4300	6515	184247.7	11476.498	4	Hazardous waste	H:h
K(nitrate)		0.06031		3/4	4	1000	1515	2512.021	195743.1	4	Hazardous waste	H:h

Waste classification report

Stream 29									Volume (kg) =		4917600	
Brine									Size (ha) =		100	
	DL	Measured	Teratogen	Mut/Car	Hazard	ARL	Disposal all.	Total load wst	EEC	RHR	Waste class	Site needed
Metals	= *	g/kg	Y=Yes	Class	Rating	Ppb	g/ha/m	kg/ha	ppb			
Ca(fluoride)		0.00328			3	1000	1515	46189.02	106.4562	delist	General waste	G:B+
K(fluoride)		0.004893		2/3	3	100	151	3086.167	158.8015	3	Hazardous waste	H:h
Na (nitrate)		0.05069		3/4	4	1000	1515	2988.755	1645.2028	4	Hazardous waste	H:h
Na (fluoride)		0.003536		3/4	4	4300	6515	184247.7	114.76498	delist	General waste	G:B+
K(nitrate)		0.06031		3/4	4	1000	1515	2512.021	1957.431	4	Hazardous waste	H:h

ANNEXURE D: DESIGN CALCULATIONS

EVAPORATION PONDS

Project	**Solar Reserve**
Project no.	**257000-PW0**
Section no.	**Evaporation of brine solution**
Sheet no.	**125 MW Power Plant**
Revision	**A**

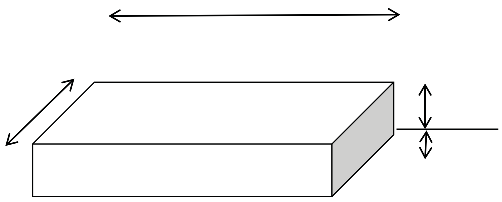
TYPICAL DESIGN DATA

Loss of water from a reservoir is measured and documented in the WRC publication
Water Resources of South Africa by Middleton and Bailey, WRC Report No. TT380/08

Obtain S-pan evaporation at site
Convert to actual gross evaporation by applying pan factor and brine factor
Obtain nett evaporation by subtracting drought rainfall
Determine area requirement
Determine depth requirement

Specific design data and input data		
Average daily flow to evaporation ponds	164	m^3/day
Average yearly flow to evaporation ponds	59860.00	m^3/annum
Design safety factor	15	%
Average brine concentration TDS	5000	mg/l
Brine load to pond	299300.00	kg/annum
Selected SG of concentrated brine	1.28	ton/m^3
Annual rainfall data for site	400	mm/annum
Drought rainfall	280	mm/annum
Maximum rainfall	100	mm/month
S-pan evaporation	2200	mm/annum
Pan factor	0.848	
Brine factor	0.7	
Design life of plant	30	years

Design dimensions of evaporation pans		
Combined brine pan factor	0.5936	
Average gross reservoir evaporation	1305.92	mm/annum
Nett evaporation En	1025.92	mm/annum
Design flow	68839.00	m^3/annum
Area requirement (total)	67099.77	m^2
Annual acquired volume of crystallised brine/salt	233.83	m^3/annum
Total acquired volume during plant life	7014.84	m^3
Depth required	104.54	mm
Freeboard required	300	mm
Total depth proposed	1200	mm
Depth allowance for fluctuations	795.46	mm
Volumetric capacity for fluctuations	53374.95	m^3
Extreme wet weather flow accumulation during highest rainfall month	6709.98	m^3
Spare capacity during highest rainfall month	46664.98	m3



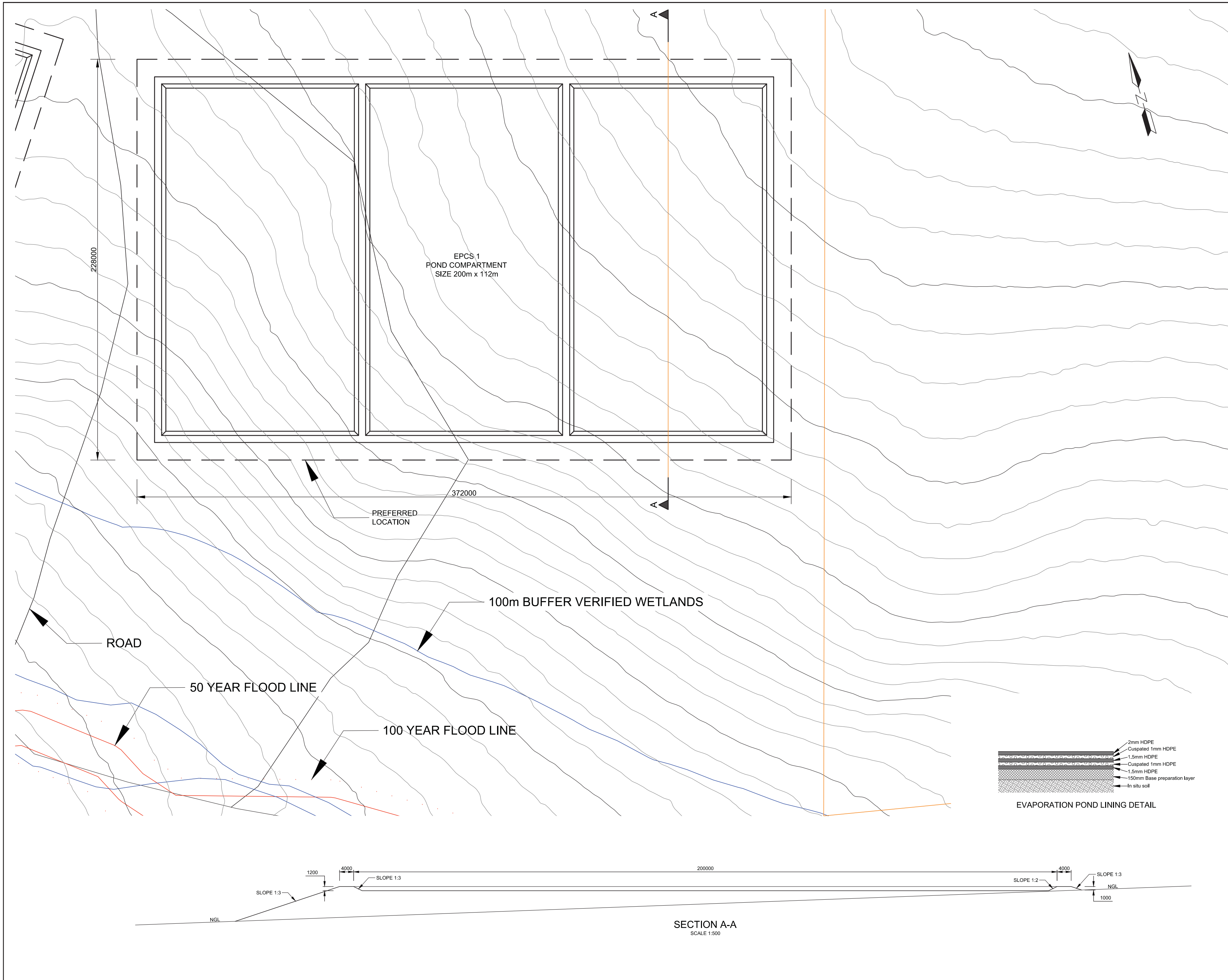
200	m	length
112	m	width
1095	mm	freeboard and accumulation capacity
105	mm	depth of crystalline salt/brine
1200	mm	total depth

Number of ponds and plant availability			
Number of ponds suggested		3	
Area per pond		22366.6	m^2
Suggested dimensions	Length	200	m
	Width	111.8	m
Accumulation potential with		2	
ponds out of service		17791.7	m^3
Monthly flow		4920.0	m^3/month
Sustainable for a month during wet weather?		Yes	

Cost estimate	
Double lined, compacted, backfilled	R 31 201 395

Comments:		Name	Date	Rev	Issued for:
	Designed				
	Checked				
	Approved				

ANNEXURE E: BASIS OF DESIGN DRAWINGS



SCALE FOR REDUCED PLAN

0 10 20 30 40 50

50MM ON ORIGINAL DRAWING

NOTES

POWER LINE

RAILWAY

50 YEAR FLOOD LINE

100 YEAR FLOOD LINE

RIVER / STREAM

EPCS = EVAPORATION POND CANDIDATE SITE
SURVEY SYSTEM: Lo 23° / WG 23

All dimensions to be checked on site before any work is put in hand. Refer any discrepancies to the engineer.

FOR APPROVAL

AMENDMENT

NO	DATE	CHECKED	DONE BY	DESCRIPTION
-	-		-	-

WorleyParsons
resources & energy

Incorporating KV3 ENGINEERS
P.O.BOX 36155
MENLO PARK, 0102
TEL:(012) 425 6300
FAX:(012) 460 1336

DESIGNED	DRAWN	CHECKED
R.R	J.B.	C.L.

CONSULTING ENGINEER DATE

CLIENT DATE

CLIENT

SOLARRESERVE

PROJECT

EVAPORATION POND
CANDIDATE SITE
POSITIONING

DRAWING DESCRIPTION

PROPOSED
EVAPORATION POND
BASIS OF DESIGN
DETAIL

SCALE 1:1000
ORIGINAL DWG SIZE A1

DATE OCTOBER 2011

DRAWING NUMBER

257000PW0-D01-0

Appendix I

Surface Hydrology Impact Assessment

Concentrating Solar Thermal Plant: Humansrus

Hydrology Environmental Impact Assessment Report

September 2011

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Executive Summary

SolarReserve SA (Pty) Ltd have proposed a concentrating solar thermal plant (CSP) in the Northern Cape on the farm 469 Humansrus near Postmasburg, adjacent to the road R385 that links Postmasburg and Kimberley. This report is the Environmental Impact Assessment (EIA) of potential hydrological impacts of the proposed CSP.

The essence of the design is a field of heliostats concentrating sunlight onto a central tower located at the top of a "power tower". The concentrated sunlight heats the central tower, which heats a molten salt flowing through a primary circuit. While the steam cycle will use mostly dry cooling, it is likely that wet cooling will be required, especially when ambient air temperatures become too high for efficient and effective dry cooling of the steam circuit. Dry cooling uses about 90% less water than wet cooling, but is less efficient.

Water for the CSP will be taken, by agreement with Sedibeng Water, from the Vaal-Gamagara pipeline.

It is highly unlikely there will be cumulative losses or gains that result from the project operations and the project could be considered to be hydrologically neutral from a surface water point of view. There will be neither a net loss or gain to surface water in the surrounding area of Humansrus 469 and nearby or adjacent properties. There will be a net economic gain to Sedibeng Water through purchase of water supplied from the Vaal-Gamagara pipeline to support CSP operations and generation of electricity. There may be a regional hydrological effect through the supply of water to the CSP from the Vaal-Gamagara pipeline, in that it will increase competition for water from that source.

The location of the proposed design of the CSP is such that it is unlikely there will be little if any effect on the identified water courses. The major channels on the Humansrus 469 property are located in catchment systems that arise off the property. The small wetland on the property is unlikely to be affected by the construction and operation of the CSP, it is outside the area of planned construction.

The alteration of the infiltration capacity of the several square kilometers of soil where the heliostats are constructed could lead to damaging overland flow and erosion should the area receive a significant rainfalls of the order of the 1:50 and 1:100 year return period. This effect should be managed, otherwise, in the event of a heavy rainfall, damage to the site and to the R385 road could be an outcome. Initial modelling procedures indicate the possibility for surface runoff to increase by 10 – 15 times as a result of changing infiltration capacity.

There are no identifiable issues from a hydrological and surface water point of view that would indicate the prevention of construction of the CSP. Where there are impacts, these can be mitigated by appropriate actions.

Abbreviations and Acronyms

AMC	Antecendent Moisture Conditions
CN	SCS Curve Number
CSP	Concentrating Solar thermal Plant
EIA	Environmental Impact Assessment
SCS	Soil Conservation Service
Tc	Time of Concentration

…..

Contents

Figures

Tables

1 Introduction

SolarReserve SA (Pty) Ltd have proposed a concentrating solar thermal plant (CSP) in the Northern Cape on the farm 469 Humansrus near Postmasburg, adjacent to the road R385 that links Postmasburg and Kimberley. The site is located 30 km east of Postmasburg and about 165km from Kimberley (see Figure 1), just north-west of Lime Acres and south-west of Danielskuil at georeference 28º 17' S and 23° 22' E.

This report is the Environmental Impact Assessment (EIA) of potential hydrological impacts of the proposed CSP. This EIA was prepared as part of an assessment contracted to OneWorld Sustainable Investments of Cape Town by Worley Parsons of Pretoria. In part execution of this EIA Report, the author visited the site on Wednesday 11 May, 2011.

This impact report assesses possible impacts of the proposed CSP on local and regional surface water hydrology. Water is critical to the operation of the CSP, primarily for cooling purposes, therefore the source of the required water is of concern. Secondly, the construction and operation of the CSP may have an impact on surface water conditions on the site and locally. This report assesses both possible potential impacts.

1.1 Expertise of the Author of This Report

This hydrological Impact Assessment was undertaken and compiled by Arthur Chapman in his capacity as a hydrologist working for OneWorld Sustainable Investments in Cape Town. He has an M.Sc in hydrology and 21 years experience as a hydrologist and related environmental sciences, with a background in assessing the impacts of land-use change on runoff, hydrological modelling, as well as environmental impact assessments. These assessments range from those of similar projects (Concentrating Solar Plants at Upington and two near Groblershoop, Northern Cape – Client: ESKOM); assessments of the impacts of mines on water resources (the Hillendale and Fairbreeze heavy sands project of the then Iscor at Mtunzini, KwaZulu Natal Province), the impacts of old mine discard dumps on surface water quality at Ogies (Client: the Oil Pollution Company of South Africa – OPCSA); a review of the hydrological assessments for possible nuclear power plants in the Western Cape (Client: ESKOM); The impacts of afforestation on surface and ground water resources in South Africa (various clients) and internationally (Forestal Oriental, Uruguay) and the impacts of invasive alien plant invasion on surface water resources (research briefs). He is also consulting to international clients on the impacts of climate change in Southern Africa across a range of different sectors that includes water resources, human health and energy supply.

2 Study Methods

The study approach utilized was as follows:

- The author consulted appropriate literature on the region, which included that on regional climate, hydrology and water resources, institutional arrangements and activities in the water sector. Included in this component on background information was consultation of the technical aspects of the design concepts of the proposed CSP facility from SolarReserve and consulting engineers Worley Parsons;
- A site visit was conducted to identify and inspect hydrological features that may be relevant to the proposed development;
- The development of the Scoping Report gave guidance to the issues investigated and subject to impact ratings;
- The Terms of Reference required a determination of the 1:50 and 1:100 year flood lines – SCS procedures were applied to the problem and appropriate maps produced;
- Impact assessments result from the synthesis of the above information and appropriate conclusions are then developed

In the pursuit of the development of this report, the study author consulted:

- Mr Allan Scholtz, the farm owner at Humansrus (visit – 11 May 2011);
- Members of the Groenwater Gemeenskap Rural Development Tribal Authority (Chief J.K. Marotobolo and Councilor Esther Diraditsile; visit 11 May 2011);
- Mr Hasenjager (Manager: Business Development and Acting Regional Manager Northern Cape, Sedibeng Water); and
- Various web resources and documents with respect to regional hydrology and climatology.

3 Review of Existing Information

3.1 Description of the Proposed Facility

The proposed CSP at Humansrus is that of the "power tower" concept, modelled on that of Solar One and Solar Two, built and proved in Southern California. The essence of the design is a field of heliostats concentrating sunlight onto a central tower located at the top of a "power tower" (See Figure 1). The concentrated sunlight heats the central tower, which heats a molten salt flowing through a primary circuit (the molten salt loop). The flow of molten salt is conveyed through a heat exchanger which transfers heat into a secondary circuit of water and the resulting steam drives a high pressure turbine and generator. The exhaust steam of this process is then reheated with molten salt in a standard Rankine cycle and injected into a low ressure turbine coaxially linked with the high pressure turbine to the generator. While the steam cycle will use mostly dry cooling, it is likely that wet cooling will be required, especially when ambient air temperatures become too high for efficient and effective dry cooling of the steam circuit. Dry cooling uses about 90% less water than wet cooling, but is less efficient.

The generating capacity of the proposed CSP at Humansrus 469 is 100MW. The design considerations and consumption of water that concerns this assessment is based on this size of

plant. A principle of operation is that a proportion of the captured energy is transmitted straight into the grid and the major proportion goes into heat storage (molten salt stored in tanks) for use during night times and periods of occluded sunlight. A salt is used (a mixture of pure potassium and sodium nitrate)because it has a high heat capacity (meaning the substance contains a lot of energy per degree increase in temperature) While the specific operational parameters of the proposed CSP have yet to be determined, the plant will start generating power each day when insolation is sufficient to provide heating for its primary thermal circuit, and it will when there is insufficient energy insolation to store and transmit power. Between these times (at night and during cloudy conditions, it will use the stored heat to generate electricity.

The proposed installation at Humansrus 469, which includes the central power tower and the field of heliostats, is estimated at being roughly 2.7 km in diameter or covering 8 km^2 (800 ha). The heliostat field will contain 17,350 heliostats, with the power tower located off-center and closer to the northern boundary of the round heliostat field. When the heliostats are not functioning (night time), they will likely be inverted, a position in which they can be cleaned and to prevent dewfalls and dust from quickly contaminating the reflecting surface. Dust on the reflecting surface i.e. mirror will significantly reduce reflectivity and will influence efficiency of the CSP plant – making a dust control suppression plan important during operations. The heliostat surfaces will be cleaned regularly by means of high pressure spray of demineralised water and possibly squeegee-like devices.

The area in the immediate vicinity of the central tower is likely to paved or have a concrete floor, as will the area around other supporting infrastructure (salt storage tanks, buildings, roads and some of the electricity distribution infrastructure). The area under the heliostats may be chipped stone or the natural veld with short shrubby vegetation or maintained as bare soil. Infiltration in this area is unlikely to be affected. The possible hydrological impacts of the CSP result from the water used in the construction and operation of the plant, as well as the effect of the installation on site hydrology.

3.2 Climate

The area is also known as the Green Kalahari, with a hot and dry climate. During the summer months (January) the temperatures can reach a maximum of 42°C. Observed rainfall mean is about 330 $mm.a^{-1}$, (determined from Smithers and Schulze, 2002 During wetter years, more than 600 mm has been recorded, whilst exceptionally dry years less than 200 mm has been recorded. Most of the rainfall received in the area is of convective origin and occurs in summer, leading to short, sharp downpours (Preston-Whyte and Tyson, 1988). Storms are relatively brief, but peak rainfall intensities over 5, 10 and 15 minutes differ little from other parts of South Africa that receive greater annual rainfall (Smithers and Schulze, 2002). Fifty and 100-year design rainfall return periods for the site are given in Table 4 in Section 8. On January 23rd, 2011, a maximum of ~150 mm in one day was recorded near the site. This is a record maximum daily rainfall for a local raingauge.

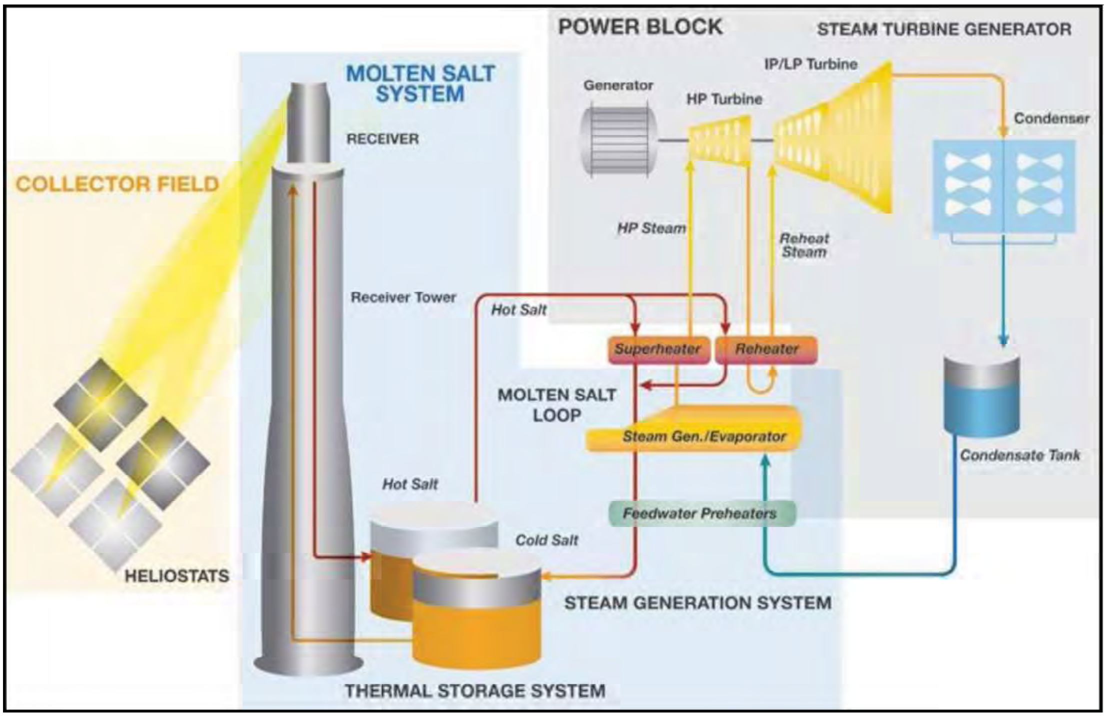

Figure 1 Conceptual layout of the proposed Concentrating Solar Thermal Plant of the type proposed for the Humansrus 469 site (source: Worley Parsons Technical).

In January daily maximum temperatures reach over 35°C on about 5 days a month, with minimum relative humidities at midday dropping to 20%-30% and even lower. During winters, frost can be severe (defined as when air temperatures at the standard thermometer measuring height of 1.3 m drops below 0°C. Air temperatures at ground level may be several degrees lower than air temperature at thermometer measuring height. The climatological definition of a frost is 2.2°C at standard thermometer measuring height). Minimum temperatures can go as low as -7°C, but these occasions are rare.

The January (14:h00) atmospheric saturation deficit averages about 40 mb (Tyson, 1986). The humidity mixing ratio (a measure of moisture content independent of temperature) for January is about 7 $g.kg^{-1}$, compared to 15 $g.kg^{-1}$ in more humid parts of the country (Preston-Whyte and Tyson, 1988. This is a measurement of the quantity of moisture in the air, measured as the number of grams of water vapour per kg of air. The quantity is controlled primarily by moisture availability, air temperature and air pressure). The dry atmosphere and good optical clarity are only a few of the reasons why this area in particular is excellent for CSP project development. Insolation of nearly 2,900 $kWh.m^{-2}.yr^{-1}$ when 1,800 $kWh.m^{-2}.yr^{-1}$ is roughly the minimum required to operate this type of CSP.

3.3 Description of Study Area and Regional Hydrology

At 330 mm.a^{-1} of rainfall and evaporation rate of about 2200-2600 mm.a^{-1}, the area is be classified as arid (Middleton and Bailey, 2009). Regional runoff ranges from 0-25 mm.a-^{1} (Middleton and Bailey, 2009). Surface water generated by rainfall is confined to stormflows following intense convective storms and quickly subsides. In general, streamflow is ephemeral, the stream beds are dry most of the time. Storage of water in dams is highly inefficient because of the high evaporation rate.

Identifiable channels are located on the southern and western boundaries and parts of the Humansrus property (See Figure 2). Small amounts of water can be found in the channels after rainfall but this is also dependent on the duration and intensity of evaporative conditions between rainfalls. The remainder of the Humansrus 469 property experiences sheet flow, most of which infiltrates into highly porous sandy soils and no channels are visible.

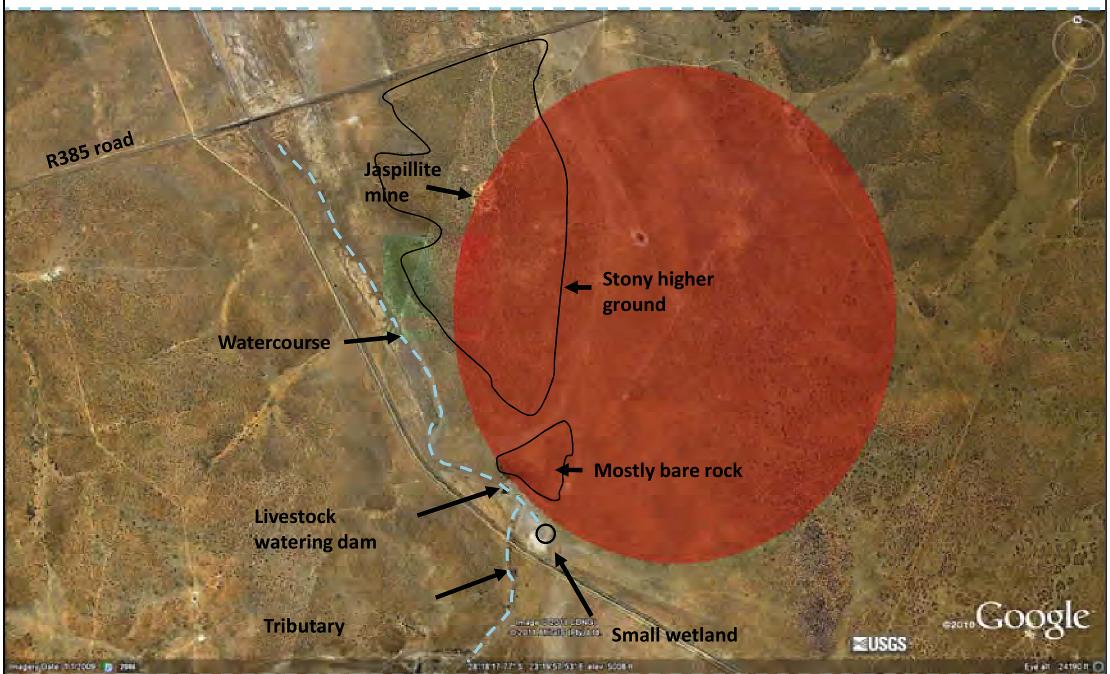

Figure 2 The proposed site of the CSP on the Humansrus farm, showing natural hydrological features (Source: Background Image: Google Earth).

3.4 Water Requirements during Construction, Operational and Decommissioning phases

The understood requirements for water for the operation of the CSP, based on Worley Parson documentation, is 1,550 $m^3.d^{-1}$ during the construction phase and about 750 $m^3.d^{-1}$ on average, during operation, or 272,400 m^3 over a full year of operation. Water demand however will vary according to cooling demands and peaking consumption can rise as high as 45 $m^3.hr^{-1}$ (See Table 1 below). The scoping report (see Chapman, 2011) identified the potential for the proposed CSP to utilize water taken from the Vaal-Gamagara pipeline and/or from local and regional groundwater resources. Water taken from the pipeline mayhave an impact on regional water supplies, through increased competition for water from the Vaal-Gamagara pipeline. The pipeline is described in further detail below.

Table 1 Water requirements during the construction and operationla phases of the CSP (Data Source: Worley Parsons, 2011)

Construction Phase	m^3 per day	m^3 over 30 months
Dust control	242	42,350
Road construction	1,170	51,100
Human use & other	137	24,050
Total	1,549	117,500

Operational Phase	m^3 per day	m^3 per year
Heliostat cleaning	8	1,319
Plant operation	746	272,400
Peaking consumption /hr	45	

3.5 Sedibeng Water and the Vaal-Gamagara Water Scheme

Sedibeng Water is the water authority for the area in terms of water supply. The proposed CSP site is located in the Northern Cape Proclaimed Service Area of Sedibeng Water. Proclamation means that the relevant water authority is the only party authorised to supply and manage water within its area of jurisdiction, unless agreed otherwise and excepting individual properties that manage their own water, as noted in this excerpt from the Water Supply Act (Act108, 1997) – that every Water Board:

“*must consider every request by a water services institution for the provision of water services within its service area and may only refuse such request if, for sound technical and financial reasons, it would not be viable to provide those water services*” (Clause 32(c));

The Vaal-Gamagara pipeline is part of a government water supply scheme managed and operated by the water authority Sedibeng Water (Jeleni and Mare, 2007). The scheme runs through six Water Service Authorities, which are composed of four local municipalities (Dikgatlong, Kgatelopele, Tsantsabane and Gamagara) and two district municipalities (Kgalagadi and Frances Baard) (See Figure 2). Key customers of Sedibeng Water using the Vaal-Gamagara scheme include mines, the agriculture sector, Public Works institutions, domestic users, Spoornet and Eskom.

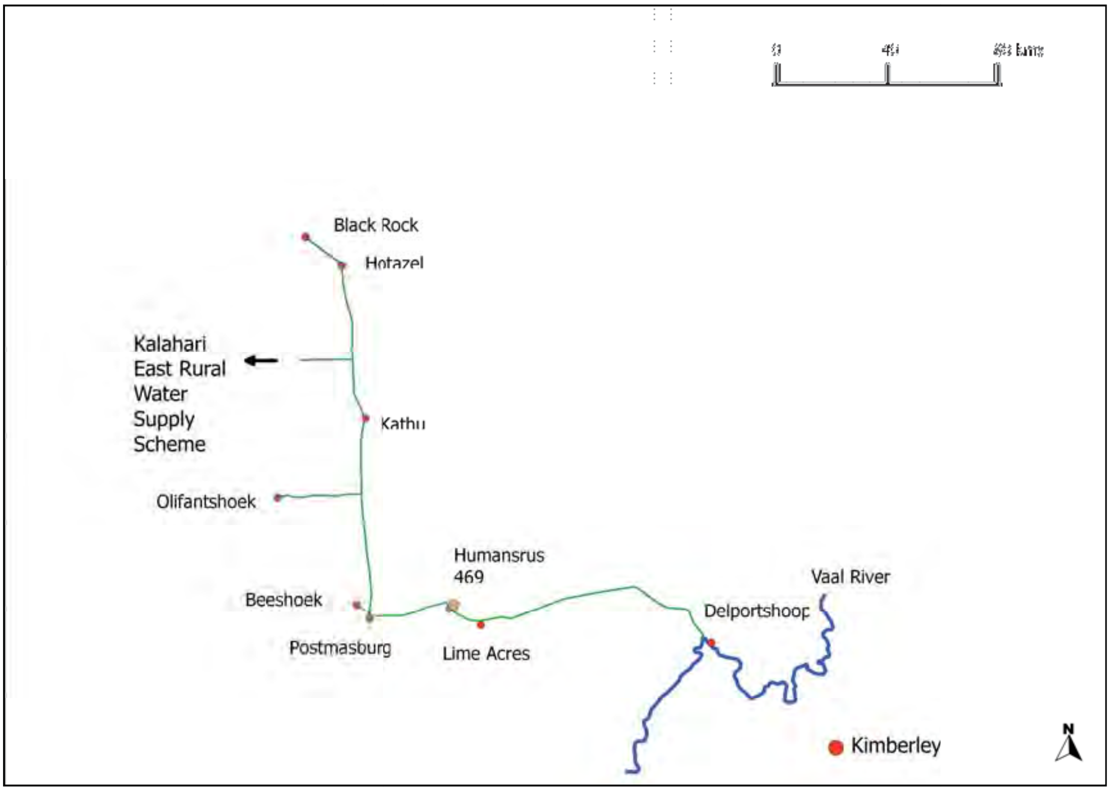

Figure 3 The approximate layout of the Vaal-Gamagara pipeline as a regional supply system operated by Sedibeng Water.

The pipeline was built in 1964 to supply water to settlements and mines in the Gamagara River catchment (Postmasburg, Beeshoek Olifantshoek Sishen/Kathu, Hotazel, and Black Rock) but was not under the control or owned by a Water Authority. The extension of the Sedibeng Water Service Area to that region serviced by the Vaal-Gamagara Water Supply Scheme was listed in the Government Gazette No 114, 8 February 2008. Water is abstracted from the Vaal River near Delportshoop upstream of the confluence with the Harts River, from where raw water is

pumped to a purification plant nearby. Purified water is then pumped via intermediate booster stations at Kneukel and Tredwil through 99 km of pipeline to reservoirs at Clifton in the hills above Lime Acres (total pipeline length of the Vaal-Gamagara system is about 1700 km). From this relatively small storage capacity of 27,000 m^3, water is gravity fed over 182 km to Kathu and reservoirs at Black Rock and other parts of the pipeline. Design capacity of the pipeline is 3,637 $m^3.day^{-1}$. In total there are six booster pump stations and a total pipeline network of 1,700 km (Sedibeng Water online). Mines use most of the water (60%) and are the biggest employers in the region.

The pipeline diameters vary between 700 mm at the source (Vaal River near the confluence with the Harts River) to 200 mm towards its terminus (Black Rocks). The pipeline branches out to supply water to surrounding areas such as Olifantshoek (including the Kalahari East pipeline) and Beesthoek. The Kalahari East Rural Water Supply Scheme is a rural water supply system, constructed in the early 1990s to supply farmers in the Kalahari with water for domestic and livestock uses (See Figure 3). The Kalahari East RWSS is located north-east of Upington and west of the Vaal-Gamagara pipeline, covering a large area all the way from the Orange River to the Molopo River channel and South African border with Botswana.

The design capacity of the pipeline is 36.37 $Ml.d^{-1}$ or 1.5 $Ml.hr^{-1}$ (1,500 $m^3.hr^{-1}$). The pipeline has a maximum allocation from the Vaal River of 13.7 million $m^3.a^{-1}$ but sometimes operates at less than full capacity. During drought, water restrictions are imposed on abstractions and allocations to users are curtailed on the basis of a priority classification, as well as the short-term yield characteristics of the Vaal River.

The pipeline is critical to the economic performance of this region of the Northern Cape. There are proposals to extend the pipeline to more settlements in the Mier district (that area primarily served by the Kalahari East and West RWSS). Capacity on the pipeline is apparently fully committed (I. M. Hasenjager, Manager: Business Development and Acting Regional Manager , Northern Cape, Pers. Comm,) and Sedibeng Water is developing a concept proposal for an additional pipeline alongside the original pipe (the water in a second pipeline would be expensive because the tariffs would need to be used to defray the costs of construction over more than 100 km through rocky ground. The Vaal River is not the only source of water in the pipeline, however. High quality water available from dewatering of the Sishen mine is pumped into the pipeline at Kathu. When the new Kumba iron ore mine near Postmasburg is developed, water from that mine will also be made available to the system.

The Vaal-Gamagara pipeline is an attractive option for supplying water to the CSP because of its proximity to the project and the high quality water. It is assumed that if the pipeline has sufficient capacity, the appropriate supply options can be put into place.

4 Description of Site and Local Environment

4.1 Site Survey

The site was visited by RA Chapman on 11 May 2011. The site was inspected for all features of hydrological importance. These included channels, areas of temporary or permanent water storage, wetlands and for signs wherever surface water is active in the landscape.

4.2 Physical Description and Catchment Characteristics

The proposed site for the CSP is illustrated in Figure 1. Within this core area, no surface drainage features such as stream channels, are observable. The area is covered with sands that have a high porosity and infiltration capacity and can be classified as soils with a deep Hutton profile (See MacVicar et al., 1997). Infiltration is rapid and surface water exists for a short time only. Surface flows that may be generated in the hills to the north and east infiltrate rapidly into the substrata near the edges of the break in slope.

To the west but within the property, the ground rises slightly more steeply with a slope of about 1:50 or 2-3%. This higher ground, that is a significant part of the western part of the CSP footprint, is not evident from the 1:50,000 topographic map, which is somewhat misleading as to land shape. The ground is stony and also has a large floating rock component (boulders not attached to the parent rock system). A small jaspillite mine or quarry is located on this feature (See Figure 1 – which identifies the feature).

4.3 Channels, Wetlands and other Water Features

The runoff patterns of Humansrus 469 are complex. In the south and west, the most significant channel enters the property from the western high ground. This area (the catchment to the west of the Humansrus property) generates more flashy hydrographs than those arising from the high ground (also outside of the property) in the north and north-east. Geological and associated soils conditions control the storm flow responses from the different areas. In the south and west, channels are easily observable, but they do not exist in the north-east.

The location of potential surface flow through the site where the CSP is proposed to be located is far less discernable. No channels exist here, pointing to the lack of preferential flow paths. Sheet flow is expected in this area during intense storms. This raises the concern of how conditions for surface flow may change with construction and vehicular activity during operation of the proposed CSP.

There is only one significant identifiable drainage channel, located on the west side of site, adjacent and parallel to the railway line. The main part of the catchment lies outside of the property, to the west (Figure 4). Ephemeral, water flows only very briefly during heavy and intense storms. This channel joins another small channel on the Humansrus property and turns north-west, where it is blocked by a small dam used for watering livestock. Further downstream, the channel, which was originally wider, has been confined through erosion of a

deeper channel into its floodplain with significant banks. All of these channels are ephemeral. Only small pools of water were visible in the channel despite it having rained during the night before this authors field visit.

There is a small wetland near the south-western boundary of the CSP footprint, about 0.2 ha in area (See Figures 2 and 4). Colloquially known as a pan or vlei, it is shallow, had no standing water at the time of the visit but its spongy soils were damp (it had rained within 24 hrs of the site visit). It appears to have a low biotic diversity. Covered mostly be a single tough type of grass about 0.6m height, it appears unpalatable to livestock (it has not been grazed, unlike surrounding grasslands) and is also unused by small birds (Figure 5). From observation, water retention is highly likely of short duration. Based on these observations and that at a regional scale other much larger pans near the Lime Acres and Finsch mines had observable open water at the time of the author's visit, it is suggested that this small ephemeral wetland is of little hydrological consequence, even at local spatial scales.

The high evaporation rate and general low rainfall signifies that there is very little surface water in the area. What little surface water that exists after a storm soon evaporates or infiltrates to groundwater. At the time of the site visit (11 May 2011), this part of the Northern Cape was at the end of the end of a particularly wet phase (caused partly by the La Niña conditions in the Pacific Ocean, which is known to cause above average rainfalls over large parts of South Africa, although not always). Despite the high rainfall, very little surface water was observed anywhere on the farm Humansrus 469. A small dam exists about 200 m further down the drainage systems on the western boundary of the farm did have a small amount of water and is used as a water source by large livestock (See Figure 4). This dam is usually dry for most of the year. Water flowing into this dam arrives mostly via the channel to the west, on the other side of the railway line.

It should be noted that the soils on the western side of the property (and outside of the boundary of the planned field of heliostats – see Figure 2) that underlay the main channel display erosive potentials. An erosion feature (channel) has become established 600 m below the small dam and appears to be eroding upstream and widthways during periods of high-velocity storm flow, with most of the stormflow flowing from the western catchments.

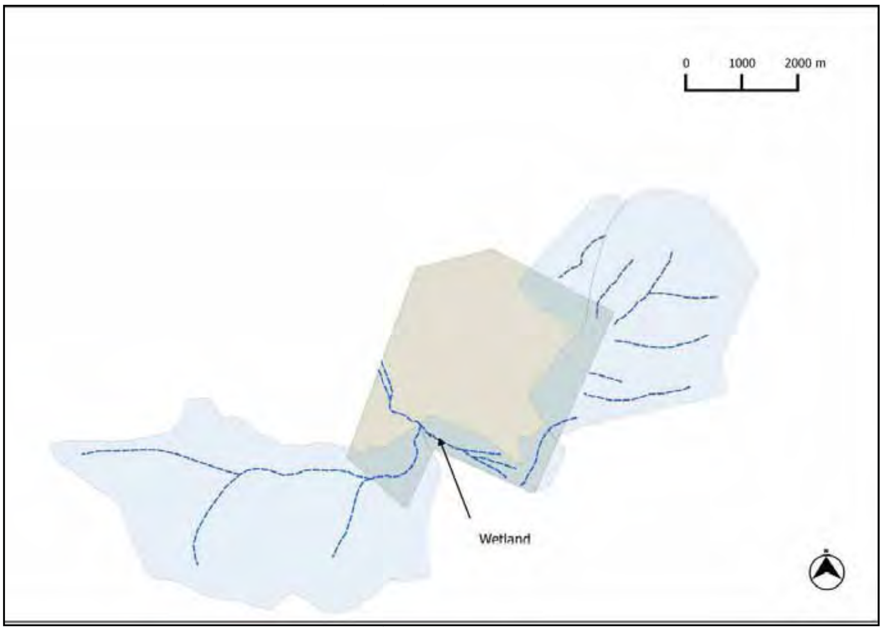

Figure 4 Drainage features and location of the wetland at the farm 469 Humansrus.

Figure 5 The small ephemeral wetland (vlei) on the Humansrus western boundary (about 0.2 ha), looking south-east.

4.4 Local Users of Water

The homestead on the farm Humansrus 469 uses groundwater supplies for its domestic and livestock supply needs. The farmer (Mr Scholtz) also irrigates about 13,8 00 m^2 of green forage for his livestock and this water also is supplied from boreholes near the homestead. The small dam on the south-west boundary of the CSP site only has water after heavy rainfalls and contains water only intermittently. The farmer does not rely on this source of water.

About 3 km west of the farm homestead, the small community of the Groenwater Gemeenskap also obtains it water from local groundwater sources. The reader is referred to the Groundwater Impact Assessment for insight into the potential impacts of the CSP on groundwater resources.

Figure 6 Natural drainage line, looking north-west, viewed from just below the wetland shown in Figure 5. The treeline indicates the livestock-watering dam wall.

Figure 7 Livestock watering dam on the drainage line on the south western boundary of Humansrus farm. The treeline indicates the livestock-watering dam wall.

5 Impact Assessment

A synthesis of available information shows that there are three possible types of impact related to hydrology and water use:

1. Regional hydrology (related to water supplies to mines, urban areas and domestic and livestock users);
2. Soil infiltration and surface flow conditions on site; and
3. Possible interference in local hydrological functioning.

Water is critical to the operation of the CSP, its water sources and cumulative impact of its water demand on other competing water users in a semi-arid region. The builders and operators of the CSP plan to use water from the Vaal-Gamagara pipelone, which could have an impact on other users dependent on water from the same pipeline, noting that the Vaal-Gamagara water supply system has a regional footprint over a large area (See Figure 3). The demand for water must be met either by regional water supplies (the Vaal-Gamagara pipeline) or by groundwater, or by a mixture of both. The groundwater assessment has been undertaken by the groundwater specialists and is not addressed here. **Table 2** below reviews likely impacts of the project on the Vaal-Gamagara Water Supply Scheme.

Local soil disturbance has the potential to reduce infiltration capacity. The surface of the proposed CSP site is notable for its lack of surface flow features such as channels, implying a high infiltration capacity of the soils. Even very heavy recent rainfalls (January 23, 2011) failed to produce observed surface runoff. The use of heavy machinery for construction of the heliostats will cause soil compaction and result in loss of infiltration capacity. This is likely to generate excess surface water through sheet flow during intense storms. Initial modelling (using SCS procedures) indicates that sheet flow of up to 13 times greater than could be generated from the same design storm in its current condition.

The effects of this increased surface flow would firstly be the significant erosion of soils on site, which would be deposited down slope where-ever water dispersion takes place or drainage flow velocities decrease. The second effect is that the increased surface flow will flow down-slope towards the R385 road. Where this road is located on the NW boundary of the intended CSP site, there is a slight dip in the road but no provision has been made by the road owners to convey water under the road through culverts. It is possible that excess surface flow generated on the CSP site will endanger the structure and integrity of the R385 at this location, either through sediment deposition or through erosion and a breach of the road, or both. This impact (of the CSP on surface flow over the site) is assessed in **Table 3**.

The construction and operation of the CSP may have an effect and disrupt local hydrological functioning. For example, it may interfere with the natural flow and storage of water in local channels and wetlands (on-site and off-site but nearby), to the detriment of their natural functioning. These possible impacts are evaluated in **Table 4**.

Table 2 Rating table on the likely impacts of the proposed project on the Vaal-Gamagara Water Supply Scheme.

Category and Scale	Rating and Description	Description and Justification	Quantitative Rating
Status of Impacts	**Neutral**: No cost to the receiving environment	Water is abstracted from the system (Vaal-Gamagara pipeline) and consumed by the CSP.	**N**
Spatial scale of impacts	**Medium and High:** Local and regional	The impact extends beyond the site boundary. Water demand by the proposed operation requires local and/or regional groundwater abstraction, as well as abstractions from the Vaal-Gamagara pipeline, which supplies water at a regional scale - the pipeline extends for 197 kms, supplies water to urban and mining operations and is of great economic importance. The pipeline requires pumping and storage capabilities. The CSP will compete for water on a commercial and first-come first serve basis (i.e. the CSP will not be able to commandeer water already allocated).	**3**
Temporal scale of impacts	**High to Very High**: Long-term: Water demands will operate for the lifespan of the project (16-30 years and longer).	The requirement for water for cooling and cleaning will last for as long as the CSP can usefully generate electricity. There is potential for the project to last >40 years, so the quantitative assessment could produce an impact lasting more than 30 years and/or result in a permanent and lasting change that will remain in place.	**4**

Probability of Impact	**Highly probable**: Likelihood of occurrence equal to or greater than 90%	Water is critical to operation of the CSP.	**4**
Severity of Impact	**Average:**	Medium to short term impacts on other Vaal-Gamagara pipeline users and managers. Water is supplied by Sedibeng Water through the Vaal-Gamagara pipeline on a commercial and availability basis.	**2**
Significance of Impacts	**Negative, Medium**	The impact is real, in that water will be supplied from the Vaal-Gamagara pipeline that could be supplied to other users. The impact is not substantial in relation to other impacts such as alternative competing uses of the same water. Social, cultural and economic activities of communities are not affected, Sedibeng Water will not switch supplies at the expense of existing users to new users..	**6**

5.1 Impacts of the Project on Local Hydrology and Erosion Potential

Table 3 Rating table on the likely impacts of the proposed CSP on local runoff and the potential for erosion

Category and Scale	Rating and Description	Description and Justification	Quantitative Rating
Status of Impacts	**Negative**: a cost to the receiving environment	Erosion potential over the footprint of the CSP and field of heliostats is increased by hardening with the mirror field and service roads – to each heliostat. Hardening occurs to about 25% of the total ground surface – altering runoff characteristics and increasing opportunities for generating overland flow, which will increase erosivity of moving surface water.	-
Spatial scale of impacts	**Medium**: Local impacts, extending beyond the site boundary and a few hundred meters downslope of the CSP.	Extra surface water generated by heavy rainfall flows downslope. Preferential flow lines may occur (channels are created through erosion) and downslope infrastructure (the R385 road) may be affected through generating surface flow and failure of any drainage systems to cope with the size of flows, resulting in damage to the road. The development of channels means loss of productive land.	**2**

Temporal scale of impacts	**Very high**: Permanent changes to infiltration capacity on the CSP site could be expected.	Roads, infrastructure and changes to the physical characteristics of the soil on site will last longer than the presence of an operating CSP. In the event of the dismantling of the CSP, it is unlikely that the infiltration condition of the site could be returned to conditions existing prior to construction.	**4**
Probability of Impact	**Highly probable**: The impact is expected to occur, with a chance of occurrence of 50-90%.	The heliostat surfaces and the service roads linking to every heliostat mean substantial alteration of the characteristics of the soil surface. A road must go to every one of the 17,350 heliostats, as well as the central power tower site and any other related facilities.	**3**
Severity of Impact	**Severe**: Medium to long term impacts but which can be mitigated.	Planning for, and construction of, suitable storm drainage and dissipation infrastructure that protects the site and the road R385.	**2**
Significance of Impacts	**Medium:** Impacts are feasible and possible.	Planning for accommodating and dispersing storm flow off site is required	**-7**

Table 4 Rating table on the likely impacts of the proposed CSP on local hydrological functioning

Category and Scale	Rating and Description	Description and Justification	Quantitative Rating
Status of Impacts	**Neutral**: No cost or benefit to the receiving environment	The project is not expected to have an impact on local hydrological functioning concerning surface water flows and storages	**N**
Spatial scale of impacts	**Medium**: Local impacts, extending beyond the site boundary and a few hundred meters downslope of the CSP.	Any temporary impact on surface water flows would be expected to have an impact on site and to areas adjacent and down-slope to the project site. Construction in waterways and wetlands is not envisaged.	**2**
Temporal scale of impacts	**Low**: Short term; Quickly reversible in 0 – 5 years	Impacts on local hydrological functioning, if any, could be remediated by operators of the CSP	**1**
Probability of Impact	**Improbable**: The possibility of the impact materializing is negligible; Chances of occurrence 10-49%	Construction within areas of noted hydrological activity (channels, wetlands) is not envisaged. Water additions to the environment from the CSP during construction and operation will be negligible, if at all (evaporating pans will dispose of waste water from the CSP).	**2**
Severity of Impact	**Neglible/minor**: The system (environment) and parties (local water users) are marginally affected by the proposed development.	The project is not expected to have an impact on local hydrological functioning concerning surface water flows and storages	**1**

Significance of Impacts	**Negative-Low:** Any impact is of low order and therefore likely to have little real effect. In case of adverse impacts, mitigation is easily achieved. Social, cultural and economic activities continue unchanged.	Any effect (which is unlikely) on local hydrological functioning will have little if any effect of significance on social, cultural and economic activities, or on environmental conditions.	**-7**

6 Discussion and Conclusions

6.1 Impacts on Regional Hydrology

The Vaal-Gamagara pipeline is used to supply water to users such as for domestic and industrial use in urban centres such as Lime Acres, Postmasburg, Olifantshoek, Hotazel and Black Rock and the Kalahari East RWSS. The pipeline plays an extremely important role as an economic multiplier in the region. Water is also injected into the system at Sishen (from mine dewatering activities) and even more water will in future come from new iron ore mines near Postmasburg. The proposed CSP is another potential user of water supporting an important economic activity (power generation). In conducting this rating assessment of the impacts of the CSP on regional hydrology, note must be made that this assessment does not make value judgements on the relative merits of alternative beneficial uses of water. The assessment does not make recommendations on whether the projected CSP use of water is better than, or worse than, an alternative use. Therefore, EIA ratings such the Severity of Impact (see Table 2) are undertaken only from the aspect of whether there is an impact.

There will be a net economic gain to Sedibeng Water through purchase of water supplied from the Vaal-Gamagara pipeline to support CSP operations and generation of electricity. There may be a regional hydrological effect through the supply of water to the CSP from the Vaal-Gamagara pipeline, in that it will increase competition for water from that source. However, there is no effect that is unique to the CSP, its draw-off of water will be a business case with Sedibeng water as would any other business that drew water from that source. Because the CSP would be a high-value asset that is critically dependent on water for its operation, it is likely that the CSP would provide another sound core client of Sedibeng water and would have a positive effect on Sedibeng Water's financial income.

6.2 Impacts on Local Hydrology

The location of the proposed design of the CSP is such that it is unlikely there will be little if any effect on the identified water courses. The major channels on the Humansrus 469 property are located in catchment systems that arise off the property. The small wetland on the property is unlikely to be affected by the construction and operation of the CSP. It is highly unlikely there will be cumulative losses or gains that result from the project operations and the project could be considered to by hydrologically neutral from a surface water point of view. There will be neither a net loss or gain to surface water in the surrounding area of Humansrus 469 and nearby or adjacent properties of any significance.

6.3 Impacts on Local Runoff and Erosion Potential

The alteration of the infiltration capacity of the several square kilometers of soil where the heliostats are constructed could lead to damaging overland flow and erosion should the area receive a significant rainfalls of the order of the 1:50 and 1:100 year return period. This effect should be managed, otherwise in the event of a heavy rainfall, damage to the site and to the R385 road could be an outcome. Initial modelling efforts using SCS procedures indicate the possibility for surface runoff to increase by 10 – 15 times as a result of changing infiltration capacity.

6.4 Surface Water Conditions for all stages of the Project

Surface water conditions should not change during the construction or the operational phases of the proposed project. Construction is not planned to take place within any watercourses or within 100-year flood zones, with the exception perhaps of an access road on the south-western boundary (see section on Flood Calculations). Once the CSP is operational, there will be less activity on the site, based around the built components and outside of any watercourses. No permanent or temporary re-alignments of water courses, wetlands or other water bodies are expected. Activities which may have an effect on surface water conditions are the construction phase, relating to road building and installation of the heliostats, and the operational phase, when there will effectively be a larger impervious area over the site (provided by the mirror field and the central power tower and associated salt storage and generating works. This issue is addressed in earlier statements.

6.5 Concluding Remarks

There are no identifiable issues from a hydrological and surface water point of view that would indicate the prevention of construction of the CSP. Where there are impacts, these can be mitigated by appropriate actions.

7 Recommended Guideline measures to manage and mitigate impacts

7.1 Possible mitigation measures for the identified impacts

Water Use

Mitigation measures for ensuring efficient use of water include alternative designs for reducing consumption of water. These have already been considered in terms of the cooling processes adopted for CSP operation. It is unlikely that there is scope for reducing water use by the CSP for operational reasons any further than has been specified to date in the conceptual design. The

remaining effort then is to optimize the cooling operations with the mixes of wet and dry cooling that maximizes cooling with the minimal use of water.

Soil Compaction and Overland Flow

The likelihood that a loss of infiltration capacity on site generates excess surface flow requires that mitigation measures be put in place during a) construction, and b) operation of the CSP. During construction, vehicular traffic on the construction site should be kept to well-defined roads or delimited zones as far as possible. Proper road drainage procedures need to be put in place and maintained to convey any surface water off the roads and into undisturbed areas. The proposers of the CSP should approach SANRAL or the owner of the R385 road about the possibility of installing a culvert under the road at the point of minimum elevation along the NW boundary of the CSP site to protect the road. During the operational phase of the CSP, vehicular traffic through the field of heliostats should be kept to a minimum, on well-defined and a minimal number of roads. Abandoned construction roads should be deep-ripped where possible to restore infiltration through the soil profile and a short vegetation cover re-established over the entire site.

Permanent or temporary re-alignments of water courses, wetlands or other water bodies

Permanent or temporary re-alignments of water courses are not envisaged by the current design of the CSP.

Location of sources, intakes and associate infrastructure

The off-take from the Vaal-Gamagara pipeline is likely to take placed at its nearest point to the CSP, which is on the boundary of Humansrus 469 on its western side, just downstream of the livestock watering dam (See Figure 2). Installed here, the pipeline will be required to cross the channel below the dam wall. The section on Best Practices for Crossing Water Courses below then applies.

Best Practices for Crossing Water Courses

The ephemeral channel on the south-west side of the property needs to be crossed by the off-take from the Vaal-Gamagara water pipeline. There are two conditions of concern regarding the nature of traverse: 1) the flood threat to the pipeline, and 2) the possibility of the physical presence of the pipeline causing opportunities for erosion to take place during flash floods. The pipeline should be buried and cross the channel below ground level at a depth of about 3 m or more. Closer to the surface, to a depth of 1.5 m or more, a gabion or wire-basket structure containing rocks of 30 cm diameter or more should be inserted into the trench to prevent turbulence removing material from the disturbed zone during peak flows. Similarly, the upslope portions of the pipe trench needs protection from washouts and erosion after heavy rainfalls. The CSP operators should inspect the pipeline route after heavy rainfalls and any incipient erosion features must be corrected immediately. As noted earlier, soils in the main channel area are prone to erosion.

7.2 Recommendations for Monitoring Programmes if any

No particular surface water hydrological monitoring programmes are recommended. Constructors and operators of the CSP should monitor soil surface conditions for signs of erosion on site during construction and during operation. Remedial measures are required if any negative erosion is noted (and signs of sediment deposition).
The proposed CSP does not impinge on surface water features, neither will its operation have effects which need a specific monitoring programme. If the CSP buys water from the Vaal-Gamagara pipeline, sufficient monitoring will be installed by Sedibeng Water with respect to impacts on regional water supplies.

7.3 Recommendations for Additional Studies

A more detailed study should be undertaken on the capability of CSP site to generate overland flow when constructed. Or, the design of the CSP layout should include the necessary drainage infrastructure to remove excess water and dispose of it safely and sustainably.

7.4 Relevant Legislation, Permits and Standards

If the CSP uses groundwater during operations, water abstraction and use licences will be required. It is likely that a supply from the Vaal-Gamagara Water Scheme will not need to be licensed – the general policy under the National Water Act (Act 36 of 1998) is that water from a local authority, a water board, an irrigation board or another bulk water supplier does not require registration of use. This policy is subject to verification. An application to use water from the Vaal-Gamagara pipeline must however be submitted to Sedibeng Water.

7.5 Assumptions, limitations and /or constraints to the Study

No particular limitations and constraints that would have a significant material effect on the impact assessment ratings given by this study to the proposed project have been observed. Best available hydrological information and data have been used in this study, which also consulted the latest conceptual design information of the CSP.

The ultimate source of water for construction and operation of the CSP has not yet been decided. This assessment considers the possibility of receiving supplies from the Vaal-Gamagara pipeline only. The reader is referred to the Groundwater Environmental Impact Assessment for conclusions with respect to that source. It is possible that the proposed CSP will use a mixture of sources, according to the availability of costs of utilizing these sources.

8 Flood Calculations

Flood level determinations for the 1:50-year and 1:100-year floods are required as a component of the EIA. This document provides the methods and results of those calculations.

8.1 Methods

SCS Unit Hydrograph methods (also known as TR20 methods) are deemed appropriate for the task. Basic steps follow. References to the source of parameter values are given in Table 1.

1. Selection of an appropriate rainfall distribution, which controls how the storm depth will be distributed over time – selected from SCS Storm Type;
2. The design storm depth, which is determined from South African hydrological literature, is based on the 50-year and 100-year return periods given in the Terms of Reference;
3. Catchment characteristics important to shaping the resulting flood hydrograph are determined from map work and field work –
    a. Time of Concentration (Tc – dependent on the SCS Curve Numbner (CN) on shape of catchment, hydraulic length, slope and area);
    b. Antecedent Moisture Conditions (AMC). Moisture condition of the soil prior to a storm exerts strong controls on stormflow response;
    c. Soil hydrological response types (according to soil texture, which controls potential infiltration characteristics);
    d. SCS Curve Number (CN), which is an index reflecting catchment surface condition and controlling likelihood of surface runoff.
4. Using Hydrocad (Hydrocad 9.10, 2010), the resulting hydrographs were modelled for the required storm return periods, at different points in the study area;
5. Channel profiles (cross-sectional channel profile, slope, roughness, with Manning's formula) were used to calculate heights of flood flow that are required to accommodate peak flows generated in the SCS calculations;
6. The resulting flood levels (in the channel profile) for the different storm return periods were mapped onto that of the physical features of the Humansrus site.

Assumptions

- Flood levels from differing AMCs were not considered. AMC level 2 is the recommended value for design work and was used in this study for the calculation of the design flood levels.
- Therefore, the flood levels estimated are based on the equivalence of 1:50 and 1:100 year design rainfalls with the 1:50 and 1:100 year peak runoffs;
- The upper and lower limits of dispersion around the predicted design storms were not included in this analysis (dispersion increases as the RP increases). The median value is used in this assessment.
- The 1-day storm is deemed appropriate as a basis for modeling stormflow response. Given the relatively short Tcs that are appropriate for the catchments within the study area (not more than a 5 hours), maximum flood peaks possible will result from intense 1-day storms and not those of storms of two or more days duration. The maximum intensities of storms longer than 1 day decline rapidly (Weddephol, 1988).

Table 5 Design storm depths for specific return periods, 1-day rainfall (Source: Smithers et al., 2002)

Design Storm Return Period (Years)	Storm Depth (mm)
50	95
100	150*

* 108 mm according to Smithers et al. (2002). The heavy rainfalls of 23 January 2011, which resulted in the floods in Postmasburg, deposited about 150 mm in one day in the Humansrus area (Mr A Scholz, Pers. Comm. – Humansrus 469 farm owner). Given that rainfall records in the area with observation periods of even 50 years are relatively uncommon, 150 mm was taken as the new 100 year Design Storm Return Period and a flood hydrograph was calculated on that basis.

Table 6 Storm flows calculated for catchments on the Humansrus 469 property.

	Design Storm Flow for Return Period	
Catchment	50 years ($m^3.s^{-1}$)	100 years ($m^3.s^{-1}$)
A	5.56	20.1
B	0.35	2.1
C	*	*
D	*	*

* Indeterminate

Catchments C and D are indeterminate (See Figure 8). While the steeper rocky high ground should produce rapid runoff and high peak flows, which the model does reproduce, there is no evidence of channels to convey that water on the site. It can be concluded then that such flows do not exist, probably because high levels of infiltration into the steeper ground occur. Models such as SCS are incapable of emulating such behavior. Even exceptional storm depths such as those of 23 January 2011 have not developed into noticeable surface flows in the north and east of the proposed CSP site.

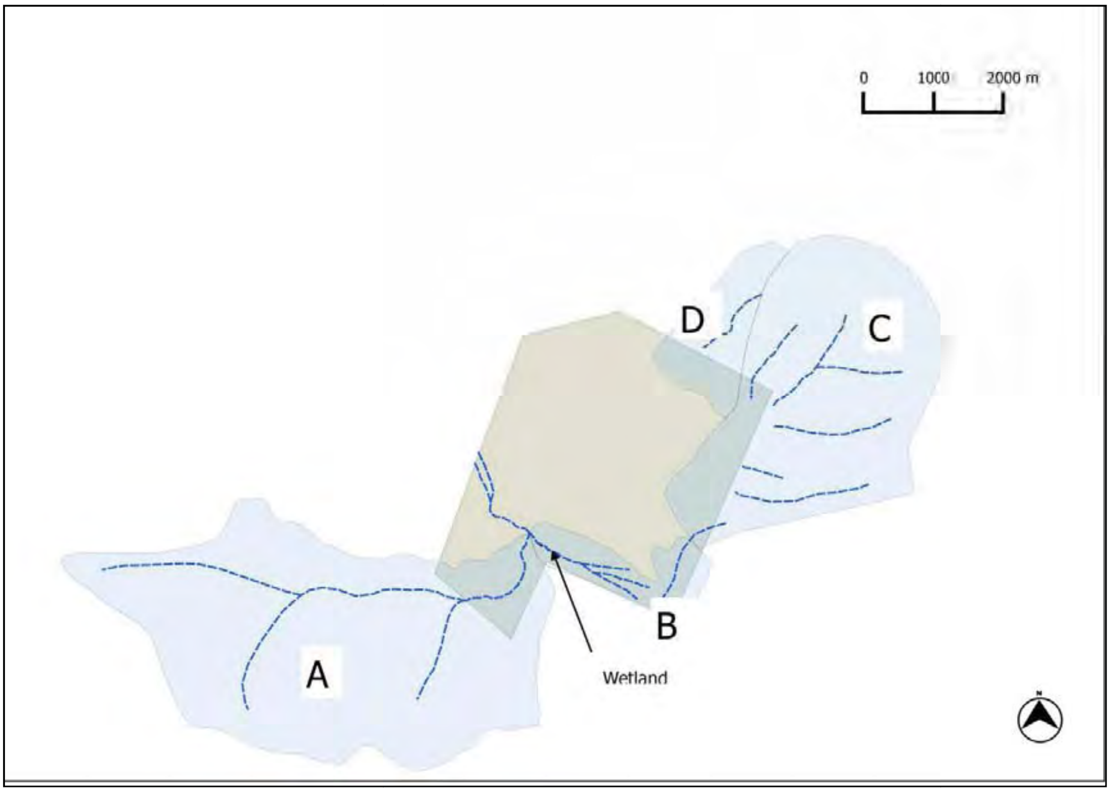

Figure 8 Catchment layout used in the flood assessment.

8.2 Assessment of Floods

The most significant floods emerge from the catchment and high ground to the west of Humansrus. Flow rates of about 20 $m^3.s^{-1}$ may be achieved, which accounts for the damage to the road and railway line on the 23 January when the heavy rainfall resulted in the failure of the road and rail culverts to accommodate the peak flows of water. The design of construction of the CSP should avoid any construction in this zone.

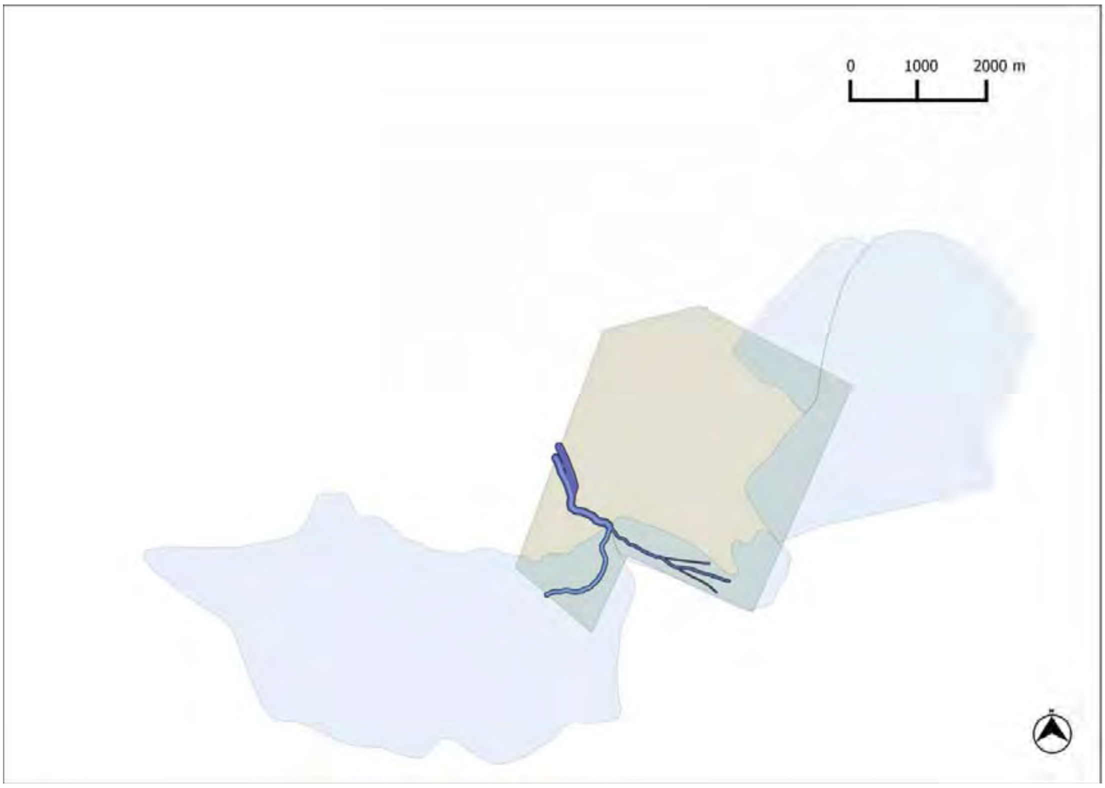

Figure 9 1:50 and 1:100 year flood lines

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Appendix J

Wetland Impact Assessment

Wetland Delineation and Assessment for the Proposed Humansrus Solar Thermal Energy Plant near Postmasburg, Northern Cape

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DOCUMENT SUMMARY DATA

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by SSI to undertake the specialist wetland delineation and assessment as part of the EIA process currently being undertaken by SSI for the proposed Humansrus Solar Thermal Energy Plant near Postmasburg in the Northern Cape. The need for the wetland delineation was identified based on the vegetation study undertaken for the site which identified a non-perennial drainage line and associated floodplain on site.

The requirement to establish the existence and/or extent of wetlands and riparian areas on the property is based on the legal requirements contained in both NEMA as well as the Water Act. Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively around them to minimize any potential impacts.

The purpose of this document is to describe the wetlands and riparian habitat within the study area, to identify expected impacts on the wetland and riparian habitats due to the proposed developments and to provide recommendations regarding appropriate mitigation and/or management measures to be implemented should the proposed activities be authorised.

2. SCOPE OF WORK

The following task formed part of the agreed upon scope of work for this initial baseline report:

- **Baseline Wetland Assessment:**
  - ⇒ Conduct a desktop and field investigation of the wetlands and riparian habitats within the study area;
  - ⇒ Assess, classify, delineate and map the identified wetlands and riparian habitats;
  - ⇒ Identify and describe the functions of the wetlands and riparian habitats;
  - ⇒ Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS); and
  - ⇒ Provide a report, including maps of the wetland and riparian habitats, detailing all the information.

Following on from this initial report, a detailed impact assessment will be undertaken to assess the impacts of the proposed developments on the identified wetlands and riparian habitats

3. LIMITATIONS

The study area was visited from the 1-3 July 2011 during the middle of winter and outside of the growing season. Due to significant frosting back of vegetation and heavy grazing in places, only limited use could be made of vegetation indicators and species. Difficulty in identifying plants to species level at this time of the year are reflected in the species list.

Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 20m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

4. STUDY AREA

4.1 Location

The study area is located on the Farm Humansrus 469 approximately 30km east of Postmasburg along the R 385 road to Barkly West; the tar road forms the northern boundary of the study area. A railway line traverses the study area within the south western reaches of the site. The study area is approximately 1 250ha.

The upper reaches of the Groenwater Spruit flow across the south western reaches of the study area.

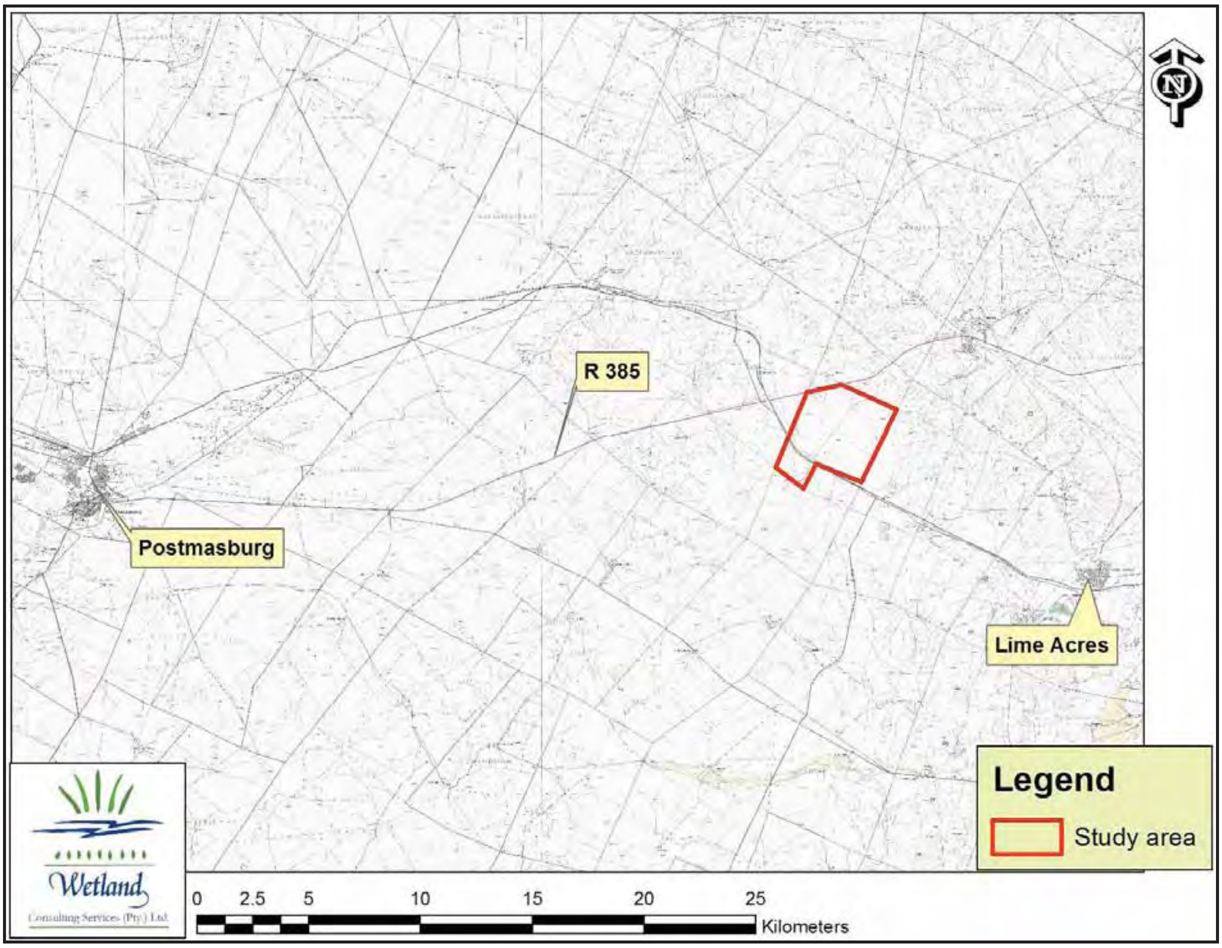

Figure 1. Map showing the location of the study area.

4.2 Catchments

The study area is located within Primary Catchment D, and more specifically within quaternary catchment D73A. The catchment is drained by the Groenwater Spruit.

Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990). Figure 2 indicates the position of study area in relation to the affected quarternary catchment. Note the low mean annul precipitation, which indicates that the study area is located within an arid environment.

Table 1. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
D73A	297 781	322.66	14.6	4.5 %

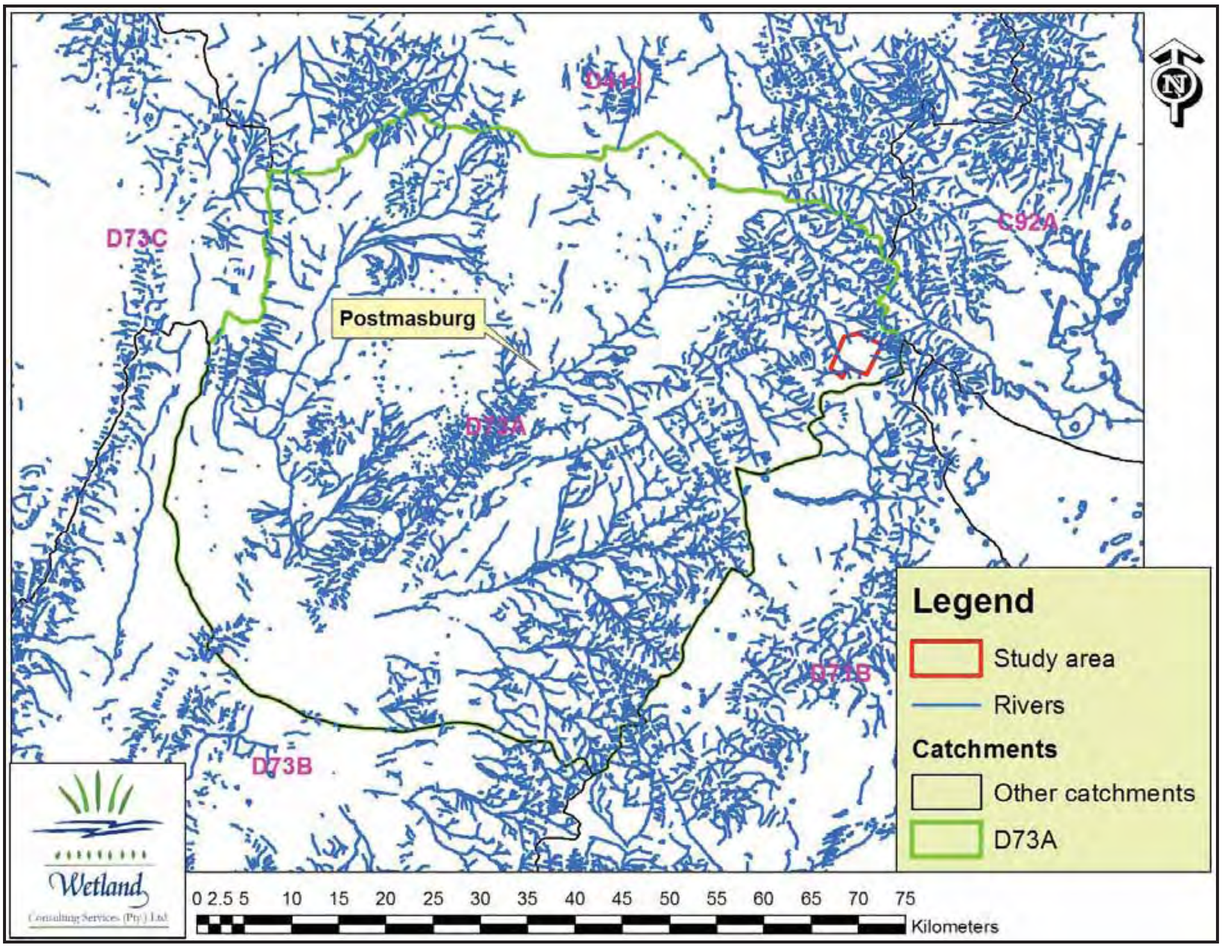

Figure 2. Map showing the study area in relation to the quaternary catchment.

4.3 Geology and Soils

No information regarding the underlying geology was available at the time of writing this report.

The soils on site were generally of a sandy nature within the valley bottom areas and on the flatter areas. The hilly sections of the site were dominated by very rocky terrain with extensive areas of exposed rocks and stones and generally shallow soils. The shallow, rocky soils encourage the surface run-off of water, while the sandy soils allow infiltration of the water into the soil. Rainfall within the area is limited (322mm per annum) and is expected to occur in high intensity storm events that result in large volumes of high velocity runoff from the rocky areas on site following these events. This is supported by the incised drainage line on site.

Within the sandy soil areas, rainfall infiltrates the sandy soil profile and is then either lost to deeper infiltration to groundwater or to evapo-transpiration, or moves through the soil as sub-surface seepage.

4.4 Vegetation

An extract of the latest vegetation mapping of South Africa, undertaken by Mucina and Rutherford (2006), is reproduced in Figure 3 below.

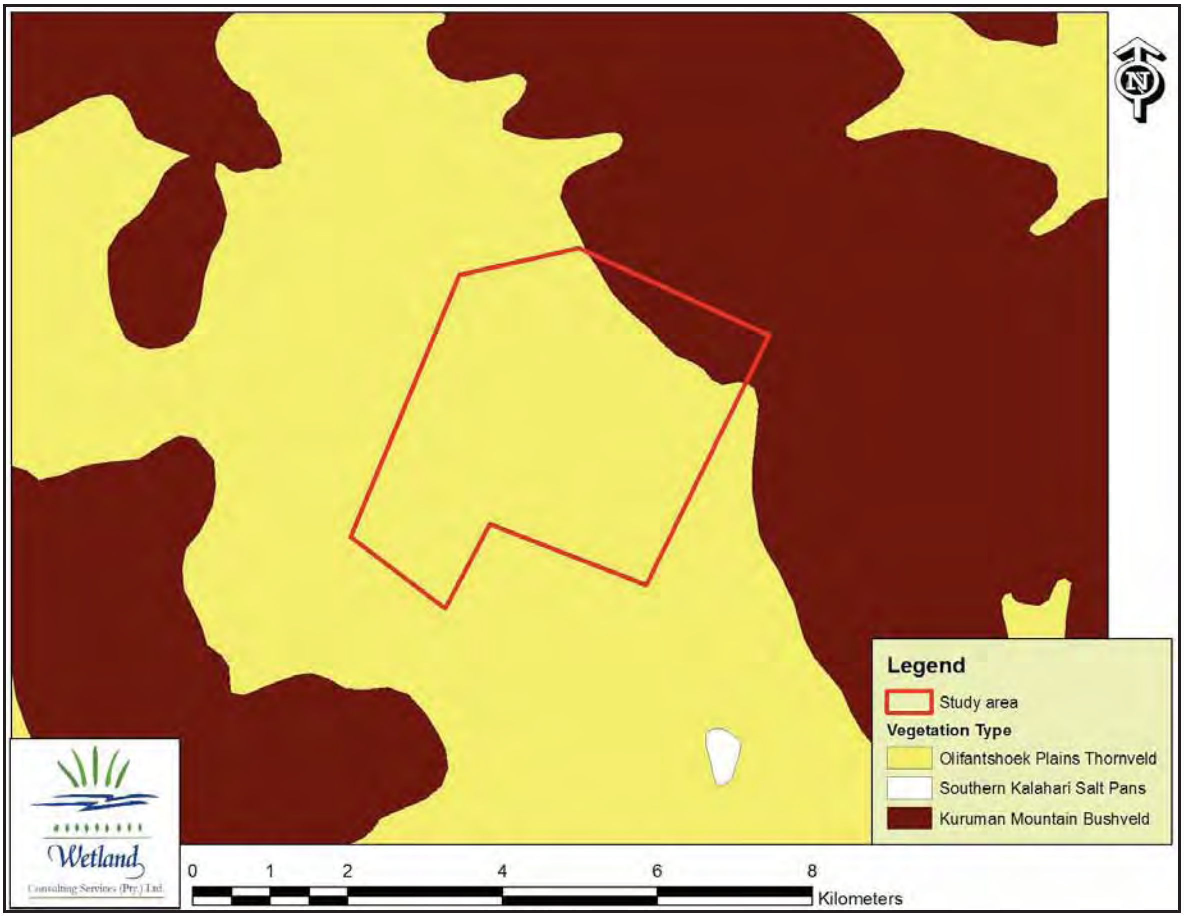

Figure 3. Vegetation types of the study area (Mucina & Rutherford, 2006).

The study area falls within the Savanna Biome and the Eastern Kalahari Bushveld Bioregion. Two vegetation types occur on site, namely Kuruman Mountain Bushveld associated with the hills in the north east of the site and Olifantshoek Plains Thornveld across the remainder of the site. Both these vegetation types are considered *Least Threatened*.

5. APPROACH

5.1 Wetland Delineation and Classification

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland and riparian habitat boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland and riparian areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands or riparian areas were then further investigated in the field.

Wetlands and riparian habitats were identified and delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator. Riparian areas are identified and delineated based mostly on vegetation indicators as well as the presence of alluvial soils

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and modified for use in South African conditions by Marneweck and Batchelor (2002).

5.2 Present Ecological State and Ecological Importance & Sensitivity

A present ecological state (PES) and ecological importance and sensitivity (EIS) assessment was conducted for every hydro-geomorphic wetland unit and riparian zone identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

6. FINDINGS

6.1 Wetland and Riparian Delineation and Classification

The National Water Act, Act 36 of 1998 (the Act), defines wetlands as follows:

> *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

Riparian habitat in turn is defined by the Act as:

> *"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."*

The 1:50 000 topographical map of the area (2823AD) indicates a number of non-perennial drainage lines within the study area. Numerous small drainage lines are shown draining onto the site from the mountains to the north and east of the site before petering out on the flat central region of the study area. In the south western portions of the site the upper reaches of the Groenwater Spruit are shown as draining across the study area in a roughly northerly direction.

The field work undertaken during July 2011 revealed that only the Groenwater Spruit and its tributary have associated riparian habitat. The remaining drainage lines indicated on the 1:50 000 topographical maps represent low points within the landscape along which water is expected to flow only occasionally following heavy storm events, but which do not differ in vegetation structure or composition from the adjacent vegetation, and do not have a defined channel. The soils within these areas also showed no hydromorphic features and were typical reddish brown terrestrial soils, presumably of the Hutton soil form. These "drainage lines" were thus not classed as either wetlands or riparian zones. A map of these drainage lines entering the site, as well as some photographs of these areas, are reproduced in Figures 4 and 5 below.

Following heavy rain, surface runoff from the rocky hills to the north and east of the study area is expected to accumulate within these low points where the sandy soil allows easy infiltration of surface water into the soil. Water is thus not retained within the upper reaches of the soil profile for an extended period that would allow the formation of wetland or riparian habitat. Rainfall that has infiltrated the soil is expected to be mostly lost to evapo-transpiration or deeper infiltration into groundwater, though some lateral seepage at depth through the soil profile is possible. To the north of the Farm Humansrus a spring is located on the Farm Groenwater (as indicated by the local farmer) at the northern end of the plain that extends into the central portions of the study area. It is possible that water infiltrating the sandy soil on site plays a role in supporting this spring. This is however mere speculation and will need to be confirmed by the groundwater and geo-technical studies of the site.

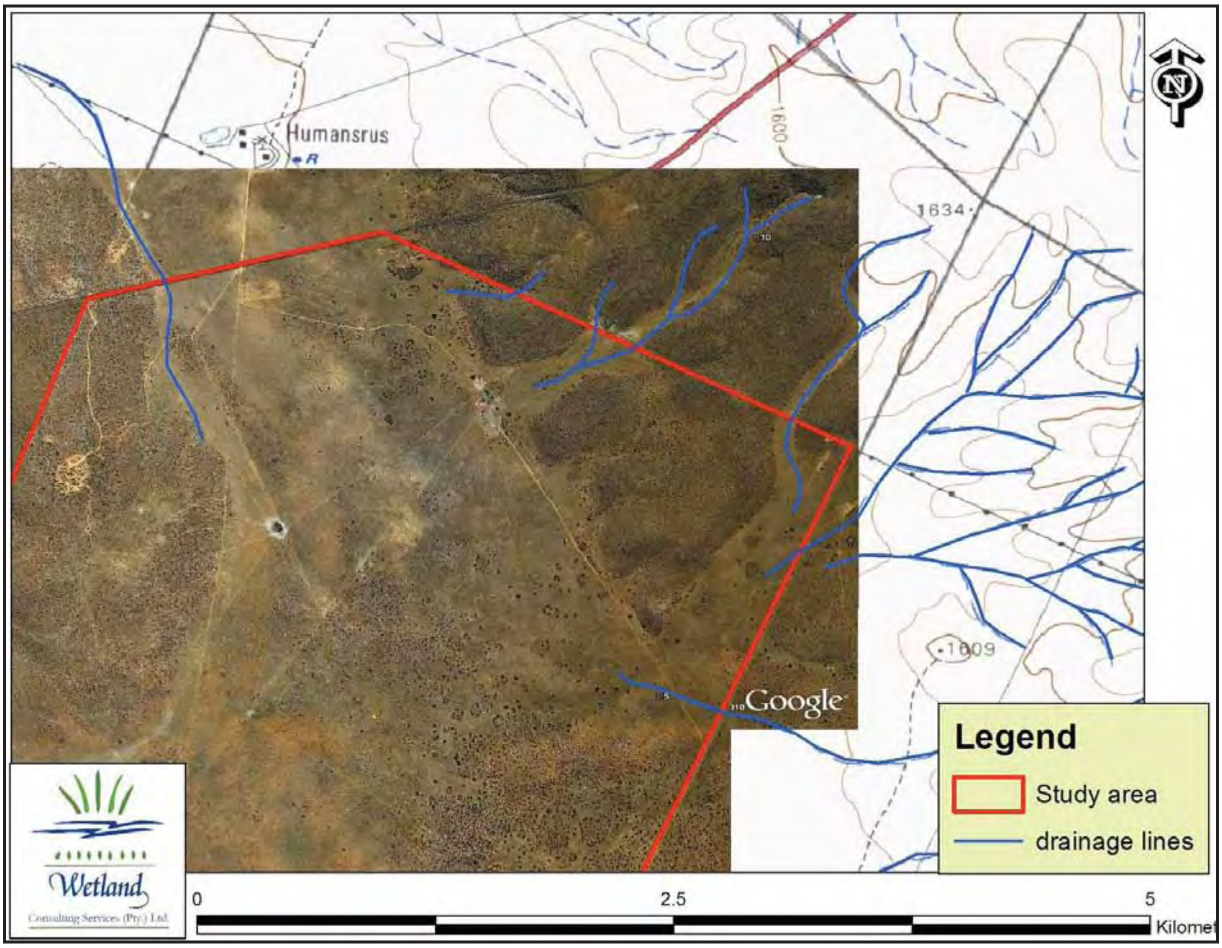

Figure 4. Map of the northern reaches of the study area indicating the drainage lines indicated on the 1:50 000 topographical maps of the area.

Figure 5. Photographs of the ephemeral “drainage lines” indicated in Figure 4. Drainage lines are indicated by a blue line.

The riparian habitat delineated along the Groenwater Spruit and its tributary is illustrated in Figure 6 below, with photographs in Figure 7.

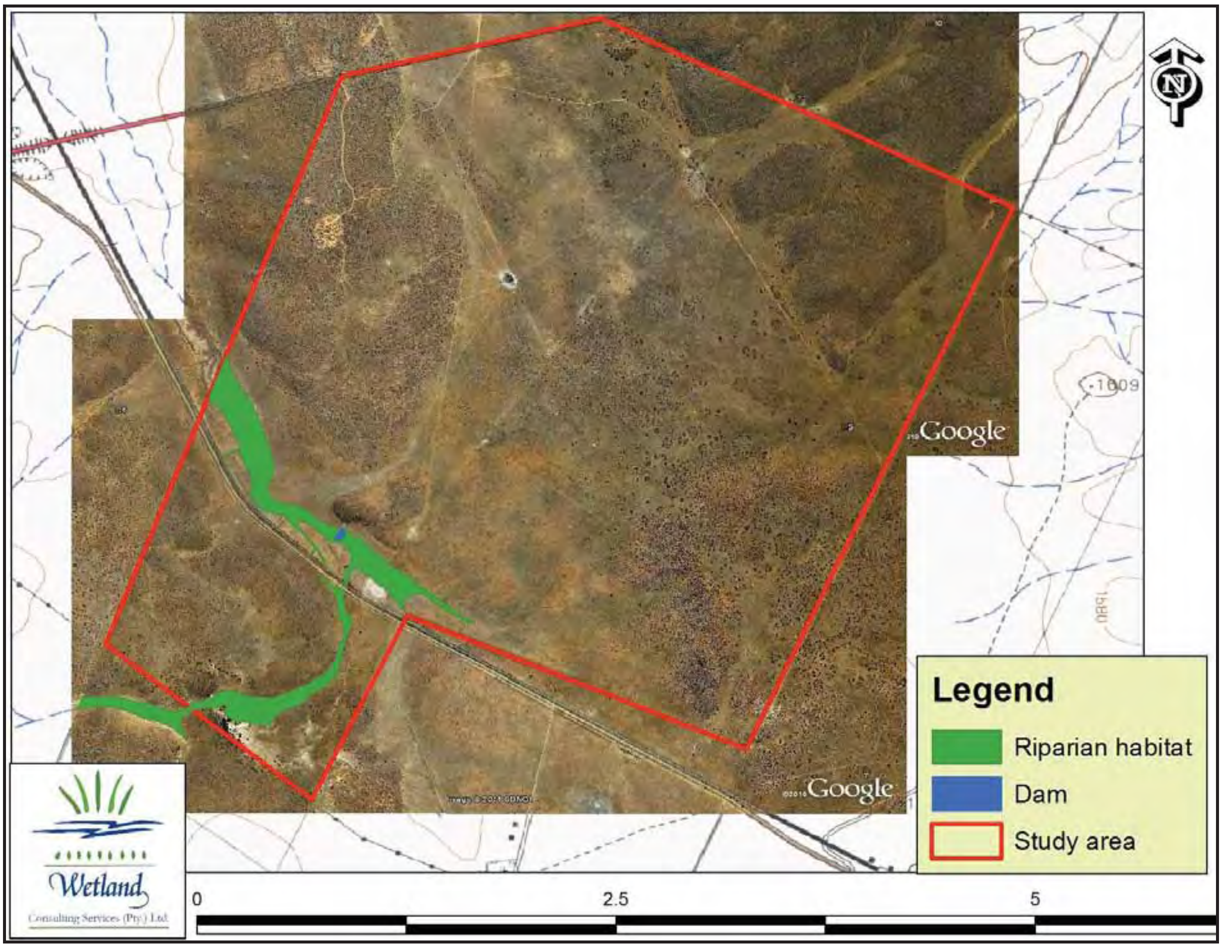

Figure 6. Map of the delineated riparian habitat associated with the Groenwater Spruit.

The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The reach of the Groenwater Spruit located upslope of the railway line and gravel road is characterised by a clearly defined, incised channel characterised by a rocky substrate. Adjacent side slopes were also generally rocky. Isolated pools of water were observed in this area. Along this section of the riparian habitat a number of tree and shrub species were observed, including *Olea europea, Rhus lancea* and *Acacia tortilis*. Grass species included *Themeda triandra, Aristida congesta, Aristida spp., Eragrostis chloromelas* and *Juncus rigidus*. Though classified as a riparian zone, isolated patches along the water course did display some wetland characteristics and sub-surface water seepage, most notably a small spring located upslope and outside of the study area in close proximity to the site boundary, as well as the area located immediately below the old farm house.

Figure 7. Photographs of the riparian habitat associated with the Groenwater Spruit (clockwise from top left): immediately upstream of the study area; directly below the old farm house; lower reaches of Groenwater Spruit on site looking upstream from northern boundary fence; and upper shallow impoundment.

To the north of the railway line upstream and immediately downstream of the small dam, the Groenwater Spruit and its tributary flow along a poorly defined channel. This section of the riparian habitat is completely devoid of trees and is dominated by various grass species. The timing of the study precluded accurate identification of many of the grass species due to the significant frosting back of vegetation that had already taken place, as well as heavy grazing by livestock. Typical species however included various *Aristida* spp., *Themeda triandra*, *Juncus rigidus*, *Eragrostis* spp, *Melinis repens*, *Sporobolus* spp. and *Cynodon dactylon*.

The lower reaches of the Groenwater Spruit on site are again characterised by a clearly defined, incised channel, the channel being broad and fairly shallow. Once again the riparian habitat is tree-less and dominated by grass species. Soils along this section of the riparian zone were typical of terrestrial soils with no signs of seepage into the stream channel. The channel was also completely dry downslope of the railway crossing.

6.2 Water Quality

At the time of the site visit in July 2011 the Groenwater Spruit on site was mostly dry with surface water restricted to small isolated pools of standing water within the stream channel. No flowing water was observed. Areas of standing water were heavily utilised and trampled by livestock.

These conditions are not ideal for the sampling of water quality and diatoms, with especially diatoms best sampled in flowing water to allow for the utilisation of the diatom pollution indices.

However, a grab water sample was collected and submitted to the ARC-ISCW for analysis of standard anions and cations, as well as an MS-ICP scan for metals. The results of the analysis are summarised in the tables below.

The water quality was sampled in the Groenwater Spruit from the largest observed extent of surface water, located below the old farmhouse (-28.320424°S; 23.352987°E). As indicated, no flowing water was present at the time of sampling, and remaining areas of standing water were heavily impacted by livestock reliant on these areas for drinking water. The impact of the livestock on the water is indicated by the elevated nitrate concentration of the water, resulting from cattle droppings in the water. Generally the water quality is however of an acceptable standard. The target water quality guidelines for aquatic ecosystems were exceeded for both Selenium and Zinc, though this is expected to be the natural condition of the stream and is not taken as being indicative of pollution.

Table 2. Results of water quality analysis for standard anions and cations.

Variable	Concentration (mg/l)
pH	8.21
EC	86.00
TDS	490.63
Alkalinity	317.00
Bicarbonate	386.74
Boron	0.07
Calcium	77.05
Carbonate	0.00
Chloride	76.60
Fluoride	0.28
Magnesium	47.60
Nitrate	**5.82**
Nitrite	0.00
Phosphate	0.00
Potassium	4.46
Sodium	30.09
Sodium Bicarbonate	0.00
Sodium Carbonate	0.00
Sulphate	55.66

Table 3. Results of the Ms-ICP scan for metals.

Element	Concentration (ppb)	Guidelines Aquatic Ecosystems
Co	0.272	≤ 0.3 µg/l
Li	0.905	
Se	3.761	≤ 2 µg/l (5 µg/l)[1]
Br	809.4	
As	1.089	≤ 10 µg/l
Zn	6.567	≤ 2 µg/l (3.6 µg/l)[2]
Sr	291.10	
Ni	1.438	
Mo	0.302	
Mn	0.098	180 µg/l
Cr	5.895	≤ 7 µg/l
V	8.789	
Ti	2.684	
B	66.15	
Be	0.00	
Cu	2.405	
Ba	66.65	
Bi	0.00	
Pb	0.00	≤ 0.2 µg/l
Tl	0.017	
Hg	0.00	≤ 0.04 µg/l
Pt	0.051	
Rb	0.825	
La	0.00	
U	3.515	
Cs	0.00	
I	48.3	
Te	0.001	
Sb	0.02	
Sn	1.275	
Cd	0.005	≤ 0.07 µg/l
W	0.023	

6.3 Functional Importance of the riparian habitat

A number of functions and ecosystem services are typically attributed to riparian habitats that are linked to the hydrology, geomorphology and vegetation characteristics of the riparian habitat in question.

The riparian habitat on site is associated with an ephemeral and highly variable stream in terms of flow characteristics, which are reflected in the riparian vegetation which is in many places poorly developed and often resembles the adjacent terrestrial habitat. Nonetheless, the riparian habitat is expected to play a role in various functions, including:

- Erosion control – the riparian vegetation stabilises river banks through the binding action of the plant roots, as well as slowing down flows through the surface roughness provided by the vegetation, further reducing erosion risk. As the riparian habitat on site is dominated by

[1] Concentration in brackets indicates the chronic effect value for Selenium as per the Guidelines for Aquatic Ecosystems.
[2] Concentration in brackets indicates the chronic effect value for Zinc as per the Guidelines for Aquatic Ecosystems.

non-woody species, the surface roughness provided by the riparian vegetation is however somewhat limited;

- Flood attenuation – the main flood attenuation function of the riparian habitat is performed when flows overtop the stream channel and spread out across the riparian habitat. This slows down flood velocities;
- Biodiversity support – the riparian habitat provides habitat differing from the surrounding terrestrial habitat and can thus support species not generally found elsewhere on site. Given the arid environment, riparian habitats within the general area are rather limited, further increasing the importance of this function;
- Water supply – the riparian habitat and associated stream represent the only natural surface water supply within the study area and thus provides important drinking areas for a variety of species, particularly bird species (e.g. Namaqua Sandgrouse were observed utilising the remaining pools of water in the stream);
- Ecological corridors – riparian areas often provide ecological corridors for the movement of fauna along the riparian habitat to other areas of suitable habitat; and
- Direct use benefits – on site, these appear to be limited, though the riparian habitat does provide livestock grazing to cattle, goats and horses.

6.4 Present Ecological Status (PES) Assessment

The present ecological state of the riparian habitat was assessed using the VegRAI Level 3 methodology.

Based on this assessment, the riparian habitat is considered to be in a B/C category, indicating a ***largely natural to moderately modified*** system.

Impacts to the riparian habitat that have resulted in degradation of the habitat can be summarised as follows:

- Livestock grazing – heavy grazing by livestock is expected to have resulted in decreased cover and abundance of especially non-woody vegetation within the riparian habitat. Decreased vegetation cover increases erosion risk within the riparian habitat, while livestock paths that lead towards remaining pools of water within the stream further exacerbate the erosion risk. A change in species composition is also likely to occur as a result of heavy grazing pressure. Areas most affected by heavy grazing include the area immediately below the old farm house, as well as around the watering trough located just to the north of the railway line and upstream of the dam;
- Road crossing – the Groenwater Spruit is crossed by both the public gravel road as well as the railway line via a number of culverts. These culverts have concentrated flows and resulted in incision of the channel downslope of the culverts; and
- Dam – the small farm dam as well as a further shallow impoundment upslope of the dam and a berm downslope of the dam have resulted in changes to the riparian vegetation through extended water retention (inundation) while also leading to further concentration of flows. Concentrated flows increase the erosion risk and have lead to channel incision within the riparian habitat.

As the definition of riparian habitat implies (see above), the primary determinant of the distribution and abundance of riparian plant biota is the hydrological regime, which in turn is defined by the depth, seasonal timing, frequency and duration of flooding (Rogers and van der Zel 1989). The volume and time distribution of run-off from the catchment are the prime determinants of the hydrological regime of a river system (Rogers 1995). The geomorphological form of the channel and riparian zone, on the other hand create the site specific condition of depth, duration, frequency and even timing of both surface and ground water fluctuations (Rogers and van der Zel 1989). The geomorphology is, in turn, a function of the run-off characteristics, the volume, timing and character of sediment delivered to the river and of the geological character and history of the local landscape (Church, 1992). The upper catchment of the Groenwater Spruit is mostly undeveloped and changes to catchment run-off quantity and quality are expected to be minimal, with the supporting hydrology of the system still largely intact. This is reflected in the overall fairly good condition of the riparian habitat on site.

Table 4. Ecological categories used for the VEGRAI scoring system (modified from Kleynhans 1996 & Kleynhans 1999).

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

6.5 Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a water course in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The riparian habitat on site is considered to be of ***High*** ecological importance and sensitivity and is placed in an ***ecological management class of B***. This rating is based mostly on the ecological

and hydrological importance of the riparian habitat (see functional assessment above) as direct human benefits provided by the system under current conditions are limited.

7. SIGNIFICANCE OF FINDINGS

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

It is recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development. A map indicating the delineated riparian habitat with a 100m buffer zone is illustrated below.

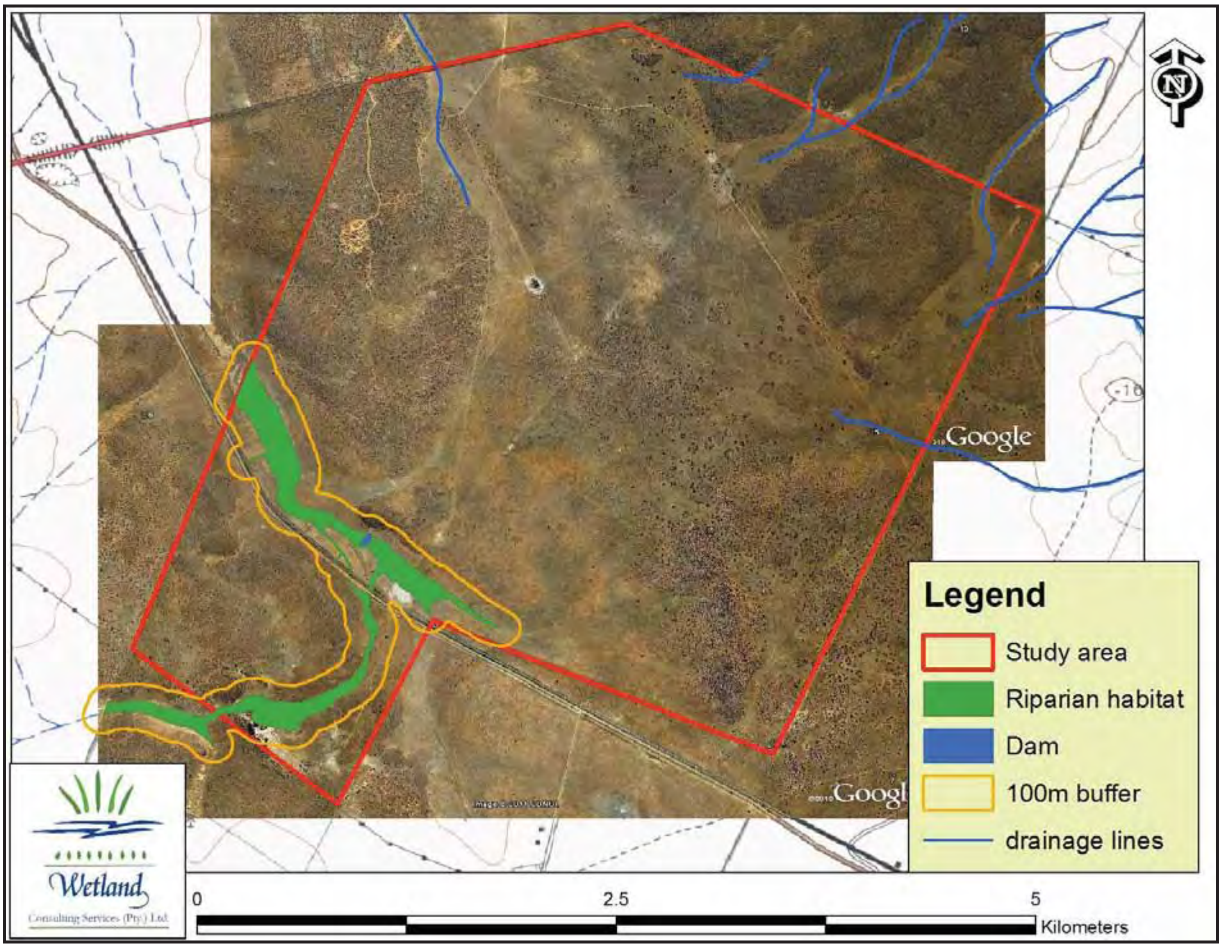

Figure 8. Map of the delineated riparian habitat with a 100m buffer zone as per the GDARD guidelines.

8. IMPACT ASSESSMENT

8.1 Project Description

It is proposed that a 80-100MW Thermal Power Plant be constructed and operated within the Humansrus study area. The power plant will take the form of a Concentrated Solar Power (CSP) Thermal Power Plant that will be connected to the national grid. The CSP Plant and all associated infrastructure will be housed within an 800ha facility located within the Humansrus study area. The following description is taken from the Technical Scope of Work (Worley Parsons, 2011):

> *The CSP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) in an area of 1.1 million m^2. The tower is erected in an inner circle inside the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt up to 580ºC, which then flows into a thermal storage tank for storage (maintaining 99% thermal efficiency).*

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankin cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In order to reduce the project's water consumption, a dry cooling system has been considered to condense the low pressure (LP) steam exhaust from the turbine.

The proposed facility will be dominated by the large heliostat field which will cover most of the 800ha facility. The heliostats will be mounted on a tubular footing imbedded in a concrete foundation. The tower will be approximately 200m high and have a base diameter of roughly 35m. All ancillary infrastructure will be located adjacent to the tower, with the exception of a new access road and a 132kV loop-in loop-out powerline from the existing powerline crossing the site. The exact location of the access road and the powerlines is not yet known.

The molten salt system will consist of a closed circuit with no discharge. The salt storage tanks will be housed in a bunded area to prevent leaks should failure of the tanks occur. The bunded area will have a capacity of 110% the capacity of the salt storage tanks.

The CSP plant will require substantial amounts of water (117 500m^3 during the 30 month construction period, while up to 44.5m^3/hr will be required for operation during peak consumption), which will need to be imported to the area. Incoming water will pass through a water treatment plant to ensure water of sufficient quality. Several treatment steps will be involved:

- Multimedia filter
- Reverse osmosis
- Electro-deionisation
- Wastewater recovery plant to maximise recovery of water
- Evaporation ponds – for discharge of final waste from treatment plant.

A wastewater purification plant will also be required on site for the treatment and management of 4 sources of waste water that have been identified:

1) Contaminated surface water – this will be capture, re-used as far as possible, and the remainder discharged to the evaporation ponds
2) Sewage effluent – this will be treated via a biological treatment system, with treated water being re-used or discharged to the evaporation ponds
3) Evaporation plant waste water – this will be routed to the water treatment plant, with treated water being reused or discharged to the evaporation ponds
4) Stormwater – clean and dirty stormwater will be separated. Clean stormwater will be captured in a drainage pool and discharged to the environment.

No dirty or treated water will be discharged to the environment.

8.2 Identification and assessment of impacts

A map showing the proposed infrastructure developments in relation to the site and the delineated riparian habitat is provided in Figure 9. A 100m buffer zone has also been delineated around the riparian habitat.

From the image it is clear that none of the proposed infrastructure will intrude into the riparian habitat associated with the Groenwater Spruit. Of the three evaporation pond alternatives indicated in the map below, only alternatives 2 and 3 infringe somewhat on the 100m buffer zone but still fall well outside of the riparian habitat.

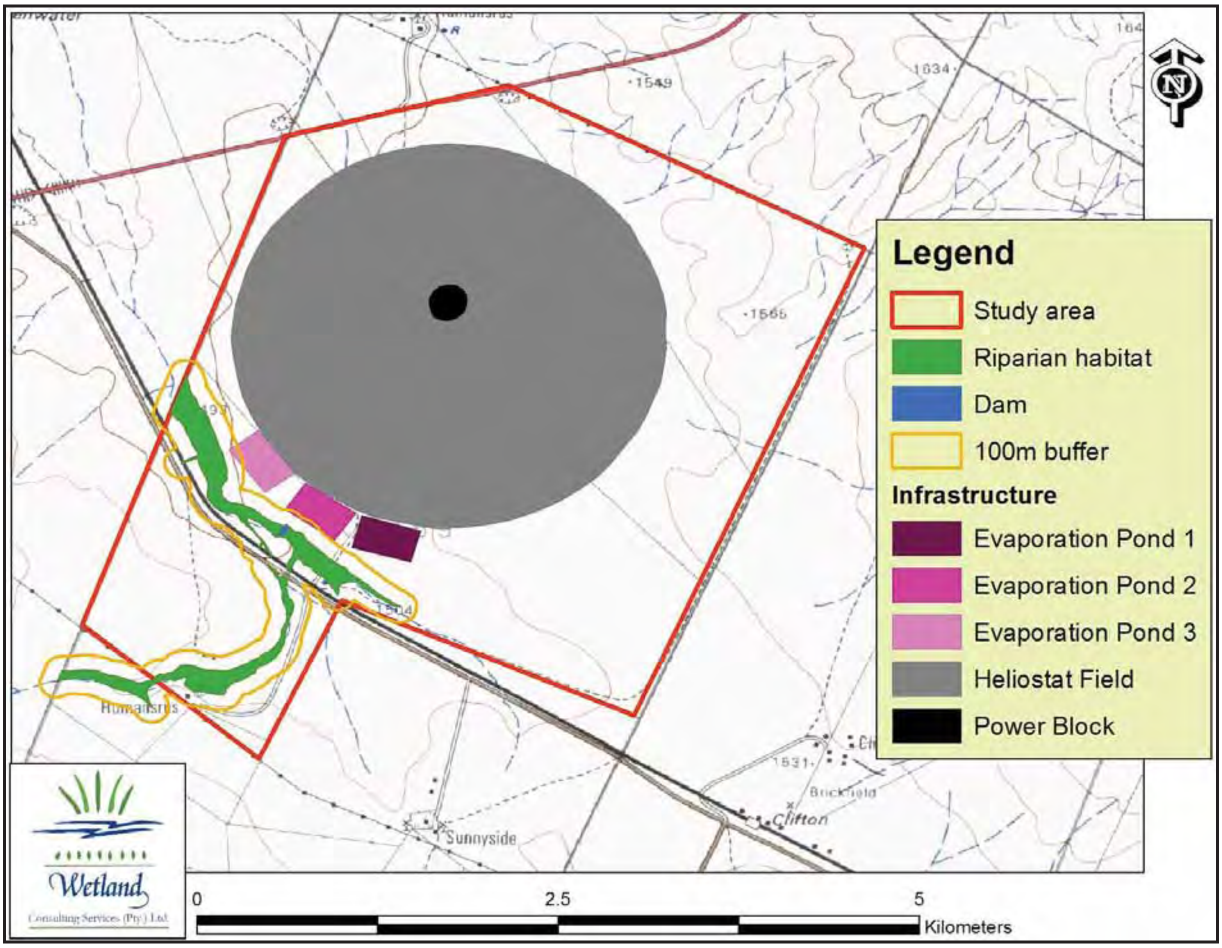

Figure 9. Map showing the proposed infrastructure in relation to the delineated riparian habitat on site.

As no infrastructure will be located within the delineated riparian habitat and associated water course and no construction activities will take place within these areas, no direct impacts to the riparian habitat are expected. Several indirect impacts due to the developments on site are however expected. Expected impacts are related mostly to increased sedimentation due to the earthworks that will be required on site, increased flow within the water course due to the import of large volumes of water, and the deterioration of water quality from leaks and spills of hazardous substances or dirty water.

All of the expected impacts have been grouped into the stage of the project in which they are expected to occur, though some of the impacts are likely to occur across several stages.

Construction Phase:

- Increased sediment movement into the riparian habitat and associated water course
- Water quality deterioration
- Increased flows within the water course

Operational Phase:

- Water quality deterioration
- Increased flows within the water course
- Stormwater discharge

8.2.1 Construction Phase – Increased sedimentation

During the construction phase it is expected that most of the 800ha footprint of the proposed CSP Plant will be cleared of vegetation and extensive earthworks will take place on site. These activities will expose the disturbed, bare soil to erosion by wind and water. As the construction phase is expected to run over 30 months, this will include at least 2 rainfall seasons. High intensity rainfall events which result in surface runoff could result in significant volumes of sediment being transported off the construction site and into downslope water courses. However, most of the proposed developments (i.e. the entire heliostat field) fall outside the direct catchment of the riparian habitat delineated on site. Though the heliostat field does fall within the Groenwater Spruit catchment, the distance between the heliostat field and the channel of the Groenwater Spruit is such that little sediment is likely to be washed into the Spruit, as most of the sediment would be expected to be trapped and deposited within the grassland downslope of the construction site. Only the proposed evaporation pond falls within the direct catchment of the riparian habitat delineated on site.

This impact is expected to be of ***Low significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	-5

Mitigation

The following mitigation measures should be implemented:

- Major vegetation clearing activities and earthworks should be undertaken during the dry season as far as practically possible.
- The footprint of vegetation clearing should be limited to the direct footprint of the proposed developments. The construction servitude should be fenced off prior to the commencement of construction activities and all construction activities should be limited to this servitude.
- Access roads and construction roads should include regular low levels humps to slow down stormwater flow and direct stormwater off the road surfaces and into adjacent grassland at regular intervals to minimise erosive energy of stormwater runoff.

- Stormwater infrastructure should include sediment traps.

8.2.2 Construction Phase – Water quality deterioration

Numerous hazardous substances will be used and stored on site during the construction phase of the project. These substances will include: diesel, oil, cement, salt mixture for the CSP Plant etc. Spillages or leaks of these substances could enter downslope water courses via surface run-off during high intensity storm events, leading to water quality deterioration within the receiving water courses and making the water less fit for use by downstream water users as well as being deleterious to aquatic biodiversity. Communication with the local farmers indicated the presence of a spring within the Groenwater Spruit further downstream of the site which plays an important role in providing drinking water to livestock as it seldom, if ever, dries up. Water quality deterioration could thus have significant consequences to downstream water users. The distance between the construction site and the Groenwater Spruit will however again ensure that pollutants do not directly enter the water course.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Local	2	Medium	3	Probable	2	Average	2	Medium	-9

Mitigation

The following mitigation measures should be implemented:

- All potentially polluting and hazardous substances used and stored on site should be stored in clearly demarcated areas.
- Storage areas for diesel, oil and other polluting substances must have adequate spillage containment measures to contain any spills within the direct area of the spill. Ideally, all potentially polluting substances should be stored in bunded areas of sufficient capacity to contain the full volume plus 10% of the storage containers.
- All re-fuelling areas and workshops should make use of drip trays to capture fuel and oil spills during re-fuelling or during vehicle maintenance and repairs.
- Stormwater should be diverted around the storage areas of polluting substances to prevent contamination of clean stormwater.
- Sufficient quantities of spill clean-up materials (e.g. Drizit or Spillsorb) should always be available on site. Once used, absorbent material and contaminated soil should be disposed of at a registered hazardous waste disposal site.
- The following guidelines apply to the use of polluting substances on site, and specifically to the use of cement and concrete:
  - Carefully control all on-site operations that involve the use of cement and concrete.
  - Limit cement and concrete mixing to single sites where possible.
  - Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
  - Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as

inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

8.2.3 Increased flows within the watercourse

Significant volumes of water will be imported to the study area during the construction of the CSP Plant - 117 500m^3 during the 30 month construction period. This water will be used mostly for dust suppression, heliostat cleaning and compaction purposes, as well as other uses. Large volumes of the water are thus likely to infiltrate into the sandy soil of the area. This could lead to increased surface run-off during rainfall events as the soil becomes saturated more easily, as well as increased seepage of water through the deeper soil profile, water which might be discharged into the Groenwater Spruit further downstream. Increased flows within the Groenwater Spruit could be considered a positive impact by downstream farmers who might have more water available for livestock watering, though increased flows will also lead to changes in the biodiversity supported by the Groenwater Spruit and should thus be seen as a negative impact. The dry climate of the area and high evaporation rates of the area will limit the significance of this impact considerably, as much of the imported water used on site will probably be lost to evaporation before it enters the Groenwater Spruit.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Local	2	Low	2	Probable	2	Average	2	Medium	-8

Mitigation

Water usage on site should be minimised and re-use of water should be maximised. No discharge of dirty water should be allowed.

8.2.4 Operational Phase – Water quality deterioration

A number of activities will pose a potential water quality hazard during the operational phase:

- The molten salt circuit
- Diesel storage on site (38 000 litres)
- Water treatment facilities, specifically the discharge of treated or untreated water
- The evaporation pond

The molten salt circuit is a closed system and no discharge of any salt from the system will take place. Both the heated salt and the cool sat tanks will be located within a bunded area that will have a total capacity of 110% the volume of the tank contents, i.e. the bunded area will be of sufficient capacity to contain the entire molten salt used in the plant should the system fail. The molten salt system should thus not pose a significant threat to water quality in the Groenwater Spruit.

It is understood that no water will be discharged from the facilities on site. All dirty water will be routed to the respective wastewater treatment plants, and all treated water will be either re-used or discharged to the evaporation dams.

The evaporation dams will contain dirty water and waste from the water treatment plants and are likely to be highly saline. Leakage or overflow from these dams will flow down the slope and into the Groenwater Spruit, resulting in water quality deterioration, specifically increased salinity, though other pollutants are also likely to occur.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	High	3	Medium	2	Probable	2	Severe	3	Medium	-10

Mitigation

The diesel storage tanks on site should be housed in a designated area that will allow for easy containment and clean-up of any spills that could occur on site, ideally in a bunded area. Drip trays should be used at all refuelling sites to capture small spills during refuelling. Emergency spill procedures must be clearly defined and all staff should be familiar with these procedures. Sufficient quantities of absorbent material should be easily available on site for containment of small spills.

Of the three proposed evaporation pond sites (see Figure 9 above), alternative 1 is the preferred alternative from a surface water resources perspective as it is located furthest away from the Groenwater Spruit. The evaporation dam should be lined with a suitable plastic liner (or series of liners) to ensure no seepage or leakage of water out of the dam occurs. The dam should be of sufficient capacity to ensure that no overflow of the dam will occur up to and including the 1:100 year storm event. The dam should be regularly inspected and cleaned to ensure that capacity is not decreased due to sedimentation. All sediments/brine cleaned from the dam should be disposed of in a registered hazardous waste facility.

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

8.2.5 Operational Phase – Increased flow

Significant volumes of water will be used during the operational phase of the project – up to 44.5m^3/hr during peak consumption. Importing such volumes of water into an area characterised by a dry climate such as is found on site could have significant consequences if released into the environment. However, it has been indicated that no water will be discharged from site other than clean stormwater captured in the attenuation facility. All water will be treated and re-used as far as possible, with waste water being discharged into the evaporation dam.

This impact is expected to be of ***Low significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	-2

Mitigation

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

8.2.6 Stormwater discharge

Clean stormwater generated on site will be captured in an attenuation facility and discharged into the environment. The location or size of the attenuation facility is not known, nor the location or design of the discharge point. The discharge of stormwater is however likely to occur as a point source discharge and be of higher velocity and concentration that pre-development flows and thus poses a significant erosion risk at the point of discharge.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Medium	2	High	3	Highly probable	3	Average	2	Medium	-10

Mitigation

To ensure effective functioning of the stormwater system, the attenuation facility should be designed to successfully attenuate all regular return rainfall events, up to at least the 1:25 year event. Silt traps should be incorporated into the stormwater system upstream of the attenuation facility to prevent sedimentation of the attenuation dam. Silt traps should be regularly cleaned.

Discharge from the attenuation facility should take place via an erosion protected discharge point and should incorporate energy dissipaters to ensure low velocity discharge with low erosive energy. Stormwater should not be discharged directly into the Groenwater Spruit.

Clean and dirty stormwater should at all times be kept separate. No dirty stormwater may be discharged.

8.2.7 Powerlines

As indicated, the exact location of the required powerlines is not yet known, though it is assumed that a crossing of the Groenwater Spruit will be required. The following recommendations should apply:

- The powerline pylons should ideally be located outside the delineated riparian habitat on site.
- No pylons may be located within the channel of the Groenwater Spruit.

- As far as possible, existing farm tracks should be utilised as service roads to the powerline rather than new tracks being created.
- The powerline should cross the Groenwater Spruit via the shortest route possible and perpendicular to the direction of flow.
- No construction camps or temporary stockpiles should be located within the riparian habitat during the construction process of the powerline.
- The construction servitude should be clearly demarcated and all construction activities limited to the servitude.

9. SUMMARY

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

It is recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development.

No infrastructure will be located within the delineated riparian habitat and associated water course and no construction activities will take place within these areas, thus no direct impacts to the riparian habitat are expected. Several indirect impacts due to the developments on site are however expected. Expected impacts are related mostly to increased sedimentation due to the earthworks that will be required on site, increased flow within the water course due to the import of large volumes of water, and the deterioration of water quality from leaks and spills of hazardous substances or dirty water. A number of mitigation measures have been proposed to mitigate these impacts.

It is pointed out that any activity that takes place within the delineated riparian habitat on site will require authorisation in terms of a Water Use Licence Application under Section 21 of the National Water Act.

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Appendix K

Noise Impact Assessment

NOISE IMPACT ASSESSMENT OF THE PLANNED CONCENTRATING SOLAR THERMAL POWER PLANT ON FARM HUMANSRUS, NORTHERN CAPE PROVINCE

(August 2011)

REPORT PREPARED BY JONGENS KEET ASSOCIATES

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APPENDICES

LIST OF FIGURES

NOISE IMPACT ASSESSMENT OF THE PLANNED CONCENTRATING SOLAR THERMAL POWER PLANT ON FARM HUMANSRUS, NORTHERN CAPE PROVINCE

1. INTRODUCTION

1.1 General

It is planned to build a Solar Thermal Energy Power Plant (otherwise known as a Concentrating Solar Power Plant or CSP Plant) with a capacity of 100MW approximately 30km east of Postmasburg in the Northern Cape Province. The proposed site is located on the Farm 469 Hay RD (Humansrus). Refer to Figure 1. An environmental impact assessment (EIA) is being undertaken. As part of the EIA, a noise impact assessment has been undertaken by Jongens Keet Associates (JKA). The study was undertaken by Mr Derek Cosijn and Dr Erica Cosijn. This report documents the findings of the EIA phase of the investigation.

1.2 Terms of Reference

The terms of reference (TOR) are as follows:

i) A sufficiently detailed quantitative (by measurement) and qualitative assessment within the area of influence of the planned new CSP Plant was to be undertaken at the development site in order to enable a full appreciation of the nature, magnitude, extent and implications of the potential noise impact.

ii) The level of investigation was to that of an Environmental Impact Assessment (EIA).

iii) The evaluation covered the CSP Plant site and proximate appurtenant works.

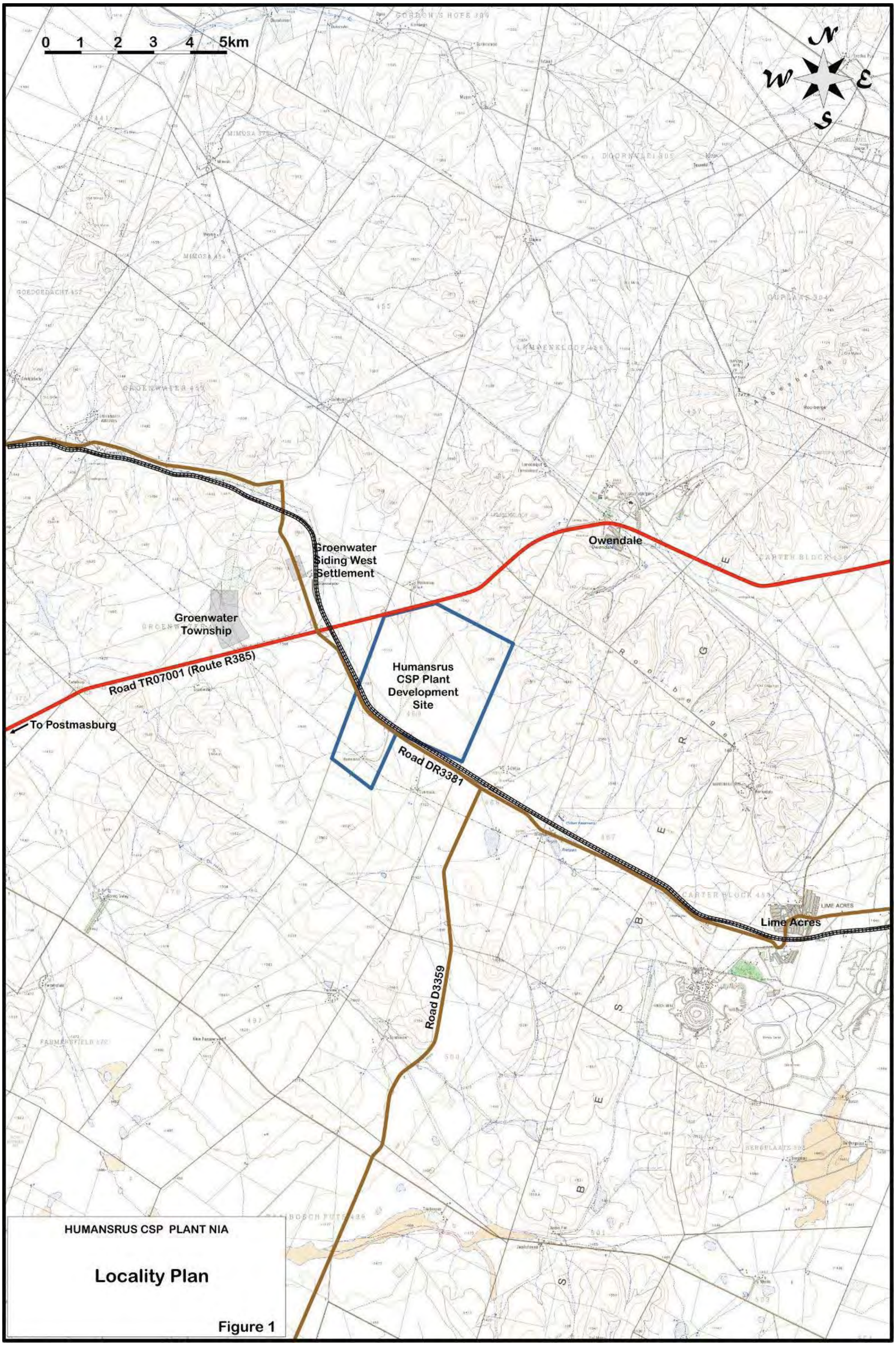
iv) All aspects of the investigation were to conform to the requirements of relevant environmental legislation and noise standards.

v) The potential impacts of the pre-construction, construction and operational phases of the project were to be assessed.

vi) Mitigation measures were to be identified. These were to be in concept only and not in detail.

1.3 Location and Extent of the Study Areas

The core study area of the noise impact assessment is that within the potential noise area of influence of the planned CSP Plant. The whole area within 10 kilometres of the site boundaries has been evaluated. Where necessary however, and particularly in regard to the CSP-generated traffic impact, a wider area of influence has been considered.


0 1 2 3 4 5km
N
W
E
S
Groenwater Siding West Settlement
Owendale
Groenwater Township
Road TR07001 (Route R385)
Humansrus CSP Plant Development Site
To Postmasburg
Road DR3381
Road D3359
Lime Acres
HUMANSRUS CSP PLANT NIA
Locality Plan
Figure 1

1.4 Scope and Limitations

Although most of the technical details of the planned CSP Plant have already been determined, not all of the final specific noise characteristics of the various component plant machinery and equipment to be installed have been finalised. These data will only be available at tender stage. Conservative (worst-case scenario) predictions based on equipment baseline noise levels of typical plant that will be installed have therefore been made.

2. DETAILS OF THE PLANNED CSP PLANT

The planned CSP Plant will have an electricity generating capacity of 100MW. The whole installation will comprise:

i) The Solar Field which consists of all services and infrastructure related to the management and operation of the heliostats.
ii) The Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
iii) The Power Block; and
iv) Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Based on the solar insolation characteristics of the Postmasburg area, the power station will be able to generate on average for at least 10 hours during the day (08h00 to 18h00) in the summer. As the salt needs to be kept at a high temperature, standby operations will take place during the night and during cloudy conditions.

The heliostats will need to be cleaned regularly. A truck mounted high pressure washing system will be used.

3. REGIONAL OVERVIEW: DETAILS OF THE STUDY AREA

Only the details relevant to the noise impact assessment are given.

3.1 Topography

The topography of the area can be defined as hilly terrain. There are low hills to the north, north-east and east of the site. The development site itself is relatively flat.

3.2 Land Use

The area to the east of Postmasburg is predominantly agricultural, interspersed with mining activities. Other significant land uses in the area are:

i) Residential.
   - a) Various farmhouses and farm labourer residences.
   - b) The residences in Groenwater Village (Metsimetala) and the village to the west of the Groenwater Siding.
   - c) The Owendale residential township.
   - d) The Lime Acres Mine residential township.
   - e) The Goedgedacht/Jenn-Haven residential township.

ii) Educational. There are three schools in the study area:
   - a) Refentse Primary school in Groenwater Village.
   - b) Two schools in Lime Acres Mine Village.

iii) Recreationally facilities at the mine at Lime Acres and at Owendale.

3.3 Roads

There are two major roads and several tertiary roads servicing the area (refer to Figure 1)

i) Provincial Road TR07001 (Route R385) from Postmasburg to Kimberley.

ii) Provincial Road DR3381 from intersection with road TR07001 (Route R385) near Groenwater Railway Siding to Road D3359 (near to the Lime Acres Mine).

3.4 Railway Lines

The Postmasburg - Beaufort-West railway line passes to the south-west of the development site dividing a small portion to the south from the main site. The line carries 14 trains per day (data obtained from Transnet Freight Rail).

3.5 Factors of Acoustical Significance

The hilly terrain in some sectors of the study area will influence the propagation of the noise from the new power plant.

A significant meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels. Refer to Appendix D for details of the meteorological aspects that may influence the propagation of noise in the area.

Temperature inversions have a significant effect on the noise propagation character of the area. Temperature inversions tend to increase noise levels at some distance from a source.

A temperature inversion is formed when air near the ground is cooler than the air above. This occurs mainly at night or to a lesser extent during cloudy days away from large bodies of water. Stable conditions with high humidity and very low velocity wind conditions are necessary. As cool air is denser than warm air, sound rays are refracted towards the cooler air, that is, towards the ground.

3.6 Noise Sensitive Receptors

The residential, educational and recreational land uses are considered to be noise sensitive receptors (NSR). Refer to Figure 2.

For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible. The following 1:50 000 topographical cadastral maps were used:

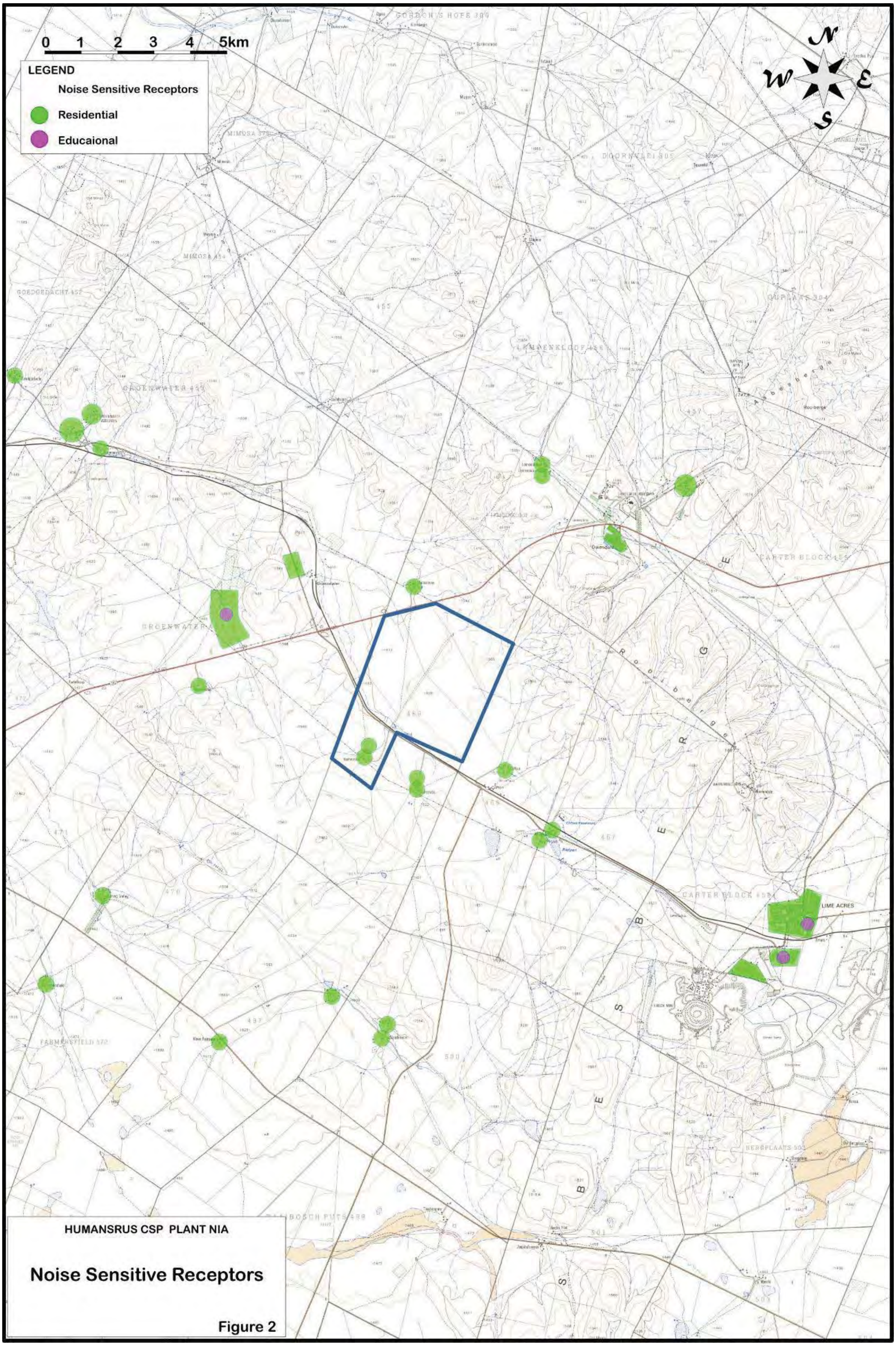
- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982.

4. METHODOLOGY

4.1 General

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328:2008: *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of an EIA. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The investigation comprised the following:

i) Determination of the existing situation (prior to the planned development).
ii) Determination of the situation during and after development.
iii) Assessment of the change in noise climate and impact.
iv) Determination of the significance of impact.
v) Comparison of alternative sites.
vi) Identification of mitigation measures.


0 1 2 3 4 5km
LEGEND
Noise Sensitive Receptors
Residential
Educaional
HUMANSRUS CSP PLANT NIA
Noise Sensitive Receptors
Figure 2

4.2 Determination of the Existing Conditions

This phase comprised the following:

i) The relevant technical details of the planned CSP Plant, the existing traffic patterns and the existing and planned land use in the study area were reviewed in order to establish a comprehensive understanding of all aspects of the project that will influence the future noise climate in the two respective study areas.

ii) Using these data, the limits of the study area for each alternative development site were determined and the potential noise sensitive areas, other major noise sources and potential problems in these areas were identified.

iii) Applicable noise standards were established. The National Noise Control Regulations and the SANS 10103:2008 standards were applied.

iv) The existing *noise climate* of the study area was determined by means of a field inspection and a noise measurement survey. The measurement survey appropriately covered the whole extent of the study area, focussing specifically on the identified noise sensitive/problem areas. Measurements were taken at six monitoring sites in the study area. The daytime conditions were measured at all sites. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the Code of Practice SANS 10103. Type 1 Integrating Sound Level meters were used for the noise measurements. All measurements were taken under dry weather and normal traffic (that is mid-week/school term) conditions.

v) On the general field inspection and at the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and that, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

vi) The existing noise climates along the main roads as related to the current traffic volumes and patterns were established. These traffic noise levels were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise*. The latest traffic was used as the baseline reference. The calculated 24-hour period noise indicators, as well as those for the daytime period and night-time period provided the main data for the impact assessment. The measured data provided a field

check of the acoustic conditions. See Section B3.4 in Appendix B for details of the road traffic noise impact on the study area.

vii) A general analysis of the rail traffic impact was undertaken. Refer to Section B3.5 in Appendix B.

4.3 Assessment of Planning/Design Phase and Construction Phase Impacts

Aspects of the pre-design field surveys and construction activities that potentially will have a noise impact were identified and, where appropriate, mitigation measures have been recommended.

4.4 Assessment of Operational Phase Impacts

The main focus of the operational phase assessment was to establish the nature, magnitude and extent of the potential change in *noise climate* in the study area directly related to and within the area of influence of the development site. The likely noise that will be generated by the CSP Plant operations was established and this was used to determine a footprint of impact. The noise footprint of the CSP Plant was calculated under inversion conditions, as well as under conditions where high winds prevail.

4.5 Determination of Significance of Impact

The significance of impact was the assessed by means of the following methodology, provided by Worley Parsons RSA (Pty) Ltd (originally proposed by SSI Bohlweki).

The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on three criteria, namely:

- The relationship of the impact/issue and impact status (Box 1);
- The relationship of the impact/issue and spatial scales (Box 2);
- The relationship of the impact/issue and temporal scale (Box 3);
- The relationship of the impact/issue and probability (Box 4);
- The relationship of the impact/issue and severity (Box 5).

These five criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment	+
Neutral	No cost to or benefit to receiving environment	N
Negative	A cost to receiving environment	-

Box 2: Spatial Scale of Impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Site specific; occurs within the site boundary	1
Medium	Local; extends beyond the site boundary. Affects the immediate surrounding environment (i.e. up to 5km for project site boundary).	2
High	Regional: extends far beyond the site boundary. Widespread effect (i.e. 5km and more from the project site boundary).	3
Very high	National and/or international: extends far beyond the site boundary; widespread effect.	4

Box 3: Temporal Scale of Impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; quickly reversible; 0-5 years	1
Medium	Medium term; reversible over time; 5-10 years	2
High	Long term; approximate lifespan of project; 16-30 years	3
Very high	Permanent; over 30 years and resulting in a permanent and lasting change that will remain.	4

Box 4: Probability of Impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Possibility of the impact materialising is negligible; chance of occurrence <10%	1
Medium	Possibility of the impact materialising is likely; chance of occurrence 10-49.9%	2
High	It is expected that the impact will occur; chance of occurrence 50-90%	3
Very high	Impact will occur regardless of any prevention measures; chance of occurrence >90%	4

Box 5: Severity of Impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible/Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short-term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time-consuming or not necessary	2
Severe	Medium or long-term impacts on the affected system(s) or party(ies) that could be mitigated.	3
Very severe	Irreversible and permanent change to the affected system(s) or party(ies) that cannot be mitigated.	4

Box 5: Severity of Impacts

Impact	Rating	Description	Quantitative Rating
Positive	**High**	Of the highest positive order within the bounds of impacts that could occur	+ 12 - 16
	Medium	Impact is real, but not substantial, in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort	+ 6 - 11
	Low	Impact is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming	+ 1 - 5
No impact	**No impact**	Zero impact	0

5. FINDINGS

5.1 Noise Sources

The main noise sources presently affecting the study area and the additional sources that will affect the area once the CSP Plant is commissioned are:

i) Road traffic noise from the traffic on Road TR07001 (Route R385) and Road DR3381.

ii) Railway traffic on the line on the Postmasburg – Beaufort-West line.

iii) The Lime Acres Mine.

iv) The Groenwater Asbestos Mine.

v) Noise from general farming operations.

vi) Near the residence on Farm Humansrus, just north of the development property, the farmer mills corn three days per week and also has a rock crushing facility that operates sporadically.

vii) Future: Humansrus CSP Plant.

5.2 Noise Sensitive Receptors

The noise sensitive sites/areas in the study area that are potentially affected by the development of the CSP Plant on this site are the suburban areas, settlements and farm residences, schools and recreational areas listed in Section 3.2 and as shown in Figure 2.

5.3 The Residual (Existing) Noise Climate

The determination of the residual (existing) noise climate in the study area is based on the measurements and observations made in the area, and where relevant also from the calculation of the noise from the traffic on the main roads.

The areas remote from the main roads are quiet and are typical of a rural/agricultural noise environment. In the residential townships of Groenwater, Groenwater Siding West, Goedgedacht/Jenn-Haven, Lime Acres Mine and Owendale the existing residual noise climate is typical of a suburban environment. The noise climate in areas close to Road TR07001 and Road R3381 are degraded. There is a noise nuisance factor in areas close to the railway lines when trains pass. Refer to Appendix B for details.

5.4 Noise Impact Criteria and Standards

From these findings and observations on site it was considered appropriate to apply the following noise standards and impact criteria to the study area:

i) Rural residential: the noise impact on the farmhouse sites and residences on game farms in the area has been determined on the basis of rural residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 45dBA and that for the night-time period should not exceed 35dBA. Measured levels indicate that parts of the (rural) study area are already severely degraded close to the main sources of noise.

ii) Educational: noise levels at the schools should not exceed 50dBA (outdoor condition) with the proviso that indoor classroom conditions do not exceed 40dBA.

The above indicates the ideal situation, where noise sensitive receptors are not already degraded by the existing (residual) noise climate. However, it is likely that the residual noise level at some of the noise sensitive receptors already exceeds the recommended maximum (e.g. next to major roads and railway line). In order to assess the actual noise impact at any particular site, therefore, the residual noise climate has to be taken into account. Where the noise level for a particular site is presently lower than the maximum ambient allowed (as indicated in SANS 10103) the recommended maximum shall not be exceeded by the introduction of the intruding noise. Where the noise level for the site is presently at or exceeds the maximum level allowed, the existing level shall not be increased by more than that indicated as acceptable in SANS 10103 (refer to Table A3 in Appendix A).

5.5 The Predicted Noise Climate

5.5.1 Pre-Construction Phase

Activities during the planning and design phase that normally have possible noise impact implications are those related to field surveys (such seismic testing and geological test borehole drilling for large building foundations). As these activities are usually of short duration and take place during the day, they are unlikely to cause any noise disturbance or nuisance in adjacent areas.

5.5.2 Construction Phase

This Section summarises the more detailed analysis, which is documented in Appendix C.

Construction will likely be carried out during the daytime only (07h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering operations and continuous concrete pouring may need to take place over a 24-hour period. It is estimated that the development of the project will take place over a period of 3 years. A large construction camp will need to be established. Details of the anticipated main sources of construction noise and the noise levels generated are given in Table C1a and Table C1b in Appendix C

The nature of the noise impact from the construction sites is likely to be as follows:

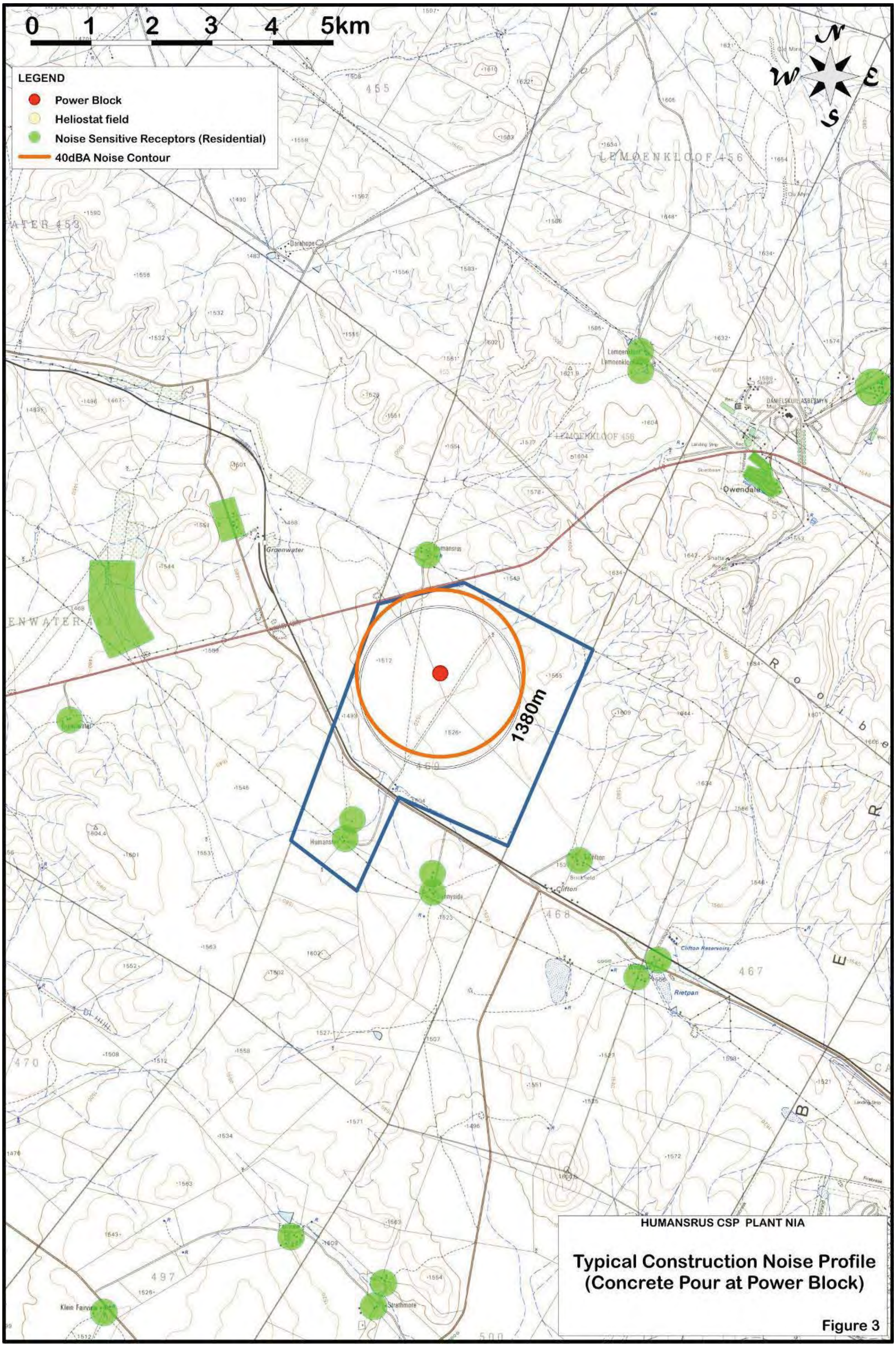
i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme for the various components, work modus operandi and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1380 metres of the construction site. Refer to Table C1b in Appendix C. Night-time construction could have a significant impact on noise sensitive sites within a radius of 3000 metres of the construction site.

iii) Slightly higher ambient noise levels than those normally considered as reasonable are acceptable during the construction period provided that the very noisy construction activities are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site.

iv) For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from Table C1a (refer to the 5 metre offset noise levels).

There is the potential for minor impact (noise nuisance) at a few sites in the immediate vicinity of the construction site (refer to Figure 3).


0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
40dBA Noise Contour
1380m
HUMANSRUS CSP PLANT NIA
Typical Construction Noise Profile (Concrete Pour at Power Block)
Figure 3

5.5.3 Operational Phase: CSP Plant Generated Noise Footprint

This Section summarises the more detailed analysis, which is documented in Appendix C.

The main noise sources at the CSP Plant will be the steam generating unit, the turbines, the cooling fans, and the pumps. The noise from the cooling fans will be the loudest and will predominate at areas outside the CSP Plant property.

Two operational situations have been modelled, namely full operations during the daytime, and standby operations during the night and during cloudy conditions. In addition, for the daytime operations, various meteorological conditions have been modelled.

It is predicted that the noise from the CSP Plant could be of the order as shown in Table 1 at the given offsets from the plant for various meteorological conditions. The equivalent continuous sound pressure level for one hour of operation ($L_{Aeq,1h}$) is indicated.

TABLE 1: NOISE LEVELS FROM CSP FOR VARIOUS METEOROLOGICAL CONDITIONS (CSP FULLY OPERATIONAL – DAYTIME)

	Offset (m)			
Noise Level (dBA)	**No wind**	**Upwind (v>6m/s)**	**Downwind (v>6m/s)**	**Inversion**
35	2850	1900	4200	4800
40	1900	1150	2850	3300
45	1200	700	1900	2150
50	780	400	1200	1400

Table 2 indicates the continuous sound pressure level for one hour of operation ($L_{Aeq,1h}$) during standby conditions. Inversion conditions (worst case scenario) have been modelled for the standby conditions.

TABLE 2: NOISE LEVELS FROM CSP UNDER INVERSION CONDITIONS (CSP STANDBY CONDITIONS)

Noise Level (dBA)	Offset (m)
35	2450
40	1500
45	950
50	600

The following figures refer:

Figure 4 Noise profile of CSP Plant (Daytime Operations): Inversion conditions

Figure 5: Noise profile of CSP Plant (Standby Operations): Inversion conditions

Figure 6: Noise profile of CSP Plant (Daytime Operations): Northerly wind

Figure 7: Noise profile of CSP Plant (Daytime Operations): Wind envelope
Figure 8: Noise profile of CSP Plant (Daytime Operations): Still wind periods

For daytime operations, noise sensitive sites (in a rural setting) within 2150 metres from the Plant could be significantly impacted by the noise from the Plant. Only one NSR is affected, namely die residence on Farm Humansrus to the north of the development site (refer to the 45dBA noise contour in Figure 4).

For night-time operations (standby) noise sensitive sites within 2450 metres of the Plant will be impacted. Only one NSR is affected, namely die residence on Farm Humansrus to the north of the development site (refer to the 35dBA noise contour in Figure 5).

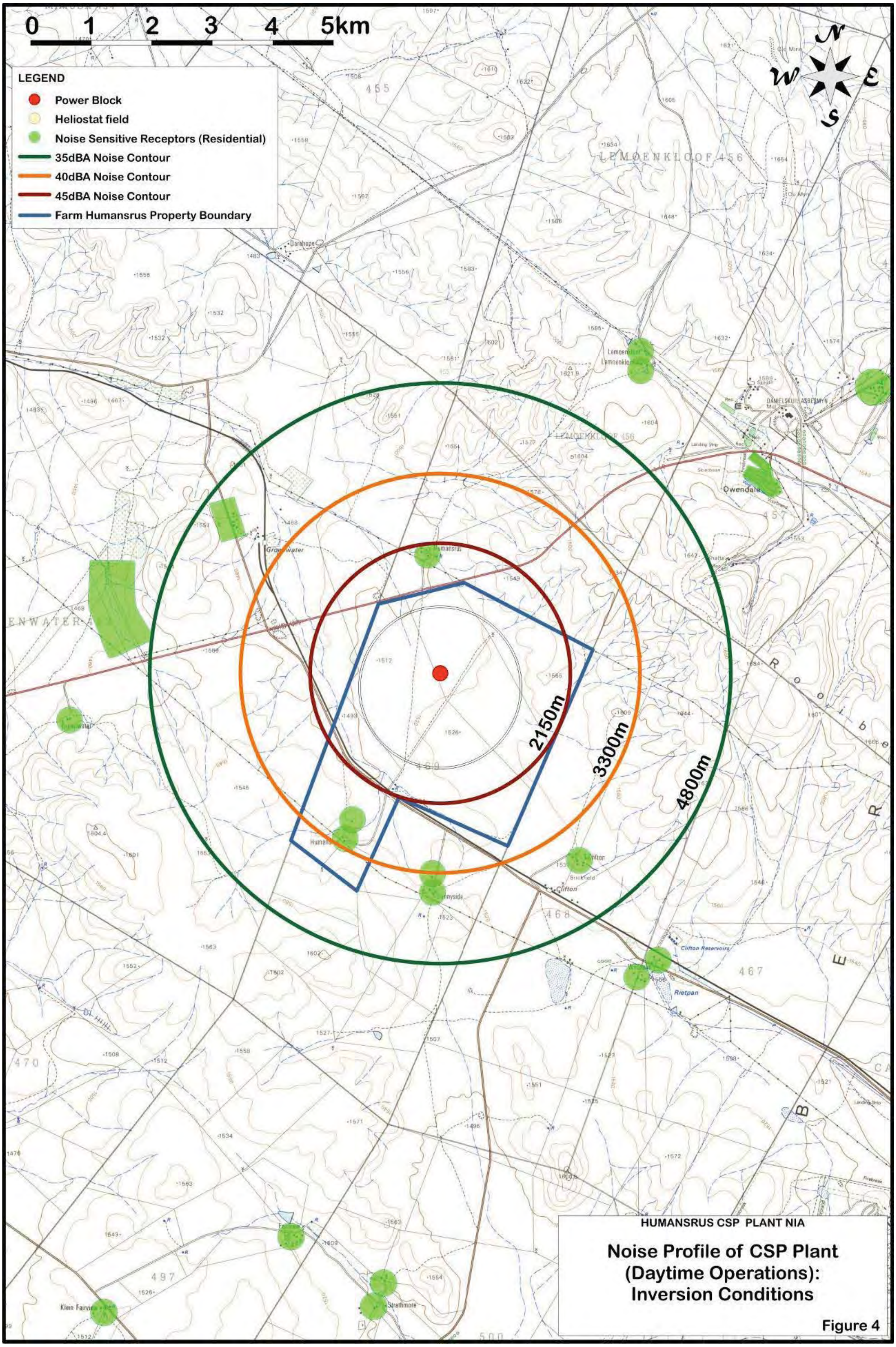
The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point. The sparse vegetation in the area will not assist the attenuation with distance.

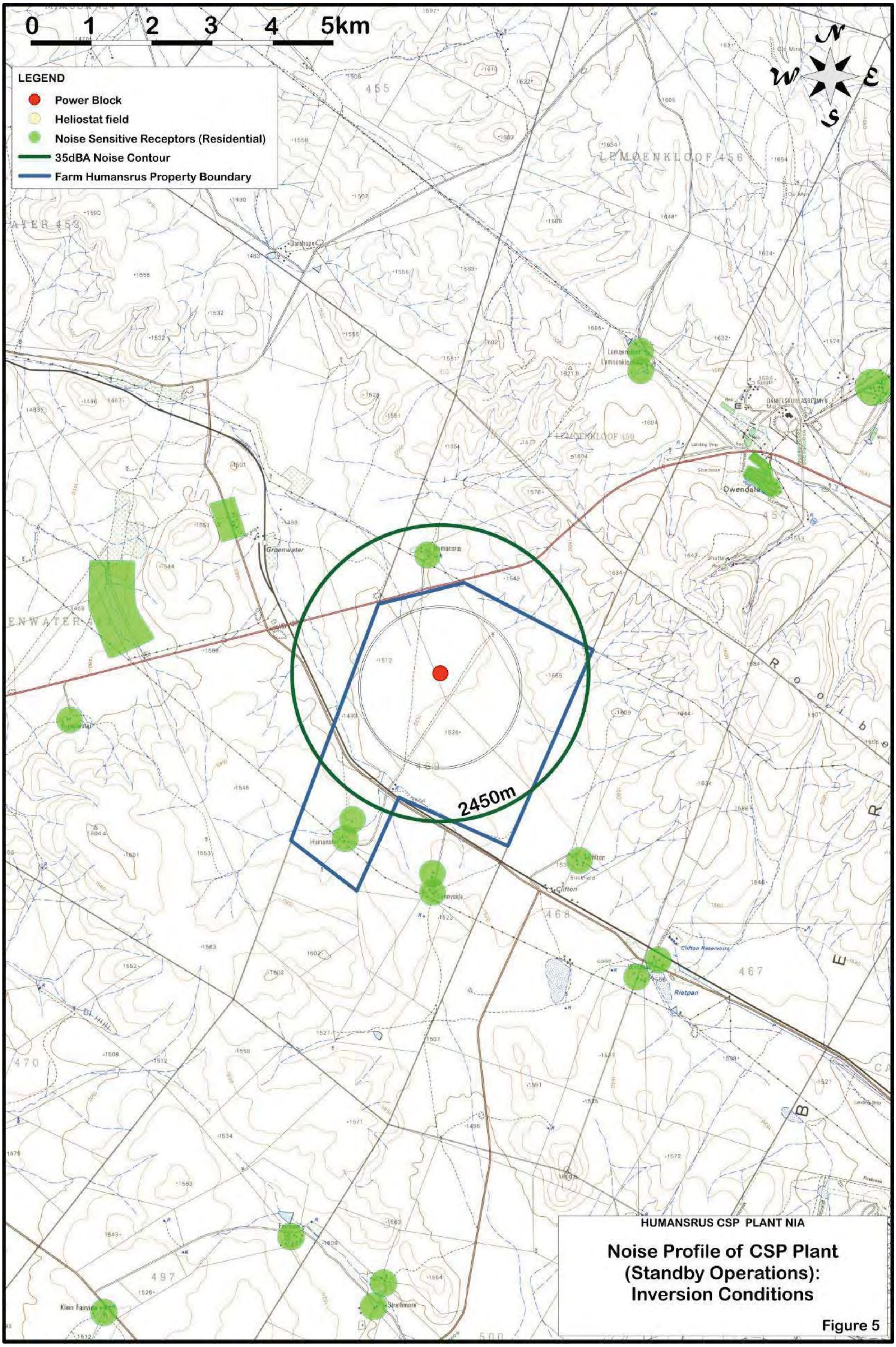
With regard to the washing of the heliostats, there will be an intermittent noise generating operation undertaken at night. A truck mounted high pressure washing system will be used. While the trucks are spraying the heliostats, maximum noise levels are not expected to exceed 35dBA at 1000 metres.

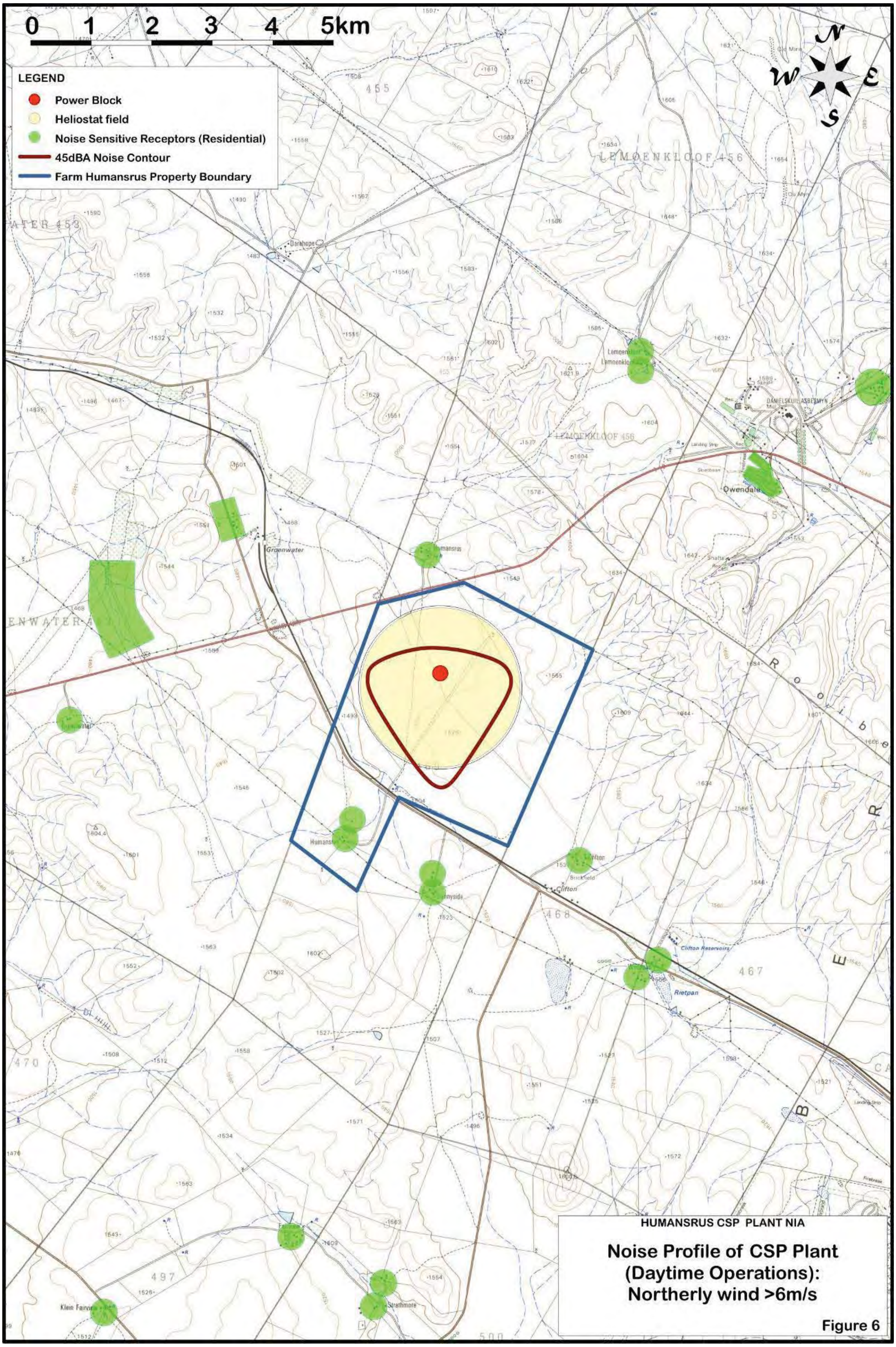
For a typical water purification or waste water treatment installation, the ambient noise level could be of the order of 40dBA at 300 metres offset.

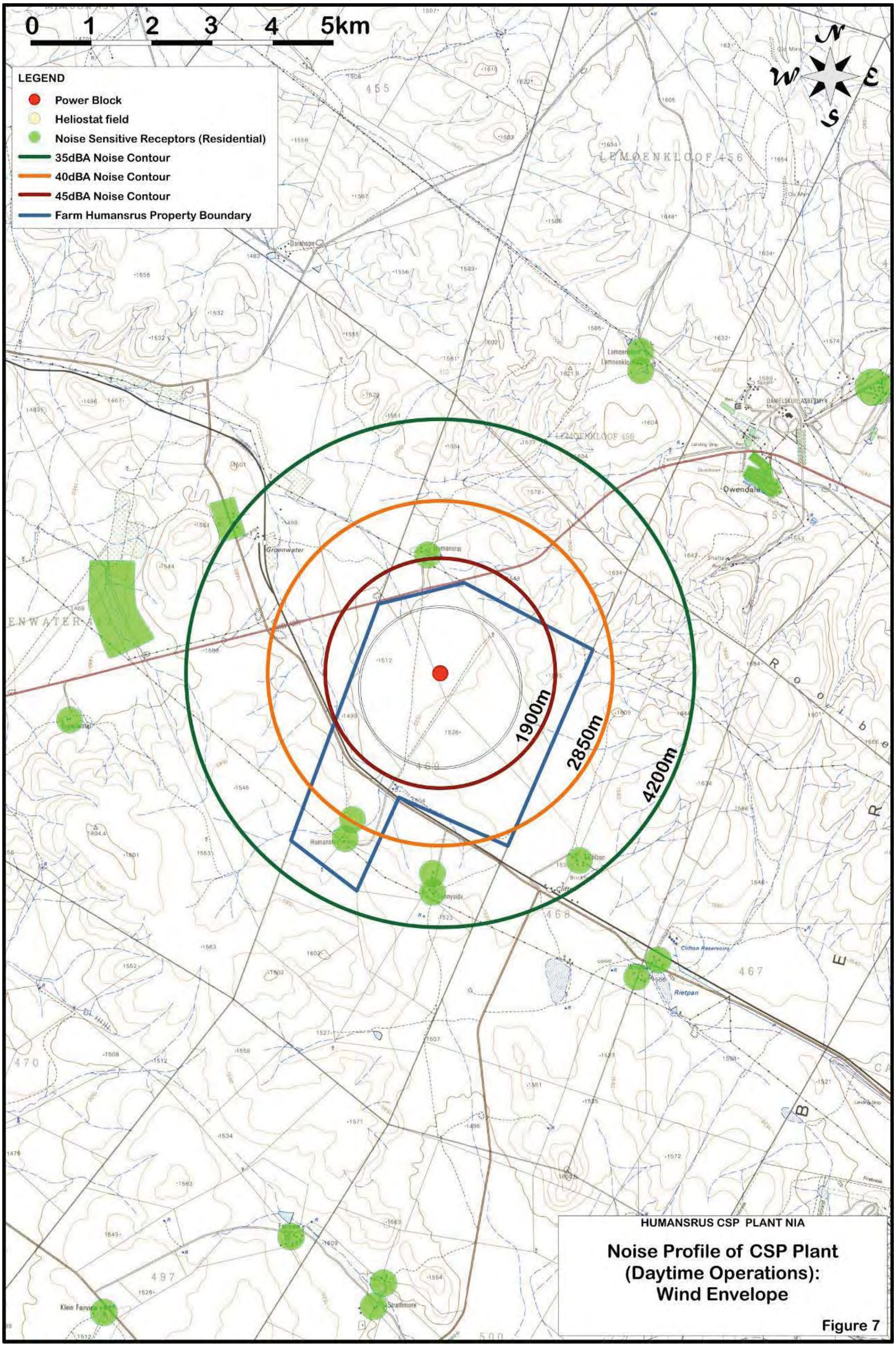
The noise profile of a typical Eskom substation (to be built to the south of the CSP Plant) is as given in Table C3 in Appendix C. There are two farmhouses in the vicinity of the Eskom substation site, but noise levels generated should not impact significantly on these residences. It should, however be noted that transformers typically emit a predominant pure tone of 100Hz, which, although not loud in volume, has the potential to induce vibrations in nearby structures, such as the farmhouses.

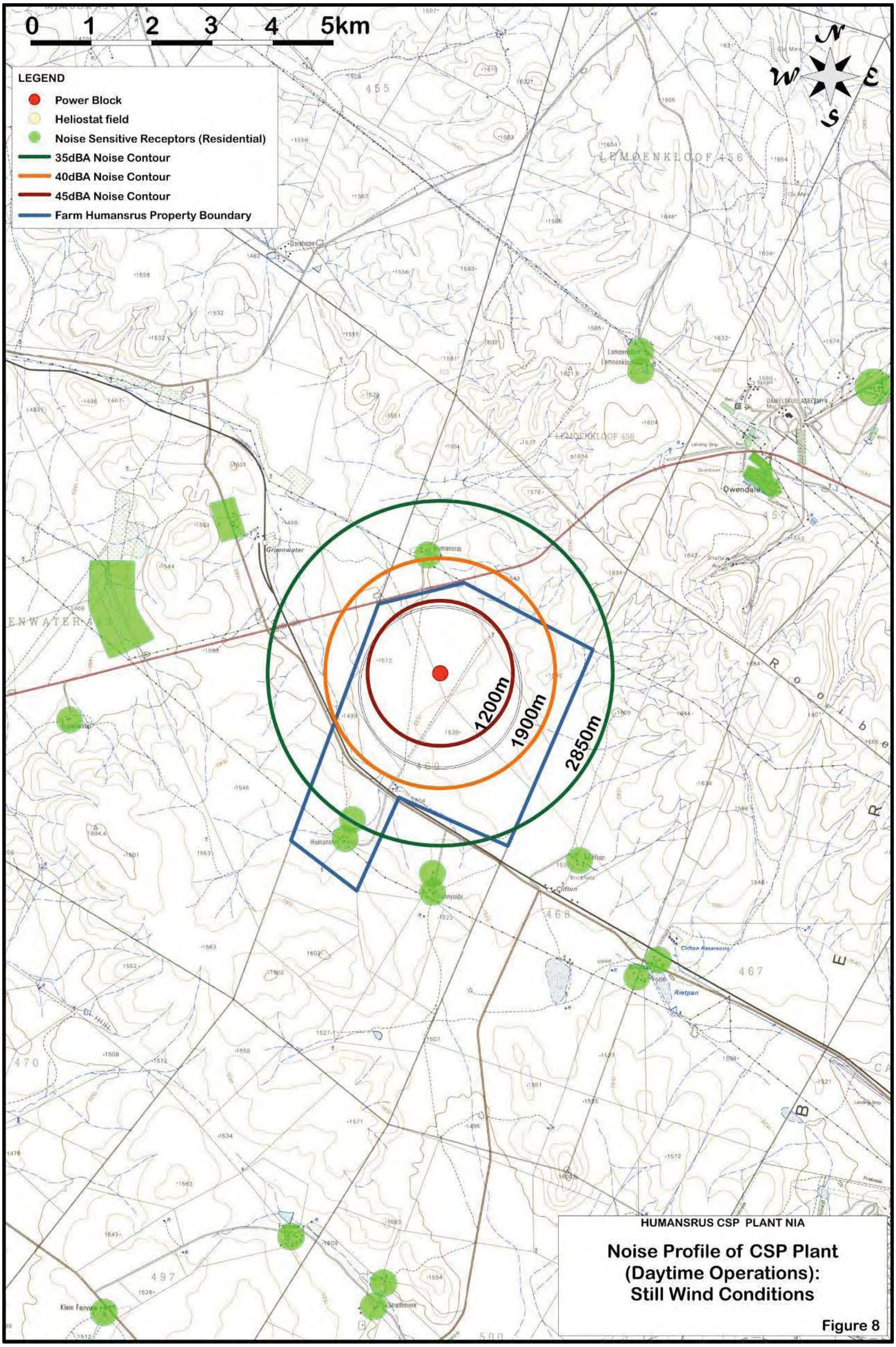
There are no other sources of noise in the study area with which the CSP will have significant cumulative effects.


0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
35dBA Noise Contour
40dBA Noise Contour
45dBA Noise Contour
Farm Humansrus Property Boundary
2150m
3300m
4800m
HUMANSRUS CSP PLANT NIA
Noise Profile of CSP Plant
(Daytime Operations):
Inversion Conditions
Figure 4


0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
35dBA Noise Contour
Farm Humansrus Property Boundary
N
W
E
S
2450m
HUMANSRUS CSP PLANT NIA
Noise Profile of CSP Plant
(Standby Operations):
Inversion Conditions
Figure 5


0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
45dBA Noise Contour
Farm Humansrus Property Boundary
N
W
E
S
LEMOENKLOOF 456
Owendale
Groenwater
Humansrus
Clifton
Clifton Reservoirs
Rietpan
Strathmore
HUMANSRUS CSP PLANT NIA
Noise Profile of CSP Plant
(Daytime Operations):
Northerly wind >6m/s
Figure 6


0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
35dBA Noise Contour
40dBA Noise Contour
45dBA Noise Contour
Farm Humansrus Property Boundary
N
W
E
S
1900m
2850m
4200m
HUMANSRUS CSP PLANT NIA
Noise Profile of CSP Plant
(Daytime Operations):
Wind Envelope
Figure 7



0 1 2 3 4 5km
LEGEND
Power Block
Heliostat field
Noise Sensitive Receptors (Residential)
35dBA Noise Contour
40dBA Noise Contour
45dBA Noise Contour
Farm Humansrus Property Boundary
N
W
E
S
1200m
1900m
2850m
HUMANSRUS CSP PLANT NIA
Noise Profile of CSP Plant
(Daytime Operations):
Still Wind Conditions
Figure 8

5.5.4 CSP Plant Generated Traffic

The total volume of traffic generated by the CSP Plant will be very small in comparison to the total volume of traffic on the adjacent main roads. It is estimated that there could be of the order of 60 vehicle trips (two-way) per day generated by the CSP Plant. These volumes are far too small to cause any significant noise impact.

6. SIGNIFICANCE OF IMPACT

The following assessment of the potential noise impact of the CSP Plant is based on the methodology provided by Worley Parsons RSA (Pty) Ltd (as proposed by SSI Bohlweki). Both the construction phase and the operational phase are analysed.

TABLE 3: IMPACT SIGNIFICANCE

Criteria	Rating	Quantitative Rating
Status of impacts	Negative	-
Spatial scale of impacts	Medium: Local	2
Temporal scale of impacts	High: Lifespan of project	3
Probability of impacts	Highly probable	3
Severity of impacts	Average to severe: Long term	2.5
Significance of impacts	Medium	10.5

7. MITIGATION MEASURES

Potential noise mitigation measures for the project were identified.

7.1 Pre-construction Phase

Local residents should be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities should be undertaken at reasonable times of the day. These works should not take place at night or on weekends.

During this phase, consideration must be given to the noise mitigation measures required during the construction phase and which should be included in the tender document specifications and the design.

7.2 Construction Phase

The noise mitigation measures to be considered during the construction phase are as follows:

i) Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas.

ii) Use of low-noise generation construction machinery. Noise control measures on construction machinery must, however, be agreed with the manufacturer.

iii) Where possible, stationary noisy equipment (for example compressors, pumps, pneumatic breakers,) should be encapsulated in acoustic covers, screens or sheds. Proper sound insulation can reduce noise by up to 20dBA. Portable acoustic shields should be used in the case where noisy equipment is not stationary (for example drills, angle grinders, chipping hammers, poker vibrators).

iv) Curtailing the uses of reverse-warning signals on site vehicles in certain areas and at certain times. Consideration of alternative safety measures may be necessary when taking such a measure.

v) All construction vehicles, plant and equipment are to be kept in good repair, for example, cover sheets should not vibrate or rattle; wheels, rollers and pulleys should not squeak.

vi) Truck traffic should be routed away from noise sensitive areas, where possible.

vii) Noisy operations should be combined so that they occur where possible at the same time.

viii) Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use radiotelephony rather than shouting for communication.

ix) Blasting operations (if required) are to be strictly controlled with regard to the size of explosive charge in order to minimise noise and air blast, and timings of explosions. The number of blasts per day should be limited, blasting should be undertaken at the same times each day and no blasting should be allowed at night.

x) Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.

xi) Construction activities are to be contained to reasonable hours during the day and early evening. Night-time activities near noise sensitive areas should not be allowed. No construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning.

xii) With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and owners on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.

xiii) As construction workers operate in a very noisy environment, it must be ensured that their working conditions comply with the requirements of the Occupational Health and Safety Act (Act No 85 of 1993). Where necessary ear protection gear should be worn.

7.3 Operational Phase

The following noise mitigation measures, which will need to be considered where appropriate, are indicators of what needs to be done to reduce or control the noise generated by the operations at the CSP Plant:

i) The design of all major plant for the plant is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous day/night rating level (L_{Rdn}), namely a noise level of 70dBA (just inside the *property projection plane*, namely the property boundary of the CSP Plant) as specified for industrial districts in SANS 10103. Refer to Appendix A. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the CSP Plant property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103.

ii) The latest technology incorporating maximum noise mitigation measures for components of the complex should be designed into the system. *Ideally*, plant and equipment should meet the following specification: the sound power level (L_W) should be such that the sound pressure level (SPL – i.e. the noise level) measured at 1 metre from the surface of the given plant/equipment should not exceed 85dBA. When ordering plant and machinery, manufacturers should be requested to provide details of the sound power level. Where possible, those with the lowest sound power level (most quiet) should be selected.

iii) The design process is to consider, *inter alia*, the following aspects:
   a) The position and orientation of buildings on the site. Ideally the power block should be located as far as possible from any of the Humansrus farm boundaries.
   b) The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
   c) The insulation of particularly noisy plant and equipment.

iv) All plant, equipment and vehicles are to be kept in good repair.

v) Where possible, very noisy activities should not take place at night (between the hours of 20h00 to 06h00). It must be ensured with the washing of the heliostats at night that noise levels from the high-pressure hose system (compressor) on the trucks are minimised.

It should be noted that any mitigation measures taken at the CSP Plant will limit the impacts in the specific areas designed for, but will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem.

8. CONCLUSIONS

The following conclusions can be drawn from the preceding analysis:

i) The existing typical residual noise climate throughout the study area is typical of a rural/agricultural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time.

ii) The noise climates near to the main roads are degraded as they are adversely affected by traffic noise. Heavy vehicle traffic has increased significantly in the last three years on Route R385.

iii) The areas alongside the railway line are significantly affected by noise with the passing of each train.

iv) The development of the Humansrus CSP Plant will introduce a very loud noise source into the area with a critical noise footprint relatively larger than the actual operational area and extends across the CSP property boundary. Fully operational daytime conditions will generate a 45dBA noise footprint of radius 2150m. Night-time standby operational conditions will generate a 35dBA noise contour of radius 2450m. If fully operational power generation conditions extend into the night-time, the 35dBA noise footprint will extend to a distance of 4800m around the power plant.

v) From a qualitative aspect, the development of the CSP Plant will bring about a change in the noise character of the area in the immediate area of the development.

vi) Daytime operations: The areas of noise impact from power generation activities from the CSP Plant site will extend onto the adjacent farms. However, the only noise sensitive receptor that will be affected is the residence on Farm Humansrus to the north of the development site.

vii) Night-time operation: The areas of noise impact from power generation activities from the CSP Plant site will extend onto the adjacent farms. However, the only noise sensitive receptor that will be affected is the residence on Farm Humansrus to the north of the development site.

viii) There are mitigation measures that can be introduced to prevent or reduce the noise impacts.

In overview, it may be concluded that the noise impact of the proposed CSP plant will not be extensive.

9. RECOMMENDATIONS

The following are recommended:

i) The National Noise Control Regulations and SANS 10103:2008 should be used as the main guidelines for addressing the potential noise impact on this project.

ii) Various measures to reduce the potential noise impact from the development are possible, and the mitigation measures indicated in Section 7 need to be considered.

iii) The power generation unit of the CSP Plant should be constructed at an offset of at least 2500 to 5000 metres from the nearest noise sensitive receptor, depending on the intended periods of operation.

iv) The noise mitigation measures will need to be designed and/or checked by an acoustical engineer in order to optimise the design parameters and ensure that the cost/benefit of the measure is optimised.

v) Once the layout of infrastructure at the proposed CSP Plant is finalised and the actual noise profile of plant and equipment is known, the position of the noise contours should be checked.

vi) At commissioning of the CSP Development, the noise footprint of each discrete element should be established by measurement in accordance with the relevant standards, namely SANS ISO 8297:1994 and SANS 10103. The character of the noise (qualitative aspect) should also be checked to ascertain whether there is any nuisance factor associated with the operations.

vii) An up-to-date traffic count on Roads TR07001 and Road DR3381 should be undertaken by the Northern Cape province Department of Transport in order to establish the exact nature of the increase of heavy vehicles using this route and the influence thereof on the noise climate of the study area.

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APPENDIX A

GLOSSARY OF TERMS
AND
NOISE IMPACT CRITERIA

APPENDIX A: GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

  $L_{pA} = 10 \log (p_A/p_o)^2$ where:

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2004. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.
- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.

- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of +10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the National Department of Environmental Affairs.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound** means the aural sensation caused by rapid, but very small, pressure variations in the air. In quantifying the subjective aural sensation, "loudness", the letters dBA after a numeral denote two separate phenomena:
  - "dB", short for *decibel*, is related to the human's subjective response to the change in amplitude (or largeness) of the pressure variations.
  - The "A" denotes the ear's different sensitivity to sounds at different frequencies. The ear is very much less sensitive to low (bass) frequency pressure variations compared to mid-frequencies.

  The level of environmental sound usually varies continuously with time. A human's subjective response to varying sounds is primarily governed by the total sound energy

received. The total sound energy is the average level of the fluctuating sound, occurring during a period of time, multiplied by the total time period. In order to compare the effects of different fluctuating sounds, one compares the average sound level over the time period with the constant level of a steady, non-varying sound that will produce the same energy during the same time period. The average energy of sound varying in amplitude is thus equivalent to the continuous, non-varying sound. The two energies are equivalent.

- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.
- **SANS 10103** means the latest edition of the South African National Standard SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
- **SANS 10210** means the latest edition of the South African National Standard SANS 10210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **SANS 10357** means the latest edition of the South African National Standard SANS 10357 titled *The Calculation of Sound Propagation by the Concawe Method*.
- Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)					
	Outdoors			Indoors with open windows		
	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

TABLE A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quiet
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the environmental guidelines of the World Bank and World Health Organisation, which specify 55dBA during the day (06:00 to 22:00) and 45dBA during the night (22:00 to 06:00) for residential purposes, determined over any hour. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (dBA)	Estimated Community/Group Response	
	Category	**Description**
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community/group action
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5dBA will be 'little' with 'sporadic complaints'. For an increase of equal or more than 5dBA the response changes to 'medium' with 'widespread complaints'.
- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated

community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

In the National Noise Control Regulations which are applicable in Northern Cape Province, an intruding noise is defined as ‘disturbing’ if it causes the ambient noise level to rise by 7dBA or more.

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and the general *noise climate* investigation related to the potential noise impact of a proposed Solar Thermal Energy Power Plant (otherwise known as a Concentrating Solar Power Plant or CSP Plant) project on the Farm 469 Hay RD, Northern Cape Province are dealt with in this Appendix. The site is located approximately 30 kilometres east of Postmasburg.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 *Methods for Environmental Noise Impact Assessments*. Noise measurements were taken at six main monitoring sites in the study area in order to establish the residual (existing) *noise climate*.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication*. A Type 1 Integrating Sound Level Meter, a Rion NA-28, was used for the noise measurements. The meter was calibrated at an accredited acoustical laboratory within the last 12 months. The calibration status of the meter was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz was applied to the meter. A Rion Sound Calibrator NC-74 was used.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. The frequency weighting setting was set on "A" and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 10 minutes were used. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the Sites. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meters were set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of each meter.

At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

At each measurement site a portable recording weather station, a Kestrel 4000 Pocket Weather Tracker (Serial No. 569322) was set up in the vicinity of the sound level meter and the wind speed, temperature, humidity, barometric pressure, and altitude were recorded. The wind direction was determined by means of a compass; and the cloud cover was noted by direct observation.

B3. MEASUREMENT DATA

B3.1. Measurement Sites

Noise measurements to establish current ambient noise conditions were taken at six (6) main sites in the study area, as indicated in Figure B1 and Table B1.

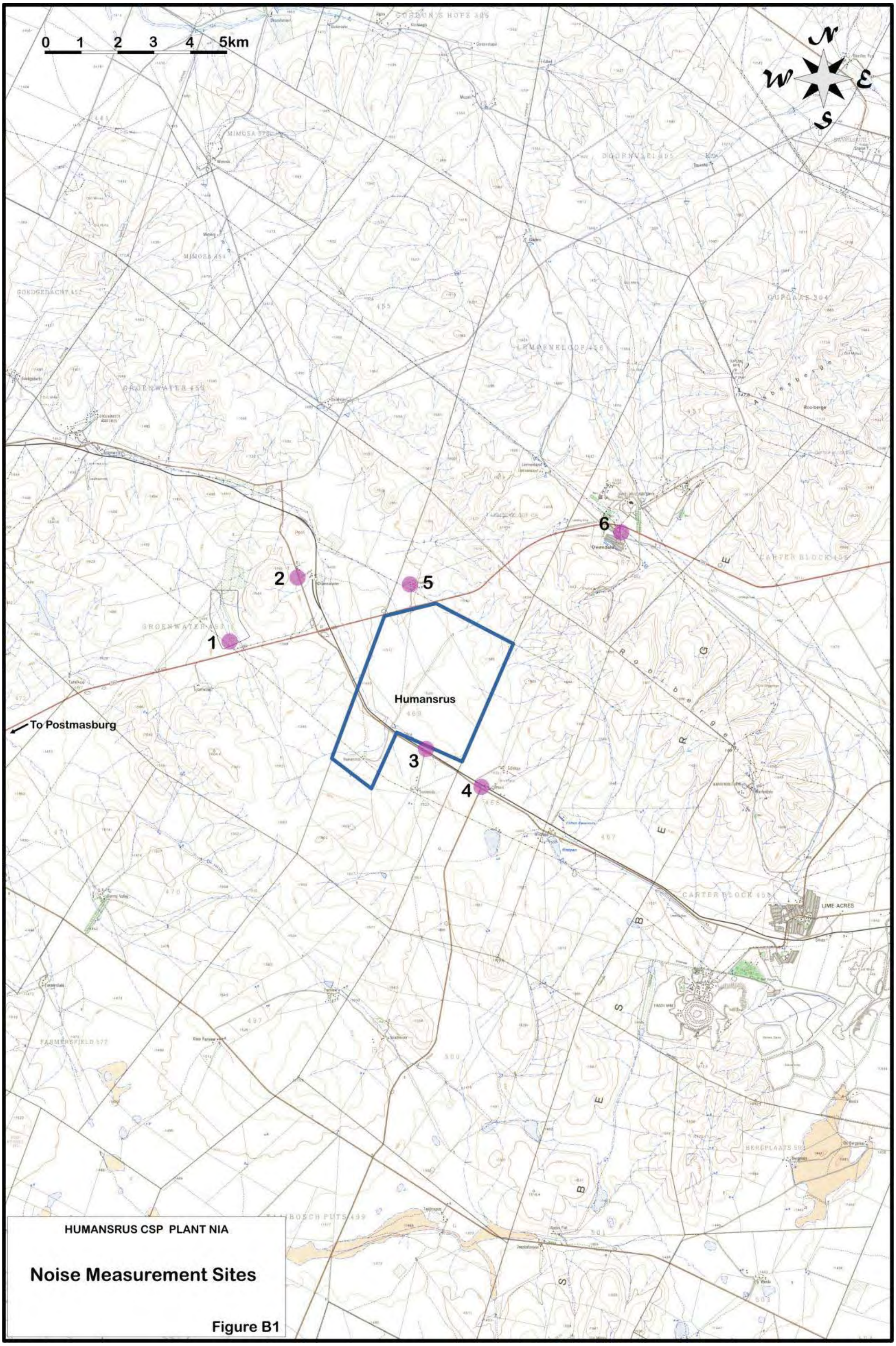
B3.2. Measurement Dates/Times

General observation of the noise conditions in the study area as well as the site specific sound pressure level (noise) measurements and observations were taken on Thursday 5 May 2011 from 10h00 to 13h00.

B3.3. Noise Measurement Details

B3.3.1. *Summary of the Residual Sound Pressure Level Measurements*

The results of the residual noise condition measurement survey are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).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LIME ACRES
HUMANSRUS CSP PLANT NIA
Noise Measurement Sites
Figure B1

TABLE B1: MEASURED CURRENT RESIDUAL NOISE LEVELS IN THE HUMANSRUS CSP STUDY AREA (YEAR 2011)

Site No	Location Description	GPS Co-ordinates	Measured Sound Pressure Level (dBA)			Estimated Sound Pressure Level* (dBA)		
			L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
1	On the southern side of Groenwater Village (Metsimatala)	S28°17.659' E23°18.914'	50.3	68.8	34.4	41		<30
2	Just to the south of the Village at Groenwater Siding	S28°16.970' E23°20.060'	43.4	55.4	27.1	28		<25
3	At entrance to Farm Sunnyside (AJ de Klerk) on Road DR3381	S28°18.213' E23°15.885'	48.8	63.6	32.7	26		<25
4	At Clifton Siding, 30 metres north of centreline of Road DR3381	S28°19.776' E23°23.037'	47.2	52.3	32.1	28		<25
5	On entrance road to residence on Farm Humansrus, approximately 150 metres north of centreline of Road TR7001 (Route R385)	S28°17.039' E23°21.836'	48.5	52.8	39.6	40		<30
6	Just outside entrance to Owendale Village, approximately 180 metres south of centreline of Road TR7001 (Route R385)	S28°16.000' E23°25.334'	53.0	65.6	37.9	40		<30

Notes:

* Based on road traffic:

i) Site 3: Night-time estimates at farmhouse 1000m south of road.

ii) Site 4: Night-time estimates at farmhouse 700m north of road.

B3.3.2. ***Determination of Night-time noise***

No night-time measurements were taken. The typical night-time residual noise conditions were established from night-time general *acoustic observations* in the area, the minimums of the daytime measurements, from previous measurements in similar areas, and from the traffic noise calculations (refer to Section B5.3).

The farming areas relatively far from the main roads and the other major noise sources are generally very quiet. The ambient noise levels are of the order of 26dBA to 41dBA during the late evening period and at night. It should, however, be noted that these levels can often be elevated significantly by the presence of insects, bats, frogs and other wildlife. These conditions generally are a seasonal phenomenon.

B3.4. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on the following main roads through the area and the roads that directly affected the CSP Plant project were calculated:

i) Provincial Road TR07001 (Route R385) from Postmasburg to Kimberley.

ii) Provincial Road DR3381 from intersection with Road TR07001 (Route R385) near Groenwater Railway Siding to Road D3359 (near to the Lime Acres Mine)

The traffic data were obtained from the Northern Cape Province Department of Transport and Microzone Information Technology Specialists.

These calculated noise values provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation site. The Year 2008 and 2010 traffic data were used as the baseline for the calculations.

The noise levels at various offsets from the relevant road centrelines were established and are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2008, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in table), namely for the period from 22h00 to 06h00).

iii) Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in table), namely for the 24 hour period from 06h00 to 06h00).

The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

TABLE B2: EXISTING NOISE CLIMATE ADJACENT TO MAIN ROADS IN THE HUMANSRUS CSP STUDY AREA (YEAR 2011 TRAFFIC)

Offset	Noise climate alongside main roads (dBA) Year 2011 (SANS 10103 Descriptor)					
	TR07001			DR3381		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
25m	58.6	49.2	58.8	46.9	44.6	51.1
50m	55.6	46.2	55.8	43.9	41.6	48.1
100m	52.4	43.0	52.6	40.7	38.4	44.9
250m	48.0	38.6	48.2	36.3	34.0	40.5
500m	44.2	34.8	44.4	32.5	30.2	36.7
1000m	39.7	30.3	39.9	28.0	25.7	32.2
1500m	36.6	27.2	36.8	24.9	22.6	29.1
2000m	34.4	25.0	34.6	22.7	20.4	26.9

B3.5. Noise Climate Related to Railway Traffic

The Postmasburg - Beaufort-West railway line passes to the south-west of the development site dividing a small portion to the south from the main site. The line carries 14 trains per day (data obtained from Transnet Freight Rail).

With the pass-by of each train past a noise sensitive receptor there will be a fluctuation in sound pressure level ranging from the normal background noise for the area (residual noise level) to a maximum as the train passes and then reducing again to the residual level as the train moves away from the receiver point. The approximate maximum noise levels that will be experienced with the pass-by of a train at various offsets from the railway line and for various typical cross-section types are given in Table B3. Note that the noise levels for the sections at-grade and the sections on fill are the same. The values given are the unmitigated noise levels.

TABLE B3: TYPICAL MAXIMUM NOISE LEVELS FOR OPERATIONAL CONDITIONS ALONG THE RAILWAY LINES

Offset (m)	Maximum Pass-by Noise Level (L_{Amax}) (dBA)		
	At-grade/Fill Section	Cutting Section	
		3m Depth	7m Depth
25	93,3	81,5	77,9
50	88,3	75,7	71,1
100	82,2	69,3	64,3
200	75,6	62,6	57,4
300	71,9	58,9	53,4
500	66,5	53,5	48,0

i) The operations of the trains have the potential to adversely influence the noise climate of the areas along the railway corridors to a larger or lesser extent for significant distances from the tracks. The propagated noise will be attenuated with distance from the source, the nature of the ground cover on the intervening ground, and from screening by the natural topography and buildings. The wheel-rail generated noise is enhanced where the train is travelling on elevated structure.

ii) The character (qualitative aspect) of the railway operational noise will have many facets. The component of noise that will predominate at maximum operating speed will be the wheel-rail interaction noise. The noise from diesel locomotives will be much higher than that from electric locomotives. The noise from the locomotives will be slightly louder than that from the wagons. With the pass-by of each train, the perceived noise at any one receiver point within the area of influence of the train will fluctuate relatively rapidly from the normal background (ambient) noise level of the area to peak at the maximum, will then fall slightly once the locomotives have passed the closest point to the receiver to remain fairly constant at this level until the whole train has passed by the near-ground and then will fall back to the area's ambient level as the train moves into the far distance. This whole cycle can take place over a period of several minutes, depending on the length and the speed of the train.

iii) The noise of the braking systems may sometimes be audible. There will possibly be some "flange squeal" (rail-wheel interaction) heard in areas where there are tight-radius track curves. There will also be mechanical banging sounds from the wagon couplings when the trains slow down or accelerate.

iv) It is normally mandatory that a train sounds a warning horn at at-grade crossings with roads. Noise from these horn soundings can be as loud as 105dBA at 30 metres and 84dBA at 350 metres from the train.

v) The noise impact from a train relates normally to the nuisance (annoyance) impact as the train passes.

B3.6. Prevailing Noise Climate

In overview, the existing situation with respect to the existing *noise climate* in the Humansrus CSP study area was found to be as follows:

i) The main sources of noise in the area are from:
   a) Road traffic noise from the traffic on Road TR07001 (Route R385) and Road DR3381.
   b) Railway traffic on the line on the Postmasburg – Beaufort-West line
   c) The Lime Acres Mine.
   d) The Groenwater Asbestos Mine.
   e) Noise from general farming operations.
   f) On Farm Humansrus just north of the development property, the farmer mills corn three days per week and also has a rock crushing facility that operates sporadically.

ii) The main noise sensitive receptors in the area are (refer also to Figure 2 in the main report):
   a) Various farmhouses and farm labourer residences.
   b) The residences in Groenwater Village (Metsimetala) and the village to the west of the Groenwater Siding.
   c) The Owendale residential township.
   d) The Lime Acres Mine residential township.
   e) The Goedgedacht/Jenn-Haven residential township.

iii) The existing residual noise climate throughout most of the study area is typical of a rural/agricultural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time.

iv) In the residential townships of Groenwater, Groenwater Siding West, Goedgedacht/Jenn-Haven, Lime Acres Mine and Owendale the existing residual noise climate is typical of a suburban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 50dBA during the day and generally do not exceed 40dBA during the night-time.

v) Sites close to the main roads in the study area are adversely affected by traffic noise.

vi) The main roads affected are listed in Section B3.4. The ambient noise levels alongside these roads exceed the acceptable levels as recommended in SANS 10103 with respect to rural and suburban residential living and other noise sensitive land uses. The noise climates in these areas can be defined as being severely degraded for these land uses.

The areas next to the main roads are in some areas degraded for up to the following distances (based on rural residential SANS 10103 standards):

- Road TR07001 (Route R385) - 2000 metres
- Road D3381 - 600 metres

vi) The train traffic is a minor factor due to the low rail traffic volumes. The noise impact from a train relates normally to the nuisance (annoyance) impact as the train passes.

APPENDIX C

ASSESSMENT OF NOISE IMPACT

APPENDIX C: ASSESSMENT OF NOISE IMPACT

C1. GENERAL

The assessment of the noise impact was guided by the requirements of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments* and the Noise Control Regulations. A comprehensive assessment using the appropriate noise impact descriptors (standards) has been undertaken. The noise impact criteria used in this investigation specifically take into account those as specified in the South African National Standard SANS 10103 *The Measurement and Rating of Environmental Noise with Respect to Land Use and Speech Communication,* as well as those in the National Noise Control Regulations. Relevant aspects of these Regulations and SANS 10103 are provided in Appendix A.

For this study the position of houses/dwellings on the farms and other noise sensitive areas/sites was taken off the following 1:50 000 topographical cadastral maps:

- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982.

For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. During the field survey for the noise measurement survey, such aspects were noted where possible.

C2. ASSESSMENT OF THE PRE-CONSTRUCTION PHASE

Activities during the planning and design stages that have possible impact implications in the study area are related to field surveys (such as seismic testing and geological test borehole drilling for large building/structure foundation investigations). As these survey activities will be of short duration and take place during the day, they are unlikely to cause any noise impact.

C3. ASSESSMENT OF THE CONSTRUCTION PHASE

C3.1. General

The potential noise climate was established in general for the construction of the CSP Plant inclusive of appurtenant works such as the construction of new access roads.

Although some of the details of the planned Plant have not yet been finalised, general concepts have been used in the noise impact evaluation and these are adequate to provide a sound basis

for the analysis of typical noise conditions and impacts that are likely to prevail on the project. Data related to construction have been sourced from various consultants and also based on the experience that JKA has had working on similar sites.

C3.2. Construction Noise Conditions

Construction will likely be carried out during the daytime only (07h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering operations may need to take place over a 24-hour period. The construction of the central concentration tower may also be a continuous pour of concrete using a sliding shutter. It is estimated that construction will take place over a period of 3 years and at the earliest the Plant could be commissioned by Year 2014.

C3.2.1. ***Sources of Noise***

The following are likely to be the main construction related sources of noise for the CSP Plant and its infrastructure:

i) Construction camp establishment. This will be for the site offices, workshops and possibly the accommodation camp for the workers on site.
ii) Activities related to the relocation of services.
iii) Excavation of building basements and service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.
iv) Piling operations for large buildings/structures.
v) Erection of shuttering for concrete.
vi) Fixing of steel reinforcing.
vii) Placing and vibration of concrete. Poker vibrators will be used.
viii) Stripping of shuttering after concrete pour.
ix) Erection of structural steelwork.
x) Finishing operations on buildings. Cladding, services installation, etc.
xi) Installation of generating plant and ancillary plant.
xii) General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) around the site.
xiii) De-watering pumps. A 24-hour operation may sometimes be necessary.
xiv) Road construction equipment. Scrapers, dozers, compactors, etc. (Construction of the internal road system and access roads).
xv) Construction site fabrication workshops and plant maintenance workshops.
xvi) Construction material and equipment delivery vehicles.
xvii) Concrete batching plant and asphalt batching plant on site.

The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by various types of construction equipment are given in Table C1a.

These noise levels assume that the equipment is maintained in good order. Conservative attenuation conditions (related to intervening ground conditions and screening) have been applied.

TABLE C1a. TYPICAL NOISE LEVELS GENERATED BY CONSTRUCTION EQUIPMENT

Plant/Equipment	Typical Operational Noise Level at Given Offset (dBA)							
	5m	10m	25m	50m	100m	250m	500m	1000m
Air compressor	91	85	77	71	65	57	51	46
Compactor	92	86	78	72	66	58	52	46
Concrete mixer	95	89	81	75	69	61	55	49
Concrete vibrator	86	80	72	66	60	52	46	40
Conveyor belt	77	71	63	57	51	43	37	32
Crusher (aggregate)	90	84	76	70	64	56	50	44
Crane (mobile)	93	87	79	73	67	59	53	47
Dozer	95	89	81	75	69	61	55	49
Loader	95	89	81	75	69	61	55	49
Mechanical shovel	98	92	84	78	72	64	58	52
Pile driver	110	104	97	91	85	77	71	65
Pump	86	80	72	66	60	52	46	40
Pneumatic breaker	98	92	84	78	72	64	58	52
Rock drill	108	102	94	88	82	74	68	62
Roller	84	78	70	64	58	50	44	38
Trucks	87	81	73	67	64	60	57	54

Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme for the various components, work *modus operandi* and type of equipment have not been finalised. Using baseline data from typical construction sites, the ambient noise conditions at various offsets from the following main construction activities are predicted:

- Noise from concrete batching plant.
- General concrete construction in the various proposed plant areas.

Refer to Table C1b.

TABLE C1b: PREDICTED AMBIENT NOISE LEVELS AT GIVEN OFFSETS FROM SOME SPECIFIC CONSTRUCTION ACTIVITIES

Equipment	Sound pressure level at given offset(dBA)					
	500m	1000m	1500m	2000m	2500m	3000m
Concrete Batching Plant	53.6	46.0	41.1	37.5	34.7	32.3
Concreting Operations	57.2	49.1	43.9	40.1	37.1	34.6

C3.2.2. ***Noise Impact***

The nature of the noise impact from the large building construction sites is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme for the various components, work modus operandi and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1380 metres of the construction site. Refer to Table C1b. Night-time construction could have a significant impact on noise sensitive sites within a radius of 3000 metres of the construction site.

iii) There are likely to be significant noise nuisance effects during the day from intermittent loud noises on people living in the area. If there is any night-time construction, fairly significant impacts will be experienced.

iv) It has been estimated that the construction activities at the site will on average generate no more than about 150 vehicle trips (two way trips) daily. The main percentage of the trips will be concentrated in the morning and evening peak periods. In general, the construction traffic will have a relatively minor effect on the noise climate alongside the main external roads in the area.

The nature of the noise impact from the road construction activities (internal roads and access roads) is likely to be as follows:

i) The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.

ii) As no specific construction details or possible locations of major ancillary activity sites are available at this stage, the anticipated noise from various types of construction activities cannot be calculated accurately. In general at this stage, it can be said that the typical noise levels of construction equipment at a distance of 15 metres lie in the range of 75 decibels (dBA) to 100dBA. Refer also to Table C1a. Based on data from similar "linear" construction sites, a one-hour equivalent noise level of between 75dBA and 78dBA at a point 50 metres from the construction would be typical for the earthmoving phase.

It should be noted that higher ambient noise levels than recommended in SANS 10103 are normally accepted as being reasonable during the construction period, provided that the very noisy construction activities (refer to Table C1a) are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site. Note that it has been assumed that construction will generally take place from 06h00 to 18h00 with no activities (or at least no noisy construction activities) at night. From the details presently available, it appears that the construction noise impact is not likely to be severe. There is the potential for minor impact at a few sites in the immediate vicinity of the construction site (refer to Figure 3 in the Noise Impact Assessment Report)

C4. ASSESSMENT OF THE OPERATIONAL PHASE

C4.1. General

The planned CSP Plant was evaluated on the following basis:

i) Noise impact from the CSP Plant power block operations:
   - a) Conventional electrical power generating station (EPGS) (specifically the cooling fans).
   - b) Heat exchangers and thermal storage tanks.
   - c) Steam generating plant.
   - d) Pumps.
   - e) Auxiliary heating system for the heat transfer fluid (night-time).

ii) Truck-mounted high-pressure washing system to clean the heliostats (night-time).

iii) Noise impact from ancillary works (such as water purification works and waste water treatment plant).

iv) CSP Plant generated traffic.

v) Effect of features of acoustical significance in the study area.

C4.2. Noise Conditions Related to the Planned CSP Plant

The CSP plant will only operate during the hours of daylight and, at best in mid-summer will operate from 08h00 to 18h00. This operation will generally be continuous during this period.

Although the power generation will be limited to the hours of sunlight, the temperature of the heat transfer fluid has to be kept heated during the night-time and/or any other down-period. An auxiliary heating system for the heat transfer fluid will be installed.

The reflective troughs will be regularly cleaned by means of a truck mounted high-pressure washing system. This operation will presumably take place at night.

C4.2.1. *CSP Plant*

The main noise sources at the CSP Plant will be the steam generating unit, the turbines, the cooling fans, and the pumps. The noise from the cooling fans will be the loudest and will predominate at areas outside the CSP Plant property. It is predicted that the noise from the CSP Plant could be of the following order (for various meteorological conditions) at the given offsets from the plant. The equivalent continuous sound pressure level for one hour of operation ($L_{Aeq,1h}$) is given in Table C2a for fully operational conditions (daytime) and in Table C2b for inversion conditions (worst case scenario) for standby conditions:

TABLE C2a: NOISE LEVELS FROM CSP FOR VARIOUS METEOROLOGICAL CONDITIONS (CSP FULLY OPERATIONAL – DAYTIME)

Noise Level (dBA)	Offset (m)			
	No wind	Upwind (v>6m/s)	Downwind (v>6m/s)	Inversion
35	2850	1900	4200	4800
40	1900	1150	2850	3300
45	1200	700	1900	2150
50	780	400	1200	1400

TABLE C2b: NOISE LEVELS FROM CSP UNDER INVERSION CONDITIONS (CSP STANDBY CONDITIONS)

Noise Level (dBA)	Offset (m)
35	2450
40	1500
45	950
50	600

For daytime operations, noise sensitive sites (in a rural setting) within 2150 metres from the Plant could be significantly impacted by the noise from the Plant. For night-time operations (standby) noise sensitive sites within 2450 metres of the Plant will be impacted. The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard

intervening ground condition has been modelled. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point. The sparse vegetation in the area will not assist the attenuation with distance.

C4.2.2. ***Heliostat Cleaning Operations (Trucks)***

This will be an intermittent noise generating operation undertaken at night. A truck mounted high pressure washing system will be used. While the trucks are spraying the heliostats, maximum noise levels are not expected to exceed 35dBA at 1000 metres.

C4.2.3. ***Ancillary Plant (Water Purification Works and Waste Water Treatment)***

For a typical installation that could be used the ambient noise level could be of the order of 40dBA at a 300 metres offset.

C4.2.4. ***Eskom Substation***

The noise profile of a typical Eskom substation (to be built to the south of the CSP Plant) is as given in Table C3 below. There are two farmhouses in the vicinity of the Eskom substation site, but noise levels generated should not impact significantly on these residences. It should, however be noted that transformers typically emit a predominant pure tone of 100Hz, which, although not loud in volume, has the potential to induce vibrations in nearby structures, such as the farmhouses.

TABLE C3: TYPICAL NOISE PROFILE OF AN ESKOM SUBSTATION

Offset Distance (m)	**250**	**500**	**1000**	**1500**	**2000**	**2500**	**3000**
Noise Level (dBA)	39.7	33.6	27.6	24.1	21.6	19.7	18.1

C4.2.5. ***Cumulative Noise Effects of the CSP Plant***

There are no other sources of noise in the study area with which the CSP will have significant cumulative effects.

C4.3. CSP Plant Generated Traffic

The total volume of traffic generated by the CSP Plant will be very small in comparison to the total volume of traffic on the adjacent main roads. It is estimated that there could be of the order of 60 vehicle trips (two-way) per day generated by the CSP Plant. These volumes are far too small to cause any significant noise impact.

APPENDIX D:
METEOROLOGICAL ASPECTS AFFECTING PROPAGATION OF SOUND

APPENDIX D: METEOROLOGICAL ASPECTS AFFECTING PROPAGATION OF SOUND

The meteorological data presented in this Appendix was provided by SSI Consulting Engineers. SSI used the data from five monitoring sites in the region, namely Jan Kempdorp, Vaalharts, Diepplotte, Kimberley and Koopmansfontein.

D1. Regional Climate

The climate in the Northern Cape is essentially a continental one - the weather provides hot wet summers (December to February) and mild dry winters (June to August). The infrequent summer rains tend to take the form of occasional severe thunderstorms rather than prolonged soft showers. It is not unusual for winter night-time temperatures to drop below freezing.

D2. Temperature

Daily summer temperatures within the region range between ~18.5 °C and ~25.4°C with an average of ~21.3 °C. Winter temperatures range between ~8.7 °C and ~17.5 °C with an average of ~12.4 °C.

The highest maximums recorded in the District range from 39.9 °C to 41.2 °C respectively. With the lowest recorded temperature recorded at -10.6 °C at the Koopmansfontein site.

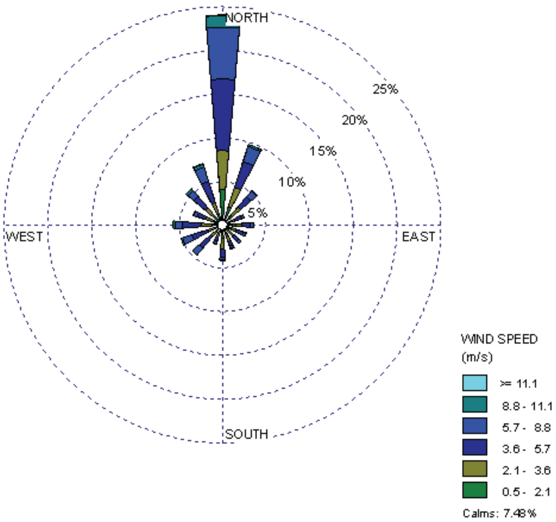
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan Kempdorp	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Vaalharts	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Diepplotte	24.8	23.6	21.2	16.7	12.4	8.8	8.7	11.3	15.6	18.7	21.6	23.7
Kimberley	25.3	24.1	22.0	17.9	13.9	10.7	10.8	13.1	17.2	19.9	22.4	24.3
Koopmansfontein	23.7	22.5	20.5	16.6	12.5	9.2	9.1	11.4	15.6	18.5	21.0	22.8

FIGURE D1: MEAN TEMPERATURE PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

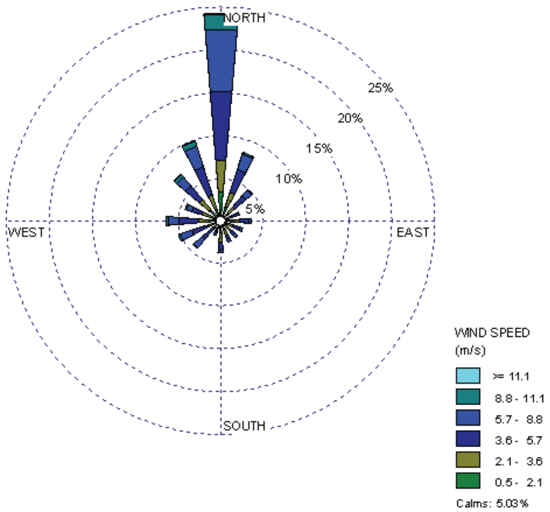
D3. Winds

One of the main meteorological aspects that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels. There is no meteorological station in the immediate vicinity of the planned CSP. Wind data from the weather station at Kimberley has thus been used for analysis of the study area. Kimberley is relatively close to the development and it is considered likely that the wind patterns at the planned CSP will be similar to those experienced in the Kimberley. The wind pattern is as shown in Figure D2.

(a)



(b)



(c)

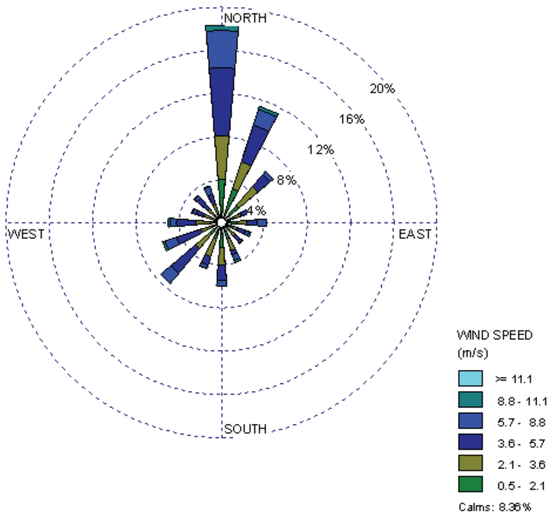


FIGURE D2: KIMBERLEY WIND ROSE (A) PERIOD (B) DAYTIME (C) NIGHT-TIME

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Period, day-time and night-time average wind roses for the South African Weather Service's Kimberley Airport station are depicted in Figure D2**Error! Reference source not found.**(a), (b) and (c) for the period January 2001 to December 2001 respectively. Similarly, period, day-time and night-time average wind speed frequency distribution graphs are presented in Figure D3**Error! Reference source not found.**(a), (b) and (c).

From the period wind rose (Figure D2(a)**Error! Reference source not found.**) it is noted that winds predominate from the north for 23% of the time. Wind speeds in the range of 3.6 - 5.7 m/s occurred for 29.1% of the time, with higher wind speeds in the range of 5.7 – 8.8 m/s and from 8.8 - 11.1 m/s noted to occur for 16.8% and 3.1% of the time respectively (Figure D3(**Error! Reference source not found.**a)). These higher wind speeds are noted to occur from the north.

When comparing day-time and night-time wind profiles a higher incidence of south-westerly winds are noted during night-times (Figure D2(**Error! Reference source not found.**c)). South-westerly winds increase in frequency from 5% to 7% of the time when comparing day-time and night-time conditions. North-north-easterly and southerly winds also increase in frequency during night-time from 8-11 % and 4-6 % respectively. As is to be expected during night-time wind speeds are noted to be lower when compared to day-time conditions, predominating in the range of 0.5 – 5.7 m/s.

From this wind profile it is noted that sources impacting on air quality would most likely impact more significantly on sensitive areas to the south of these activities.

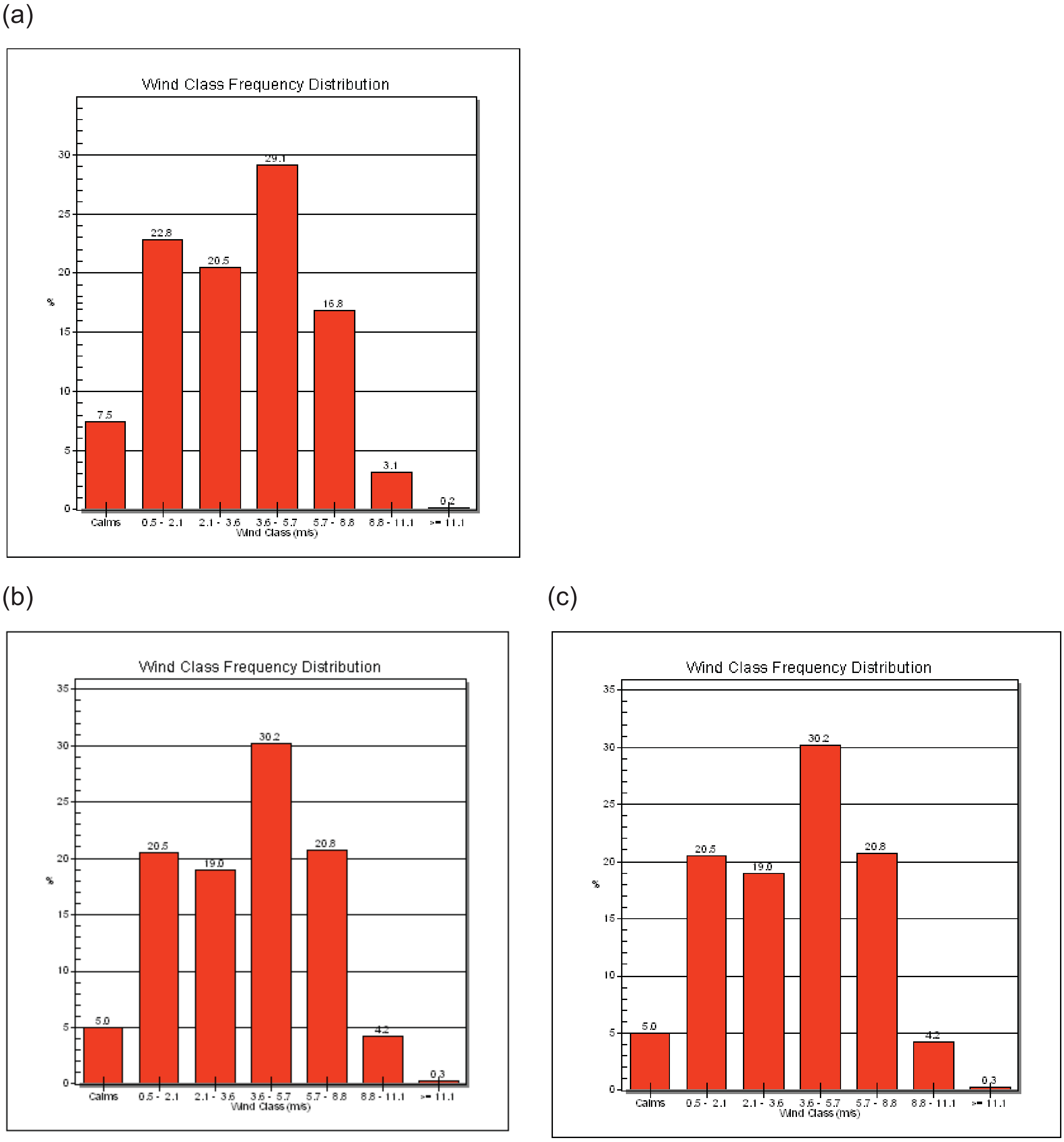


FIGURE D3: KIMBERLEY WIND CLASS FREQUENCY DISTRIBUTION (A) PERIOD (B) DAYTIME (C) NIGHTTIME

D4. Atmospheric Stability

Atmospheric stability is commonly categorised into six stability classes. These are briefly described in Table D2. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a

stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. Figure D4 indicates that calm stable conditions occur 40.7% of the time, which is conducive to the formation of inversion layers.

TABLE D2: ATMOSPHERIC STABILITY CLASSES

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

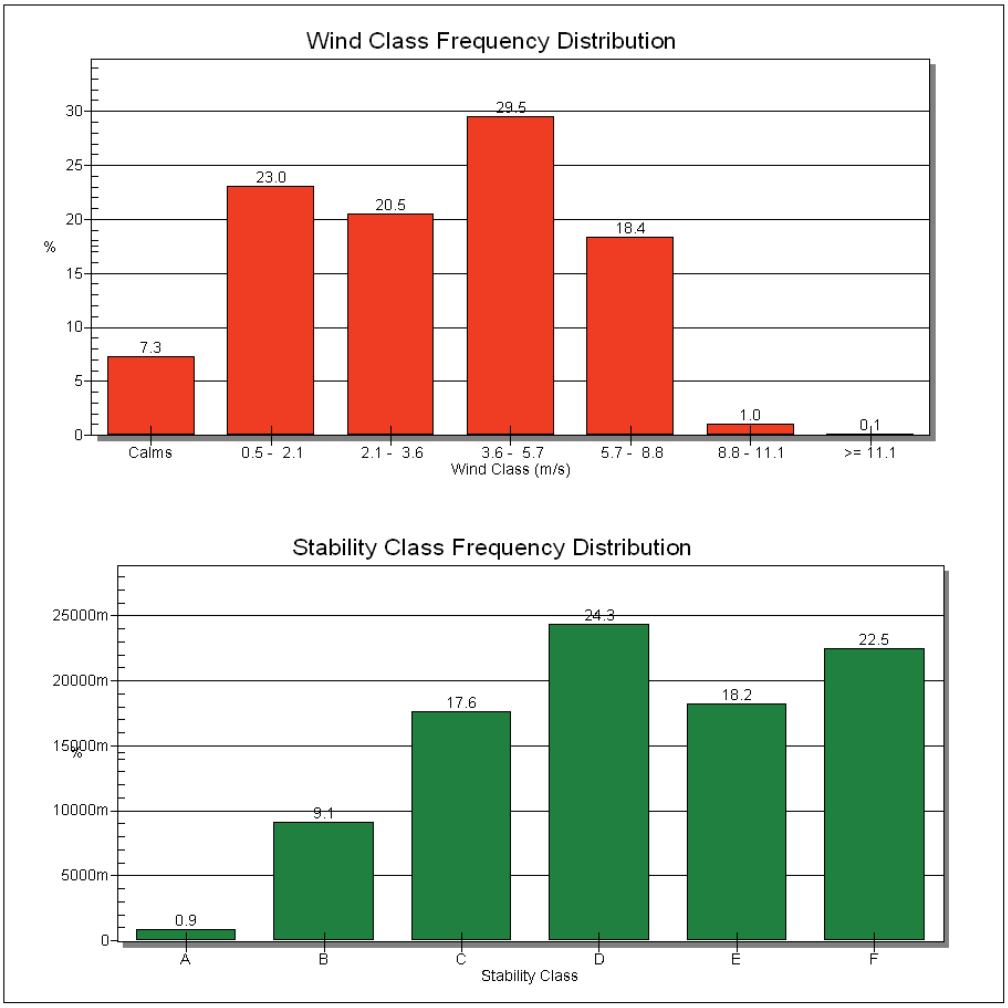


FIGURE D4: KIMBERLEY STABILITY CLASS FREQUENCY DISTRIBUTION BY WIND SPEED

Temperature inversions have a significant effect on the noise propagation character of the area. Temperature inversions tend to increase noise levels at some distance from a source. A temperature inversion is formed when air near the ground is cooler than the air above. This occurs mainly at night or to a lesser extent during cloudy days away from large bodies of water. Stable conditions with high humidity and very low velocity wind conditions are necessary. As cool air is denser than warm air, sound rays are refracted towards the cooler air, that is, towards the ground.

Appendix L

Air Quality Impact Assessment

Humansrus CSP

1 October 2011

A Report for: Worley Parsons

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A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS
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Signature

Approval: Raylene Watson

Signature

TABLE OF CONTENTS

List of Figures

List of Tables

1 INTRODUCTION

1.1 Background

SSI Environmental was requested by Worley Parsons to carry out an air quality impact assessment for the development of a proposed Concentrated Solar Power plant, near the town of Groenwater in the Northern Cape Province (Figure 1). The intention is to develop solar resources to generate electricity and reduce the dependence on non-renewable fossil fuel resources. Emergency load shedding in 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation. This study aims to assist in the development of a scoping study for the site and its potential to utilise the resource in the area.

1.2 Scope of Work

This project aims to identify the potential air quality impacts associated with the construction, operation and eventual decommissioning of the proposed Power Plant, and associated infrastructure, as well as provide guidance on possible mitigation measures to reduce environmental impacts.

FIGURE 1: LOCALITY MAP SHOWING LOCATION OF THE CSP SITE IN RELATION TO LOCAL TOWNS (SOURCE: GOOGLE EARTH)

1.3 Project Team

Raylene Watson is currently employed as the Air Quality Unit Manager for Bohlweki-SSI Environmental in South Africa. Her key responsibilities are to manage the air quality unit and to promote SSI Environmental as a Company within South Africa and the rest of Africa.

She completed her Bachelor of Science Degree (BSc) in 1994 at the Rand Afrikaans University (now called University of Johannesburg), majoring in Botany and Zoology. Her BSc (Honours - Zoology) course was subsequently completed at the same institution (1995). She was awarded an NRF scholarship to undertake her Masters Studies in Ecotoxicology. This Thesis focused on the assessment of heavy metal bioaccumulation in fish, found in the Olifantsriver Catchment area (one of the main river systems in South Africa). Her Masters was completed in 1997, this work was used to supplement further studies, culminating in the completion of a Doctorate in 2000, which focused on the assessment of a Fish Health Assessment Index. Her Doctorate was awarded the Nights Awards by the Parasitological Association of South Africa for its contribution to the Field of Parasitology in 2001.

After completing her studies she worked as an air quality impact assessor at Airshed Planning Professional, where after 5 years of service she moved over to SSI to start up the air quality unit for SSI Environmental. The air quality unit has now been in existence for 4 years, and has developed into a team of 4 individuals. During her work as an air quality specialist she has undertaken over 200 assessments focusing primarily on industrial related source impacts. Key studies undertaken focused on the assessment of impacts related to mining operations, smelters, landfill sites, sewage works, airports, harbour developments, residential developments and the expansion of road networks. Work has been undertaken in South Africa and further afield on the African Continent, including countries like, Angola, Mozambique, Zimbabwe, Zambia, Namibia, Democratic Republic of the Congo, Botswana and Mauritius.

Stuart Thompson is a senior environmental consultant for SSI Engineers and Environmental Consultants, and a specialist in the field of air quality assessments. Qualified as an Applied Environmental Scientist (BSc. Hons) and a Member of the South African Geophysical Association (SAGA) as well as the Society of South African Geographers (SSAG), Stuart has 7 years experience in the environmental field, including 5 years in the field of air quality. He has managed and contributed to a variety of project in South Africa, as well as further afield on the African continent, including Tanzania, Malawi, DRC, Mozambique, Mauritius, Swaziland, Zambia, Sierra Leone and Botswana on assessments ranging from large-scale commercial developments and Power Generation Projects to numerous mining operations. Stuart spent 6 months working with the SSI parent company DHV B.V. based in Amersfoort, Netherlands. During this time he worked on several projects for the European Union, as well as acting as a specialist technical advisor for a large scale environmental project in India.

Nicola Walton is an air quality specialist with over five years of experience in the air quality field. Over this time, she has been involved in numerous air quality management and monitoring projects. Her primary areas of expertise include emissions inventory development, dispersion modelling simulations, air quality impact assessments and air quality management plans.

1.4 Project Description

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a Concentrated Solar Power (CSP) Plant. This project focuses on the possible establishment of a Concentrating Solar Power (CSP) plant in the Northern Cape area. The proposed CSP plant is proposed to consist of a maximum installed capacity of up to 100 MW. The plant requires approximately 3 square kilometres of terrain with little relief to satisfy construction needs. The key factor, however, is the amount of thermal storage required, as this determines the number of heliostats to be installed.

The CSP Plant being considered is a molten salt-type, Central Receiver technology. This technology is based on the concept of thousands of large tracking mirrors (known as heliostats) which track the sun and reflect the beam radiation to a common focal point. This focal point (the receiver) is located well above the heliostat field in order to prevent interference between the reflected radiation and the other heliostats.

A heliostat is a mirror mounted on an axis by which the sun is steadily reflected onto one spot. Heliostats are arranged in an elliptical formation around the focal point with the majority of the reflective area weight to the more effective side of the heliostat field.

The central receiver is situated on the top of the central tower. This receiver is in essence a heat exchanger which absorbs the concentrated beam radiation, converts it to heat and transfers the heat to the working fluid (i.e. molten salt) which is in turn used to generate steam for conventional power generation.

2 APPLICABLE LEGISLATION

The information presented in the section which follows, details the local legislation within South Africa, as well as a list of international laws and conventions to which South Africa is a signatory.

2.1 South African legislative and standards frameworks

2.1.1 National Environmental Management: Air Quality Act 39 of 2004

The National Environmental Management: Air Quality Act (39 of 2004) represents a move to an air pollution control strategy that is based on receiving air quality management. It focuses on the adverse impacts of air pollution on the ambient environment and sets standards as the benchmark for air quality management performance. At the same time it sets emission standards to minimize the amount of pollution that enters the environment. The Act regulates the control of noxious and offensive gases emitted by industrial processes, the control of smoke and wind borne dust pollution, and emissions from diesel vehicles.

The promulgation of the National Air Quality Act (2004) resulted in a shift from national air pollution control based on source based controls to decentralised air quality management through an effects-based approach. An effects based approach requires the meeting of ambient air quality standards. These ambient standards are to be set by the Local and District Municipalities which govern air quality management in the area. The Municipality of concern here is the eThekwini Municipality. If these standards have not been set yet the National Ambient Air Quality Standards will need to be adhered to. Such standards provide the objectives for air quality management.

Multiple levels of standards provide the basis for both ‘continued improvements’ in air quality and for long term planning in air quality management. Although maximum levels of ambient concentrations should be set at a national level, more stringent ambient standards may be implemented by provincial and local authorities.

The control and management of all sources of air pollution relative to their contributions to ambient concentrations is required to ensure that improvements in air quality are secured in the timeliest, even handed and cost-effective way. The need to regulate diverse source types reinforces the need for varied management approaches ranging from command and control methods to voluntary measures.

The objectives of the Air Quality Act as stated in Chapter 1 are as follows:

- Give effect to everyone’s right ‘to an environment that is not harmful to their health and well-being’ and
- Protect the environment by providing reasonable legislative and other measures that (i) prevent pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The National Framework is one of the significant functions detailed in Chapter 2 of the Air Quality Act. The Framework serves as a blueprint for air quality management and aims to achieve the air quality objectives as described in the preamble of the Air Quality Act.

Chapter 3 of the Air Quality Act covers institutional and planning matters, and is summarised as follows:

- The Minister may establish a National Air Quality Advisory Committee as a subcommittee of the National Environmental Advisory Forum established in terms of the National Environmental Management Act (NEMA);
- Air Quality Officers must be appointed at each level of Government (National, Provincial, Municipal);
- Each National Department or Province preparing an Environmental Implementation Plan or Environmental Management Plan in terms of NEMA must include an Air Quality Management Plan (AQMP). Each Municipality preparing an Integrated Development Plan must include an AQMP;
- The contents of the AQMPs are prescribed in detail; and
- Each organ of state is required to report on the implementation of its AQMP in the annual report submitted in terms of NEMA.

In Chapter 4 of the Air Quality Act, air quality management measures are outlined in terms of:

- The declaration of Priority Areas, where ambient air quality standards are being, or may be, exceeded;

- The listing of activities that result in atmospheric emissions and which have or may have a significant detrimental effect on the environment;
- The declaration of Controlled Emitters;
- The declaration of Controlled Fuels;
- Other measures to address substances contributing to air pollution, that may include the implementation of a Pollution Prevention Plan or an Atmospheric Impact Report; and
- The requirements for addressing dust, noise and offensive odours.

Licensing of Listed Activities through an Atmospheric Emission Licence is addressed in Chapter 5 of the Air Quality Act. On 31 March 2010, the Minister of Water and Environmental Affairs published the Listed Activities and Minimum Emission Standards. International air quality management is outlined in Chapter 6 and offences and penalties in Chapter 7.

2.1.2 National Ambient Air Quality Standards

The Air Quality Act makes provision for the setting and formulation of National ambient air quality standards for substances or mixtures of substances which present a threat to health, well-being or the environment. On 24 December 2009, the Minister of Water and Environmental Affairs established National ambient air quality standards (Table 2-1). These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area. If the air quality standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

TABLE 1: NATIONAL STANDARDS (µG/M^3) WITH ALLOWABLE FREQUENCIES OF EXCEEDANCE FOR IMMEDIATE COMPLIANCE. THE VALUES INDICATED IN BLUE ARE EXPRESSED IN PPB.

Pollutant	Averaging Period	Concentration	Frequency of Exceedance
Sulphur dioxide SO_2	10-min average	500 (191)	526
	1-hr average	350 (134)	88
	24-hr average	125 (48)	4
	Annual average	50 (19)	0
Nitrogen dioxide NO_2	1-hr average	200 (106)	88
	Annual average	40 (21)	0
Carbon monoxide CO	1-hr average	30 000 (26 000)	88
	8-hourly running average	10 000 (8 700)	11
Ozone O_3	8-hourly running average	120 (61)	11

Particulate Matter PM10	24-hr average	120 75 (from 2015)	4
	Annual average	50 40 (from 2015)	0
Lead Pb	Annual average	0.5	0
Benzene C_6H_6	Annual average	10 (3.2) 5 (from 2015)	0

2.2 International guidelines and standards

2.2.1 United Nations Framework Convention on Climate Change (UNFCCC1)

The Convention entered into force on 21 March 1994. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 192 countries having ratified including South Africa.

Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change

2.2.2 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. This amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The Kyoto Protocol is generally seen as an important first step towards a truly global emission reduction regime that will stabilize GHG emissions, and provides the essential architecture for any future international agreement on climate change. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 180 nations including South Africa have ratified the treaty to date. Under the Treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms.

The Kyoto mechanisms are:

[1]www.UNFCCC.org

- Emissions trading – known as “the carbon market"
- the clean development mechanism (CDM)
- joint implementation (JI).

These mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.

2.2.3 The Vienna Convention for the Protection of the Ozone Layer

The ultimate objective of the Convention is to protect human health and the environment against adverse effects resulting from human activities which modify or are likely to modify the ozone layer and urges the Parties to take appropriate measures in accordance with the provisions in the Convention and its Protocols which are in force for that party. To achieve the aforementioned objectives, the Parties, within their capabilities, are expected to: cooperate to better understand and assess the effects of human activities on the ozone layer and the effects of the modification of the ozone layer; adopt appropriate measures and cooperate in harmonizing appropriate policies to control the activities that are causing the modification of the ozone layer; cooperate in the formulation of agreed measures for the implementation of this Convention; and cooperate with competent international bodies to implement effectively this Convention and protocols to which they are party.

2.2.4 The Montreal Protocol on Substances that deplete the Ozone Layer

These protocol controls production of ozone depleting substances: The Montreal Protocol on Substances that Deplete Ozone Layer is a protocol under the Vienna Convention. The Protocol controls the production and consumption of the most commercially and environmentally significant ozone-depleting substances - those listed in the Annexes to the Protocol. One feature of the Montreal Protocol which makes it unique, is Article 6 that requires the control measures to be revised at least every four years (starting 1990), based on the review and assessment of latest available-information on scientific, environmental, technical and economic aspects of the depletion of the ozone layer. Based on reports of assessment panels appointed by the Parties and taking into consideration the needs and situation of the developing countries, the Protocol has already been adjusted and amended twice.

At present, 191 nations have become party to the Montreal Protocol. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was opened for signature on September 16, 1987 and entered into force on January 1, 1989 followed by a first meeting in Helsinki, May 1989. Since then, it has undergone seven revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

2.2.5 The Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention is an international legally binding agreement on persistent organic pollutants (POPs). In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs, which it defined as

“chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment”.

Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme for Chemical Safety (IPCS) prepared an assessment of the 12 worst offenders. Known as the Dirty Dozen, this list includes eight organo-chlorine pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene; two industrial chemicals: hexachlorobenzene (HCB) and the polychlorinated biphenyl (PCB) group; and two groups of industrial by-products: dioxins and furans.

The negotiations for the Stockholm Convention on Persistent Organic Pollutants were completed on May 23rd 2001 in Stockholm, Sweden. The convention entered into force on May 17th, 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agreed to outlaw nine of the "dirty dozen" chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans. Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans boundary threat. Several other substances are being considered for inclusion in the Convention. These are: hexabromobiphenyl, octaBDE, pentaBDE, pentachlorobenzene, short-chained chlorinated paraffin’s, lindane, α- and β-hexachlorocyclohexane, dicofol, endosulfan, chlordecone and PFOS.

The Convention sets out several objectives including:

- The elimination from commerce of identified POPs and others that may be identified in the future;
- encouraging the transition in commerce to safer alternatives;
- identifying additional POPs;
- the clean-up of old stockpiles and equipment containing POPs; and
- encouraging all stakeholders to work towards a POP-free environment.

2.2.6 International Concerns Around mercury

There are international initiatives to address mercury but to date no international policy has been developed. A recent programme backed by the United Nations (UN) that aims to reduce the health and environmental impacts of mercury includes a two-year period of voluntary action to reduce emissions and an evaluation to determine whether an international treaty is necessary. It aims to develop partnerships between government, industry and other key groups to reduce emissions.

2.2.7 Equator Principles

The Environmental Assessment report required needs to addresses baseline environmental and social conditions, requirements under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health, cultural properties, and biodiversity, including endangered species and sensitive ecosystems, use of dangerous substances, major hazards, occupational health and safety, fire prevention and life safety, socio-economic impacts, land acquisition and land use, involuntary resettlement, impacts on indigenous peoples and

communities, cumulative impacts of existing projects, the proposed project, and anticipated future projects, participation of affected parties in the design, review and implementation of the project, consideration of feasible environmentally and socially preferable alternatives, efficient production, delivery and use of energy, pollution prevention and waste minimization, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.

2.2.8 International Finance Corporation

The International Finance Corporation (IFC) recommends the following in regards to air pollution. “Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislation standards, or in their absence, the current World Health Organization (WHO) Air Quality Guidelines (AQGs0 or other internationally recognized sources. …As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.” However also includes that the “25 percent increment rule itself is too strict to be applied universally on all guidelines, to be noted that the immission figures vary greatly between different guidelines and therefore a universal increment rule will lead in most cases to big unnecessary problems without enhancing the environment.”,

3 BASELINE ENVIRONMENT

3.1 Description of Environment

3.1.1 Regional and Local Climate and Atmospheric Dispersion Potential

The nature of the local climate will determine what will happen to pollution when it is released into the atmosphere (Tyson & Preston-Whyte, 2000). Pollution levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion of pollution.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson & Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air lies directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth’s surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson & Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth’s surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth’s surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson & Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversions is most common over Southern Africa (Tyson & Preston-Whyte, 2000).

The climate in the Northern Cape is essentially a continental one - the weather provides hot wet summers (December to February) and mild dry winters (June to August). The infrequent summer rains tend to take the form of occasional severe thunderstorms rather than prolonged soft showers. It is not unusual for winter night-time temperatures to drop below freezing (Available at URL: http://www.bdb.co.za/kimberley/climate.htm).

Figure 2 provides an indication where various meteorological measurements have taken place within the immediate vicinity of the plant site in the past. All sites with the exception of the Kimberley sites have however been discontinued since the early nineties so no recent data is available for presentation within the region. All the sites with the exception of Kimberley are agricultural stations and recorded measurements for temperature, humidity, rainfall as well as incidents of thunderstorms, hail and fog. A summary of this historical data collected is presented in the subsections which follow. Kimberley represents the South African Weather Services weather office, where over and above the variables listed above wind data is also recorded. Due to the data availability for Kimberly, this site has been used to determine the general meteorological conditions for the area. However as the site is approximately 140km from Kimberly microclimatic conditions will vary, therefore site specific meteorological data will be used for all modelling purposes and for the Environmental Impact Report.

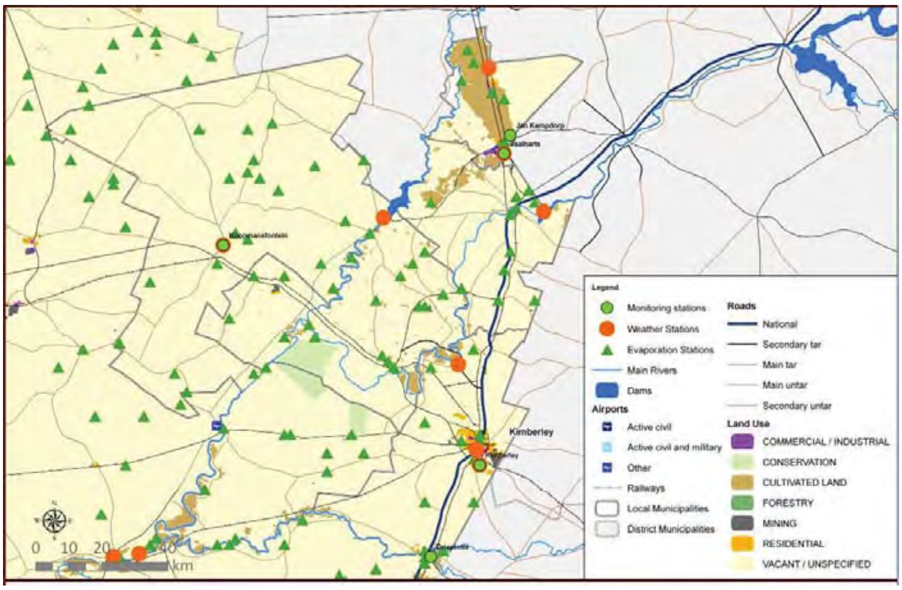


FIGURE 2: LOCATION OF METEOROLOGICAL SAMPLING POINTS WITHIN THE REGION.

3.1.2 Temperature

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella and Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity.

Temperature also provides an indication of the rate of development and dissipation of the mixing layer. This is the zone within the upper atmosphere where air movement takes place and where pollutants released can more easily be diluted by mixing with surrounding air before it reaches ground level.

Daily summer temperatures within the region range between ~18.5 ℃ and ~25.4℃ with an average of ~21.3 ℃. Winter temperatures range between ~8.7 ℃ and ~17.5 ℃ with an average of ~12.4 ℃ as is indicated in Figure 3.

Of the five sites assessed, the temperature profile differs very slightly. With marginally lower temperatures recorded at the Kimberley and Diepplotte sites (Figure 3).

The highest maximums recorded in the District range from 39.9 ℃ to 41.2 ℃ respectively. With the lowest recorded temperature recorded at -10.6 ℃ at the Koopmansfontein site (Table 2).

3.1.3 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella and Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Total monthly rainfall figures for the five sites assessed are depicted in Figure 2-4. The area under investigation lies in the summer rainfall region of South Africa, receiving an average total annual rainfall of ~484 mm.

Of the data collected for the various site within the region, no real variation in rainfall patterns could be observed (Figure 4). The number of rain days does however vary with more rain days noted at the Kimberly site to the southeast and at the Koopmansfontein site to the west, indicating that even though the same amount of rainfall fell in these areas this rainfall is distributed over a longer period (Table 3).

3.1.4 Relative Humidity

When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

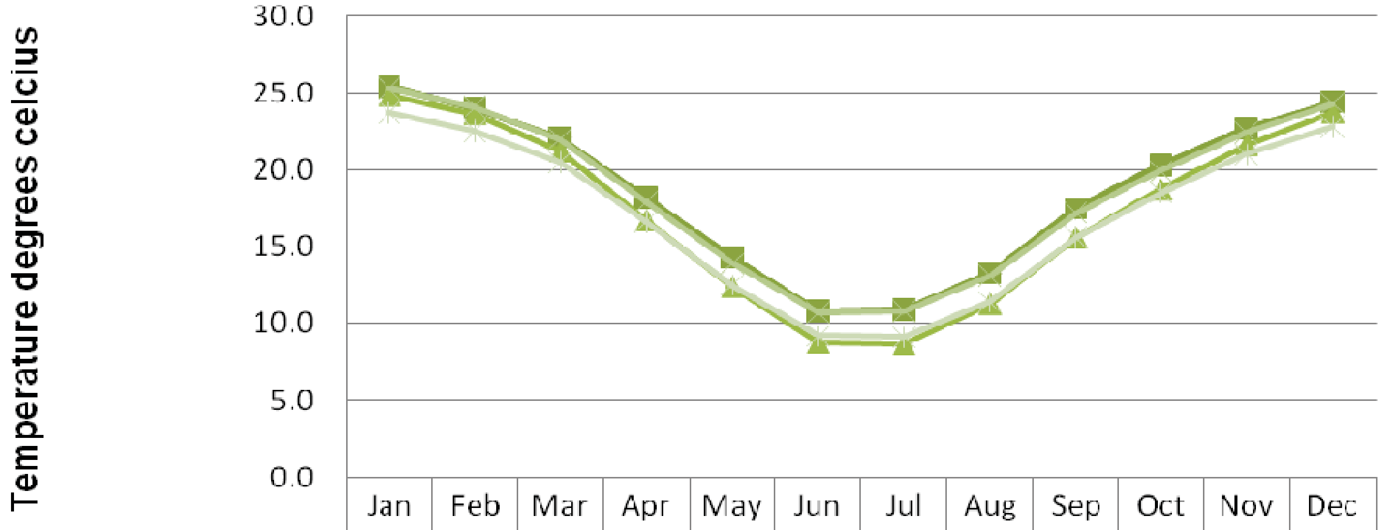
Within the region being assessed incidence of humidity above 70% occur quite often. This is illustrated in Figure 5, with a slightly lower level of maximum humidity recorded at Jan Kempdorp. Figure 6 similarly presents the lowest humidity figures recorded at these sites over the periods sampled, of significance is the marked difference in humidity between Jan Kempdorp and Vaalharts which are situated geographically quite closely to each other (Table 3, Figure 3).

3.1.5 Thunderstorms, Hail and Fog

The analysis of the occurrence of certain meteorological variables such as the development of thunderstorms, hail and fog, provides an indication of the severity and variability of climatic conditions in the area being investigated.

Incidents of thunderstorms, hail and fog were reported at four of the five sites. Thunderstorms were noted to occur more often at Kimberley with a total average of 55 days per year expected, this compared to only 25 days for Vaalharts, 47 days for Diepplotte and 39 days for Koopmansfontein. It appears that the southern and eastern portions of the region experience more thunderstorms than the north and west (Table 4).

A similar profile is presented with the comparison of hail and fog occurrences in the District. Both these phenomena however occur infrequently (Table 4).



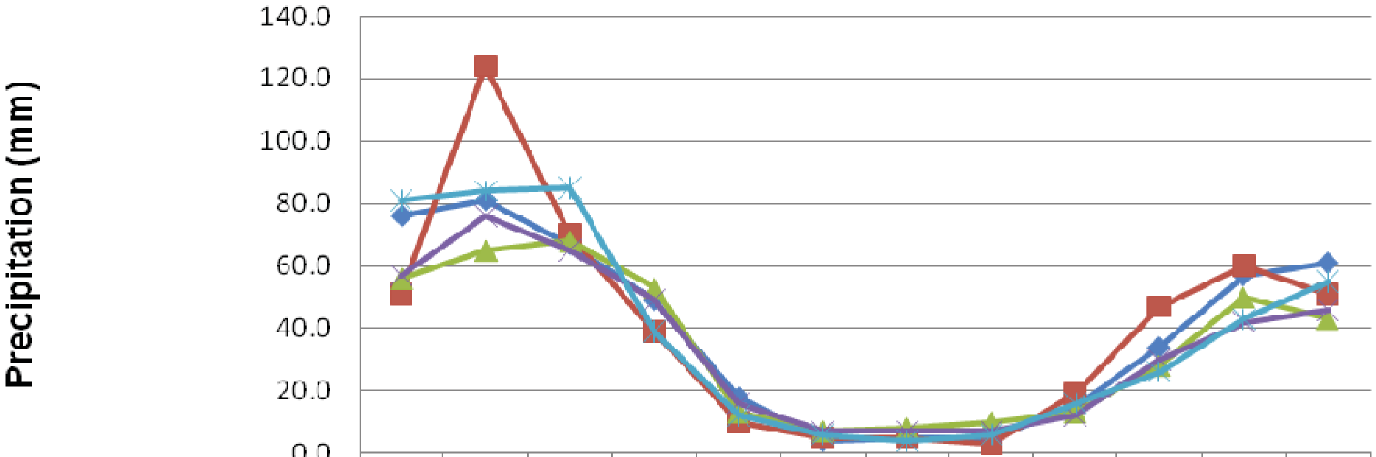
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan Kempdorp	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Vaalharts	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Diepplotte	24.8	23.6	21.2	16.7	12.4	8.8	8.7	11.3	15.6	18.7	21.6	23.7
Kimberley	25.3	24.1	22.0	17.9	13.9	10.7	10.8	13.1	17.2	19.9	22.4	24.3
Koopmansfontein	23.7	22.5	20.5	16.6	12.5	9.2	9.1	11.4	15.6	18.5	21.0	22.8

FIGURE 3: MEAN TEMPERATURE PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

TABLE 2: TEMPERATURE PROFILE FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Temperature - Agricultural Station (ºC)					Temperature - Agricultural Station (ºC)					Temperature - Agricultural Station (ºC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.7	33.0	25.4	41.2	8.5	16.9	32.7	24.8	40.5	10.0	16.4	33.2	24.8	41.0	6.3
February	17.0	30.9	24.0	38.7	6.1	16.6	30.8	23.8	38.0	4.5	15.8	31.5	23.6	40.5	3.3
March	15.0	29.1	22.1	37.1	1.5	14.2	29.2	21.8	37.0	3.0	13.4	29.0	21.2	38.0	1.0
April	10.7	25.7	18.2	35.0	0.1	10.0	26.3	18.1	34.5	-0.5	8.7	24.8	16.7	36.0	-2.5
May	6.0	22.5	14.3	31.6	-3.7	4.8	23.1	13.9	30.5	-3.4	3.1	21.7	12.4	33.0	-6.5
June	2.3	19.2	10.8	27.1	-6.4	0.8	19.4	10.1	26.5	-7.5	-0.8	18.2	8.8	27.5	-9.3
July	2.1	19.8	10.9	26.6	-7.2	0.1	19.7	9.9	26.0	-8.0	-1.5	18.8	8.7	27.1	-9.8
August	4.2	22.4	13.3	32.6	-6.8	3.1	22.8	12.9	30.5	-5.5	1.1	21.5	11.3	31.0	-9.3
September	8.5	26.4	17.5	35.5	-4.0	7.0	25.6	16.3	34.5	-3.5	5.6	25.6	15.6	36.0	-6.2
October	11.9	28.7	20.3	38.2	-2.0	11.2	27.9	19.6	36.5	-1.0	9.3	28.1	18.7	37.2	-2.7
November	14.5	30.8	22.7	39.0	4.0	13.8	30.3	22.0	37.3	5.1	12.6	30.5	21.6	38.5	3.8
December	16.5	32.3	24.4	39.9	4.5	15.7	31.8	23.7	39.0	3.5	14.9	32.5	23.7	40.6	4.6
Annual Avg	10.5	26.7	18.6	41.2	-7.2	9.5	26.6	18.1	40.5	-8.0	8.2	26.3	17.3	41.0	-9.8

Month	Kimberley (1961-1990)					Koopmansfontein (1961-1990)				
	Temperature - Weather Office (ºC)					Temperature - Agricultural Station (ºC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.9	32.8	25.3	40.4	7.1	15.7	31.6	23.7	39.9	5.6
February	17.3	31.0	24.1	39.9	5.6	15.1	30.0	22.5	39.0	3.4
March	15.2	28.8	22.0	36.2	2.0	13.1	27.9	20.5	36.1	-1.0
April	10.9	24.8	17.9	34.9	0.0	8.8	24.5	16.6	35.5	-3.0
May	6.5	21.4	13.9	31.1	-5.7	3.8	21.3	12.5	30.9	-6.8
June	3.2	18.2	10.7	26.6	-6.7	0.3	18.1	9.2	29.1	-9.5
July	2.8	18.8	10.8	26.8	-7.9	-0.3	18.6	9.1	26.0	-10.1
August	4.9	21.3	13.1	30.5	-6.7	1.7	21.1	11.4	29.9	-10.6
September	8.9	25.5	17.2	35.5	-5.5	6.0	25.2	15.6	34.9	-7.2
October	11.9	27.8	19.9	37.6	-0.5	9.4	27.6	18.5	36.4	-2.6
November	14.6	30.2	22.4	39.2	3.3	12.2	29.8	21.0	39.5	-1.5
December	16.6	32.1	24.3	39.7	4.8	14.2	31.4	22.8	39.3	3.6
Annual Avg	10.9	26.0	18.5	40.4	-7.9	8.3	25.6	16.9	39.9	-10.6



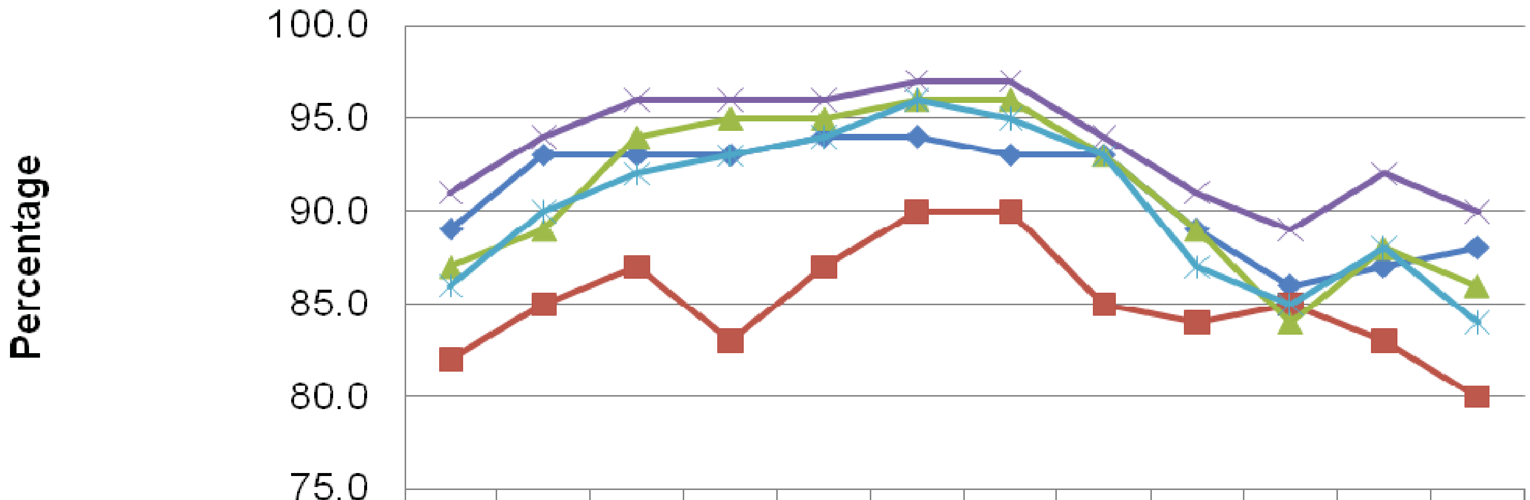
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	76.0	81.0	67.0	49.0	18.0	4.0	5.0	5.0	15.0	34.0	57.0	61.0
Jan Kempdorp	51.0	124.0	70.0	39.0	10.0	5.0	5.0	3.0	19.0	47.0	60.0	51.0
Diepplotte	56.0	65.0	68.0	53.0	13.0	7.0	8.0	10.0	13.0	28.0	50.0	43.0
Kimberley	57.0	76.0	65.0	49.0	16.0	7.0	7.0	7.0	12.0	30.0	42.0	46.0
Koopmansfontein	81.0	84.0	85.0	39.0	12.0	6.0	4.0	6.0	16.0	26.0	43.0	55.0

FIGURE 4: AVERAGE MONTHLY RAINFALL PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

TABLE 3: RAINFALL PROFILE FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

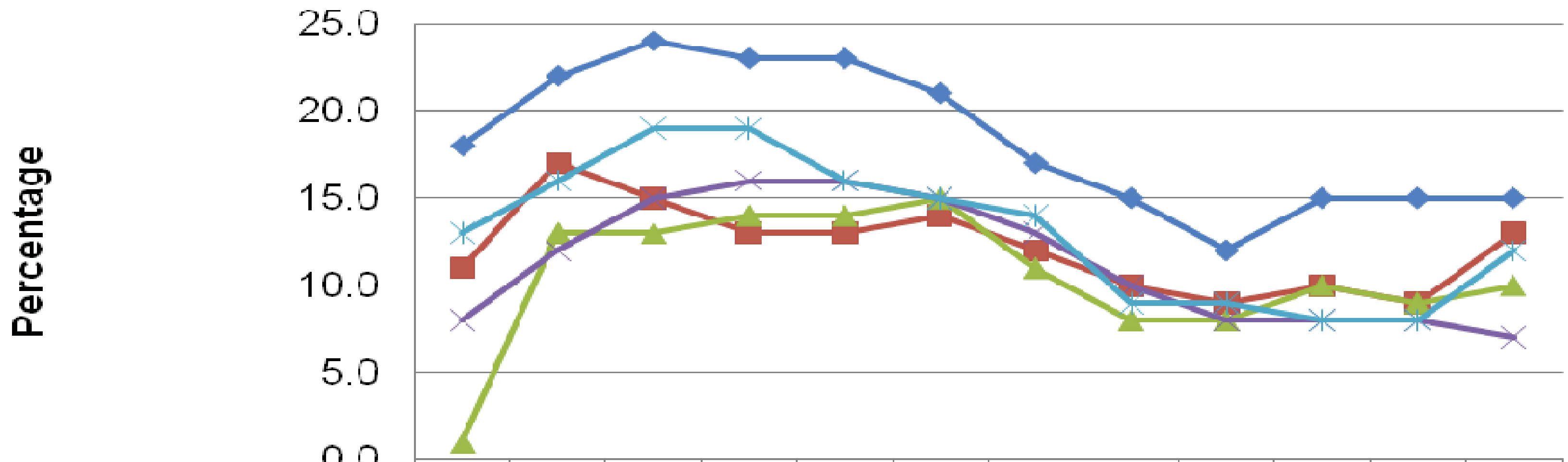
Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Precipitation - Agricultural Station (mm)					Precipitation - Agricultural Station (mm)					Precipitation - Agricultural Station (mm)				
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm
January	76.0	84.0	8.5	17.0	3.0	51.0	29.0	6.3	9.0	3.0	56.0	82.0	7.4	20.0	1.0
February	81.0	169.0	8.5	16.0	2.0	124.0	157.0	8.9	16.0	2.0	65.0	61.0	8.3	16.0	1.0
March	67.0	55.0	8.5	17.0	3.0	70.0	30.0	7.4	12.0	6.0	68.0	95.0	8.0	16.0	4.0
April	49.0	59.0	6.1	12.0	0.0	39.0	44.0	5.0	12.0	0.0	53.0	77.0	6.6	12.0	3.0
May	18.0	53.0	2.2	6.0	0.0	10.0	32.0	1.5	4.0	0.0	13.0	43.0	2.4	7.0	0.0
June	4.0	14.0	1.2	5.0	0.0	5.0	11.0	1.1	3.0	0.0	7.0	19.0	2.0	6.0	0.0
July	5.0	40.0	0.9	4.0	0.0	5.0	33.0	0.2	1.0	0.0	8.0	24.0	1.3	5.0	0.0
August	5.0	23.0	1.2	5.0	0.0	3.0	15.0	0.6	1.0	0.0	10.0	35.0	2.0	8.0	0.0
September	15.0	31.0	2.4	9.0	0.0	19.0	21.0	2.6	9.0	0.0	13.0	28.0	2.5	11.0	0.0
October	34.0	40.0	4.7	12.0	0.0	47.0	34.0	5.1	10.0	0.0	28.0	34.0	5.2	15.0	0.0
November	57.0	75.0	7.1	13.0	2.0	60.0	83.0	5.2	8.0	2.0	50.0	51.0	6.7	13.0	2.0
December	61.0	52.0	7.3	14.0	2.0	51.0	33.0	6.0	12.0	0.0	43.0	37.0	6.1	13.0	2.0
Annual Avg	472.0	169.0	59.0	76.0	46.0	484.0	157.0	50.0	64.0	37.0	414.0	95.0	58.0	89.0	40.0

Month	Kimberley (1961-1990)					Koopmansfontein (1961-1990)					
	Precipitation - Weather Office (mm)					Precipitation - Agricultural Station (mm)					
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	
January	57.0	45.0	9.8	21.0	2.0	81.0	109.0	9.5	21.0	2.0	
February	76.0	88.0	9.8	19.0	2.0	84.0	77.0	10.3	21.0	3.0	
March	65.0	54.0	10.2	16.0	3.0	85.0	90.0	10.4	17.0	4.0	
April	49.0	51.0	7.6	14.0	3.0	39.0	48.0	7.0	12.0	3.0	
May	16.0	55.0	3.3	8.0	0.0	12.0	41.0	2.6	7.0	0.0	
June	7.0	18.0	2.5	7.0	0.0	6.0	23.0	1.3	5.0	0.0	
July	7.0	22.0	1.5	5.0	0.0	4.0	28.0	0.9	4.0	0.0	
August	7.0	26.0	1.8	8.0	0.0	6.0	32.0	1.4	7.0	0.0	
September	12.0	44.0	3.1	12.0	0.0	16.0	57.0	2.0	9.0	0.0	
October	30.0	35.0	6.1	13.0	0.0	26.0	25.0	5.4	12.0	1.0	
November	42.0	60.0	7.7	16.0	3.0	43.0	98.0	7.0	16.0	2.0	
December	46.0	60.0	7.9	13.0	3.0	55.0	51.0	8.4	16.0	1.0	
Annual Avg	414.0	88.0	71.0	98.0	49.0	457.0	109.0	66.0	88.0	50.0	



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	89.0	93.0	93.0	93.0	94.0	94.0	93.0	93.0	89.0	86.0	87.0	88.0
Jan Kempdorp	82.0	85.0	87.0	83.0	87.0	90.0	90.0	85.0	84.0	85.0	83.0	80.0
Diepplotte	87.0	89.0	94.0	95.0	95.0	96.0	96.0	93.0	89.0	84.0	88.0	86.0
Kimberley	91.0	94.0	96.0	96.0	96.0	97.0	97.0	94.0	91.0	89.0	92.0	90.0
Koopmansfontein	86.0	90.0	92.0	93.0	94.0	96.0	95.0	93.0	87.0	85.0	88.0	84.0

FIGURE 5: MAXIMUM MONTHLY HUMIDITY PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	18.0	22.0	24.0	23.0	23.0	21.0	17.0	15.0	12.0	15.0	15.0	15.0
Jan Kempdorp	11.0	17.0	15.0	13.0	13.0	14.0	12.0	10.0	9.0	10.0	9.0	13.0
Diepplotte	1.0	13.0	13.0	14.0	14.0	15.0	11.0	8.0	8.0	10.0	9.0	10.0
Kimberley	8.0	12.0	15.0	16.0	16.0	15.0	13.0	10.0	8.0	8.0	8.0	7.0
Koopmansfontein	13.0	16.0	19.0	19.0	16.0	15.0	14.0	9.0	9.0	8.0	8.0	12.0

FIGURE 6: MINIMUM MONTHLY HUMIDITY PROFILE FOR FIVE SAMPLE SITES WITHIN THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

TABLE 4: THUNDER-STORMS, HAIL, FOG AND HUMIDITY FOR THE REGION (SUMMARY DATA FROM THE SOUTH AFRICAN WEATHER SERVICES)

Month	Vaalharts (1961-1990)					Jan Kempdorp (1983-1990)					Diepplotte (1961-1990)				
	Other - Agricultural Station					Other - Agricultural Station					Other - Agricultural Station				
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %
January	3.7	0.2	0.0	89.0	18.0				82.0	11.0	7.9	0.1	0.1	87.0	1.0
February	4.0	0.1	0.0	93.0	22.0				85.0	17.0	5.8	0.0	0.1	89.0	13.0
March	2.9	0.0	0.0	93.0	24.0				87.0	15.0	6.2	0.1	0.2	94.0	13.0
April	1.7	0.2	0.0	93.0	23.0				83.0	13.0	4.4	0.2	0.3	95.0	14.0
May	0.6	0.2	0.0	94.0	23.0				87.0	13.0	1.6	0.0	0.2	95.0	14.0
June	0.2	0.0	0.2	94.0	21.0				90.0	14.0	1.2	0.0	0.6	96.0	15.0
July	0.3	0.1	0.1	93.0	17.0				90.0	12.0	1.2	0.0	0.5	96.0	11.0
August	0.3	0.0	0.1	93.0	15.0				85.0	10.0	1.5	0.0	0.2	93.0	8.0
September	1.5	0.1	0.1	89.0	12.0				84.0	9.0	1.9	0.0	0.1	89.0	8.0
October	2.7	0.1	0.0	86.0	15.0				85.0	10.0	4.6	0.2	0.0	84.0	10.0
November	3.6	0.4	0.0	87.0	15.0				83.0	9.0	5.9	0.3	0.0	88.0	9.0
December	3.5	0.1	0.0	88.0	15.0				80.0	13.0	5.3	0.2	0.0	86.0	10.0
Annual Avg	25.0	2.0	1.0	98.0	10.0				93.0	5.0	47.0	1.0	2.0	98.0	5.0

Month	Kimberley (1961-1990)	Koopmansfontein (1961-1990)	

	Other - Weather Office					Other - Agricultural Station					
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	
January	8.4	0.3	0.0	91.0	8.0	8.1	0.0	0.0	86.0	13.0	
February	7.7	0.4	0.3	94.0	12.0	6.4	0.2	0.3	90.0	16.0	
March	6.7	0.3	0.3	96.0	15.0	6.1	0.2	0.3	92.0	19.0	
April	4.8	0.2	0.7	96.0	16.0	3.7	0.2	0.1	93.0	19.0	
May	1.7	0.0	0.4	96.0	16.0	1.0	0.1	0.1	94.0	16.0	
June	0.7	0.1	0.4	97.0	15.0	0.2	0.1	0.0	96.0	15.0	
July	0.8	0.1	0.7	97.0	13.0	0.4	0.0	0.0	95.0	14.0	
August	1.3	0.1	0.5	94.0	10.0	0.5	0.0	0.0	93.0	9.0	
September	2.5	0.1	0.2	91.0	8.0	1.4	0.1	0.0	87.0	9.0	
October	5.7	0.3	0.1	89.0	8.0	2.9	0.2	0.0	85.0	8.0	
November	6.4	0.5	0.0	92.0	8.0	3.8	0.1	0.0	88.0	8.0	
December	8.0	0.3	0.1	90.0	7.0	4.6	0.4	0.1	84.0	12.0	
Annual Avg	55.0	3.0	4.0	98.0	5.0	39.0	2.0	1.0	97.0	6.0	

3.1.6 Wind Field

Wind is important in that it cleans by diluting and dispersing pollutants but it can also transport pollutants over large distances. Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

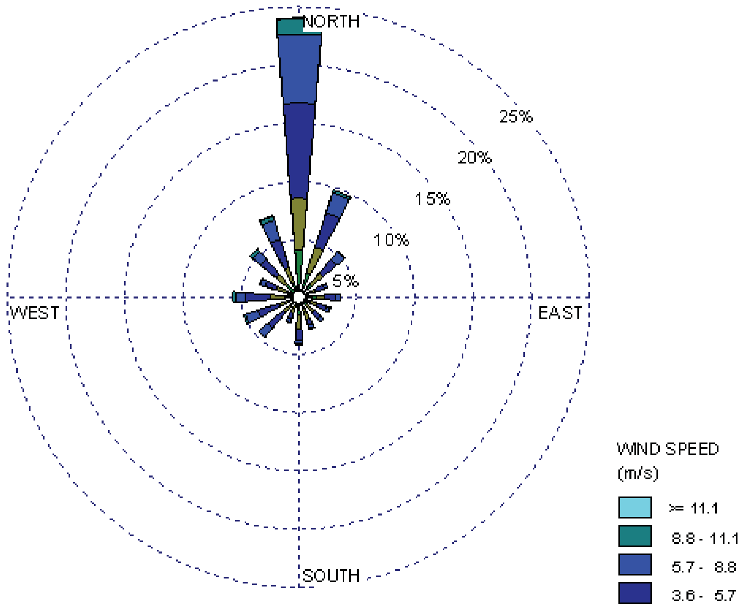
Period, day-time and night-time average wind roses for the South African Weather Service's Kimberley Airport station are depicted in Figure 7 a), b) and c) for the period January 2001 to December 2001 respectively. Similarly, period, day-time and night-time average wind speed frequency distribution graphs are presented in Figure 8 a), b) and c).

From the period wind rose (Figure 7a) it is note that winds predominate from the north for 23% of the time. Wind speeds in the range of 3.6 - 5.7 m/s occurred for 29.1% of the time, with higher wind speeds in the range of 5.7 – 8.8 m/s and from 8.8 - 11.1 m/s noted to occur for 16.8% and 3.1% of the time respectively (Figure 8a). These higher wind speeds are noted to occur from the north.

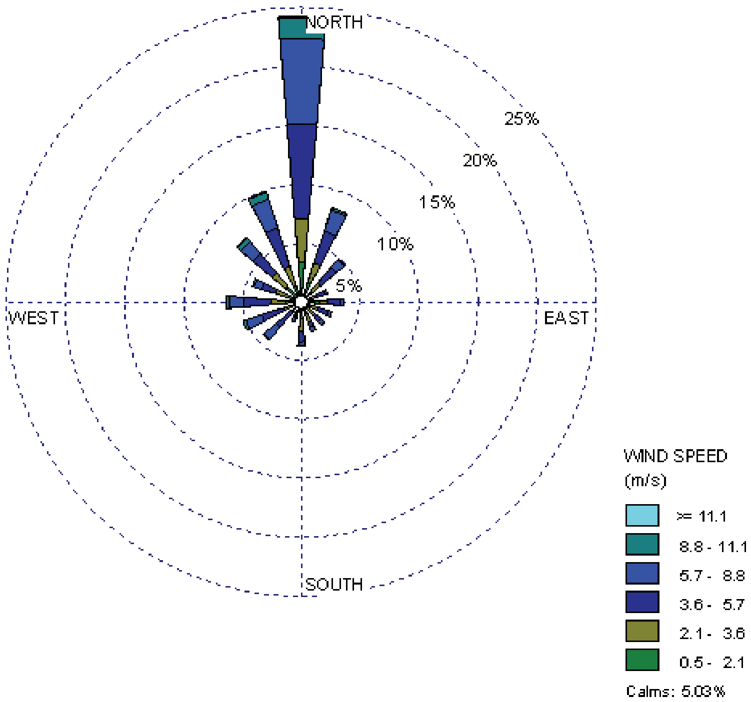
When comparing day-time and night-time wind profiles a higher incidence of southwesterly winds are noted during night-times (Figure 7c). Southwesterly winds increase in frequency from 5% to 7% of the time when comparing day-time and night-time conditions. North-northeasterly and southerly winds also increase in frequency during night-time from 8-11 % and 4-6 % respectively. As is to be expected during night-time wind speeds are noted to be lower when compared to day-time conditions, predominating in the range of 0.5 – 5.7 m/s.

From this wind profile it is noted that sources impacting on air quality would most likely impact more significantly on sensitive areas to the south of these activities. With wind speeds in the calm (0.5 – 5.7) to moderate (5.7 – 8.8) range predominating indicates that the dispersion potential for the area can be considered to be poor to moderately good.

(a)


NORTH
WEST
EAST
SOUTH
5%
10%
15%
20%
25%
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 7.48%

(b)



(c)

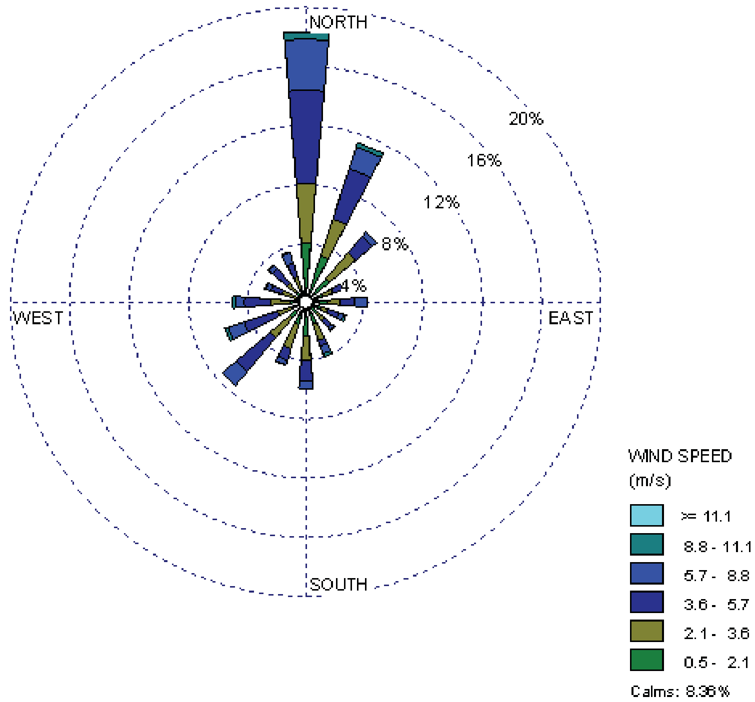


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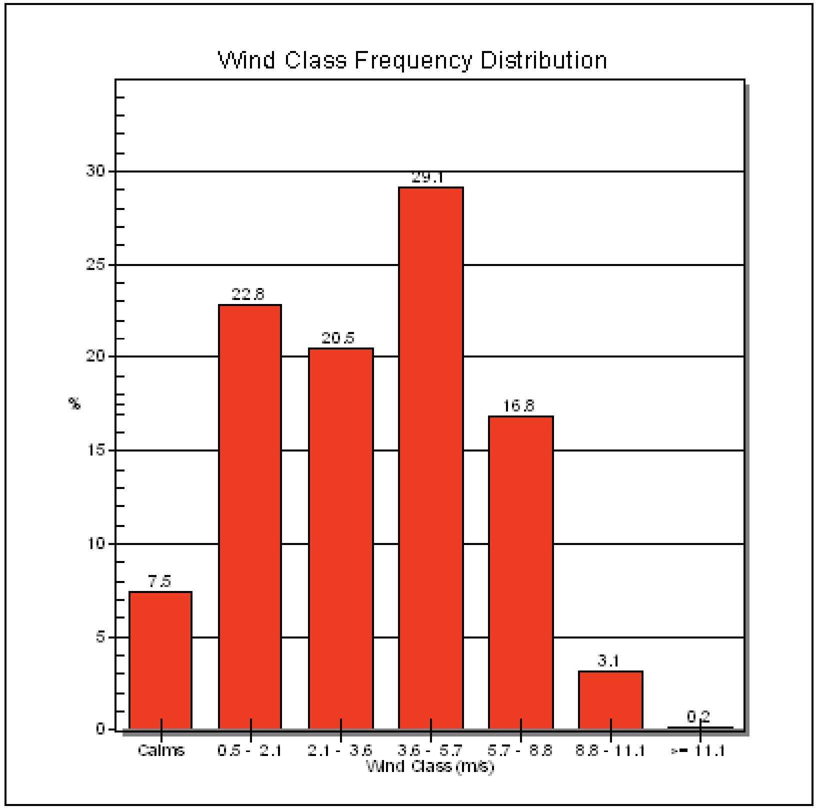
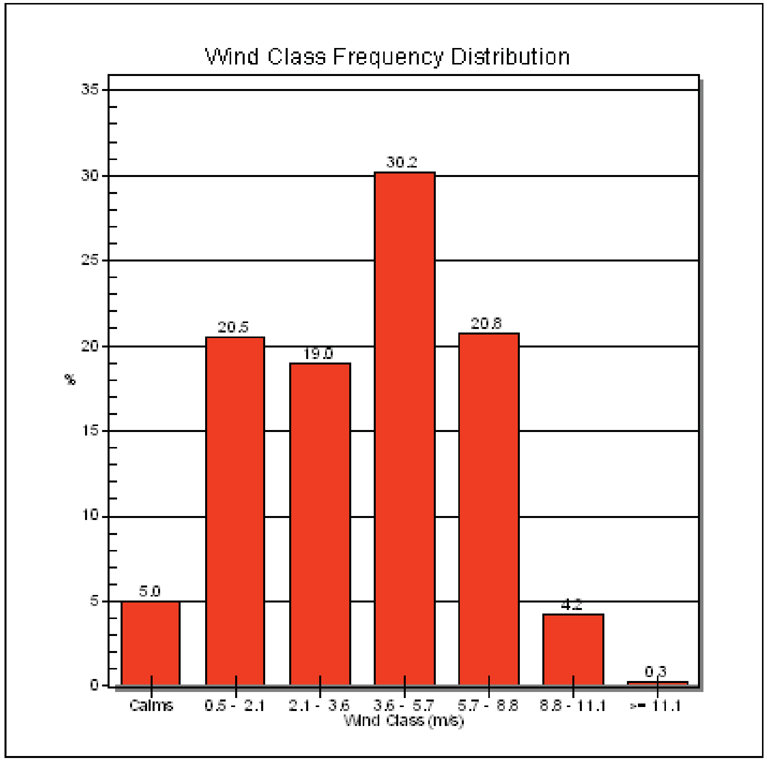
FIGURE 7: KIMBERLEY WIND ROSE (A) PERIOD (B) DAYTIME (C) NIGHTTIME

(a)



Wind Class Frequency Distribution
%
30
25
20
15
10
5
0
29.1
22.8
20.5
16.8
7.5
3.1
0.2
Calms
0.5 - 2.1
2.1 - 3.6
3.6 - 5.7
5.7 - 8.8
8.8 - 11.1
>= 11.1
Wind Class (m/s)

(b)



(c)

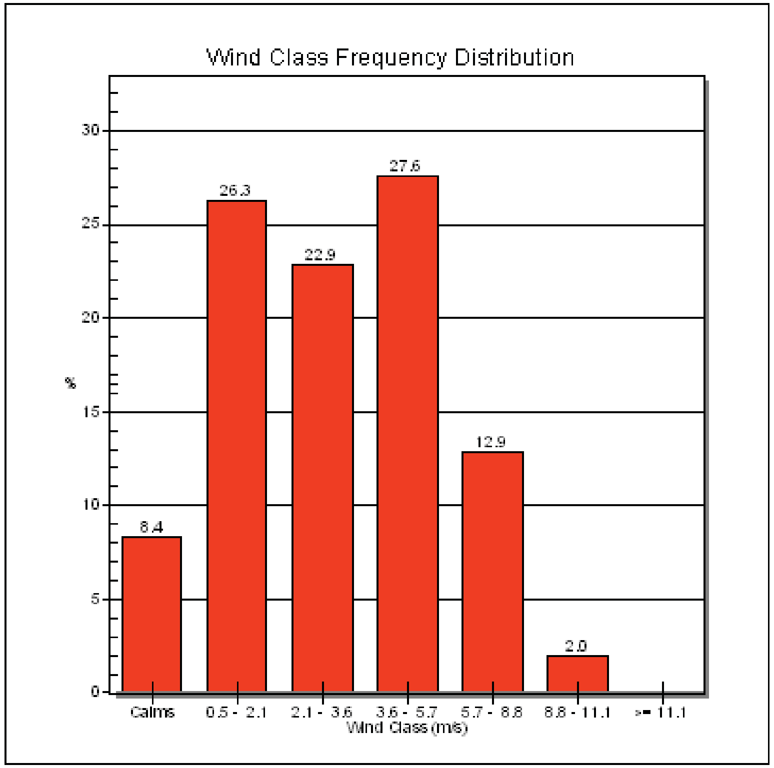


FIGURE 8: KIMBERLEY WIND CLASS FREQUENCY DISTRIBUTION (A) PERIOD (B) DAYTIME (C) NIGHTTIME

3.1.7 Atmospheric Stability

Atmospheric stability (indication of the amount of mixing and movement of air possible in an area) is commonly categorised into one of six stability classes. These are briefly described in Table 5.

The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Figure 9 depicts the estimated atmospheric stability for the Kimberley area in the form of a rose. The rose indicates how the atmospheric stability differs from different wind directions. It can be noted however that there is not a marked difference in the variability of stability class types with wind direction. Figure 10 indicating that a neutral stability class occurs for 24.3% of the time, stable atmospheric conditions can be expected to occur for 18.2% of the time with very stable conditions noted for 22.5 % of the time. The predominance of atmospheric stability for the region in the neutral to very stable range, suggests that very little movement and potential for mixing of pollutants and the consequent dilution of a pollution plume exists. Thus when pollutants are released they will tend not to dissipate quickly from source.

TABLE 5: STABILITY CLASS

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

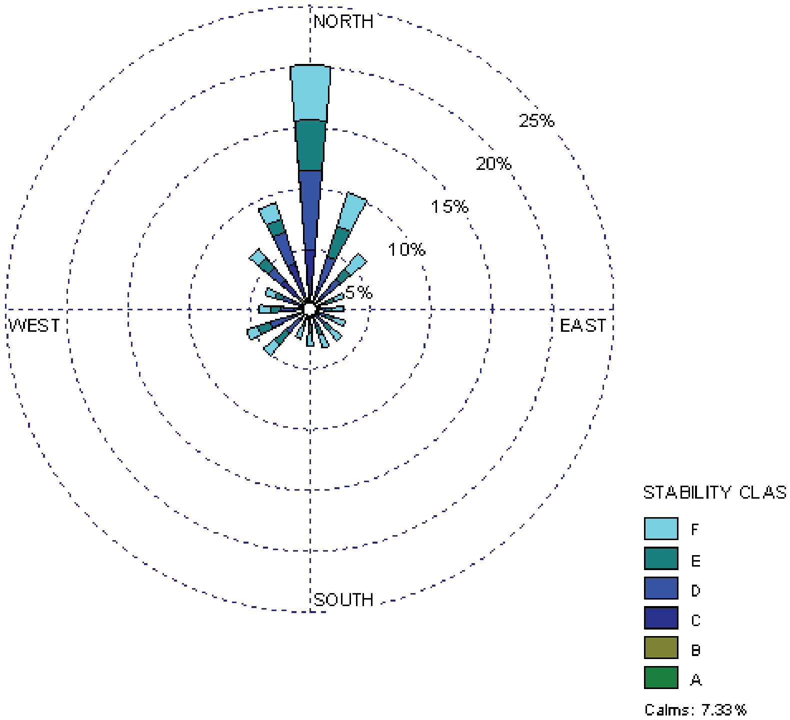


FIGURE 9: KIMBERLEY STABILITY CLASS FREQUENCY DISTRIBUTION BY WIND DIRECTION

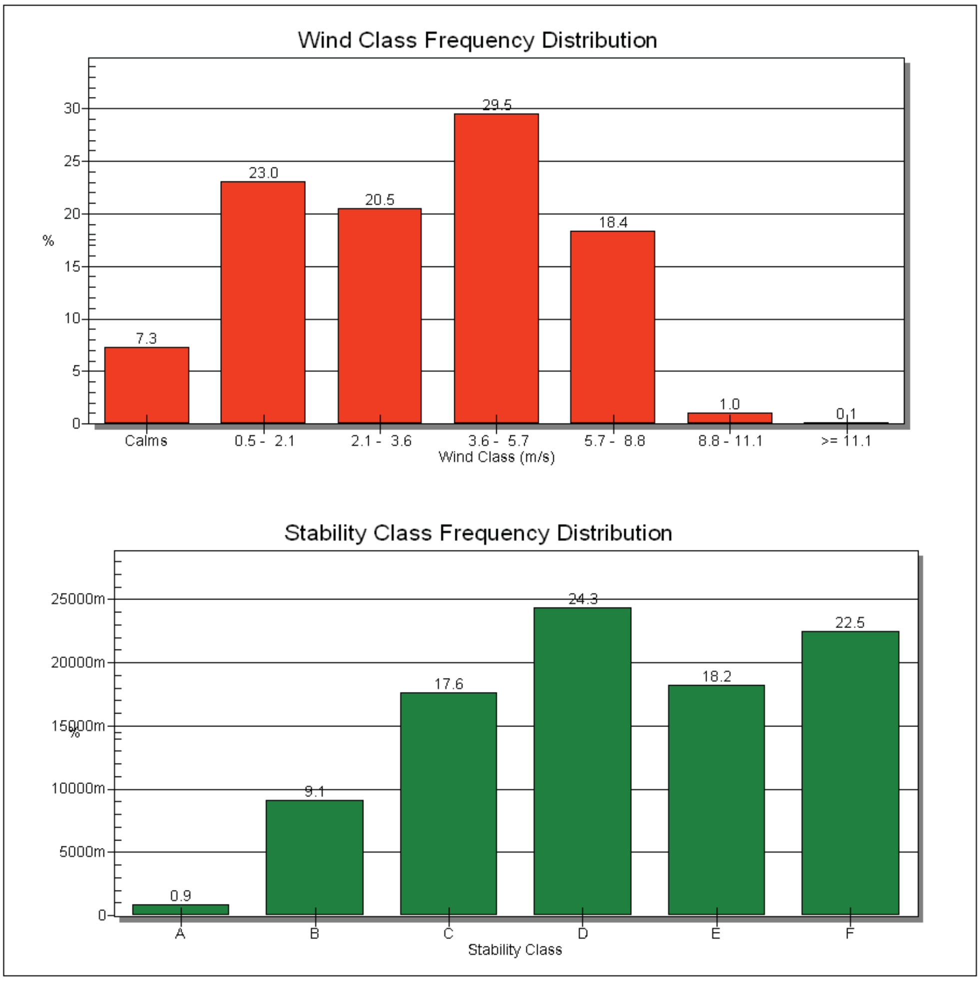


FIGURE 10: KIMBERLEY STABILITY CLASS FREQUENCY DISTRIBUTION BY WIND SPEED

3.2 Other Polluting Sources in the Area

A detailed emissions inventory for the Groenwater area is not available. Based on site visits and 1:50 000 topographical maps; the following sources of air pollution have however been identified. These are important to consider in terms of assessing the cumulative impact potential on air quality in the region:

- Agricultural activities;
- Vehicle entrainment and exhaust gas emissions;
- Mining activities
- Veld Fires; and
- Domestic Fuel Burning

A qualitative discussion on each of these source types is provided in the subsections which follow.

3.2.1 Agriculture

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. Mixed farming is practised in the area. The farming includes maize, wheat, grain sorghum, sunflower seed, drybeans and soybeans. Vegetables are produced under irrigation. The types of livestock assessed included pigs, sheep, goats, chickens and cattle. Emissions assessed include ammonia and hydrogen sulphide (USEPA, 1996).

3.2.2 Vehicles

The force of the wheels of vehicles travelling on unpaved roadways causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic (USEPA, 1996). Due to the nature of both mining and agricultural activity, road networks can often be of a temporary nature, and are thus unpaved. An extensive unpaved road network exists in the area.

Due to the high degree of transport of product from the site expected during mining operations, exhaust tailpipe emissions from vehicles is a significant source of particulate emissions. Exhaust fumes contain nitrogen, oxygen, carbon monoxide, water vapour, sulphur dioxide, nitrogen oxide, volatile hydrocarbons and polyaromatic hydrocarbons (PAHs) and their derivatives, acetylaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

3.2.3 Mining

Mining results in significant sources of fugitive dust emissions which primarily occur due to wind erosion of extensive poorly controlled tailings impoundments. Such sources are frequently associated with localised nuisance dust that contributes to the concentration of fine particulate matter in the atmosphere. Whereas high dust fallout rates have been measured to occur in close proximity to poorly controlled tailings impoundments, the contribution of such impoundments to airborne fine particulate concentrations is lower. Other emissions generated due to mining operations are generally associated with surface mining activity. Dust fallout and inhalable particulate emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing, screening and milling of ore and ore products). Subsurface mining operations result in small quantities of particulate, sulphur dioxide (SO2), nitrogen dioxide (NO2) and carbon monoxide (CO2) being released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground

3.2.4 Veld Fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amounts of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads. The factors that affect the rate of spread are (1) weather (wind velocity, ambient temperature, relative humidity); (2) fuels (fuel type, fuel bed array, moisture content, fuel size); and (3) topography (slope and profile). However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier *et al*, 1995).

3.2.5 Domestic Fuel Burning

It is anticipated that low income households in the area surrounding the site are likely to use coal and wood for space heating and/ or cooking purpose. The problems facing Metsimatala around the impact of air pollution generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[*a*]pyrene (Ezzati and Kammen, 2002).

Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and

low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest Mozambique Air Quality Objectives, for instance, required the monthly average concentration of PM_{10} (particulate matter < 10 µm in diameter) to be < 200 µg/m^3 (annual average < 100 µg/m^3). In contrast, a typical 24-hr average concentration of PM_{10} in homes using biofuels may range from 200 to 5000 µg/m^3 or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥ 50000 µg/m^3 in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

3.3 Standards and guidelines

The main pollutant of concern which may poses a health risk to surrounding sensitive receptors and possible communities during the current investigation is particulate matter. Particulate matter is a collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface. Particulate matter includes dust, smoke, soot, pollen and soil particles (Kemp, 1998). An overview is provided of the available local regulations and standards (SANS), and then for comparison, international guidelines and standards prescribed for inhalable particulate and nuisance dust exposure, these include the World Bank (WB), European Union (EU), United Kingdom (UK), World Heath Organisation (WHO), and the United States Environmental Protection Agency (USEPA).

3.3.1 Inhalable Particulates

Particulate matter (PM) has been linked to a range of serious respiratory and cardiovascular health problems. The key effects associated with exposure to ambient particulate matter include: premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, decreased lung function, and increased risk of myocardial infarction (USEPA, 1996).

PM represents a broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behaviour and method of measurement. The concentration of particles in the air varies across space and time, and is related to the source of the particles and the transformations that occur in the atmosphere (USEPA, 1996).

PM can be principally characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions (USEPA, 1996):

- PM10 (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are not generally deposited in the lung);

- PM2.5, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less)
- PM10-2.5, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and
- Ultra fine particles generally defined as those less than 0.1 microns.

Fine and coarse particles are distinct in terms of the emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters. Fine particles are directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulphur dioxide, nitrogen oxides, or organic compounds. Fine particles are generally composed of sulphate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometres, while most coarse particles typically deposit to the earth within minutes to hours and within tens of kilometres from the emission source. Some scientists have postulated that ultra fine particles, by virtue of their small size and large surface area to mass ratio may be especially toxic. There are studies which suggest that these particles may leave the lung and travel through the blood to other organs, including the heart.

Coarse particles are typically mechanically generated by crushing or grinding and are often dominated by resuspended dusts and crustal material from paved or unpaved roads or from construction, farming, and mining activities (USEPA, 1996).

Table 6 outlines the local and international health risk criteria used for the assessment of inhalable particulate matter (PM10). Guidelines and standards are provided for a 24-hour exposure and annual average exposure period respectively.

TABLE 6: AVAILABLE LOCAL AND INTERNATIONAL STANDARDS USED FOR THE EVALUATION OF INHALABLE PARTICULATE MATTER (PM10).

Origin	24-Hour Exposure (µg/m³)	Annual Average Exposure (µg/m³)	Number of Exceedances Allowed per year
RSA(1)	120(1)	50(1)	4 daily exceedances
RSA(2)	75(2)	40(2)	0 daily exceedances
Australia	50		5 daily exceedances
World Bank(3)	500	100	NA
EU(4)	50	20	7 daily exceedances
US-EPA(5)	150	50(6)	1 daily exceedance
UK(7)	50	40	35 daily exceedances
WHO(8) (9) (10)	50	20	NA

Notes: (1) Standard laid out in the National Environment Management: Air Quality Act. No. 39 of 2004:

(2) Compliance by 1 January 2015

(3) World Bank Air Quality Standards summary obtainable at URL http://www.worldbank.org/html/fpd/em/power/standards/airqstd.stm#paq.

(4) European Union Air Quality Standards summary obtainable at URL http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Directive&an_doc=1999&nu_doc=30.

(5) United States Environmental Protection Agencies National Air quality Standards obtainable at URL http://www.epa.gov/air/criteria.html

(6) To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 µg/m^3.

(7) United Kingdom Air Quality Standards and objectives obtainable at URL http://www.airquality.co.uk/archive/standards.php

(8) WHO = World Health Organisation

(9) Guidance on the concentrations at which increasing, and specified mortality responses due to PM are expected based on current scientific insights (WHO, 2005).

(10) Air quality guideline

3.3.2 Nuisance Dust

Nuisance dust is known to result in the soiling of materials and has the potential to reduce visibility. Atmospheric particulates change the spectral transmission, thus diminishing visibility by scattering light. The scattering efficiency of such particulates is dependent upon the mass concentration and size distribution of the particulates. Various costs are associated with the loss of visibility, including: the need for artificial illumination and heating; delays, disruption and accidents involving traffic; vegetation growth reduction associated with reduced photosynthesis; and commercial losses associated with aesthetics. The soiling of building and materials due to dust frequently gives rise to damages and costs related to the increased need for washing, cleaning and repainting. Dustfall may also impact negatively on sensitive industries, e.g. bakeries or textile industries. Certain elements in dust may damage materials. For instance it was found that sulphur and chlorine if present in dust may cause damage to copper (Maeda *et al.*, 2001).

The physical smothering of the leaf surface of plants by dust particles causes reduced light transmission, affecting photosynthetic processes resulting in growth reduction (Thompson et al., 1984; Pyatt and Haywood, 1989; Farmer, 1993).

Increases in the temperature of particle-covered leaves result in a positive impact on respiration and a negative impact on photosynthesis and productivity (Eller, 1977). The physical obstruction of the stomata has been observed to reduce stomatal resistance, resulting in the potential for higher uptake of pollutant gases, and it may also affect the exchange of water vapour (CEPA/FPAC Working Group, 1999). Particle accumulation on leaf surfaces may cause plants to become more susceptible to other stresses such as disease (CEPA/FPAC Working Group, 1999). A review of the effects of cement dust on trees showed that the dust caused physical damage to the leaves, reduced fruit setting and generally reduced growth (Farmer, 1993). Several studies in Europe and the United States have indicated that a decline in species diversity may be linked to declining air quality around urban and industrial areas (Gunnarsson, 1988; Hallingbäck, 1992; Váňa, 1992; Van Zanten, 1992; Finizio *et al.*, 1998; Jones & Paine, 2006; Motiejūnaitė, in press; Otnyukova, in press).

Air pollution is a recognized health hazard for man and domestic animals (Newman *et al.*, 1979). Air pollutants have had a worldwide effect on both wild birds and wild mammals, often causing marked decreases in local animal populations (Newman *et al.*, 1979). The major effects of industrial air pollution on wildlife include direct mortality, debilitating industrial-related injury and disease, physiological stress, anaemia, and bioaccumulation. Some air pollutants have caused a change in the distribution of certain wildlife species.

South Africa is one of the only countries who have issued guideline limits for the evaluation of nuisance dust levels. A four banding system has traditionally been used which describes the dust deposition as resulting in a slight, moderate, heavy or very heavy nuisance impact. These criteria are summarised as follows:

Slight	: < 250 mg/m²/day
Moderate	: > 250 mg/m²/day < 500 mg/m²/day
Heavy	: > 500 mg/m²/day < 1200 mg/m²/day
Very Heavy	: > 1200 mg/m²/day

The South African Department of Minerals and Energy (DME) use the 1 200 mg/m²/day threshold level as an action level. In the event that on-site dustfall exceeds this threshold, the specific causes of high dustfall should be investigated and remedial steps taken.

"Slight" dustfall is barely visible to the naked eye. "Heavy" dustfall indicates a fine layer of dust on a surface, with "very heavy" dustfall being easily visible should a surface not be cleaned for a few days. Dustfall levels of > 2000 mg/m²/day constitute a layer of dust thick enough to allow a person to "write" words in the dust with their fingers. Local experience, gained from the assessment of impacts due to dust from mine tailings dams in Gauteng, has shown that complaints from the public will be activated by repeated dustfall in excess of ~2000 mg/m²/day. Dustfall in excess of 5000 mg/m²/day impacting on residential or industrial areas generally provoke prompt and angry complaints.

The main limitation in using this type of classification system is that it is purely descriptive and does not provide and indication as to what action needs to be taken to remediate the problem. The South African Bureau of Standards in their SANS 1929:2005 publication, "Ambient air quality – limits for common pollutants", provides additional criteria which can be used for the evaluation of fallout dust deposition. A four banded scale has been provided, with target, action and alert thresholds indicated. Permissible margins of tolerances are outlined with possible exceptions noted. Table 7 and Table 8 detail these evaluation criteria.

TABLE 7: FOUR BAND SCALE EVALUATION CRITERIA FOR DUST DEPOSITION (SANS, 2005).

Band Number	**Band Description**	**Dustfall rate, D (mg/m²/day, 30-day average)**	**Comment**

1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of the dustfall rate being exceeded. Incidence reported to be submitted to the relevant authority.

TABLE 8: TARGET, ACTION AND ALERT THRESHOLDS FOR DUST DEPOSITION (SANS, 2005).

Level	**Dustfall rate, D ($mg/m^2/day$, 30-day average)**	**Averaging Period**	**Permitted Frequency of Exceeding dustfall rate**
Target	300	Annual	
Action residential	600	30 days	Three within any year no two sequential months
Action industrial	1200	30 days	Three within any year not sequential months
Alert threshold	2400	30 days	None. First incidence of dust fall rate being exceeded requires remediation and compulsory report to the relevant authorities.

An enterprise may submit a request to the authorities to operate within band 3 (action band), as specified in Table 7, for a limited period, provided that this is essential in terms of the practical operation of the enterprise and provided that and appropriate control technology is applied for the duration. No margin of tolerance will be granted for operations that result in dustfall rates which fall within band 4 (alert band) as specified in Table 8 (SANS, 2005).

Dustfalls that exceed the specified rates but that can be shown to be the result of some extreme weather or geological event shall be discounted for the purpose of enforcement and control. Such an event might typically

result in excessive dustfall rates across an entire metropolitan region, and not be localised to a particular operation. Natural seasonal variations, for example, the naturally windy months each year, will not be considered extreme events for this definition (SANS, 2005).

3.3.3 Methane

Methane is not toxic to humans but is of concern in terms of its explosion potential and its impact on the global climate. The most commonly accepted flammability ranges for methane in air mixtures are given as 5.3% to 14%. The flammability range becomes slightly extended to 5.0% to 15% when mixtures of methane in air are retained with a small void such as might occur should the gas collect within an enclosed void within buildings (Campbell, 1996). Methane is one of the most significant greenhouse gases known (21 times stronger than carbon dioxide). Over the last two centuries, methane concentrations in the atmosphere have more than doubled, largely due to human-related activities.

3.3.4 Oxides of Nitrogen

Air quality guidelines and standards issued by most other countries and organisations tend to be given exclusively for NO_2 concentrations. The reason being that NO_2 is the most important species from a human health point of view. International and proposed South African standards for NO_2 are presented in Table 9.

TABLE 9: AMBIENT AIR QUALITY GUIDELINES AND STANDARDS FOR NO_2

Averaging Period	WHO		South Africa		EC		Australia	
	$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	$\mu g/m^3$	ppm
Annual Ave	40	0.021	40	0.021	40[(b)]	0.021[(b)]	57[(d)]	0.03[(d)]
Max. 24-hr	-	-	-	-	-	-	-	-
Max. 1-hr	200	0.10	200	0.10	200[(c)]	0.10[(c)]	240[(e)]	0.12[(e)]

Notes:

[(a)] Annual arithmetic mean.

[(b)] Annual limit value for the protection of human health, to be complied with by 1 January 2010.

[(c)] Averaging times represent 98th percentile of averaging periods; calculated from mean values per hour or per period of less than an hour taken through out year; not to be exceeded more than 8 times per year. This limit is to be complied with by 1 January 2010.

[(d)] Standard set in June 1998. Goal within 10 years given as being no exceedances.

[(e)] Standard set in June 1998. Goal within 10 years given as maximum allowable exceedances of 1 day a year.

NO is one of the primary pollutants emitted by aircraft and motor vehicle exhausts. As discussed previously, NO_2 is formed through oxidation of these oxides once released in the air. NO_2 is an irritating gas that is absorbed into the mucous membrane of the respiratory tract. The most adverse health effect occurs at the junction of the conducting airway and the gas exchange region of the lungs. The upper airways are less affected because NO_2 is not very soluble in aqueous surfaces. Exposure to NO_2 is linked with increased susceptibility to respiratory

infection, increased airway resistance in asthmatics and decreased pulmonary function.

Available data from animal toxicology experiments indicate that acute exposure to NO_2 concentrations of less than 1 880 µg/m^3 (1 ppm) rarely produces observable effects (WHO 2000). Normal healthy humans, exposed at rest or with light exercise for less than two hours to concentrations above 4 700 µg/m^3 (2.5 ppm), experience pronounced decreases in pulmonary function; generally, normal subjects are not affected by concentrations less than 1 880 µg/m^3 (1.0 ppm). One study showed that the lung function of subjects with chronic obstructive pulmonary disease is slightly affected by a 3.75-hour exposure to 560 µg/m^3 (0.3 ppm) (WHO 2000).

Asthmatics are likely to be the most sensitive subjects, although uncertainties exist in the health database. The lowest concentration causing effects on pulmonary function was reported from two laboratories that exposed mild asthmatics for 30 to 110 minutes to 565 µg/m^3 (0.3 ppm) NO_2 during intermittent exercise. However, neither of these laboratories was able to replicate these responses with a larger group of asthmatic subjects. NO_2 increases bronchial reactivity, as measured by the response of normal and asthmatic subjects following exposure to pharmacological bronchoconstrictor agents, even at levels that do not affect pulmonary function directly in the absence of a bronchoconstrictor. Some, but not all, studies show increased responsiveness to bronchoconstrictors at NO_2 levels as low as 376-565 µg/m^3 (0.2 to 0.3 ppm); in other studies, higher levels had no such effect. Because the actual mechanisms of effect are not fully defined and NO_2 studies with allergen challenges showed no effects at the lowest concentration tested (188 µg/m^3; 0.1 ppm), full evaluation of the health consequences of the increased responsiveness to bronchoconstrictors is not yet possible.

Studies with animals have clearly shown that several weeks to months of exposure to NO_2 concentrations of less than 1 880 µg/ m^3 (1ppm) causes a range of effects, primarily in the lung, but also in other organs such as the spleen and liver, and in blood. Both reversible and irreversible lung effects have been observed. Structural changes range from a change in cell type in the tracheobronchial and pulmonary regions (at a lowest reported level of 640 µg/m^3), to emphysema-like effects. Biochemical changes often reflect cellular alterations, with the lowest effective NO_2 concentrations in several studies ranging from 380-750µg/m^3. NO_2 levels of about 940 µg/m^3 (0.5ppm) also increase susceptibility to bacterial and viral infection of the lung. Children of between 5-12 years old are estimated to have a 20% increased risk for respiratory symptoms and disease for each increase of 28 µg/m^3 NO_2 (2-week average), where the weekly average concentrations are in the range of 15-128 µg/m^3 or possibly higher. However, the observed effects cannot clearly be attributed to either the repeated short-term high-level peak, or to long-term exposures in the range of the stated weekly averages (or possibly both). The results of outdoor studies consistently indicate that children with long-term ambient NO_2 exposures exhibit increased respiratory symptoms that are of longer duration, and show a decrease in lung function.

3.4 Sensitive Receptors

The residential, educational and recreational land uses are considered to be sensitive receptors. For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth. Even though the latest editions were used, the relevant maps are 30 years

out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict. The following 1:50 000 topographical cadastral maps were used:

- SOUTH AFRICA 1:50 000 Sheet 2823AB, GROENWATER Second Edition 1989.
- SOUTH AFRICA 1:50 000 Sheet 2823AD, LIME ACRES Second Edition 1982

The proposed plant is located to the east of Postmasburg (Figure 1). A number of small villages such as Metsimatala, and the Lime Acres Mining Area are located in close proximity to the proposed site. Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust settling on the leaves of plants can result in damage to plants and inhalation of dust may result in sickness and associated lung diseases for wildlife and humans which will be present in the vicinity of the proposed plant. A more detailed inventory of settlements and sensitive receptors will be obtained on site visits and with assistance of the public participation specialists working on the project.

4 ASSESSMENT OF ENVIRONMENT LIKELY TO BE AFFECTED

The impact assessment phase of this investigation assesses the impact the construction and operational phase of the proposed plant will have on the surrounding areas.

This Section of the report outlines the predicted increase in impacts with the introduction of the plant and operations. To clearly detail the predicted impacts in ambient inhalable particulate ground level concentrations, only operational emissions will be included in this evaluation. The construction and decommissioning phases of the operation can only qualitatively be addressed due to the variability and unpredictable nature of the construction operations on site.

4.1 Methodology

Dispersion modelling will be undertaken using the US-EPA approved Aermod Dispersion Model. This model is based on the Gaussian plume equation and is capable of providing ground level concentration estimates of various averaging times, for any number of meteorological and emission source configurations (point, area and volume sources for gaseous or particulate emissions).

The AERMOD View model is used extensively to assess pollution concentrations and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows 2000/XP and NT4 (Service Pack 6).

The AERMOD (dispersion model used during the current investigation, is a steady state Gaussian plume model which can be used to assess pollutant concentrations and /or deposition fluxes from a wide variety of sources associated with an industrial source complex. Some of the modelling capabilities are summarised as follows:

- AERMOD may be used to model primary pollutants and continuous releases of toxic hazardous waste pollutants;
- AERMOD model can handle multiple sources, including point, volume, area and open pit source types. Line sources may also be modelled as a string of volume sources or as elongated area sources;
- Source emission rates can be treated as constant or may be varied by month, season, hour of day, or other periods of variation, for a single source or for a group of sources;

- The model can account for the effects aerodynamic downwash due to nearby buildings on point source emissions;
- The model contains algorithms for modelling the effects of settling and removal (through dry deposition) of large particulates and for modelling the effects of precipitation scavenging from gases or particulates;
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system;
- AERMOD incorporates the COMPLEX1 screen model dispersion algorithms for receptors in complex terrain;
- The model uses real-time meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impact on the modelling area; and
- Output results are provided for concentration, total deposition, dry deposition, and/or wet deposition flux.

Input data to the AERMOD model includes: source and receptor data, meteorological parameters, and terrain data. The meteorological data includes: wind velocity and direction, ambient temperature, mixing height and stability class.

The uncertainty of the AERMOD model predictions is considered to be equal to 2, thus it is possible for the results to be over predicting by double or under predicting by half, it is therefore recommended that monitoring be carried out at the proposed more during operation to confirm the modelled results, to ensure legal standards are maintained.

4.2 Input parameters

The emissions inventory will need to be developed to determine the emissions generated from each source. This is likely to be undertaken using the US-EPA AP42 emission factors. These emission factors are calculated based on standard operating conditions for various industries, and activities, and are used as an accepted alternative if no site specific or monitored data is available. The inventory will be developed based on the plant operations and will require information relating to processes used. Meteorological data obtained from the South African Weather Services Unified Model was used to ensure site specific data was used for all modelling.

4.3 Potential impacts

4.3.1 Construction Phase

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access roads, and the plant area. These predicted impacts cannot be quantified, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities. Instead a qualitative description of the impacts will be provided. This will involve the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

1. Product Transport
    - Scraping;
    - Debris handling;
    - Debris stockpiles; and
    - Truck transport and dumping of debris.

2. Power Plant
    - Clearing of area for infrastructure;
    - Debris handling;
    - Debris stockpiles; and
    - Truck transport and dumping of debris.

4.3.1.1 Creation and Grading of Access Roads

Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

The periodic watering of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases.

4.3.1.2 Preparation of areas identified for the construction of the plant and supporting infrastructure.

Removal of material usually takes place with a bulldozer, extracted material is then stored in piles for later use

during rehabilitation procedures. Fugitive dust is generated during the extraction and removal of overlying material, as well as from wind blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the extracted material, usually by truck, to the stock piles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

To avoid the generation of unnecessary dust, material drop height should be reduced and material storage piles should be protected from wind erosion. This can take the form of wind breaks, water sprays or vegetation of piles. All stockpiles should be damped down, especially during dry weather.

It should be noted that emissions generated by wind are also dependent on the frequency of disturbance of the erodable surface. Each time material is added to or removed from a storage pile or surface, the potential for erosion by wind is restored. Any crusting of the surface binds the erodable material (USEPA, 1996). Dust created during the transportation can be limited by watering the road sections that are being used and by either wetting the material being transported or covering the back of the trucks, to limit the wind blown dust from the load.

The removed topsoil will have to be transported to a designated collection point from where it can be recovered later during site rehabilitation. The removal of this material for storage should be done along designated roads which are properly maintained (watering), to reduce the amount of vehicle entrained dust which can be kicked up during these activities. In addition to the use of dedicated, treated roads, the material transported can be wet or covered to limit the wind blown dust being released from the load.

4.3.1.3 Overview of potential Impacts

The following components of the environment may be impacted upon during the construction phase:

- ambient air quality;
- local residents and neighbouring communities;
- employees;
- the aesthetic environment; and
- possibly fauna and flora

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

Sensitive receptors were identified in Section 3.4. Given the short duration and low level of activity expected during construction, but bearing in mind that no quantitative emission figures exist, no long adverse impacts are

anticipated on these receptors. Impact of fugitive dust emissions on employees on site could however be significant during the construction phase, but will vary between phases, with level of activity and meteorological conditions.

4.3.2 Operational Phase

This section aims to deal with the predicted air quality impacts which result due to the proposed operations. Details regarding the source characteristics will be obtained from site layout plans and process specific information provided and a questionnaire filled in by the client. The sources to be included in this assessment can be categorised as follows:

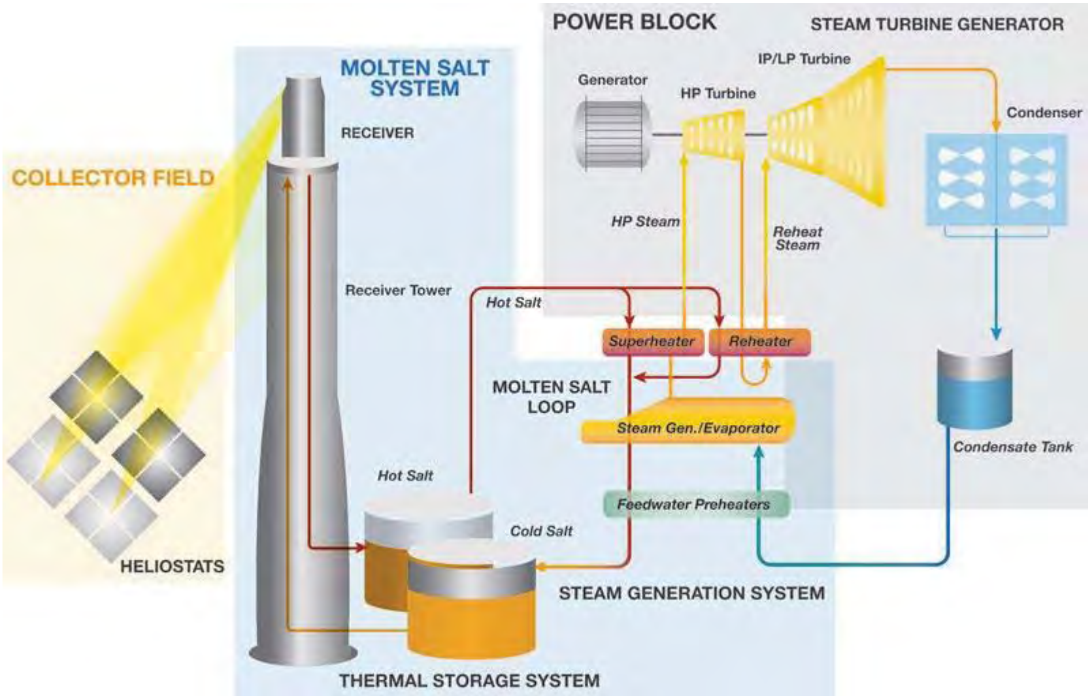
- Material handling;
- Plant Installation; and
- Equipment Transport

Once all site layouts and final geotechnical works are complete, information will then be sufficient for dispersion modelling and will be included in the Environmental Impacts Report.

4.3.2.1 Process Description

The proposed project can be defined as a solar thermo-electric power plant that in embodied in the form of a CS plant. The electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower where a large heat exchanger captures the solar heat.
- A molten salt mixture is pumped from the cold salt thermal storage tank to the central receiver where it is circulated in the heat exchanger until the temperature reaches 566ºC.
- The molten salt concentration is then transported to the hot salt thermal storage tank.
- Hot salt is pumped from the hot salt storage tank to the steam generator where heat is transferred from the salt to water in order to generate high pressure steam.
- The highly pressurised steam is then passed through a steam turbine, which is linked to an electric generator to generate electricity.



During the start-up phase of the plant, diesel/fuel/trucked in LPG will be used for plant start-up and the salt melting process. During the operational phase, diesel/fuel/trucked in LPG gas will be used for the initial salt heating process and oil for operating of the salt pumps. A diesel operated stand-by generator will be implemented on site, however it is not expected that this will be used. Fuel consumption estimations for a 100 MW plant are as follow:

- It is estimate that 50 to 70 days are required for initial salt melting for the 100 MW plant. During this period an estimated 35 400 m^3 of natural gas (final volume of fuel to be confirmed) will be consumed for the melting process
- It is estimated that roughly 15 000 m^3/hour of natural gas is required for auxiliary heating of the salt, with an added 2 015 litres of fuel per day for operating the molten salt pumps.

NO_x will not be generated during operation of the CSP. However, during plant commissioning, the initial melting, heating, and conditioning of the salt will result in limited NO_x emissions. For the melting and heating segments of the process, two small boilers each employing ultra low NO_x burners and flue gas recirculation, will be used to mitigate emissions from the combustion of LPG or natural gas. For the salt conditioning process, a multi-stage wet scrubber will be used to limit NO_x emissions from the decomposition of magnesium nitrate inherent in the salt mixture. This series of operations is limited to a one-time event, resulting in a closed loop system of liquid salt storage and circulation. At no other time will NO_x be generated during the operation of the CSP.

4.3.2.2 Input parameters

The emissions inventory has been developed in conjunction with the staff from Worley Parsons, who provided mass balance calculations, technical specifications and input parameters for various sources. The information provided has been used in conjunction with the United Stated Environmental Protection Agency AP42 schedule to determine emission rates used for modelling. The inventory is developed based on plant operations and is based on information relating to plant processes, and provided by the Worley Parsons staff.

TABLE 10: EMISSIONS EXPECTED FROM THE BURNING OF NATURAL GAS FOR THE HEATING OF

SALT

Heating	based on 529.719 scf	
Natural Gas	T/a	g/s
NO_x	2.32E+02	7.35667174
methane	1.07E+01	0.33929477
PM-total	3.53E+01	1.11935566

TABLE 11: EMISSIONS EXPECTED FROM THE BURNING OF NATURAL GAS FOR THE MELTING OF SALT

Melting	based on 1041.782 scf	
Natural Gas	T/a	g/s
NO_x	2.32E+02	12.05662059
methane	1.07E+01	0.55605966
PM-total	3.53E+01	1.83447719

TABLE 12: EMISSIONS EXPECTED FROM DIESEL FUELED SALT PUMPS

Salt Pumps	based on 3.087378763 mmbtu/h	
Diesel Fuel	T/a	g/s
NO_x	1.19E-01	0.00377347
PM10	8.39E-03	0.00026605
Methane	2.53E-05	0.00000080

4.3.2.3 Potential impacts at start-up

Start-up is expected to last between 50 and 70 days depending on weather and salt conditions. During this time natural gas and diesel fuel will be used to heat and melt the salt and begin pumping the salt through the system until the plant has reached its operational temperatures and pressures. During this time the emissions from the fuels will result in an increased pollution load within the atmosphere. As mentioned this process is not expected to last more than 70 days, and therefore the model has been adjusted to take this into consideration. Table 13 below indicated the maximum predicted ambient concentrations as a result of the start-up of the site. Figure 11, Figure 12 and Figure 13 provide a graphic illustration as to the movement of pollutants through the atmosphere once generated and in the natural environment.

TABLE 13: MAXIMUM PREDICTED CONCENTRATIONS (µG/M³)

	1 Hour	24 Hour	Annual
Particulate Matter	115.26787	28.83432	1.98844
Oxides of Nitrogen	75.89721	18.98573	1.30927
Methane	34.94812	8.7422	0.60288

FIGURE 11: 24-HOUR PREDICTED PARTICULATE MATTER CONCENTRATIONS DURING START-UP (SA STANDARD – 120µG/M³)

FIGURE 12: 1-HOUR PREDICTED OXIDES OF NITROGEN CONCENTRATIONS DURING START-UP (SA

STANDARD AS NO_2 – 200µG/M³)

FIGURE 13: ANNUAL PREDICTED METHANE CONCENTRATIONS DURING START-UP (SA STANDARD AS BENZENE – 10µG/M³)

4.3.2.4 Potential impacts once operational

Once start-up is complete no fuels are required to ensure the ongoing operations of the CSP plant, therefore all emissions as identified above will no longer be produced and the plant should continue to run on solar power from then on. Should be plant be shut down in its entirety then emissions as described above will resume during start-up.

4.3.3 Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and tailings impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;

- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.4 Proposed mitigation

4.4.1 Construction Phase

Due to the lack of quantitative dust emissions data for the site, it is recommended that the precautionary principle be followed and dust control measures be implemented. Recommendations for the control of fugitive dust emissions are given in Table 14. Wet suppression with water is the least expensive of the possible control measures but is temporary in nature.

TABLE 14: RECOMMENDATIONS FOR THE CONTROL OF FUGITIVE DUST EMISSIONS DURING THE CONSTRUCTION PHASE (USEPA, 1996).

Emission Source	Recommended Control Methods
Debris handling and debris piles	Wind speed reduction
	Wet suppression (1)
Truck transport (2)	Wet suppression
	Paving
	Chemical stabilisation (3)
Bulldozers	Wet suppression
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression

	Paving
	Chemical stabilisation
General construction	Wind speed reduction
	Wet suppression
	Early paving of permanent roads

Note: (1) Dust control plans should contain precautions against watering programs that confound trackout problems.

(2) Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.

(3) Chemical stabilisation is usually cost-effective for relatively long-term or semi-permanent unpaved roads.

Water may be combined with a surfactant as wetting agent. Surfactants increase the surface tension of water, reducing the quantity of water required. Chemical stabilisation is of longer duration but is not cost effective for small-scale operations. Dust-A-Side (DAS) represents an example of a chemical product, which is commercially available and widely used by mines and quarries. The DAS product binds with the aggregate used to build on-site roads. It should be noted however, that the treatment with chemical stabilisers can have adverse effects on plant and animal life and can contaminate the treated material (USEPA, 1996).

Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. Facilities for the washing of vehicles could be provided at the entry and exit points. A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas or near stockpiles. Traffic over exposed areas should be kept to a minimum (USEPA, 1996).

All stockpiles should be maintained for as short a time as possible and should be enclosed by wind breaking enclosures of similar height to the stockpile. Stockpiles should be situated away from the site boundary, water courses and nearby receptors and should take into account the predominant wind direction.

During the transfer of material to piles, drop heights should be minimised to control the dispersion of materials being transferred (USEPA, 1996).

Additional preventative techniques include the reduction of the dust source extent and adjusting work processes to reduce the amount of dust generation (USEPA, 1996).

4.4.2 Operational Phase

It is recommended that vegetation levels below the heliostats is maintained to ensure no exposed surfaces are present for the liberation of dust from within and surrounding the site. Larger trees should also be planted surrounding the site to act as wind breaks and reduce the wind speeds within the plant area.

4.4.3 Decommissioning Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus

preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.4.4 Post-Closure Phase

Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

5 CONCLUSIONS

Figure 11, Figure 12 and Figure 13 provide a graphic illustration as to the movement of pollutants through the atmosphere once generated and in the natural environment. Based on the predicted emissions expected from the CSP plant, as provided in the Figures and Table 13 the plant is not expected to exceed the National Standards for South Africa, and due to the relatively short duration of the plant start-up no long term air quality concerns are expected.

Assessment of Potential Air Quality Impacts

Table: Significance Assessment of Impacts associated with all activities for all phases of the project,

Activity	Potential Impact	Status	Spatial Scale	Temporal Scale	Probability	Severity	Significance without mitigation	Mitigation measures	Significance with mitigation
Construction Phase	Dust impact - Construction	-	2	1	2	2	-7 Negative Medium	Construction & tarring of access road	Low
								Application of dust suppression – main haul road	
								Water sprays at storage piles & transfer points	
								Cladding of storage piles	
								Vehicle speed on unpaved roads limited to prevent dust creation	
								Employ latest technology to reduce vehicle exhaust gas emissions	
								All construction vehicles and equipment are to be kept in good repair	
Operational Phase	Dust impact – bare ground	-	2	3	2	1	-8 Negative Medium	Re-vegetation of site and covering of all exposed soil	Low
	Particulate Matter generated during start-up.	-	1	1	2	1	-5 Negative Low	Ensure Start-up's are kept to a minimum	Low
	Oxides of Nitrogen generated during start-up.	-	1	1	2	1	-5 Negative Low	Ensure Start-up's are kept to a minimum	Low
	Methane generated during start-up.	-	1	1	2	1	-5 Negative Low	Ensure Start-up's are kept to a minimum	Low
Decommissioning Phase	Clearing of material	-	1	1	1	1	-4 Negative Low	Re-vegetation of site and covering of all exposed soil	
	Demolishing of infrastructure	-	1	1	1	1	-4 Negative Low	Reduce drop heights of material	Low
								Water sprays during demolishing	

Appendix M

Geohydrological Impact Assessment

Humansrus Solar Thermal Energy Power Plant Groundwater Impact Assessment

Report Prepared for

WorleyParsonsRSA (Pty) Ltd

Report Number SRK436964

Report Prepared by

srk consulting

October 2011

HumansrusSolar Thermal Energy Power Plant Groundwater Impact Assessment

WorleyParsonsRSA (Pty) Ltd

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SRK Project Number 439652

October 2011

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Table of Contents

List of Tables

List of Figures

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa)(Pty) Ltd (SRK) by SSI Engineers and Environmental Consultants, the Department of Water Affairs and local property owners in the Humansrus area. SRK has exercised due care in reviewing the supplied information. Whilst SRK has compared the available data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the availabledata. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Glossary of Terms

Aquifer: A water-bearing geological formation capable of supplying economic quantities of groundwater.

Aquitard: A saturated geological unit with a relatively low permeability that retards and, but does not prevent the movement of water; while it may not readily yield water to boreholes and springs, it may act as a storage unit.

Baseline: Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.

Conceptual Model: A conceptual model includes designing and constructing equivalent but simplified conditions for the real world problem.

Contamination: The introduction of any substance into the environment by the action of man.

Dispersivity:A geometric property of a porous medium which determines the dispersion characteristics of the medium by relating the components of pore velocity to the dispersion coefficient

Ecosystem: An organic community of plants, animals and bacteria and the physical and chemical environment they inhabit.

Electrical Conductivity: A surrogate measure of salinity based on the electrical conductivity (measured as mili-Siemens per metre) produced through the ionic concentration of water.

Environmental Impact Assessment: A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.

Ephemeral River: A river that does not flow year-round, in response to seasonal rainfall and run-off

Fractured-rock Aquifer: Groundwater occurs within fractures and fissures in hard-rock formations.

Hydrogeological: Geological features related groundwater.

Graben: A depressed block of land bordered by parallel faults.

Groundwater:Refers tothe water filling the pores and voids in geological formations below the water table.

Groundwater Flow: The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the slope of the water table and the transmissivity of the geological formations.

Groundwater Recharge: Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic Zone).

Groundwater Resource: All groundwater available for beneficial use, including by man, aquatic ecosystems and the greater environment.

Groundwater Resource Units: (GRUs) Represent provisional zones defined for the purposes of assessing and managing the groundwater resources of a region, in terms of large-scale abstraction from relatively shallow (depth < 300m) production boreholes. They represent areas where the broad geohydrological characteristics (i.e. water occurrence and quality, hydraulic properties, flow regime, aquifer boundary conditions etc.) are anticipated to be similar.Sometimes also called groundwater management units (GMUs).

Hydraulic Conductivity: Measure of the ease with which water will pass through earth material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow (in m/d).

Intergranular Aquifer: Groundwater contained in intergranular interstices of sedimentary and weathered formations.

Life of Facility: The life of a facility includes all the phases of the facility's existence from the conceptual and planning phases, through design, construction, operation and decommissioning to the post-closure and aftercare phases.

Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing and/or intergranular porosity; may be highly productive and able to support large abstractions for public supply and other purposes; water quality is generally very good.

Minor Aquifer System: Fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability; aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.

Mitigation: Measures taken to reduce adverse impacts on the environment.

Natural Attenuation: Is the biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility or volume to levels that are protective of human health and the ecosystem.

Non-Aquifer: A groundwater body that is essentially impermeable, does not readily transmit water and/or has a water quality that renders it unfit for use.

Non-Aquifer Systems: formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities; water quality may also be such that it renders the aquifer unusable; groundwater flow through such rocks does take place and needs to be considered when assessing the risk associated with persistent pollutants.

Piezometric surface: Describes the water level in a confined or semi-confined aquifer.

Permeability: The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as $m^3/m^2 \cdot d$ or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with *hydraulic conductivity*, which relates specifically to the movement of water.

Pollution: The introduction into the environment of any substance by the action of man that is, or results in, significant harmful effects to man or the environment.

Recharge: The addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.

Saline Water: Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids.

Saturated Zone: The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere

Small Industrial Users: Means water users who qualify as work creating enterprises that do not use more than twenty cubic metres per day and identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented, under the following categories:

1: food processing

2: prospecting, mining and quarrying

3: manufacturing

4: construction

Specific Yield: Ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity from that mass.

Storativity (S): The volume of water released from storage per unit of aquifer storage area per unit change in head.

Transmissivity: The rate which groundwater flows horizontally through an aquifer.

Unconfined Aquifer: An aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate and at atmospheric pressure.

Unsaturated Zone: That part of the geological stratum above the water table where interstices and voids contain a combination of air and water; synonymous with *zone of aeration* or *vadose zone*.

Waste rock: The non-mineralised rock and/or rock that generally cannot be mined economically that is conveyed to the surface for disposal.

Water Table: The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

List of Abbreviations

DWA	Department of Water Affairs (previously DWAF)
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity (Salinity of water)
GA	General Authorisation
GRU	Groundwater resource unit
L/s	litres per second
m	metres
mamsl	metres above mean sea level
mbgl	metres below ground level
mS/m	milli-Siemens per metre
m^3/a	cubic metres per annum
mm	millimetres
m^3/m	cubic metres per month
SRK	SRK Consulting
mg/ℓ	milligrams per litre
Ma	Million years
STEP Plant	Solar Thermal Energy Power Plant

1 Introduction

During June 2011 SRK Consulting was requested by Mr. Frank Benedek of SSI Engineers and Environmental Consultants to submit a cost proposal for a detailed groundwater resource assessment and provide specialist input to the Waste Management Licence Application, Environmental Impact Assessment and the Water Use Licence required for a proposed Concentrated Solar Power Plant (STEP Plant) on the farm Humansrus(Farm 469) near Postmasburg in the Northern Cape Province.Subsequent to the scoping report SSI withdrew from the project whereafterSRK was re-appointed by WorleyParsons for the impact assessment and report

The Humansrus STEP plantsite, (hereinafter referred to as the site) is located approximately 30 km eastof Postmasburg along the R31 route to Kimberley (**Figure 1**). Farms and small communities in the area are totally dependent on groundwater whilst the larger communities like Postmasburg, Daniëlskuil and Lime Acres use groundwater as well as surface water from the Vaal-Gamagara pipeline, which crosses the site.

1.1 Scope of Work

The following scope of work and deliverables were provided by SSI, *quote*:

1. *To provide a detailed description of the site topography, geological and geo-hydrological characteristics of the study area;*
2. *Depiction and characterization of the groundwater regime in a regional geological and geohydrological context indicating the overall characteristics of the geological settings and aquifer parameters, and identification of immediate groundwater users;*
3. *Data obtained from hydrocensus survey as well as the data obtained from the NGDB to be mapped.*
    1) *A desktop study to be undertaken for the analysis of data obtained from the National Department of Water Affairs' National Groundwater Database (NGDB);*
    2) *Site visit for purposes of the hydrocensus; and*
    3) *Consultation with relevant landowners to obtain additional borehole data, if available.*
4. *Determination of pre-project groundwater quality by means of baseline groundwater quality monitoring and sampling;*
5. *Assess the potential impacts (direct, indirect and cumulative) of the proposed development and the significance thereof on groundwater resources and downstream water users in the general area.*
6. *Description of groundwater management measures related to all project phases;*
7. *Groundwater monitoring protocols and a report containing groundwater monitoring data and analysis;*
8. *A groundwater model illustrating the above mentioned analysis will be required.*

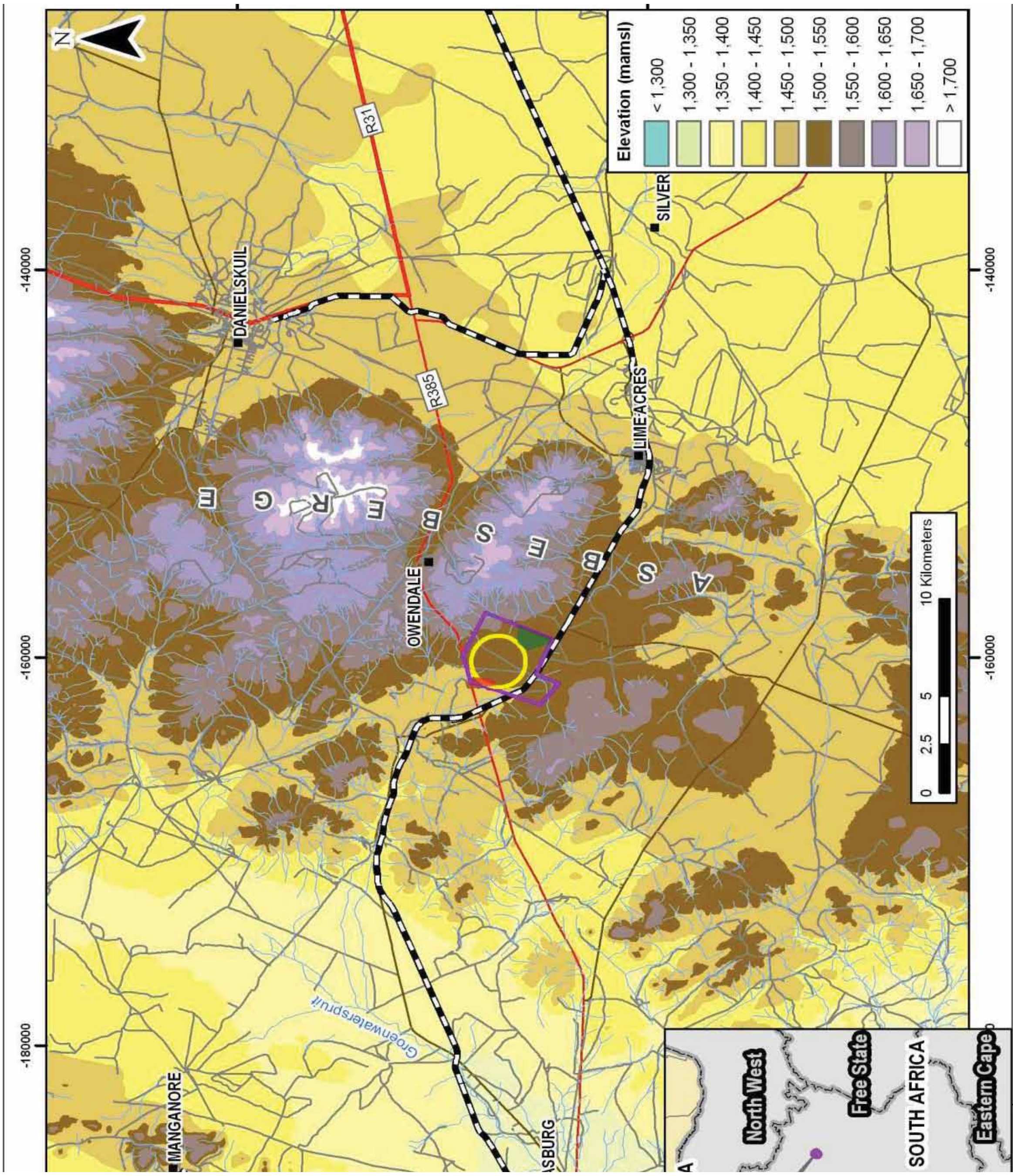


Figure 1: Locality of the HumansrusSolar Energy Thermal Power Plant site

9. *Attend a specialist integration workshop to be held with the specialist project team during the EIA phase of the project prior to the finalisation of the respective specialist reports. The aim of this workshop will be to:*
   1) *Discuss and evaluate the findings of each of the various specialist studies;*
   2) *Integrate findings to identify workable solutions;*
   3) *Recommend appropriate mitigation measures, where required, and*
   4) *Formulate final recommendations.*
10. *Following the phase-specific specialist workshop, specialists will be required to finalise the various specialist reports for inclusion in the EIA Report.*

11. *Recommendations on any further studies / additional scope of work that may be required during or after the EIA process.*

1.2 Deliverables

Project deliverables:

1. Groundwater resource assessment report;
2. Groundwater Scoping Report (for the EIA/Waste Management Licence); and
3. Groundwater EIA Report (for the EIA/Waste Management Licence).

1.3 Methodology

The methodology employed for the investigation was as follows:

- All existing groundwater related information was collated and reviewed for the site and its surrounds. This included information from existing reports, the NGA, Water Authorisation and Registration Management System (WARMS database) and published maps;
- A detailed hydrocensuswas carried out on existing boreholes, shallow wells and springs on the property, as well as a representative number of private boreholes, wells and springs that occur on the surrounding properties. During this field survey water levels, current abstraction, type of equipment, water usage, and basic chemistry based on field testing and any other information that was available from the owners/operators were measured and recorded;
- Groundwater resource units (GRUs) were delineated for the site and the recharge, exploitation potential, and water balance of the groundwater resources in each GRU were derived. For this purpose the GIS grids generated for the DWA National Groundwater Resource Assessment, Phase 2 wereused. The quality of the groundwater resources in eachGRU was also assessed. All data were captured into an ArcGIS 10 database and the aquifers defined and groundwater flow directions, aquifer boundaries, e.g. structural and lithological, were defined;
- The current and anticipated groundwater uses were compared to the exploitation potential of the aquifers in the GRUs;
- Potential groundwater bearing structures and formations were mapped on satellite imagery and aerial photographs using the ArcGIS desktop software. The geological data of the area wereobtained andgeoreferenced for use in the GIS. The boreholes and other relevant groundwater information were superimposed on GIS generated maps for analysis;
- The data were analyses and collated for the Scoping Report;
- Three test boreholes were drilled to assess the aquifer parameters and groundwater quality at the STEP plant footprint area;
- Two existing boreholes and the three new boreholes were test pumped to obtain aquifer parameters and water samples for chemical analysis. Test pumping complied with the DWA's minimum requirements. Test pumping of each borehole consisted of a step drawdown test (SDT) consisting of 4 x 60 min consecutive tests each at a higher pumping rate. After completion the water level was allowed to recover whereafter a 72 hr constant discharge test (CDT) was carried out. At completion the water level recovery was monitored for up to 72 hr. During these tests the water level, discharge rate, electrical conductivity, pH and temperature of the water abstracted were measured at fixed intervals.Where necessary, other nearby boreholes were also monitored during testing.

- The test pumping data wereanalysed by a principal hydrogeologist in order to determine the long-term sustainable yield of the boreholes and aquifer parameters such as transmissivity and storativity. Parameters such as available drawdown, recharge and abstraction from other production boreholes located in the same aquifer, drought periods, etc. were taken into account when calculating the safe yield.
- At the end of each CDT a groundwater sample was collected for macro-chemical and trace element analysis at a SANAS accredited laboratory.
- A conceptual and numerical hydrogeological model were drawn up and the anticipated abstraction and potential contaminant transportsimulated;
- The potential impacts on the environment and other water users were assessed, mitigation measures formulated, baseline and operational groundwater monitoring programme defined and a hydrogeological impact report compiled, which compare the results to the anticipated water demand, and for inclusion in the EIA and WULA (Water Use License Application).

1.4 Work Programme

A hydrocensus of the boreholes on the Farm Humansrus and adjacent farms was conducted on 14 and 15 July 2011. All available geohydrological information (borehole depth, yield, groundwater intersections, groundwater use and estimated abstraction, etc.) was collected from the respective owners during this visit. Boreholes were visited and the relevant geohydrological data (e.g. groundwater levels, quality, equipment, etc.) were measured and recorded. The local geology was noted and red flag areas identified. The final Scoping Report was submitted on 1 August 2011. Drilling commenced on 17 August 2011 and was completed by 19 August 2011. Test pumping commenced on 31 August 2011 and was completed on 6September 2011. The last chemical analysis results were received on 3 October 2011, whereafter this report was finalised and internally peer reviewed by 5 October 2011.

2 Project Description

SolarReserveSA (Pty) Ltd (hereinafter referred to as SRSA) plans to construct a Solar Thermal EnergyPower Plant (hereinafter referred to as a STEP Plant) on the Humansrus farm. The following project description was provided by WorleyParsons, *quote*:

The STEP Plantgenerates power by concentrating the heat from the sun on a receiver whereafter the salt (heat transfer medium consisting of sodium and potassium nitrate) is heated for the generation of electricity. Unlike wind and photovoltaic technology, the technology implemented by the proposed STEP Planthas the ability to store energy, which means that electricity can be delivered as and when needed dependent solely on demand and not climatic factors.

STEP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) arranged within a circle shaped heliostat field with an estimated land coverage of 3 km^2. The tower is erected slightly off-centre in the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver on top of the tower. The concentrated sunlight within the receiver, heats molten salt to over 550ºC, which then flows into a saltthermal storage tank.

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In short the electricity generation process can be summarised as follows:

- *Heliostats reflect the solar radiation towards the central receiver tower;*
- *The salt complex is pumped from the cold salts thermal storage tank to the central receiver. The salt complex is transported through the central receiver tower by means of extremely thin tubes;*
- *The molten salt complex is heated up to approximately 566ºC and is circulated in the central receiver tower;*
- *The molten salt concentration is then transported to the hot salt thermal storage tank;*
- *Energy is transferred by means of a heat exchanger or steam generator to generate steam for the turbine;*
- *The highly pressurised steam is then passed through a steam turbine to generate electricity;*
- *The salt complex cools down to an approximate 288ºC in the steam generator; and*
- *After this process is completed, the molten salt concentrate is transported to the cold salt thermal storage tank – in order for the electricity generation cycle to commence once more.*

The STEP Plant comprises four main subsystems which will be summarised below:

1. *Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats;*
2. *Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);*
3. *The Power Block; and*
4. *Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).*

Three (3) different plant setups are under investigation for the Humansrus site of which 3 (Hybrid Cooled Zero Discharge System) is the preferred setup. The annual water demands of the different setups are as follow(see **Figure 2** for a schematic flow diagram)*:*

1. *Dry Cooled Zero Discharge System - 169,200 m^3*
2. *Dry Cooled Non Zero Discharge System - 211,900 m^3*
3. *Hybrid Cooled Zero Discharge System - 246,200 m^3*

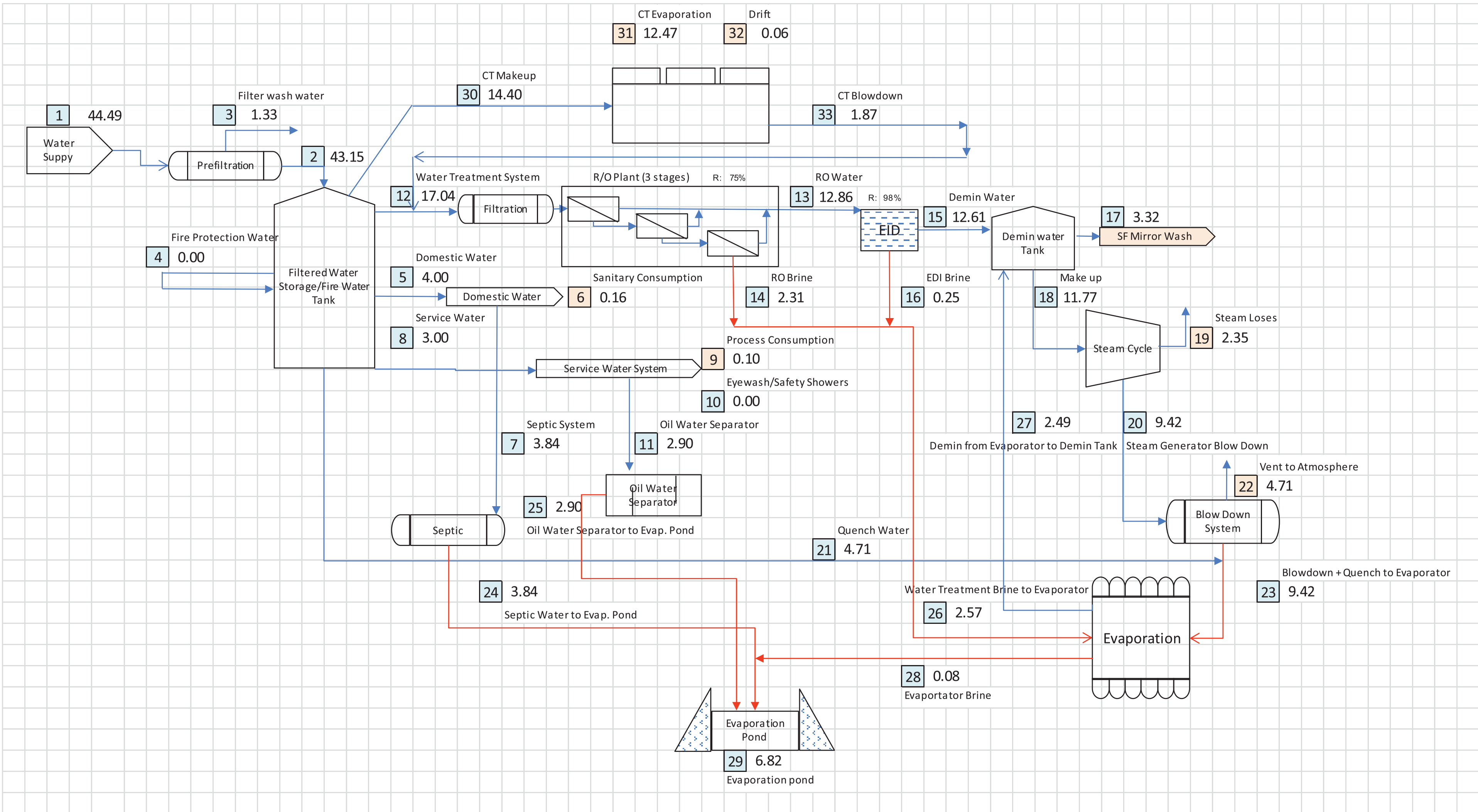


Figure 2: Schematic water flow diagram for the STEP Plant

3 Baseline Data

3.1 Physiography and Climate

The Farm Humansrus is located in a northwest-southeast trendingvalley with two semi-parallel rangesof hills occurring on the western and eastern sides of the farm (**Figure 1**).This valley is controlled by faults on the two flanks with the eastern hills formed by hard, weathering-resistant banded ironstone and jaspilite. The eastern hills form part of the Asbestos Hills stretching from Kuruman in the north to Prieska in the south.

The elevation of the study area varies between 1 460 mamsl in the far north-west and 1 630 mamsl on the eastern side of Humansrus. Hills on the western side of the valley are more subdued with only a few points where the elevation reaches >1 600 mamsl. The central valley on Humansrus farm is elevated between 1 500 and 1 540 mamsl.

The climate of the area is typical of a semi-desert with very hot summers and cold winters. Temperature data for Kimberley (as supplied by the South African Weather Service) for the period 1960 to 2000are summarized in **Table 1**below. The data indicate that January is the hottest month with an average maximum daily temperature of 32^{o}C and June the coldest with an average maximum daily temperature of 18^{o}C. During June and July the average minimum daily temperature drops to <3^{o}C.

Table 1: Temperature data for Kimberley (South African Weather Service)

KIMBERLEY CLIMATIC AVERAGES 1960-2000													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP	32.6	31.2	28.9	25	21.5	18.4	18.8	21.4	25.7	28	30.1	32.1	26.2
MIN TEMP	17.7	17.3	15.2	10.7	6.2	2.8	2.5	4.7	8.8	11.9	14.5	16.5	10.7
AVE TEMP	25.2	24.3	22	17.9	13.9	10.6	10.6	13.1	17.3	19.9	22.3	24.3	18.5
KIMBERLEY CLIMATIC ABSOLUTES 1960-2000													
HIGHEST TEMP	40.4	39.9	37.8	34.9	31.3	26.6	26.8	31.2	36.6	37.6	39.2	40.9	40.9
LOWEST TEMP	6.5	5.6	2	-2.8	-5.7	-7.9	-8.1	-7.8	-5.5	-0.5	2.5	3.8	-8.1

The data also indicates that the absolute maximum temperature recorded during the period was 40.9^{o}C and the lowest -8.1^{o}C.

The average monthly precipitation and standard deviation (SD) values for the study area, as provided by the South African Weather Service, are summarized in**Table 2** below. The Humansrus area falls within the summer rainfall area with a mean annual precipitation (MAP) of 401.1 mm.

Table 2: Precipitation statistics for the Humansrusarea (Source: South African Rain Atlas)

Average monthly precipitation in mm) at Measuring Station Coordinates: S28^{o}18' E023^{o}22'													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Mean:	**64.7**	**76.3**	**77.8**	**42.5**	**15**	**5.2**	**3.6**	**5.6**	**11.2**	**22.2**	**31.3**	**45.9**	**401.1**
Standard Deviation:	**46**	**50.9**	**49.7**	**35.2**	**18.6**	**10.1**	**8.2**	**11.2**	**17.0**	**24.1**	**28.4**	**36.5**	**107.9**

The data indicate that 84% of the precipitation occurs during November to April. This phenomenon is characteristic of a summer rainfall area. March is the wettest month with an average precipitation of ~78 mm, whilst July is the driest with <4 mm.

The rainfalldistribution for this area is indicated in **Figure 3**over page. Rainfall generally decreases from the site (Humansrus) to the west, south and southeast. The highest precipitation occurs in the mountainous area west and southwest of Danëlskuil, where the MAPexceeds520 mm. The lowest precipitation occurs at two isolated localities southeast of Danëlskuil and Lime Acres, respectively. These areas have a MAP of <360 mm.

3.2 Geology

The geology of the study area, whichis located on the eastern flank of the Dimoten Syncline striking in a general north-south direction, is depicted in **Figure 4** on page 10. The geological map indicates that significant parts of the study area are covered by Recent-age deposits of mainly windblown sand. These deposits occur along the valleys in the area and are normally thin, seldom exceeding 10 m in vertical thickness. A borehole drilled by SRK, north of the Groenwater settlement, intersectedargillaceous, loose and well weathered material up to 30 mbgl. However, this is an anomaly and likely linked to a lineament. However, on the eastern side of the Asbestos Hills the Recent deposits are much thicker and comprise of windblown sand, rubble and surface calcrete deposits. A borehole drilled by the DWA east of Lime Acres intersected 60 m of surface calcrete and calcified gravel before intersecting dolomite bedrock.

The eastern part of the study area is underlain by rocks of the Daniëlskuil Member of the Asbestos Hills Formation, which forms part of the Griquatown Group of the Griqualand West Sequence. These rocks consist mainly of brown jaspilite and crocidolite and form the prominent hills on the eastern side of the farm.

The Asbestos Hills Formation is followed by the Makganyene Formation, which forms part of the lower Postmasburg Group. The Makganyene Formation contains a variety of rock types including diamictites, sandstones, shales andbanded ironstone, which were deposited after a period of erosion forming an unconformity in this specific area. The upper part of this formation consists of a 1–3 mthick tuffaceous unit that characteristically separates the diamictites of the Makganyene Formation from an overlying 900 m thick succession of basaltic-andesitic lavas of the Ongeluk Formation. ThisMakganyene Formation displays extreme thickness variations, from 3 m near the Orange River, to 70 m near Kuruman and to 500 m in a borehole near Postmasburg (Visser, 1971). In the study area outcrops of the thin tuffaceous unit could not be located, likely due to the limited extend thereof, weathering and weak outcrops of the Makganyene Formation. The Ongeluk Formation, consisting of amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper, rests conformably on the Makganyene Formation. This formation covers most of the study area including the area where the STEP Plant is proposed. Limited outcrops of lavas occur on the eastern side of the study area (at Humansrus homestead and south-east thereof).

Several structural features such as lineaments, faults and dykes are mapped in the area. A few unmapped, or partially mapped, structures were mapped during the field visit and from Google Earth images. Most significant are the two semi-parallel faults that control the valley at Humansrus (see **Figure 4**). The area between these faults has apparently been displaced downwards to form a graben structure.

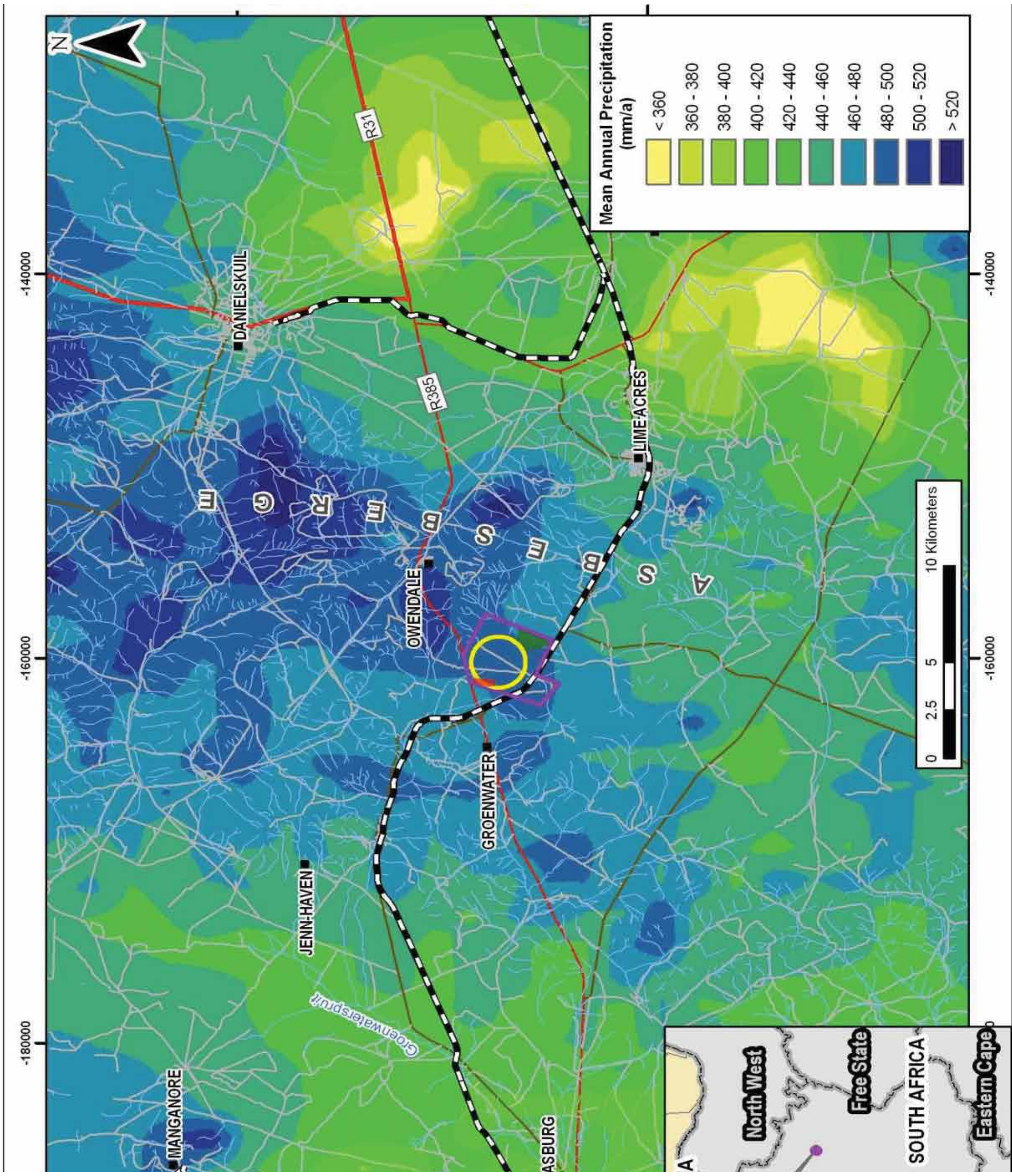


Figure 3: Rainfall distribution in the Humansrus area

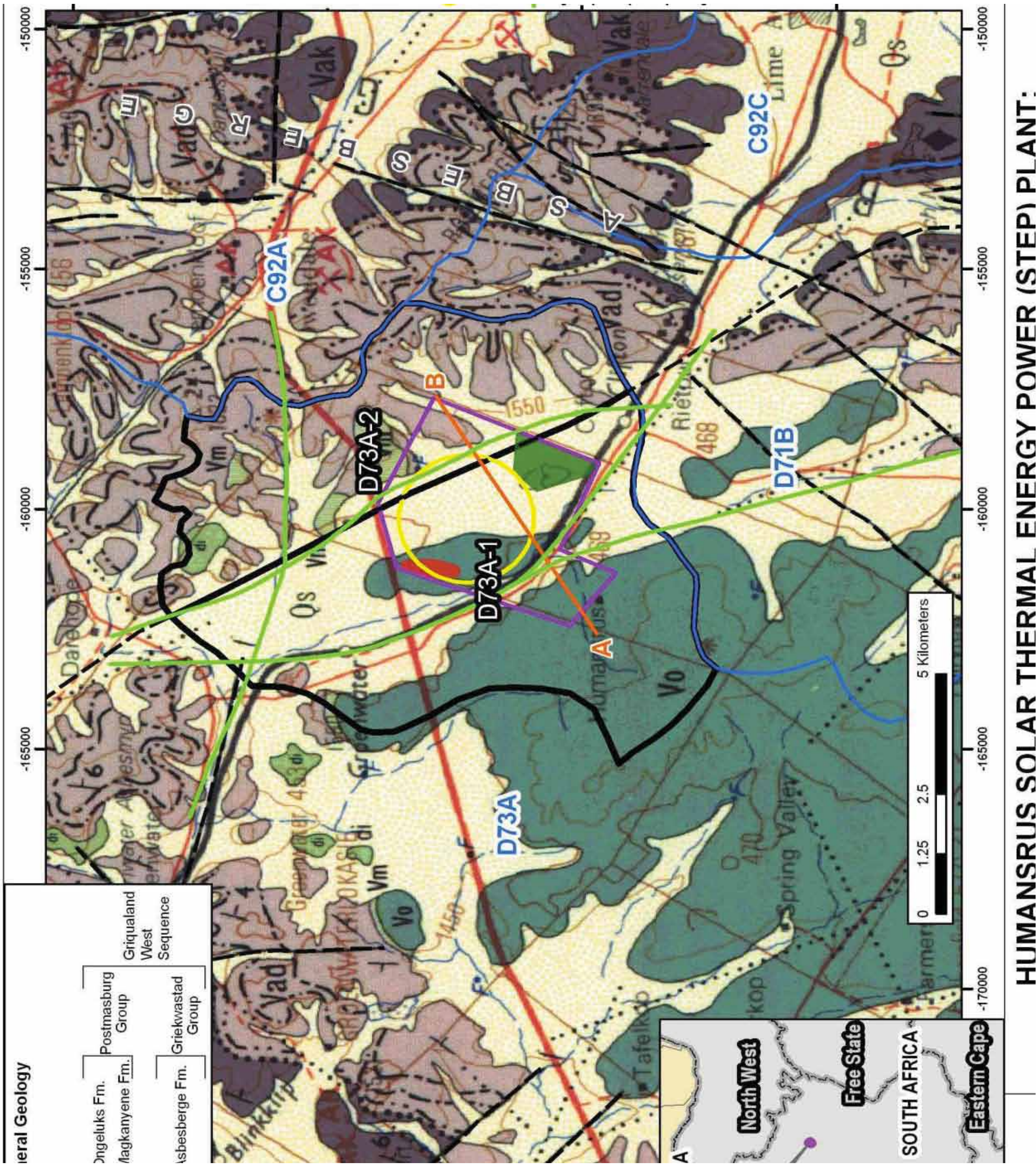


Figure 4: Geology of the Humansrus area (after Council for Geoscience)

3.3 Hydrogeology

3.3.1 Aquifer Type

Groundwater in the study area occurs mainly in semi-confined fractured-rock aquifers, also known as secondary aquifers(**Figure 5**). Thesetype of aquifers are formed by jointing and fracturing of the otherwise solid bedrock by compressional and tensional forces that operate in the Earth's crust from time to time. The fractures are formed by faulting, folding, cooling of magma outflows, intrusion of dolerite dykes and other geological forces. Generally the harder rocks (banded ironstone, jaspilite and lava) fracture more easily under stress to form superior aquifers compared to the softer sediments such as shaleand mudstone, which rather deform than fracture under stress.

Someunconfined intergranularaquifers (also known as primary aquifers) also occur in and near the main drainage channelof the area at Groenwater station northwest of Humansrus. Here the groundwater levels are shallow and within the unconfined unconsolidated alluvial sediments and weathered zone. The alluvial deposits in this area are normally limited in the vertical and horizontal extend and form pockets of clay, silt, sand and pebbles. All these result in a poorly developed primary aquifer that is very vulnerable to droughts.

3.3.2 HydrocensusResults

The hydrocensus results are summarized in **Table 3**(page 12) with the localities of these boreholes indicated in **Figure 6**. Forty-oneboreholes and onespring were surveyed on the Farm Humansrus and its surrounds.

Four anomalously high yielding boreholes were located in the area, i.e. boreholes HS2, GR10, GR11 and GR12. These boreholes are located on the two graben-faults in the area with boreholes GR10, GR11 and GR12 on the western fault and borehole HS2 on the eastern fault. Borehole HS2 intersected highly fractured lava and tillite, as evident from drill cuttings around the borehole. It was reportedly yield tested by a Mr Scholtz at 40 L/s. However, during removal of the test pump, it got stuck in the borehole at 60 mbgl, probably as a result of the borehole collapsing due to an insufficient length of casing been inserted. This borehole cannot be used and a new borehole needs to be drilled adjacent to it for production purposes, if required. Borehole HS4, which is also located on or close to the eastern fault, has a maximum immediate yield of only 0.3 L/s. (*Note: In the previous report the maximum yield of this borehole was indicated at 1 L/s, but the yield testing suggests a maximum immediate yield of only 0.3 L/s. The borehole is also 74 m deep compared to the 54 m reported by the owner. These discrepancies emphasize the erroneousness of geohydrological data supplied by property owners*).It is believed that this borehole was not drilled deep enough to intersect the main fault and hence the relatively low yield. Borehole GR11 is a replacement borehole drilled for borehole GR10 and is ~5 m from the latter. This borehole and borehole GR12 were previously used to irrigate ~25 ha of lucerne.

The average yield of the surveyed boreholes is 4.6 L/s. This value is skewed by a few anomalously high yielding boreholes. Therefore, the median borehole yield of 1.4 ℓ/s gives a much better indication of the yield that can be expected from a successful borehole drilled in this area. Boreholes drilled to intersect the graben faults could be much higher yielding, possibly 20 ℓ/s to as high as 40 ℓ/s.

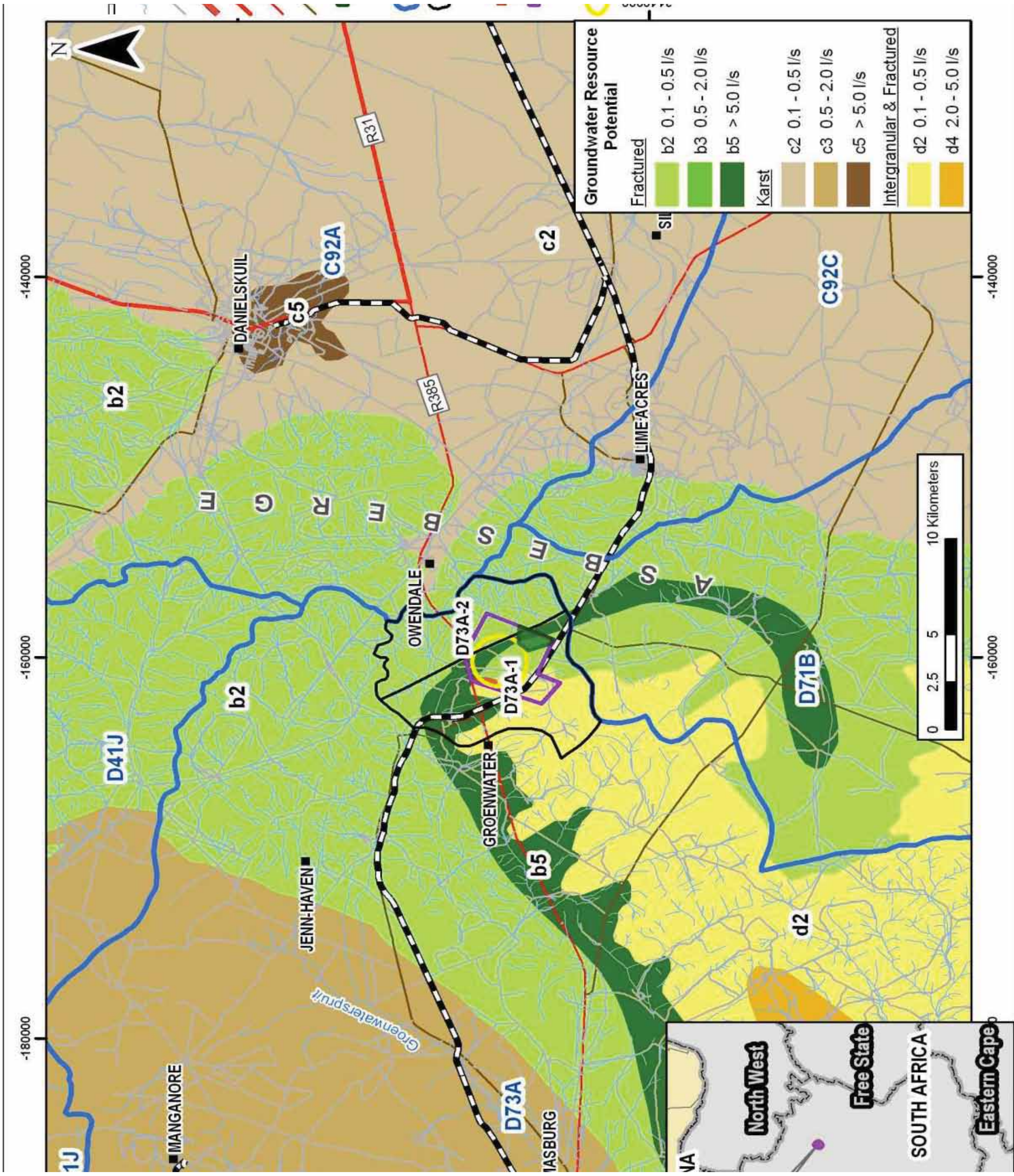


Figure 5: Aquifer type and yield potential in the Humansrus area (after the DWA 1:500 000 scale hydrogeological map series data)

Table 3: Summary of hydrocensus results of theHumansrus area.

Bh Nr	Date	Latitude	Longitude	Eleva-tion (mamsl)	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Pump intake (mbgl)	Use	pH	EC (mS/m)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Land Reform												
GR1	15-Jul-11	-28.29228	23.31879	1499	73	4.0	19.00	None		Domestic			G47253, Pump removed
GR10	15-Jul-11	-28.28773	23.34227	1476		20.0	5.87	None					
GR11	15-Jul-11	-28.28773	23.34225	1477	60	20.0	7.05	None					Replacement bh for GR10
GR12	15-Jul-11	-28.27770	23.33874	1467	28	10.0	2.12	None					
GR13	15-Jul-11	-28.25558	23.32697	1458	0		0.00	None		Irrigation	7.22	132	Spring
GR14	15-Jul-11	-28.25672	23.33109	1461	9			WP 100mm cylinder	5	Domestic, Stock	7.70	33	Closed
GR15	15-Jul-11	-28.27567	23-Jan-00	1488	91		19.49	None					
GR16	15-Jul-11	-28.26194	23-Jan-00	1495	73		18.79	WP 75mm cylinder		Stock	7.45	43	
GR17	15-Jul-11	-28.25250	23-Jan-00	1493	52			WP 60mm cylinder		Stock	7.37	61	
GR2	15-Jul-11	-28.29878	23.31550	1496	60			50mm Mono		Domestic			Pump out of order, Closed
GR3	15-Jul-11	-28.28208	23.31056	1485	64	3.5	29.11	40mm Submersible	55	Domestic	7.90	97	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	15-Jul-11	-28.27552	23-Jan-00	1479	32	0.3	27.59	None					Tested by SRK in 2007, Likely partially collapsed
GR5	15-Jul-11	-28.27740	23.30551	1463	50	4.1	17.33	None					Tested by SRK in 2007
GR7	15-Jul-11	-28.27743	23.30550	1464	78	1.4	17.07	None					Drilled by SRK 2008, Blow yield
GR8	15-Jul-11	-28.27703	23.33501	1470	11			Handpump					Closed
GR9	15-Jul-11	-28.27719	23.33510	1471	15		4.00	40mm submersible					Out of order
Farm:	Humansrus - Owner: Mr. Allen Scholtz												
HS1	14-Jul-11	-28.27903	23.36406	1491	50	1.8	27.27	40mm Submersible	45	Domestic, Stock	7.15	52	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	14-Jul-11	-28.27681	23.36466	1467	107	40.0	28.02	None					Water strike at 98 mbgl Fractured lava and tillite
HS3	14-Jul-11	-28.28088	23.36538	1493	36	0.2		None					Roots at 10 mbgl
HS4	14-Jul-11	-28.29156	23.37531	1530	74	0.3		WP 90mm cylinder	48	Stock	7.90	54	Bees in borehole, tested yield
HS5	14-Jul-11	-28.32079	23.35028	1525	54	1.8	18.27	WP 90mm cylinder	42	Stock			Out of order, Water flows in @ 10 mbgl
HS6	14-Jul-11	-28.28322	23.39720	1627	210	0.5		None					Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk												
SE1	14-Jul-11	-28.32690	23.36535	1519	84	3.6		WP 65mm cylinder	45	Stock			Baseplate closed
SE10	14-Jul-11	-28.32897	23.37159	1515	60	2.5		None					Collapsed at 6.8 mbgl
SE2	14-Jul-11	-28.32920	23.36567	1521	24	0.3		WP 65mm cylinder	24	Stock			Baseplate closed
SE3	14-Jul-11	-28.32963	23.36553	1522	33	0.5	17.00	WP 65mm cylinder	30	Domestic, Stock			
SE4	14-Jul-11	-28.32989	23.36586	1522	35	1.0		40mm Submersible	30	Domestic, Stock	7.23	90	Baseplate closed
SE5	14-Jul-11	-28.32921	23.36266	1516	35	1.9		WP 100mm cylinder	18	Stock			Baseplate closed
SE6	14-Jul-11	-28.33779	23.35252	1567	150	0.3	73.44	WP 65mm cylinder	81	Stock	7.70	70	Water strike at 75 mbgl
SE7	14-Jul-11	-28.32590	23.34681	1534	15	0.1	12.35	Solarpump	14	Stock	7.90	59	Alt Nr GW9
SE8	14-Jul-11	-28.32722	23.34662	1537	30	0.0		None					Dry
SE9	14-Jul-11	-28.32923	23.37240	1516	60	4.2		None					Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk												
CN1	15-Jul-11	-28.32497	23.39030	1506			31.71	WP 60mm cylinder	39	Domestic			
CN2	15-Jul-11	-28.32503	23.38942	1535				50mm Mono	42	Domestic, stock	6.85	32	Closed, Pump yield = 0.9 ℓ/s
CN3	15-Jul-11	-28.32493	23.38938	1535		0.3	29.65	None					
CN4	15-Jul-11	-28.32333	23.38965	1541			32.46	WP 60mm cylinder	36	Stock			
CN5	15-Jul-11	-28.32609	23.38891	1534		0.7	25.79	None					Was equipped with 40mm Subm., Intake @ 45m
CN6	15-Jul-11	-28.32919	23.38791	1528			19.31	None					
CN7	15-Jul-11	-28.32916	23.38609	1523		0.9	12.22	None					Blocked 0.2m below water level
CN8	15-Jul-11	-28.32973	23.38429	1526				None					Blocked at 16.7 mbgl, Dry
CN9	15-Jul-11	-28.33991	23.38789	1517			9.27	WP 60mm cylinder	21	Stock	7.25	51	
CN10	15-Jul-11	-28.34507	23.38803	1514			9.18	WP 60mm cylinder	24	Stock	7.20	59	
					Average	4.6					7.4	64	
					Median	1.4					7.4	59	

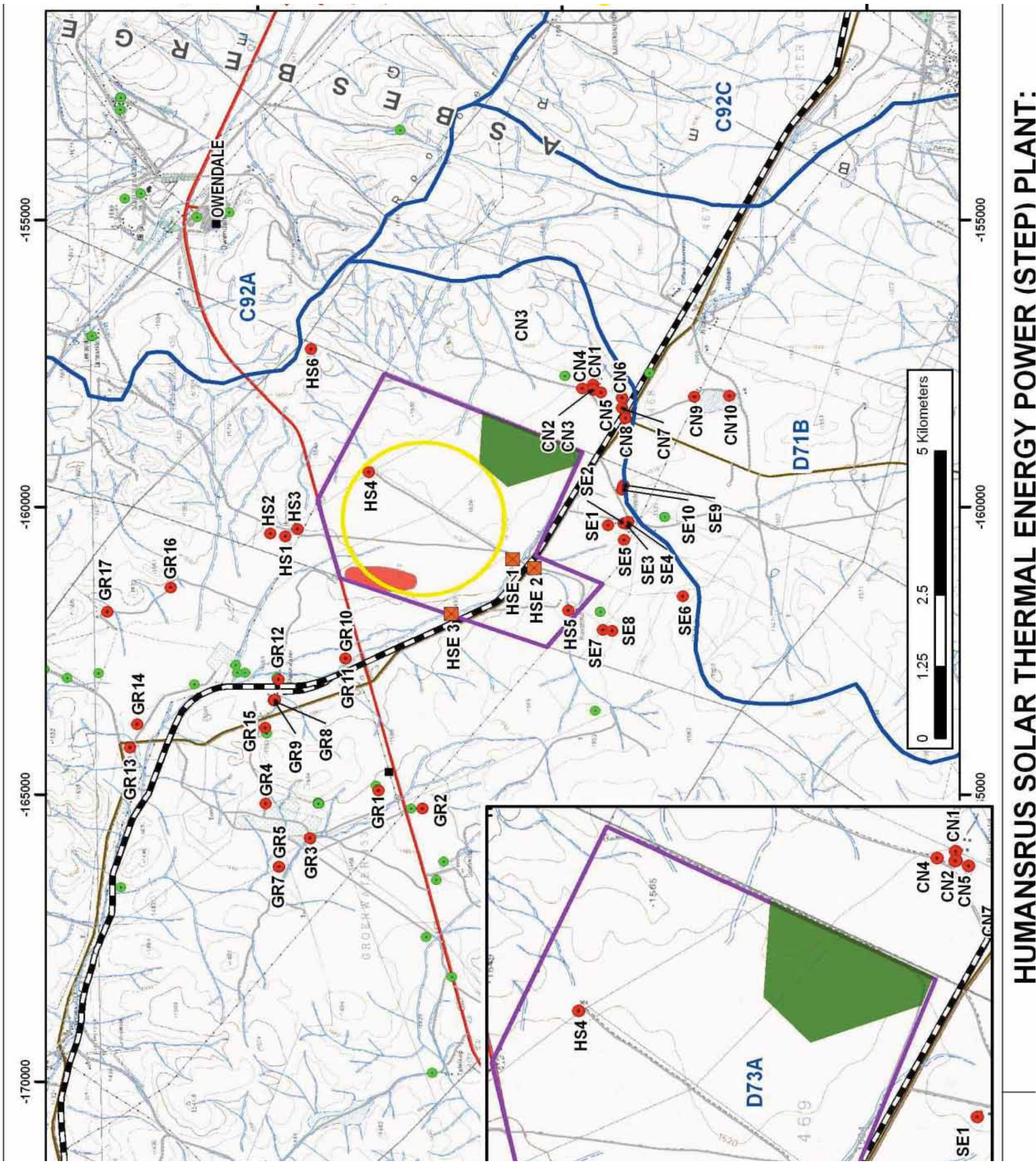


Figure 6: Localities of surveyed boreholes in the Humansrus area

3.3.3 Current Abstraction

The estimated abstraction from the Farm Humansrus and the surrounding areas is summarised in **Table 4** page16. In the case of electric pumps, the estimates are based on pump yields and daily operating hours as reported by the owners. For windpumps a 24 hr/d operation at 12% of the maximum yield was assumed (which is determined by the cylinder size). This assumption is based on the author's personal experience in the Karoo area. Based on these assumptions a total abstraction of approximately 104 000 m^3/a iscalculated for the study area. Nearly 66% (~68 000 m^3/a) of this volume is abstracted in the Groenwater rural area, of which ~54% is for domestic use and 46% (31 500 m^3/a) spring flow at GR13.

No large scale irrigation currently takes place in the area and most of the abstracted groundwater is used for stock watering and domestic use. However, groundwater was previously abstracted from

boreholes GR11 and GR12 at a rate of ~180 000 m^3/a to irrigate 25 ha of lucerne. This abstraction continued for several years and only ceased after this portion of Groenwater was bought by the Department of Rural Affairs and Land Reform (pers. Comm. Mr.Scholtz).

3.3.4 Groundwater Resource Potential

The Humansrus area falls within Quaternary Drainage RegionD73A (see **Figure 4** and**Figure** 6) for which the amount of water available under General Authorisation is listed under Zone A of the Groundwater Taking Zones, where no water may be taken from this drainage regions except as set out under Schedule 1[1] and small industrial users[2] (DWAF, 2004).Therefore, if the water demand is to be satisfied from groundwater resources a WULA will have to be submitted.

TwoGRUs were defined for this area. These are based on surface drainage, measured groundwater elevations and lineaments such as faults and dykes. The boundaries of these GRUs are indicated in **Figure 4**. The GRA2 grid datasets (DWAF, 2005) were used to derive the MAP, effective recharge and groundwater resource potential for these GRUs. As boreholes cannot capture all the available recharge in an area, an exploitability factor (DWAF, 2005) was used to calculate the volume of groundwater that can actually be abstracted through boreholes. Current abstraction based on the hydrocensus data was subtracted from this value to determine the current Groundwater Exploitation Potential. These calculated values are summarised in **Table 5**on page 17.

[1] Not taking more than 10 cubic metres from groundwater on any given day.

[2] •"Small industrial users" mean water users who qualify as work creating enterprises that do not use more than twenty cubic metres per day (i.e. 20 000 litres/day) and identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented, under the following categories:-

a) 1: food processing;
b) 2: prospecting, mining and quarrying;
c) 3: manufacturing;
d) 5: construction

Table 4: Estimated groundwater abstraction in the Humansrus area

Bh Nr	Depth (mbgl)	Max Yield (ℓ/s)	Water level (mbgl)	Equipment	Use	Estimated Annual Abstraction (m^3)	Comments
Farm:	Groenwater - Owner: Dept of Rural Affairs and Lan				TOTAL	68,223	
GR1	73	4.0	19.00	None	Domestic	11,000	Pump removed, Abstraction was ~11,000 m^3/a
GR10		20.0	5.87	None			
GR11	60	20.0	7.05	None			Previous abstraction 120,000 m^3/a
GR12	28	10.0	2.12	None			Previous abstraction 60,000 m^3/a
GR13	0		0.00	None	Irrigation	31,500	Spring - rough estimate - difficult to measure flow
GR14	9			WP 100mm cylinder	Domestic, Stock	3,406	Closed
GR15	91		19.49	None			
GR16	73		18.79	WP 75mm cylinder	Stock	1,514	
GR17	52			WP 60mm cylinder	Stock	1,135	
GR2	60			50mm Mono	Domestic	7,900	Pump out of order, Previously pumped at ~7,900 m^3/a
GR3	64	3.5	29.11	40mm Submersible	Domestic	11,038	Pumping water level, Pump yield = 0.7 ℓ/s
GR4	32	0.3	27.59	None			Tested by SRK in 2007, Likely partially collapsed
GR5	50	4.1	17.33	None			Tested by SRK in 2007
GR7	78	1.4	17.07	None			Drilled by SRK 2008, Blow yield
GR8	11			Handpump		730	Closed
GR9	15		4.00	40mm submersible			Out of order - not used anymore
Farm:	Humansrus - Owner: Mr. Allen Scholtz				TOTAL	17,082	
HS1	50	1.8	27.27	40mm Submersible	Domestic, Stock	10,512	Pump yield = 1.6 ℓ/s, Alt Nr GW1
HS2	107	40.0	28.02	None			Water strike at 98 mbgl Fractured lava and tillite
HS3	36	0.2		None			Roots at 10 mbgl
HS4	54	0.3		WP 90mm cylinder	Stock	6,570	Bees in borehole, tested yield
HS5	54	1.8	18.27	WP 90mm cylinder	Stock		Out of order, Water flows in @ 10 mbgl
HS6	210	0.5		None			Water level >100 mbgl, Was pumped at 180 mbgl
Farm:	Sunnyside - Owner: Mr. Andries de Klerk				TOTAL	10,549	
SE1	84	3.6		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE10	60	2.5		None			Collapsed at 6.8 mbgl
SE2	24	0.3		WP 65mm cylinder	Stock	1,135	Baseplate closed
SE3	33	0.5	17.00	WP 65mm cylinder	Domestic, Stock	1,135	
SE4	35	1.0		40mm Submesible	Domestic, Stock	1,971	Baseplate closed
SE5	35	1.9		WP 100mm cylinder	Stock	3,406	Baseplate closed
SE6	150	0.3	73.44	WP 65mm cylinder	Stock	1,135	Water strike at 75 mbgl
SE7	15	0.1	12.35	Solarpump	Stock	631	Alt Nr GW9
SE8	30	0.0		None			Dry
SE9	60	4.2		None			Collapsed at 8 mbgl
Farm:	Clifton - Owner: Mr. B.J. van Niekerk				TOTAL	8,089	
CN1			31.71	WP 60mm cylinder	Domestic	1,135	
CN2				50mm Mono	Domestic, stock	3,548	Closed, Pump yield = 0.9 ℓ/s
CN3		0.3	29.65	None			
CN4			32.46	WP 60mm cylinder	Stock	1,135	
CN5		0.7	25.79	None			Was equipped with 40mm Subm., Intake @ 45m
CN6			19.31	None			
CN7		0.9	12.22	None			Blocked 0.2m below water level
CN8				None			Blocked at 16.7 mbgl, Dry
CN9			9.27	WP 60mm cylinder	Stock	1,135	
CN10			9.18	WP 60mm cylinder	Stock	1,135	
					TOTAL FOR STUDY AREA	103,942	

Table 5: Groundwater exploitation potential of the Humansrus area

Groundwater Resource Unit	Area (m^2)	Area (km^2)	No. of cells	MAP (mm/a)	Recharge Factor (%)	Average Mean Annual Recharge		Groundwater Exploitation Potential (m^3/a)		Volume of Water stored in Aquifer (m^3/a)	5m Drawdown Storage Volume (m^3/a)
						(m^3/a)	(mm/a)	Wet Season	Dry Season		
Quaternary Catchment											
D73A	1,558,947,048	1,558.95	63,737	407	2.10%	23,021,400	8.6	19,554,500	15,472,300	333,785,000	25,459,600
Groundwater Resource Units (GRU's)											
D73A-1	42,490,000	42.49	4,249	476	2.00%	627,462	9.4	437,116	325,853	9,097,502	693,916
D73A-2	27,820,000	27.82	2,782	487	2.00%	410,826	9.9	340,868	268,020	5,956,520	454,336
TOTAL						***1,038,287***		***777,984***	***593,873***	***15,054,022***	***1,148,252***
Humansrus CSP Development Area											
Development Area	13,560,000	13.56	1,356	488	2.10%	200,244	10.1	170,089	134,581	2,903,322	221,452

The GRA2 data indicate that the HumansrusGRU (D73A-1) has an estimated average mean recharge of approximately 627 000 m^3/a, i.e. 2% of the MAP of 476 mm. The mean annual recharge in the Humansrus area is shown in **Figure 7** page 18. The groundwater exploitation potential was calculated to vary from 326 000 m^3/a for dry seasons to 437 000 m^3/a for wet seasons, i.e. a mean of approximately 381 000 m^3/a. The volume of groundwater that is potentially stored in the aquifers of the HumansrusGRU has been calculated as approximately 9.1 million m^3.

Based on information supplied by SSI, the maximum water demand of any of the three types of STEP Plants that is under consideration, is 246 200 m^3/a, for the Hybrid Cooled Zero Discharge Plant.

Hourly water demand ranges from 41.5 m^3/h (11.53 L/s) under full load to 8.35 m^3/h (2.32 L/s) during offtimes. *Note: For this study, as a worst case scenario, this maximum demand figure was used for comparison to the sustainable amount of water available for exploitation*.

Comparing this maximum water demand (worst case scenario) to the exploitation potential of the HumansrusGRU (D73A-1), it is evident that this demand is well within (65%) the long term yield capacity of the aquifers of the GRU.

3.3.5 Depth to Water Table and Inferred Groundwater Flow Directions

Depth to water table at Humansrus varies from 18 to 28 mbgl.

The hydrocensus data and data from the NGDB were used to plot the groundwater elevations on the topgraphical map, from which the groundwater flow directions were inferred (**Figure 8**). The groundwater elevations normally mimic the surface elevation contours indicating unconfined conditions and generally flows from higher lying to lower lying areas. The inferred flows are from the surrounding high lying flanks of the valley towards the centre lower lying floor of the valley at Humansrus and then along the valley towards the north-west. These groundwater elevations indicate that the southern part of the surveyed area (i.e. the farm Clifton and part of the farm Sunnyside) falls outside the HumansrusGRU in another drainage region (D71B).

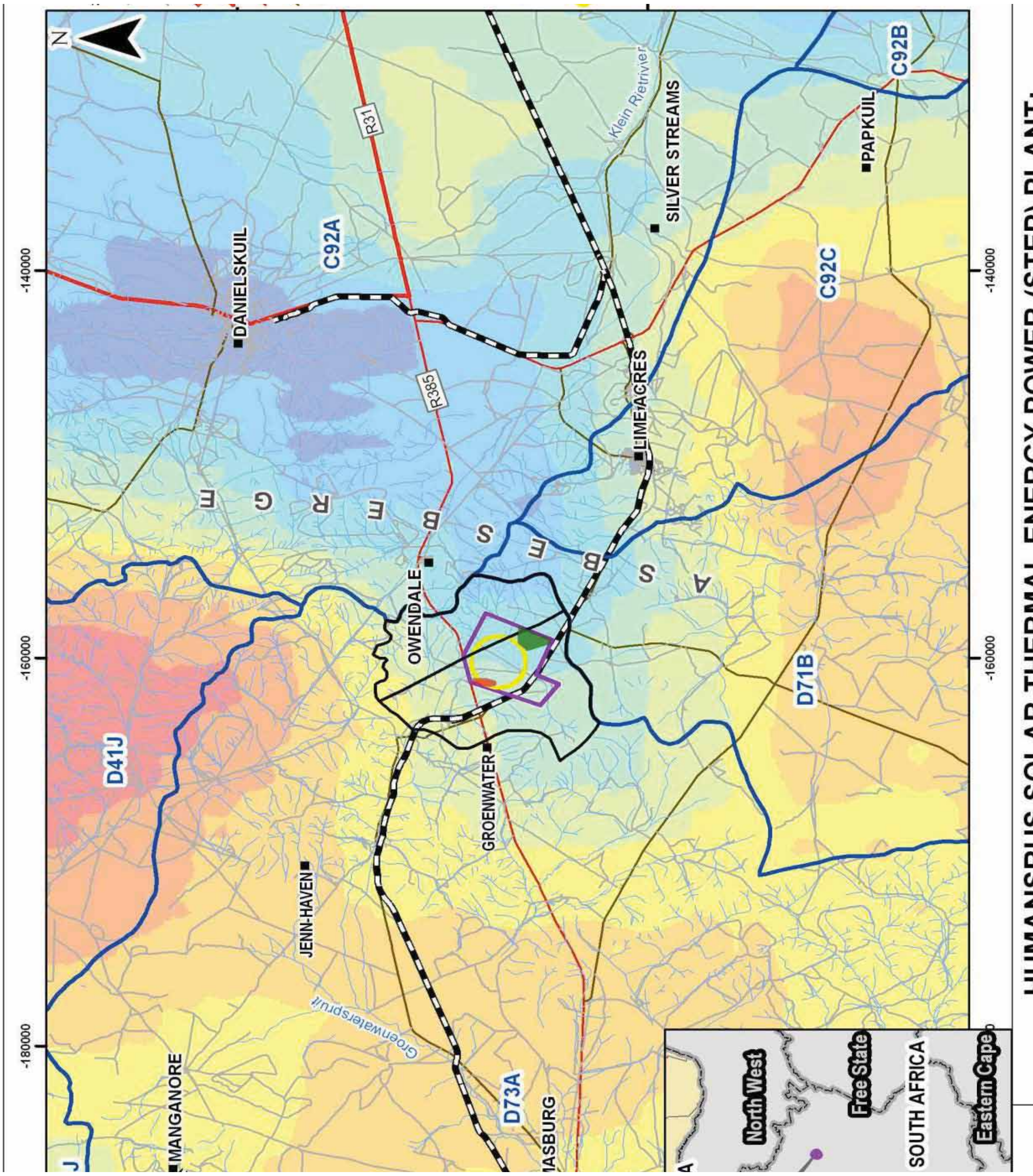


Figure 7: Mean annual recharge in the Humansrus area

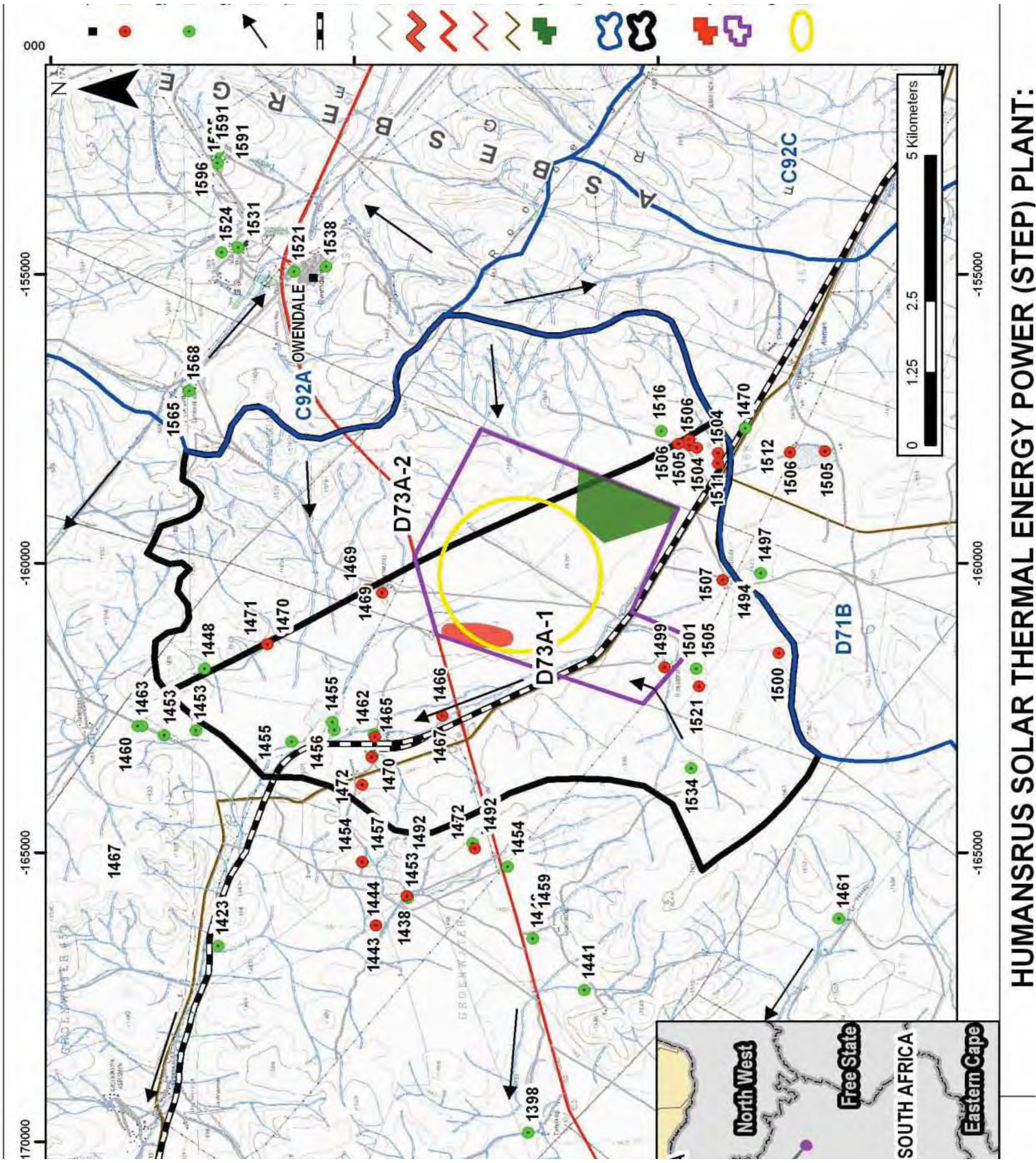


Figure 8: Groundwater elevations and inferred flow directions in the Humansrus area

3.3.6 Groundwater Quality

The groundwater salinity (expressed as Electrical Conductivity in mS/m) of the Humansrus area is shown in **Figure 9** (page 21). Groundwater quality varies throughout the area with the best quality occurring in the recharge areas, i.e. the jaspilite and banded ironstone hills in the eastern and northern parts of the study area. However, the groundwater quality throughout the area is generally good and based on the field measured Electrical Conductivity's (EC), which ranged between 32 and 132 mS/m (mean EC = 64mS/m), suitable for human consumption[3]. Noticeable anomalies in the field measured ECs were recorded near potential pollution sources (e.g. stock pens) in areas with shallow water levels.

[3] ≤150 mS/m is acceptable for long term human consumption (SABS, 2006)

This indicates that the aquifers are easily polluted by surface pollution sources due to a rapid recharge and relative quick vertical infiltration.

The average EC and pH values of the surveyed boreholes are 64 mS/m and 7.4, respectively, and correlate well with the median values. This means that there are no highly anomalous values for these parameters which skew the average values. Borehole GR14 and the spring GR13 are in the same area with largely different EC values. The relatively high EC measured at the spring can likely be attributed to surface pollution from animals congregating at this open stock watering source. Boreholes GR14 and CN2 are drilled into the Daniëlskuil Member (jaspilite) of the Asbestos Hills Formation and yield groundwater with very low EC values. The Asbestos Hills Formation in this area is characterized by a very good groundwater quality.

3.3.7 Aquifer Vulnerability

Figure 10shows aquifer vulnerability as determined by evaluating seven standard parameters, namely:

- Depth to groundwater;
- Recharge;
- Aquifer media;
- Soil media;
- Topography;
- Impact on vadose zone; and
- Hydraulic conductivity.

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer. The aquifers at Humansrus are classified as having low to very high vulnerability to contamination. The lowest vulnerability is the south-western part of the farm with the highest in the north-eastern and eastern parts, i.e. the areas close to the large fault zone. In view of this aquifer vulnerability, care should be taken to establish the facilities with the highest contamination risk, e.g. the evaporation ponds, as far as possible from the high risk areas in the north and east. The best position will be in the south-western parts of the farm where the aquifer vulnerability is lowest.

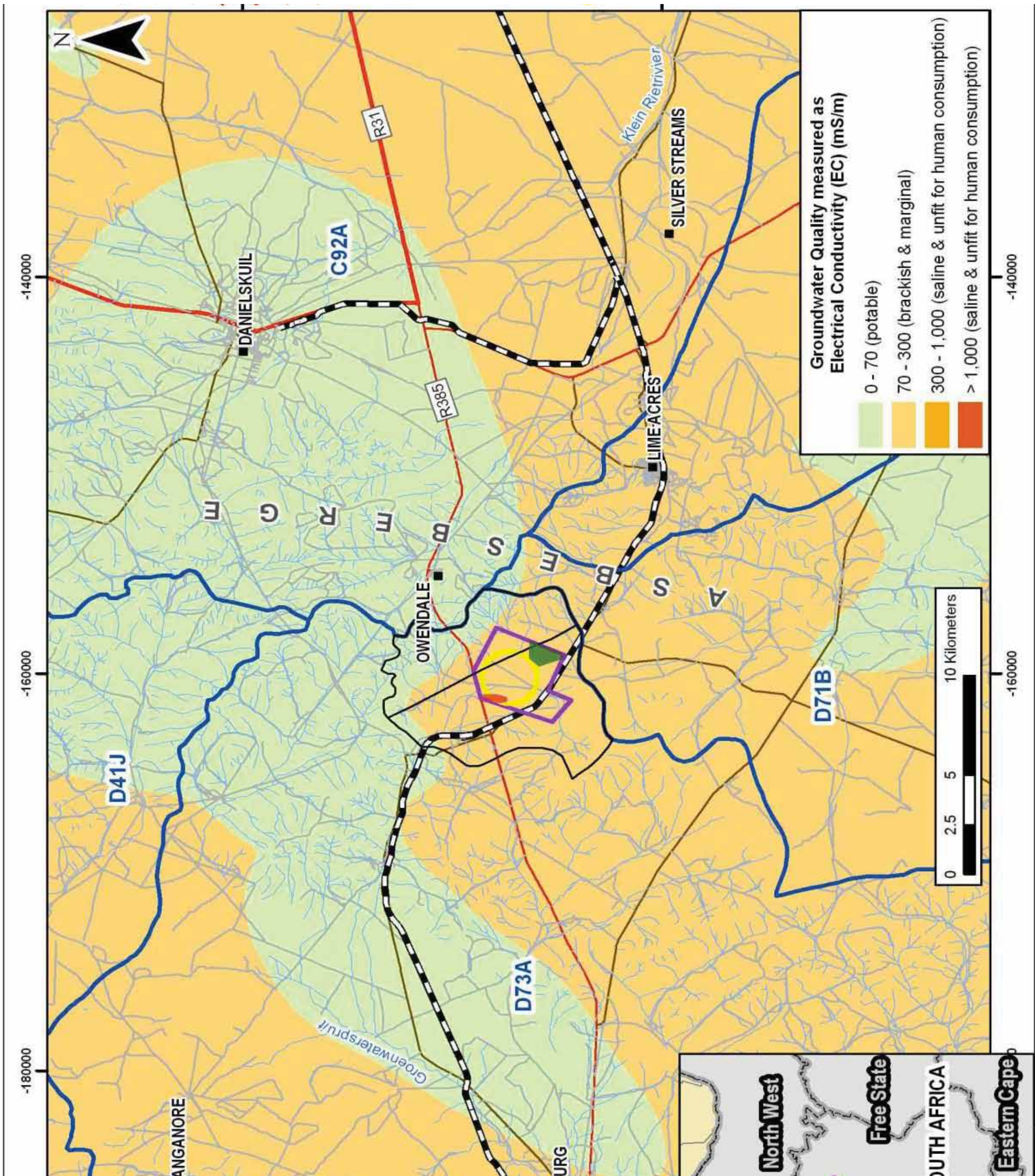


Figure 9: Groundwater salinity in the Humansrus area

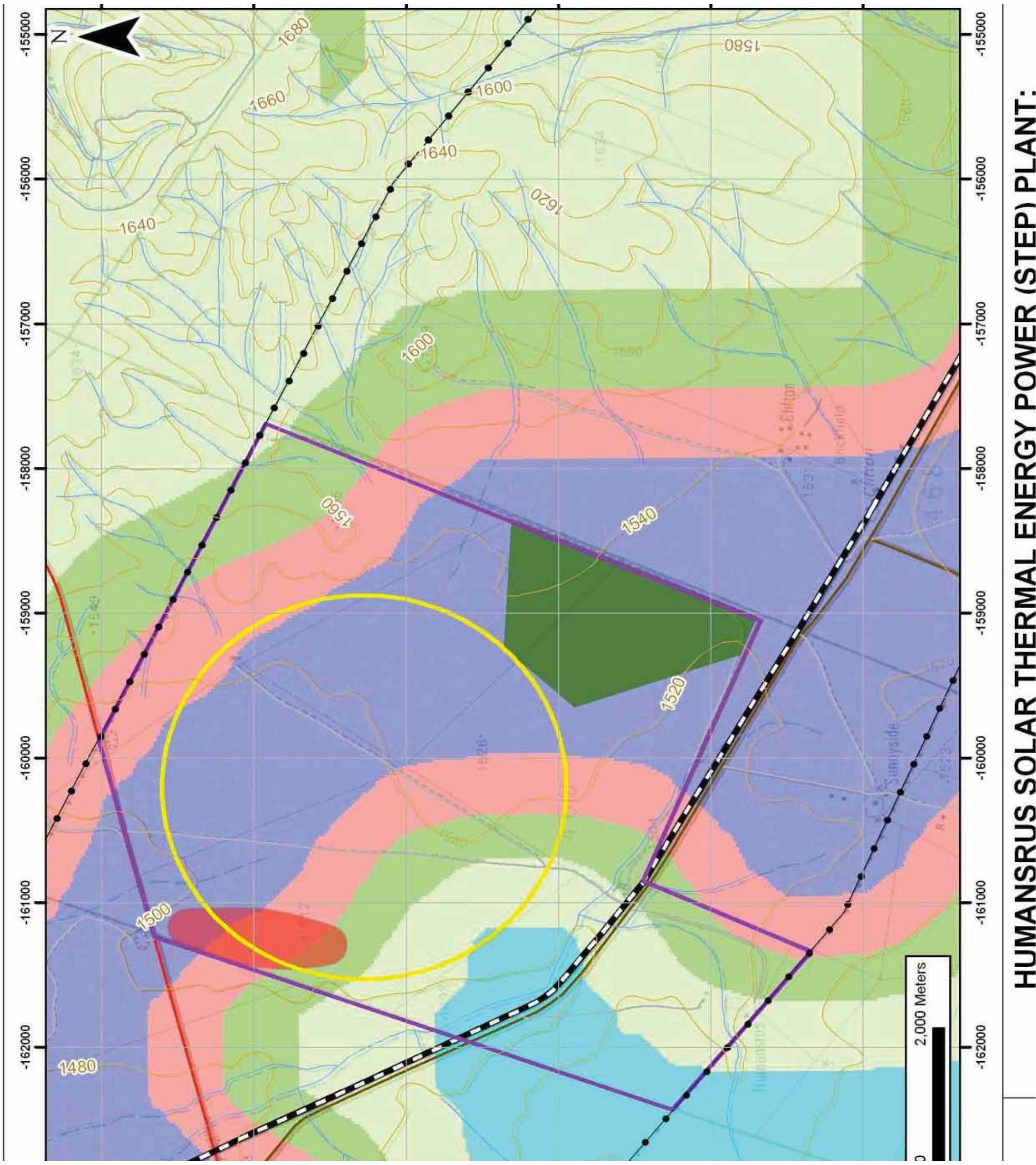


Figure 10: Aquifer vulnerability map of the Humansrus area

3.4 Drilling Results

Three exploration boreholes were drilled by the drilling contractor GEP van Rensburg in the area of the proposed evaporation ponds during the period 17 to 19 August 2011. These boreholes were drilled for monitoring purposes and to obtain more information about the hydrogeology and aquifer parameters of the area. The proposed evaporation ponds will be on the western part of the STEP plant site and relative close to the western grabenfault. **Table 6** below summarizes the drilling results with the localities of the boreholes are indicated in **Figure 6**. The complete borehole logs are included in **Appendix A** at the end of this report.

Table 6: Summary of drilling results obtained at Humansrus

Borehole No	COORDINATES		Elevation (mamsl)	Depth (mbgl)	Nominal Diameter (mm)	Water Strikes (m.bgl.)	Casing	Final Blow Yield (ℓ/s)	Water Level (mbgl)	EC (mS/m)	pH
	Latitude	Longitude									
HSE1	-28.31267	23.35948	1505	48	165	16	6m x 165mm plain steel	Seep			
HSE2	-28.31585	23.35790	1504	36	165	16-19, 20-22	24m x 165mm steel; Perforated 18-24m	3.40	12.57	123	7.39
HSE3	-28.30349	23.34995	1490	60	165	18, 30, 42, 45, 51	18m x 165mm plain steel	3.80	13.16	108	7.52

Borehole HSE1 was drilled ~100 m south-west of the south-western corner of proposed evaporation pond candidate site 1 (EPCS1). EPCS1 is located in the south-western part of the area and immediately east of the railway line and ~100 m north-east of the south-western graben fault structure running towards Lime Acres. EPCS1 occurs in area with a Medium 3 to Medium 4 groundwater vulnerability classification on the groundwater vulnerability map (**Figure 10**). However, borehole HSE1 was drilled to a final depth of 48 mbgl and only intersected groundwater seepage at 16 mbgl. No groundwater was airlifted during the drilling and the drill cuttings were only damp after changing of the drill stems. A thin layer of reddish brown topsoil was intersected, followed by jointed and fractured lava to 9 mbgl and fresh lava thereafter. The jointed and weathered lava intersected from 7 to 9 mbgl was argillaceous, which will restrict vertical water infiltration from surface. The rest groundwater level is estimated to be between 12 and 14 mbgl. This is based on the groundwater levelof nearby borehole HSE2. The groundwater level of borehole HSE1 was measured at 40.74 mbgl 26 hours after completion thereof, which indicates an extremely slow inflow of groundwater into the borehole. This means that this site is very well suited for the evaporation ponds due to the insignificance of the aquifer and the clay layer that protects the aquifer from surface pollution.

Borehole HSE2 was drilled on the western graben fault as interpolated from satellite imagery and approximately 390 m south-west of borehole HSE1. No fractured outcrops were visible in the area as it is largely covered by topsoil and silt. However, some scattered quartz fragments were noticed in the area. This borehole intersected 1 m of topsoil followed by fractured and weathered lava to 22 mbgl and jointed lava with quartz veining thereafter to the final depth of 36 mbgl. Groundwater was intersected from 16 to 22 mbgl with a final airlift yield of 3.4 ℓ/s (see **Figure 11**). The field measured EC and pH were 123 mS/m and 7.39, respectively. Immediately after completion of the borehole the groundwater level was measured at 14.37 mbgl and it was 12.57 mbgl prior to the yield testing.

Figure 11: Borehole HSE2 airlift yield.

Borehole HSE3 was drilled on the extrapolated western graben fault and very close to the north-western boundary of the property. It is approximately 1.5 km downstream of EPCS1. This borehole intersected fractured and weathered lava from surface to 16 mbgl, followed by partially weathered and jointed lava to 30 mbgl and fresh solid lava to 40 mbgl. Jointed lava was again intersected from 40 - 50 mbgl and fractured lava from 50 – 52 mbgl. Partially weathered and jointed lava with calcite veining was thereafter intersected to the final depth of 60 mbgl. Groundwater seeps were intersected at 18 and 30 mbgl and minor groundwater intersections at 42 and 45 mbgl. At 45 mbgl the airlift yield was only 0.3 ℓ/s. A major groundwater strike occurred at 51 mbgl where the airlift yield increased to 3.8 ℓ/s. Air lifted groundwater from this zone was very muddy with a dark grey colour (see **Figure 12).** The bottom section from 40 mbgl to the end of the hole is believed to represent the fault zone.

All the exploration boreholes were properly sealed and capped as indicated in **Figure 13**to prevent surface contamination of groundwater and vandalism of the borehole. The concrete block extends ~500mm below ground level and a sanitary seal consisting of a bentonite plug is installed directly beneath it.

Figure 12: Main water strike at borehole HSE3

Figure 13: Concrete block and sealing cap installed at exploration boreholes

3.5 Yield Testing Results

Boreholes HSE2, HSE3, HS2 and HS4 were yield tested during the period 31 August 2011 to 6 September 2011. The yield test data were analyzed by using an Excel-based software package developed by Van Tonder et al (2002). In the software package various methods such as the Flow Characteristic method (FC-method), porous aquifer solutions (Theis, Cooper-Jacob and Hantush methods) and fractional pumping test analysis (Barkers Generalised Radial Flow Model) were used to estimate a risk-based sustainable yield for the borehole as well as aquifer parameters such as transmissivity (T) and the storage coefficient (S). In the analyses the following aquifer input parameters were used:

- Effective recharge of 9.6 mm per annum.
- Data were extrapolated for 15 years.

Available drawdown for each borehole was determined by the inflection point, where the rate of drawdown increases when plotted on a semi-log scale. The yield test analyses are summarized in **Table 7** below whilst the yield test data, diagnostic plots and sustainable yield analyses are included in **Appendix2**to**Appendix 4**.

Table 7: Summary of yield test analyses

Bh No	Depth (mbgl)	Rest Water Level (mbgl)	Available Draw Down (m)	Fractal Dimen-sion	Log Derivative	FC-Method Sustainable Yield		Recovery Time (min)	Constant Discharge (L/s)	Duration of CDT (min)	Recovery Safe Yield (m^3/d)	Recovery Safe Yield (L/s @ 24h/d)	Ave S	Ave T (m^2/d)
						L/s @ 24h/d	m^3/d							
HSE2	**37.02**	**13.90**	**5**	**1.98**	**0.40**	**1.20**	**104**	**4,320**	**5.03**	**4,320**	**217.30**	**2.52**	**3.68E-03**	**65**
HSE3	**61.37**	**13.62**	**26**	**2.10**	**0.18**	**0.50**	**43**	**5,000**	**1.07**	**4,320**	**42.85**	**0.50**	**1.67E-03**	**3**
HS2	**62.18**	**29.34**	**14**	**1.93**	**0.24**	**2.20**	**190**	**9,000**	**10.13**	**4,320**	**283.86**	**3.29**	**2.60E-03**	**49**
HS4	**73.72**	**32.63**	**3**	**1.30**	**0.13**	**0.05**	**4**	**360**	**0.32**	**90**	**5.53**	**0.06**	**1.12E-03**	**3**

The table indicates that the storativity value, S, is in the order of 2×10^{-3} for both fractured and fresh, solid lava (borehole HS4). However, the transmissivity (T) varies between 3 m^2/d for weakly fractured, relative fresh, lava (borehole HS4) and 65 m^2/d for fractured and weathered lava associated with fault zones (borehole HSE2). A previous yield test conducted by SRK Consulting near Groenwater village (SRK Report 396867) yielded S and Tvalues of 8.4×10^{-4} and 0.9 m^2/d, respectively, for fresh un-fractured lava and 1.11×10^{-3} and 25 m^2/d, respectively, for fractured and weathered lava associated with a fault zone. These values correlate well with the values obtained from the recent yield tests. The yield test data were also analyzed with the recovery method to obtain the long term sustainable yields of the boreholes. This method calculates the long term sustainable yield of a borehole based on the recovering data as follows:

$Q = V/((PT+RT)/1440)$, where

Q= Long term sustainable yield in m^3/d
V= Volume of groundwater abstracted during the yield test in m^3
PT= Pumping time in minutes
RT= Recovery time in minutes

These calculated values are also indicated in **Table 7**. For boreholes HSE2 and HS2 the recovery method yields a higher sustainable yield than the FC-method due to relatively quick water level recovery after pump shutdown. For boreholes HSE3 and HS4 the recovery method yields sustainable yields similar to that of the FC-method.

The fractal dimension and log derivative values indicated in the table describes the fractured zones and groundwater flow regimes. Aquifers can be classified by the log derivative values as follows:

<0.25=	Radial flow, homogeneous aquifer (very well developed fracture network, aquifer behaves like a primary aquifer with no preferred direction of groundwater flow)
0.25 - 0.50=	Good fracture network with groundwater flow more prominent in one direction than the others
>0.50=	Single fracture, limited fracture network with groundwater flow mainly in one direction along the fracture and very little or no groundwater flow perpendicular to the fracture.

The fractal dimension value indicates the type of groundwater flow as follows:

1=	Linear flow: groundwater flows mainly in one direction
1.5=	Bi-linear flow: groundwater flow is more prominent in one direction than the others
2=	Radial flow: groundwater does not flow in a preferred direction

The log derivative values indicate radial flow at boreholes HSE3 and HS4. These two boreholes do not have the best long term sustainable yields and these values merely indicate that fracturing, although limited, is developed equally in all directions. The log derivative values of boreholes HSE2 and HS2 indicate bi-linear flow with groundwater flow more prominent in one direction, along the fault zone.

The fractal dimension values indicate radial flow at boreholes HSE2, HSE3 and HS2 and linear flow at borehole HS4. This correlates with the yield test analyses which indicate that these three boreholes have the highest sustainable yields.

During the CDT test on borehole HSE2,Mr.Andries de Klerk, owner of the farm Sunnyside, complained about his private borehole SE4 pumping dry due to the yield testing. This borehole is located approximately 1 750 m upstream of the test borehole. The yield test team measured the groundwater level of this borehole at 17.23 mbgl after two days of pumping at borehole HSE2. Eight hours later the groundwater level was at exactly the same level and after another 14 hours it had declined to 18.48 mbgl. This represents a groundwater decline of 1.25 m. During the hydrocensus the groundwater level of borehole SE3 (43 m away from SE4) was 17.00 mbgl, which indicates that the first measured groundwater levels have not been affected by the abstraction at borehole HSE2. The farmer did not want the yield test team to drive on his farm road with the heavy truck and he transported the team to this borehole and back for groundwater level measurements, which explains the irregular measurements. Two days after pump shutdown the groundwater level of this borehole was again 17.23 mbgl. The anomalous value measured is believed to be a recovery water level measured shortly after the submersible pump, installed in borehole SE4, had been switched off. Due to irregular visits to this borehole, the yield test team could not verify the times when it was pumped.

Borehole HS4 has a reported maximum yield of 1 L/s and is drilled to a final depth of 54 mbgl. The pump intake of the windpump is reported at 42 mbgl. However, the yield testing indicated that the borehole is 73.7 m deep and has a maximum immediate yield of only 0.3 L/s. The pump intake was noted as 48 mbgl while removing existing equipment to yield test the borehole.

3.6 Groundwater chemistry

Groundwater samples for chemical analysis at Talbot Laboratories were collected during the hydrocensus at boreholes CN2, GR8, GR14 and SE4. During the yield testing groundwater samples were collected at all the tested boreholes as well (boreholes HSE2, HSE3, HS2 and HS4). The results of these analyses are indicated in **Table 8**.

Table 8: Groundwater chemistry of Humansrus area

BH NO:	CN2	GR8	GR14	SE4	HSE3	HSE2	HS2	HS4	SANS (241 - 2006) Specifications for drinking water		
LAB NUMBER:	13925/11	13926/11	13927/11	13928/11	15145/11	15146/11	15147/11	15148/11			
SAMPLE DATE: Determinants (in mg/l unless stated otherwise)	12-Sep-11	12-Sep-11	12-Sep-11	12-Sep-11	30/09/2011	30/09/2011	30/09/2011	30/09/2011	Class 1 (Recom. limit)	Class 2 (Max. Allowed)	Class 2 water Consumption Period, Max.a
Potassium as K mg/L	2.7	1.4	2.0	9.5	2.7	5.8	3.5	2.5	<50	50 – 100	7 years
Sodium as Na mg/L	11.0	19.0	12.0	43.0	24.0	28.0	12.0	16.0	<200	200 – 400	7 years
Calcium as Ca mg/L	22	51	26	100	51	35	51	35	<150	150 – 300	7 years
Magnesium as Mg mg/L	19	32	20	67	34	33	28	25	<70	70 – 100	7 years
Sulphate as SO4 mg/L	6.26	19.29	27.5	9.27	16	17.5	3.79	12.9	<400	400 – 600	7 years
Chloride as Cl mg/L	40	19	18	287	20	21	22	24	<200	200 – 400	7 years
Total Hardness	133	259	147	526	267	266	243	190	Not Specified - Not a health issue		
Total Alkalinity as CaCO3 mg/L	101	227	152	355	260	272	226	195	Not Specified - Not a health issue		
Nitrate as N mg/L	2.41	10.7	23.9	3.78	4.17	8.32	2.56	1.24	<10	10 - 20	7 years
Fluoride as F mg/L	0.62	0.62	0.28	0.45	0.65	0.83	0.39	0.60	<1.0	1.0 – 1.5	7 years
Iron as Fe mg/L	0.01	0.01	0.01	0.01	0.07	0.15	0.06	0.07	<0.2	0.2 – 2.0	7 years
Manganese as Mn mg/L	0.00569	0.00446	0.0271	0.00749	0.18	0.02	0.02	0.1	<0.1	0.1 - 1.0	7 years
Conductivity mS/m (25°C)	39	67	41	145	65	70	56	50	<150	>150 – 370	7 years
pH (Lab) (25°C)	6.7	7.1	7.5	7.1	7.6	7.4	7.2	7.3	5.0 – 9.5	4.0 - <5.0; >9.5 - 10.0	7 years
Total Dissolved Solids	218	362	216	716	394	386	322	278	<1000	1000 - 2400	7 years
Hexavalent Chromium (Cr^{6+})	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0011	0.0008	<0.1	0.1 - 0.5	3 months
Bromide, Br	0.3	0.4	0.2	1.1	0.1	0.1	0.1	0.1	<3	3 - 6	1 year
Arsenic, As	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	<0.01	0.01 - 0.05	1 year
Selenium, Se	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	<0.02	0.01 - 0.05	1 year
Total Chromium, Cr	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	<0.1	0.1 - 0.5	3 months
Silicon, Si	14.16	9.58	8.32	20.66	12.25	9.96	6.49	5.31	Not Specified - Not a health issue		
Boron, B	33	103	59	119	523	479	403	459	Not Specified - Not a health issue		
Orthophosphate, PO_4	0.015	0.016	0.021	0.01	0.006	0.008	0.002	0.002	Not Specified - Not a health issue		
Mercury	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	<0.001	0.001 - 0.005	3 months
Chemical oxygen demand	20	20	20	20	20	20	20	26	Not Specified - Not a health issue		
Colour	1	1	1	1	1	1	1	1	<20	20 - 50	No Limit
Soluble organic carbon	1.41	1.64	1.28	6.78	1.17	1.57	2.85	1.37	<10	10 - 20	3 months
Suspended solids	22	10	10	10	48	12	32	40	Not Specified - Not a health issue		
Turbidity	1.1	1.1	1.1	2	0.9	10.1	0.3	0.2	<1	1 - 5	No Limit
Overall Classification	1	2	3	2	2	2	1	1	Turbidity not health issue; Therefore Class1		

[a] The limits for the consumption of class 2 water are based on the consumption of 2 l of water per day by a person of mass 70 kg over a period of 70 years.

The data indicates that the groundwater is generally of a good quality, except for elevated nitrate concentrations encountered in boreholes GR8 and GR14, a high chloride concentration in borehole SE4 and relatively high levels of iron in boreholes HSE2 and HSE3. The high iron content in boreholes HSE2 and HSE3 could be a result of the casing in these boreholes being installed to below the groundwater level compared to very little casing installed in the other boreholes.Boreholes GR8 and GR14 are located downstream of the proposed STEP plant and the groundwater levels at these localities are very shallow (<4 mbgl). Therefore, these anomalous nitrate concentrations are believed to be caused by surface pollution from animals drinking at these water sources. *Note: During the hydrocensusit was noted that spilled water from the hand pump has accumulated around borehole GR8 and the nearby open dug well, which could easily pollute the shallow groundwater source.*

3.7 Conceptual Model

The drilling results and hydrocensus information were used to compile a conceptual hydrogeological cross section through boreholes HS4, HSE1 and HSE2. This cross section is indicated in **Figure 14** below. The yield test results obtained at borehole HS4 indicate that the weathered formation in this area does not extend down to the groundwater level resulting in the low immediate borehole yield. This is due to the deeper groundwater levels in the eastern part of the farm which are primarilycaused by the higher ground elevation in this area.Potential paths for contaminants to reach the groundwater are:

- The fault zones;
- The weathered lava; and
- Existing boreholes where safeguards such as sanitary seals and concrete collars have not been installed. *Note: These have been installed at the new test boreholes.*

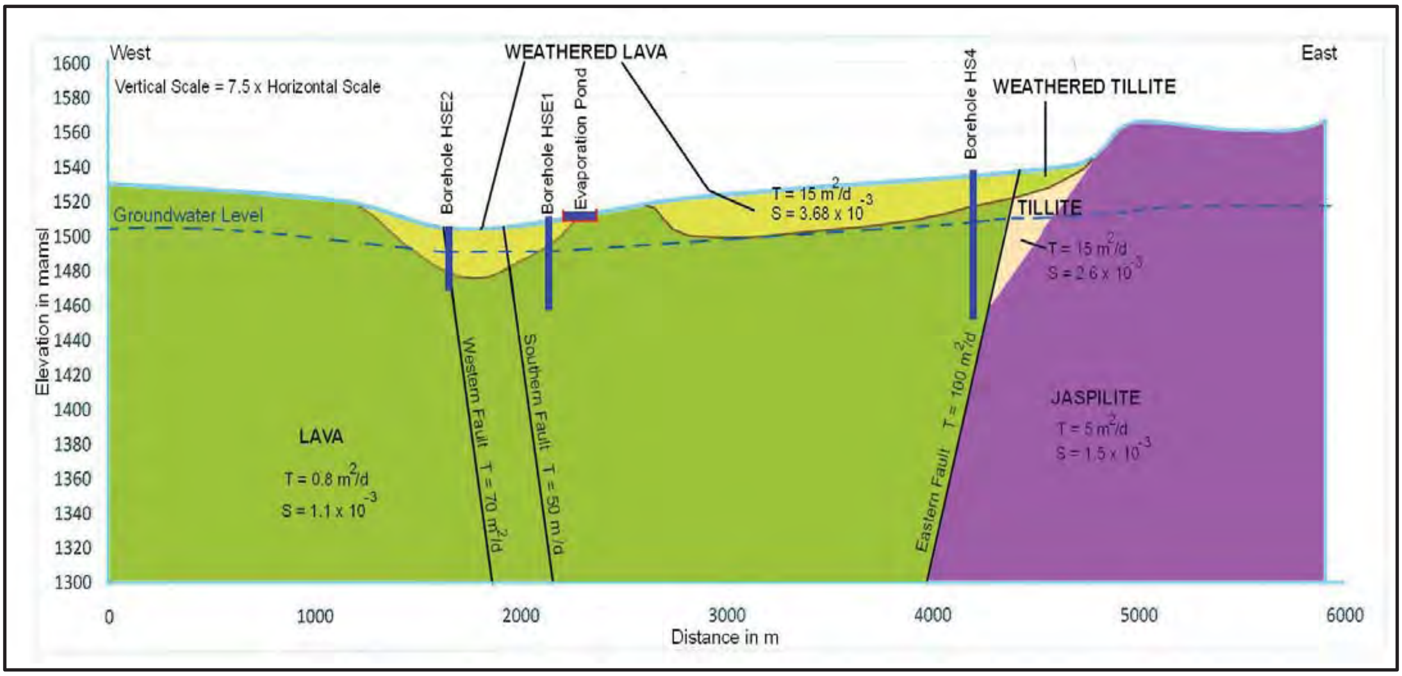


Figure 14: Geohydrological cross section across Humansrus farm

4 Numerical Groundwater Model

4.1 Introduction

The simulation of groundwater flow and transport by numerical models is a relatively recent development, dating from the early 1970s. Today numerical models dominate the study of complex groundwater problems. Numerical models basically represent an assembly of many single-cell models. Tremendous advances in computer technology have made them the standard procedure for the solution of groundwater flow and mass transport models.

The numerical model solves both complex and simple problems. Once the numerical model is completed, various scenarios can be simulated without undue effort. The dominance of the numerical models has led to the use of ‘groundwater model’ as a synonym for numerical groundwater models. The basic steps involved in modelling can be summarised as:

- Collecting and interpreting field data: Field data are essential to understand the natural system and to specify the investigated groundwater problem. The numerical model actually develops into a site-specific groundwater model when real field parameters are assigned. The quality of the simulations depend largely on the quality of the input data.
- Calibration and validation: Model calibration and validation are required to overcome the lack of input data, but they also accommodate the simplification of the natural system in the model. In model calibration, simulated values like potentiometric surface or concentrations are compared with field measurements. The model input data are altered within ranges, until the simulated and observed values are fitted within a chosen tolerance. Input data and comparison of simulated and measured values can be altered either manually or automatically.

  Model validation is required to demonstrate that the model can be reliably used to make predictions. A common practice in validation is the comparison of the model with a data set not used in model calibration. Calibration and validation are accomplished if all known and available groundwater scenarios are reproduced by the model without varying the material properties or aquifer characteristics supplied to the model.
- Modelling scenarios: Alternative scenarios for a given area may be assessed efficiently. When applying numerical models in a predictive sense, limits exist in model application. Predictions of a relative nature are often more useful than those of an absolute nature.

4.2 Assumptions and Limitations

The following conditions typically need to be described in a model:

- Geological and hydrogeological features;
- Boundary conditions of the study area (based on the geology and geohydrology);
- Initial water levels of the study area;
- The processes governing groundwater flow; and
- Assumptions for the selection of the most appropriate numerical code.

Adequate field data are essential in solving the conditions listed above and developing the numerical model into a site-specific groundwater model. Specific assumptions related to the available field data include:

- The top of the aquifer is represented by the generated groundwater heads.
- The available geological/ hydrogeological information was used to describe the different aquifers. The available information on the geology and field tests are considered as correct.
- Many aquifer parameters related to the contamination have not been determined in the field and therefore have to be estimated.

In order to develop a model of an aquifer system, certain assumptions have to be made. The following assumptions were made:

- The system is initially in equilibrium and therefore in steady state, even though natural conditions have been disturbed.
- The boundary conditions assigned to the model are considered correct.

- The impacts of other activities (adjacent agriculture) have not been taken into account.

It is important to note that a numerical groundwater model is a representation of the real system. It is therefore at most an approximation, and the level of accuracy depends on the quality of the data that is available. This implies that there are always errors associated with groundwater models due to uncertainty in the data and the capability of numerical methods to describe natural physical processes.

4.3 Generation of the Finite Difference Network

In order to investigate the behaviour of aquifer systems in time and space, it is necessary to employ a mathematical model. MODFLOW, a modular three-dimensional finite difference groundwater flow model, which was developed by the U.S. Geological Survey, is the software used during this investigation. It is an internationally accepted modelling package, which calculates the solution of the groundwater flow equation using the finite difference approach.

The mesh constructed for the site consists of 388 x 444 cells in the x and y directions, respectively. **Figure 15** is a schematic representation of the mesh. Each of the cells is 25 x 25 m. The coordinates for the modelled area are -165300, -3137700 (lower left corner) to -155600, -3126600 (upper right corner).

The model network extends over a larger area than the area under investigation to ensure that the model boundaries will not affect simulated results.

Once the network has been set up, all initial and boundary conditions, sources, sinks, and aquifer parameters are entered. A steady state calibration is then conducted to ensure the flow model has the same behaviour as the actual system under investigation.

4.4 Boundary Conditions

One of the first and most demanding tasks in groundwater modelling is that of identifying the model area and its boundaries. Consequently, a model boundary is the interface between the model area and the surrounding environment. Conditions on the boundaries, however, have to be specified. Boundaries occur at the edges of the model area and at locations in the model area where external influences are represented, such as rivers, wells, and leaky impoundments.

Criteria for selecting hydraulic boundary conditions are primarily topography, hydrology and geology. The topography, geology, or both, may yield boundaries such as impermeable strata or potentiometric surface controlled by surface water, or recharge/discharge areas such as inflow boundaries along mountain ranges. The flow system allows the specification of boundaries in situations where natural boundaries are a great distance away.

Boundary conditions must be specified for the entire boundary and may vary with time. At a given boundary section just one type of boundary condition can be assigned. As a simple example, it is not possible to specify groundwater flux and groundwater head at an identical boundary section. Boundaries in groundwater models can be specified as:

- Dirichlet (also known as constant head or constant concentration) boundary conditions
- Neuman (or specified flux) boundary conditions
- Cauchy (or a combination of Dirichlet and Neuman) boundary conditions

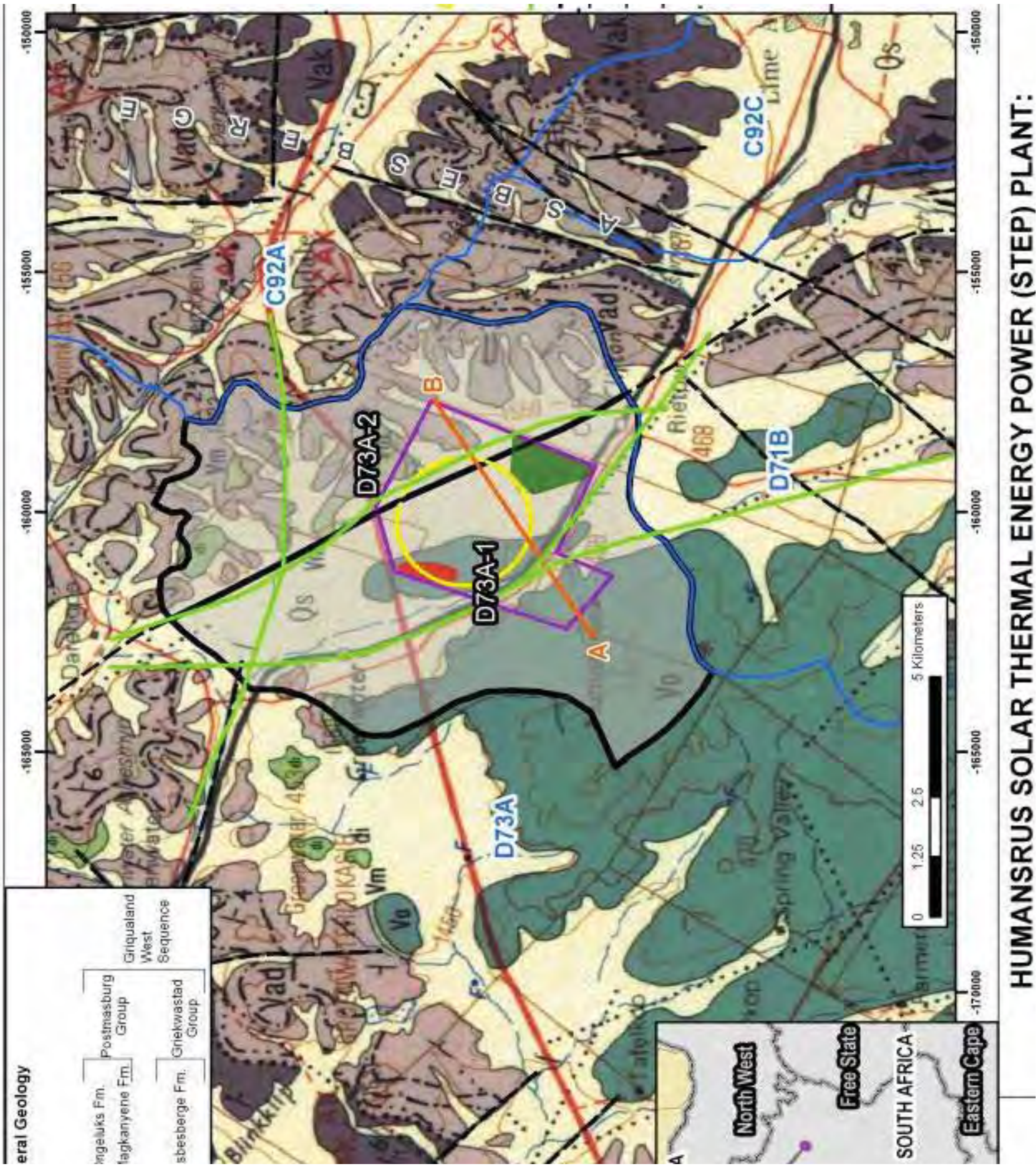


Figure 15: Model mesh

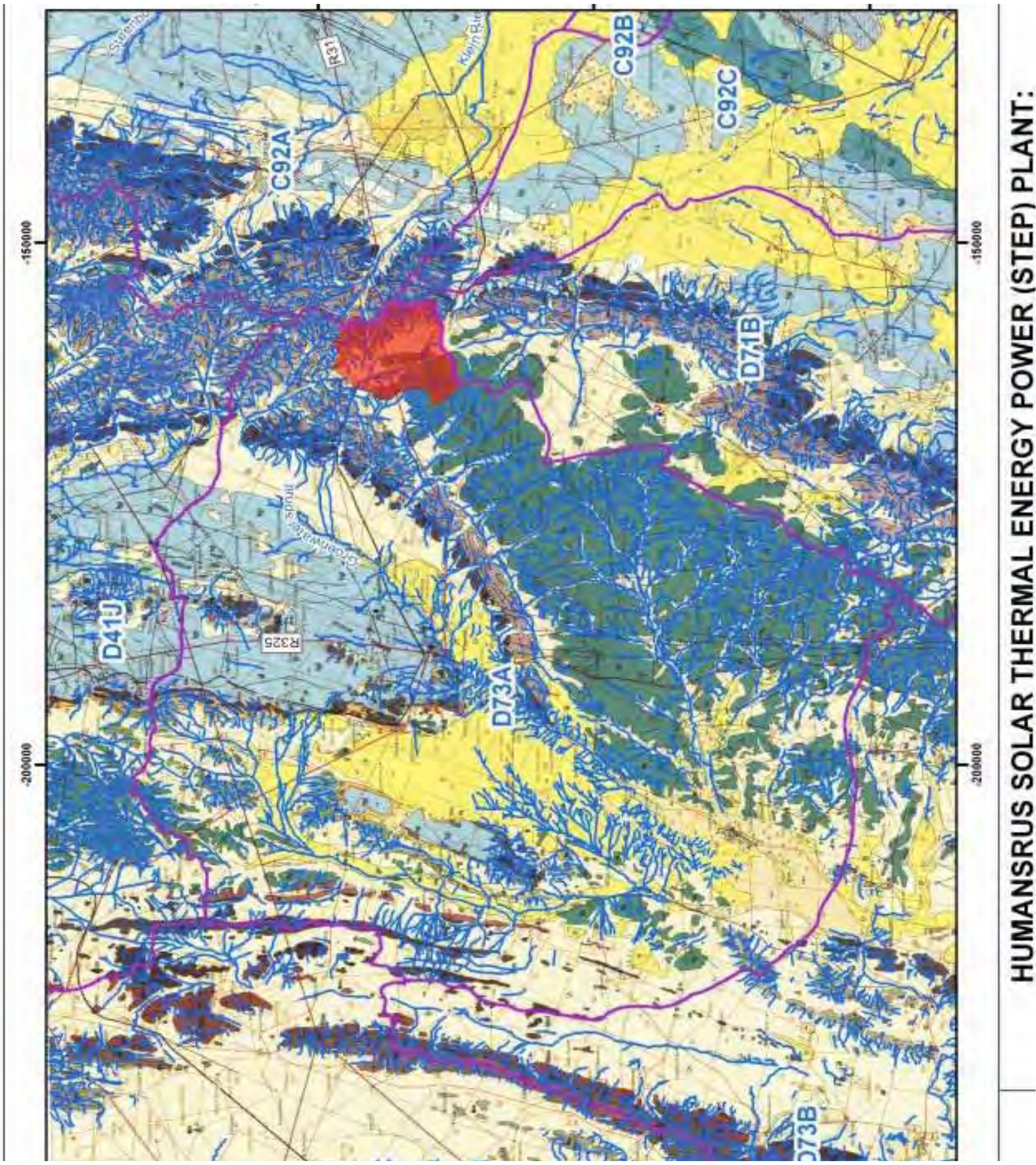


Figure 16: Boundary conditions

There are no major rivers in the area that can be used as boundaries. The eastern boundary was set as the quaternary catchment boundary and therefore also as a no-flow boundary (see **Figure 16**). The remaining boundaries were shifted far enough from the area of interest as not to influence the groundwater flow.

4.4.1 Initial Conditions

Initial conditions are vital for modelling flow problems and must be specified for the entire area. Generally, the initial water level/head distribution acts as the starting distribution for the numerical calculation. The depth to water level data was obtained from monitoring boreholes within and close to the study area, and privately owned boreholes situated in the vicinity of the study area.

The water level in the aquifer ranges between 0.00 (spring) and >100 mbgl with an average water level of 22.7 mbgl.

An interpolation technique, using the available data, was used to simulate water levels over the entire model area. The interpolation technique used is referred to as Bayesian interpolation where water levels are correlated with the surface topography. All available levels were plotted against topography as shown in **Figure 17**. The results indicate a correlation of 87.8%. Therefore, Bayesian interpolation was valid and used to calculate water levels for the entire model area. The water levels are shown in **Figure 18**.

As groundwater levels follow topography it can be assumed that groundwater flow takes place under semi-confined conditions.

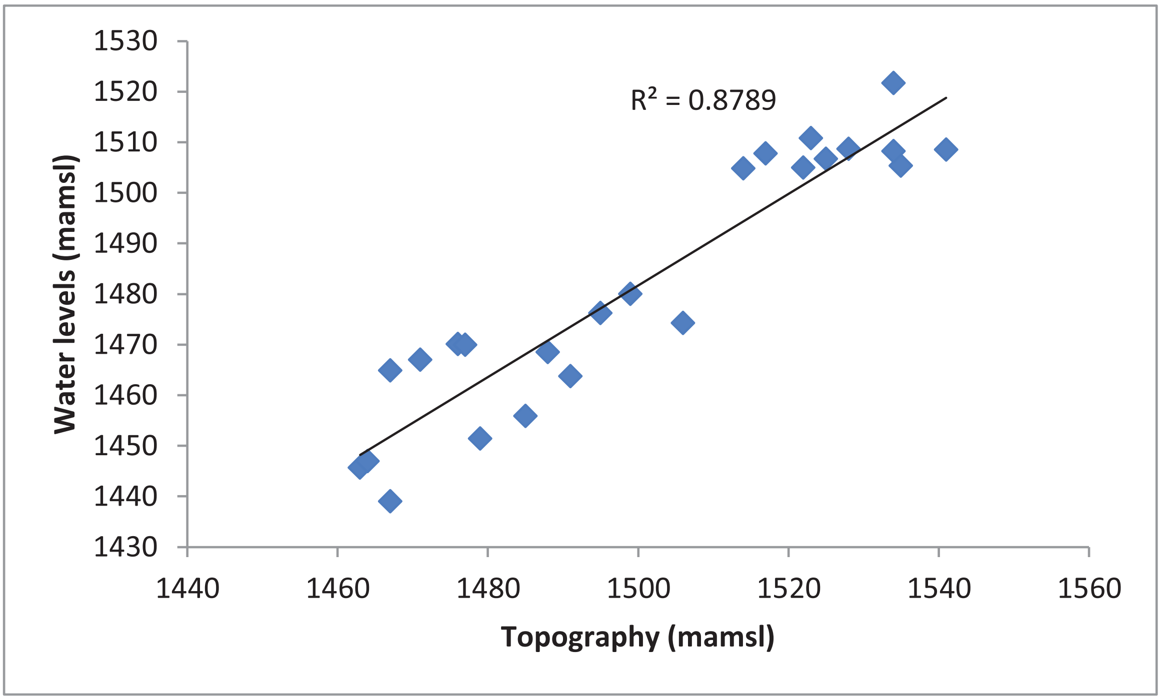


Figure 17: Correlation between groundwater levels and topography

4.4.2 Sources and Sinks

Sources and sinks can be defined as recharge and abstraction sources in the aquifer. Recharge is the addition of water to the saturated zone, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers. Abstraction can be abstraction boreholes, springs, evapotranspiration and outflow to surface water. According to SRK (2011) the recharge for the study area varies between 8.6 – 10 mm/a.

4.4.3 Aquifer Parameters

Water in a fractured rock aquifer flows along fractures, faults, joints and bedding planes within the rock matrix. Aquifer tests were performed by SRK consulting. The results of these tests are summarised in **Table 9**.

Table 9: Aquifer parameters derived from the pumping test results

Borehole	Coordinates (WGS84)		S	T (m^2/d)
	Latitude	Longitude		
HSE2	-28.31585	23.35790	3.69×10^{-3}	65
HSE3	-28.30349	23.34995	1.68×10^{-3}	3
HS2	-28.27681	23.36466	2.60×10^{-3}	49
HS4	-28.29156	23.37531	1.00×10^{-3}	3

Transmissivity is a measure of the ease with which groundwater flows in the subsurface and is related to hydraulic conductivity (K) as follows:

$$T = Kd$$

Where d is the saturated thickness of the aquifer.

The variable transmissivities derived are typical of a fractured rock environment. Storativity (S) is a volume of water per volume of aquifer released as a result of a change in head.

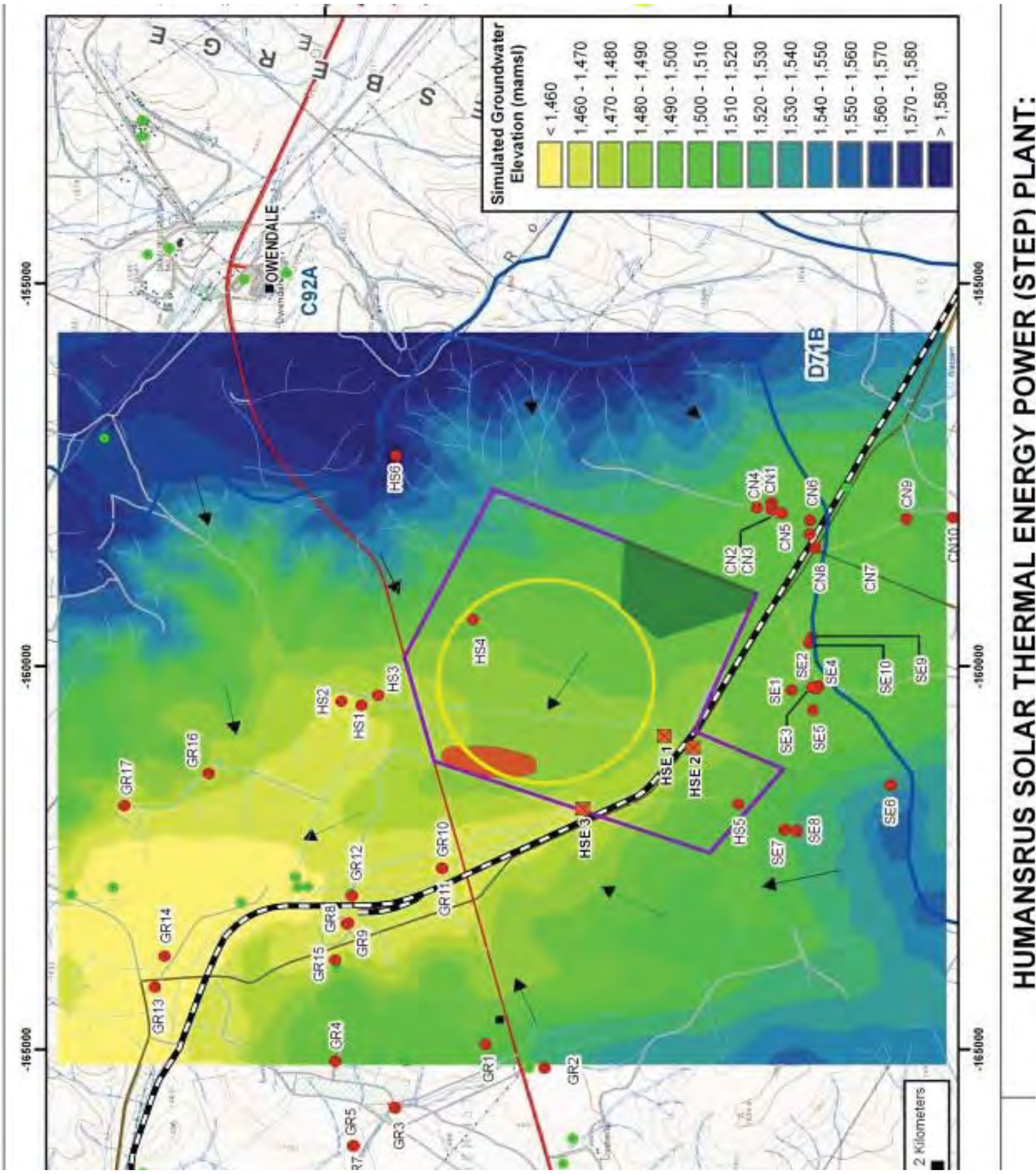


Figure 18: Simulated groundwater level elevation and flow direction

4.5 Numerical Flow Model

A steady state groundwater flow model for the study area was constructed to simulate undisturbed groundwater flow conditions. These conditions serve as starting heads for the transient simulations of groundwater flow where the effects of, for example, the waste water evaporation ponds which are potential contamination sites are taken into account.

Modflow used in this modelling study is based on three-dimensional groundwater flow and may be described by the following equation:

$$\frac{\partial}{\partial x}\left(K_x \frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_y \frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_z \frac{\partial h}{\partial z}\right)\pm W = S\frac{\partial h}{\partial t} \qquad (1)$$

where

h = hydraulic head [L]

Kx,Ky,Kz = Hydraulic Conductivity [L/T] in the x, y and z directions

S = storage coefficient

t = time [T]

W = source (recharge) or sink (pumping) per unit area [L/T]

x,y,z = spatial co-ordinates [L]

For steady state conditions the groundwater flow Equation (1) reduces to the following:

$$\frac{\partial}{\partial x}(K_x \frac{\partial h}{\partial x}) + \frac{\partial}{\partial y}(K_y \frac{\partial h}{\partial y}) + \frac{\partial}{\partial z}(K_z \frac{\partial h}{\partial z}) \pm W = 0 \qquad (2)$$

4.5.1 Calibration of the Steady State Flow Model

The steady state head distribution is dependent upon the recharge, transmissivity, sources, sinks and boundary conditions specified. For a given recharge component and set of boundary conditions, the head distribution across the aquifer under steady-state conditions can be obtained for a specific transmissivity value. The simulated head distribution can then be compared to the measured head distribution and the transmissivity or recharge values can be altered until an acceptable correspondence between measured and simulated heads is obtained. An advantage of a steady state model is that the parameter for storativity is not required to solve the groundwater flow equation, therefore, there are less unknown parameters to determine.

The calibration process was done by changing the model parameters for transmissivity and recharge. Sixteen boreholes were used to calibrate the steady state groundwater flow model (see **Figure 19**). The calibration objective was reached when an acceptable correlation was obtained between the observed and simulated piezometric heads. A correlation of 97% was achieved (**Figure 20**). It is important to note that only a steady state calibration was performed and this is not ideal. The confidence in the model would be increased if the model was calibrated with time series water level data, which in this case do not exist.

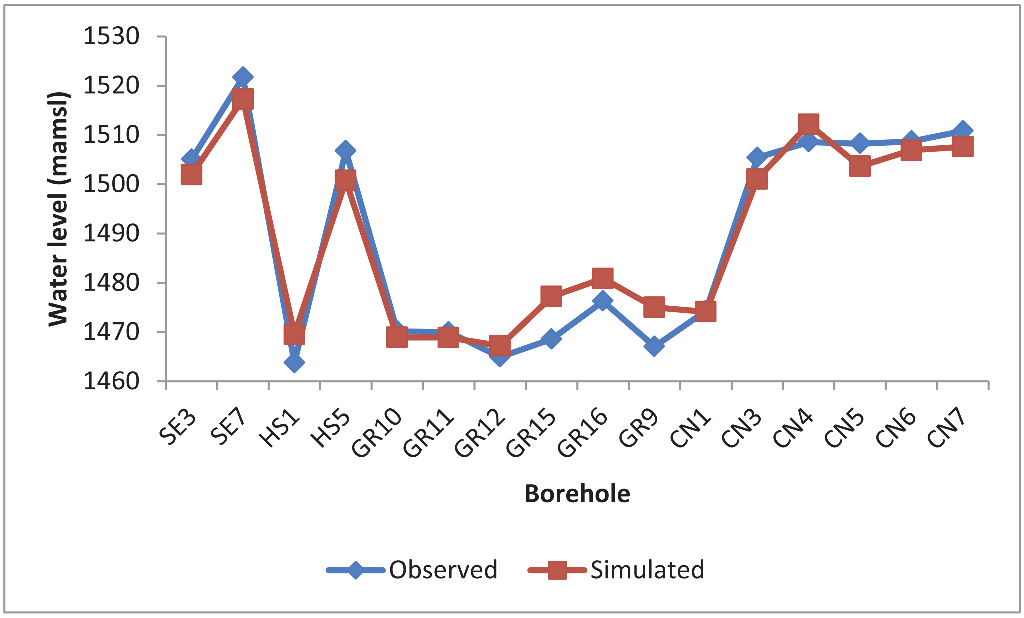


Figure 19: Calibration results

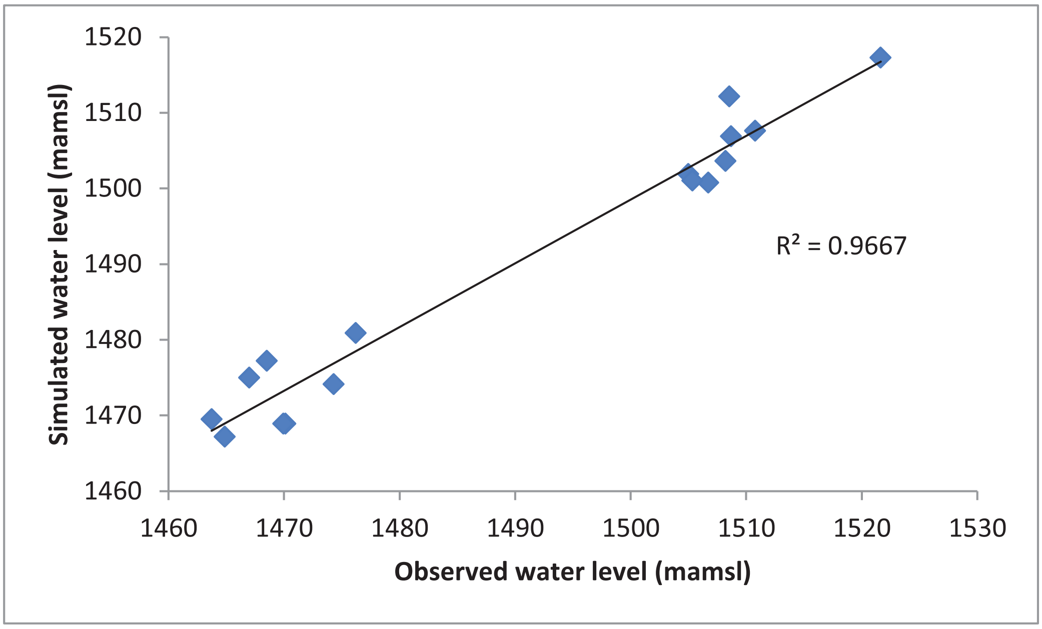


Figure 20: Correlation between simulated and observed water levels

Resultant transmissivity values used in the model are shown in **Table 10**. The model calibrated at a recharge of 8.95 mm/a.

Table 10: Calibrated transmissivities

Aquifer	T (m^2/d)
Weathered/Fractured lava	15
Fresh lava	0.8
Tillite	15
Eastern fault zone	100
Western fault zone	70
Southern fault zone	50
Northern fault zone	70

4.5.2 Mass Transport Model

Mass transport modelling in this situation refers to the simulation of water contamination or pollution due to deteriorating water quality in response to man's disturbance of the natural environment (for example construction of waste site, pollution control dams etc.). Transport through a medium is mainly controlled by the following two processes:

- Advection is the component of contaminant movement described by Darcy's Law. If uniform flow at a velocity V takes place in the aquifer, Darcy's law calculates the distance (x) over which a labelled water particle migrates over a time period t as x = Vt.
- Hydrodynamic dispersion comprises two processes:
  - Mechanical dispersion is the process whereby the initially close group of labelled particles are spread in a longitudinal as well as in a transverse direction because of the velocity distribution (as a result of varying microscopic streamlines) that develops at the microscopic level of flow around the grain particles of the porous medium. Although this spreading is both in the longitudinal and transversal direction of flow, it is primarily in the former direction. Very little spreading can be caused in the transversal direction by velocity variations alone.
  - Molecular diffusion mainly causes transversal spreading, by the random movement of the molecules in the fluid from higher contaminant concentrations to lower ones. It is thus clear that if V = 0, the contaminant is transported by molecular diffusion, only or in other words the higher the velocity of the groundwater, the less the relative effect of molecular diffusion on the transportation of a labelled particle.

In addition to advection, mechanical dispersion and molecular diffusion, several other phenomena may affect the concentration distribution of a contaminant as it moves through a medium. The contaminant may interact with the solid surface of the porous matrix in the form of adsorption of contaminant particles on the solid surface, deposition, solution of the solid matrix and ion exchange. All these phenomena cause changes in the concentration of a contaminant in a flowing fluid.

The MT3D software was used to provide numerical solutions for the concentration values in the aquifer in time and space. Input required in the software is:

- input concentrations of contaminants;
- transmissivity values;
- porosity values;
- longitudinal dispersivities;
- transversal dispersivities;
- hydraulic heads/water levels in the aquifer over time.

Input concentrations in the model were specified at cells over the areas where contamination is expected, e.g. across the areas of the evaporation dams and waste sites. The input concentrations were specified as a percentage of the source concentration.

Transmissivities for the aquifer were specified according to the values obtained during the scenario of the steady state water level calibration. The hydraulic head values as calculated during the steady simulations were specified in the model.

One of the biggest uncertainties encountered during transport modelling of pollutants is the kinematic porosity of the aquifer. Porosities were set as 3% as determined by AEC (1996.

A longitudinal dispersivity value of 50 m was selected for the simulations (see Table D.3 – Field-Scale Dispersivities in Spitz and Moreno, 1996). Bear and Verruijt (1992) estimated the average transversal dispersivity to be 10 to 20 times smaller than the longitudinal dispersivity. An average value of 5 m was selected for this parameter during the simulations.

No mass transport calibration was possible due to insufficient monitoring data.

4.5.3 Modelling Predictive Scenarios

5.5.3.1 Scenario 1: STEP Plant water supply from groundwater

In the first scenario the STEP Plant is dependent on groundwater and therefore two abstraction points are selected, one along the western fault (ABS1) and one along the eastern fault (ABS2). Each of these boreholes are pumped at 84 600 m^3/a. The results of this abstraction after 5, 15 and 30 years are shown in **Figure 21** to **Figure 23** on the following pages. Steady state conditions are reached after approximately 15 years, with a maximum radius of influence being 1 500 m. Drawdown variations after 15 years will thus rather be linked to rainfall and droughts than abstraction.

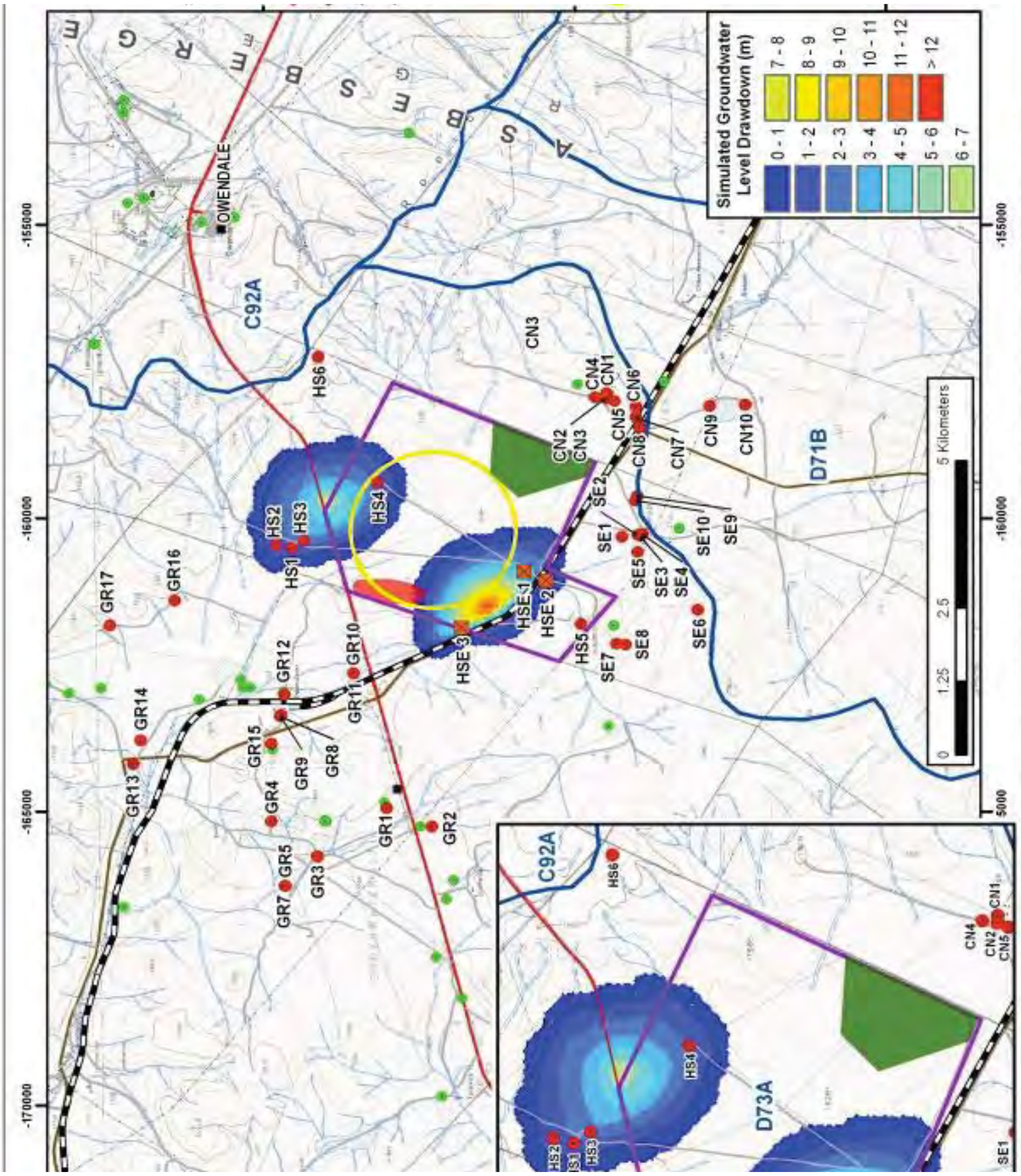


Figure 21: Humansrus simulated groundwater levels after 5 years of abstraction

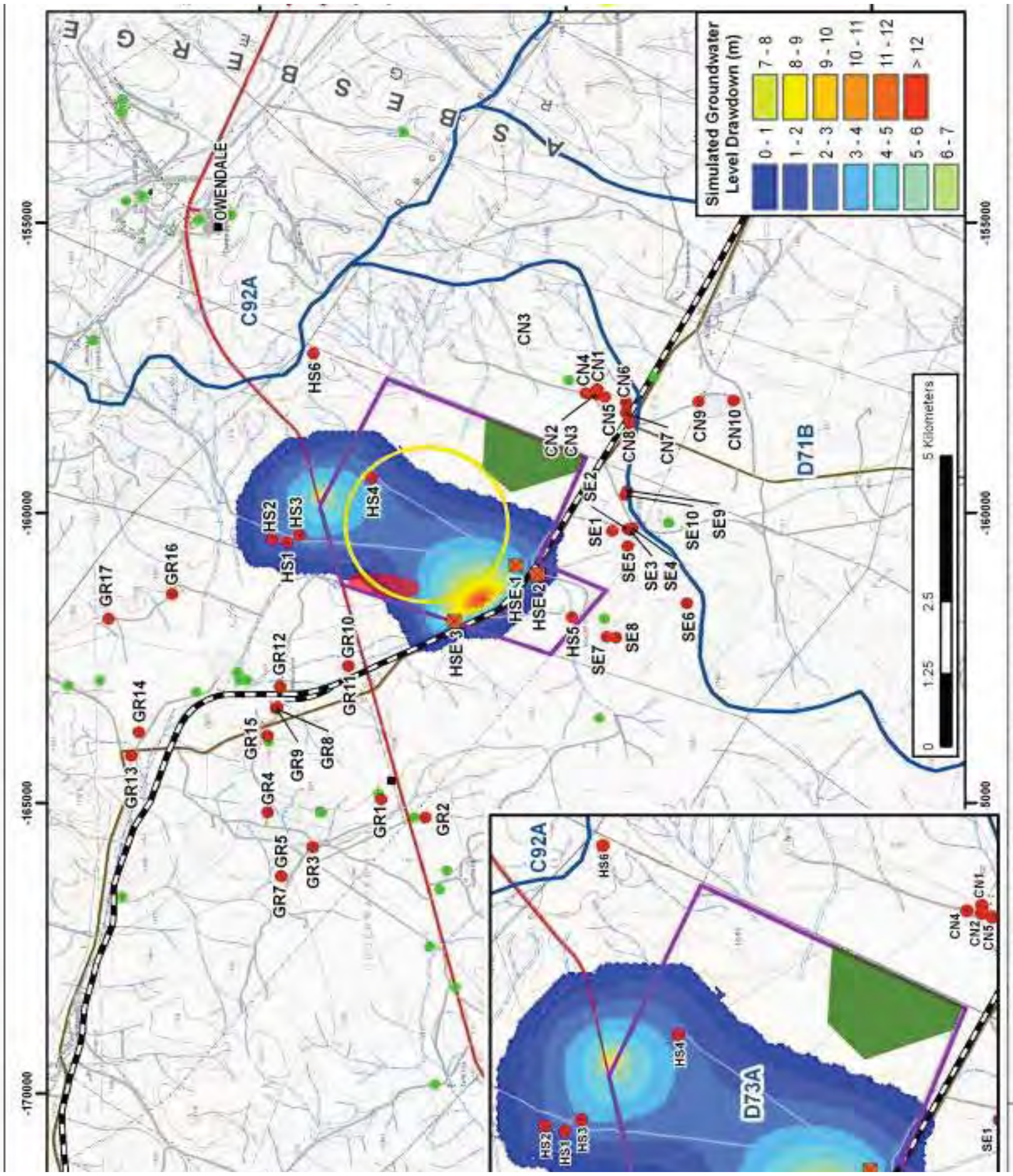


Figure 22: Humansrus simulated groundwater levels after 15 years of abstraction

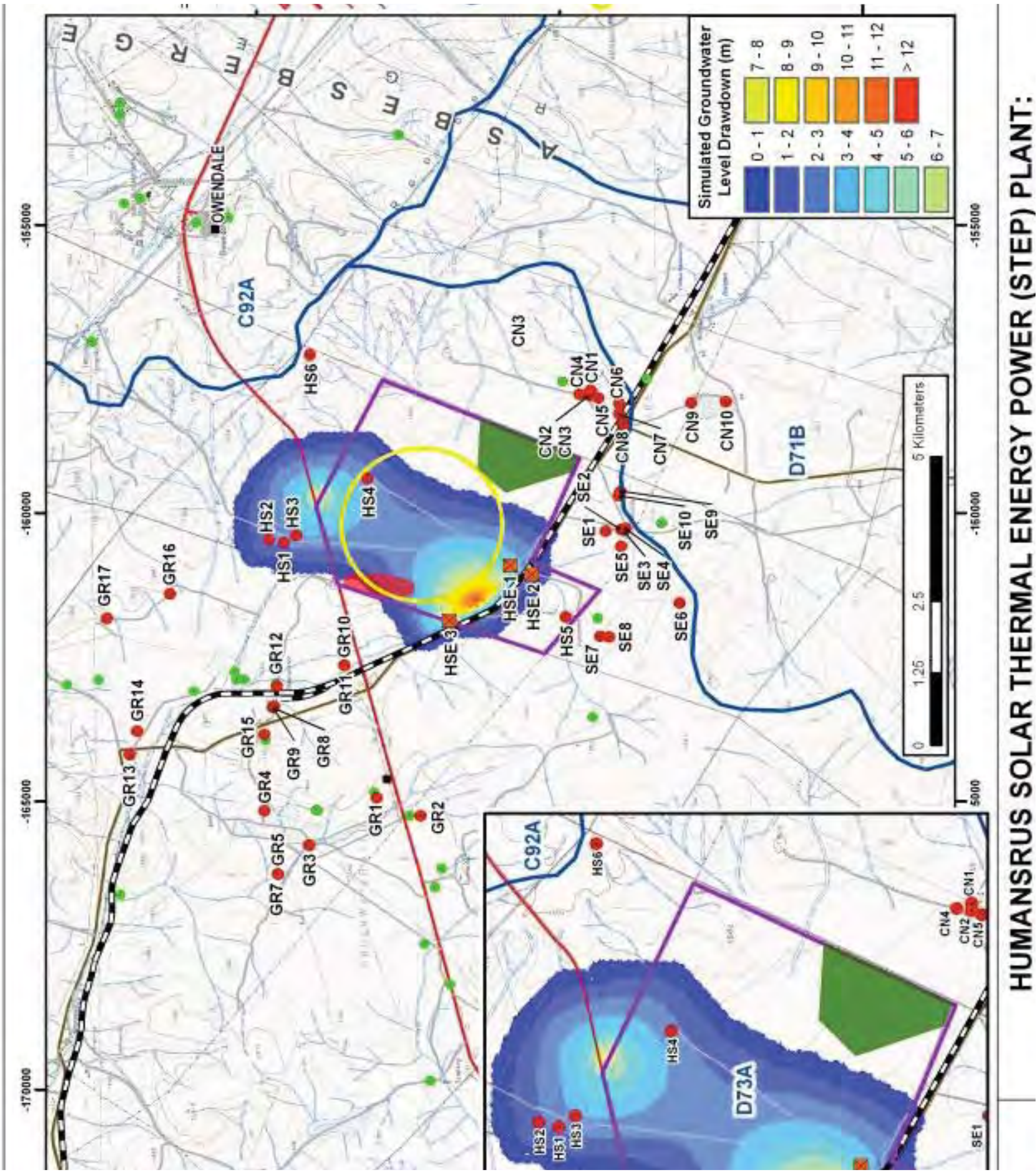


Figure 23: Humansrus simulated groundwater levels after 30 years of abstraction

5.5.3.2 Scenario 2: Groundwater dependent STEP plant – resultant contamination from evaporation pond

In the second scenario the plant is dependent on groundwater and therefore the two abstraction points are selected, one along the western fault (ABS 1) and one along the eastern fault (ABS 2). Each of these boreholes are pumped at 84 600 m^3/a. In addition, the evaporation pond is assumed to be 100% contaminated and polluting groundwater, i.e. a worst case scenario which is highly unlikely to occur. The contamination plumes with time for this scenario are shown in **Figure 24** to **Figure 26**. The figures indicate that after five years, pollution from the evaporation ponds will be limited to <200 m from the ponds and mainly downstream (north-west and south-west) thereof. Two distinctive plumes can be identified, i.e. a plume on the north-western side of the pond and one on the south-eastern side of the

pond. The highest level of pollution will be at the south-western plume and directly upstream of borehole HSE1 where contamination concentrations will reach ~50% of the evaporation pond level.

After 15 years the contamination plume will have expanded into the drainage channel ~300 m south of the evaporation ponds. A third plume is formed on the south-eastern corner of the evaporation ponds, whilst the north-western plume is very similar to that of the 5-year contamination. The predictedcontamination concentrations will reach ~80% of the evaporation pond level in the drainage channel, whilst the other plumes will reach levels of maximum 50% of the evaporation pond level.

The contamination plumes after 30 years of operation are very similar to the 15-year plumes. Both north-western and south-western plumes will have extended marginally westward in the direction of the simulated groundwater abstraction point ABS1. The maximum contamination level remains at ~80% of the evaporation pond level and occurs in the drainage channel south-east of the evaporation pond. It is thus clear that the contamination plumes become stagnant after 15 years of operation with groundwater abstraction and that contamination will be limited to ~300 m from the ponds.

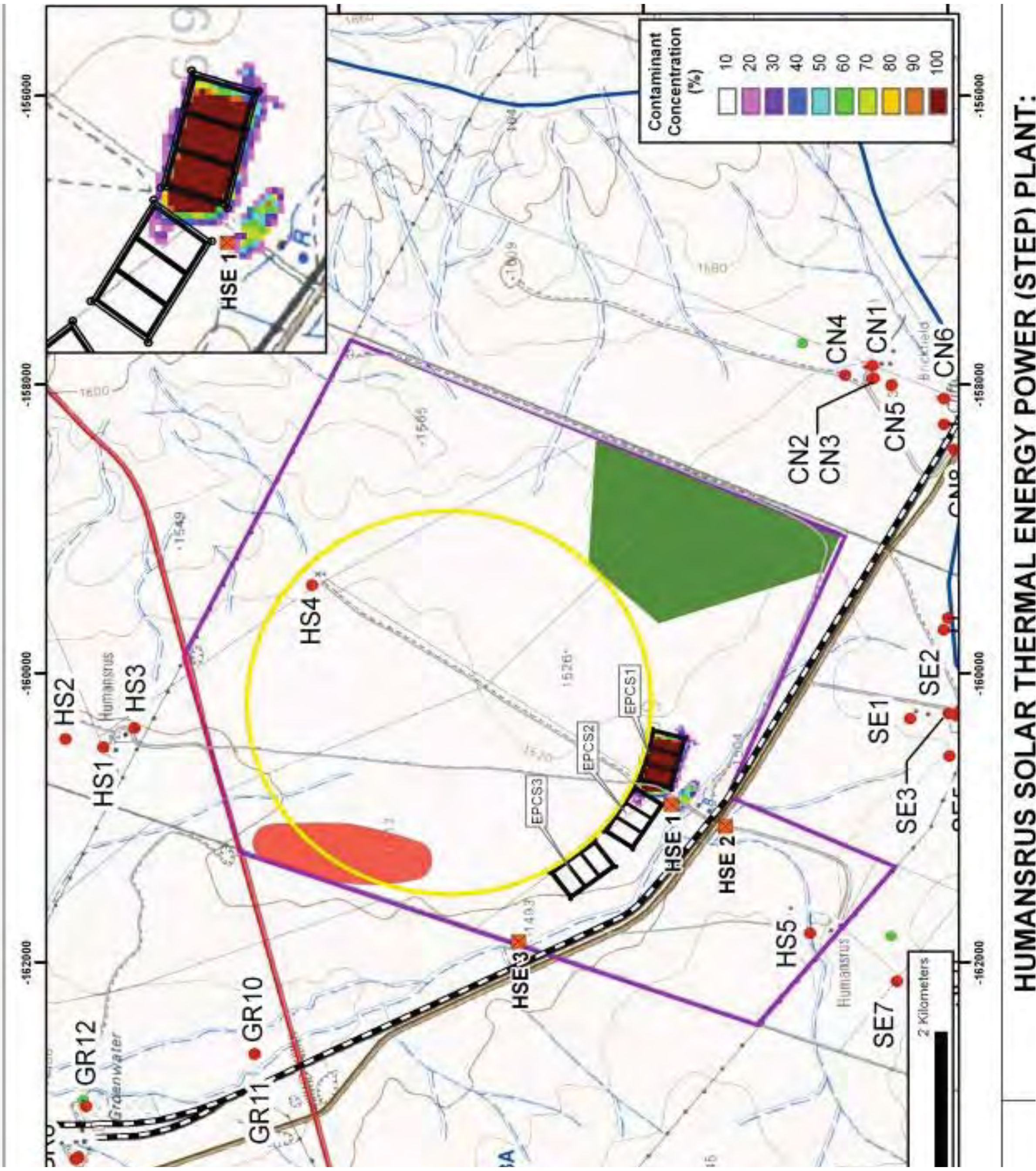


Figure 24: Contamination plume after 5 years with abstraction

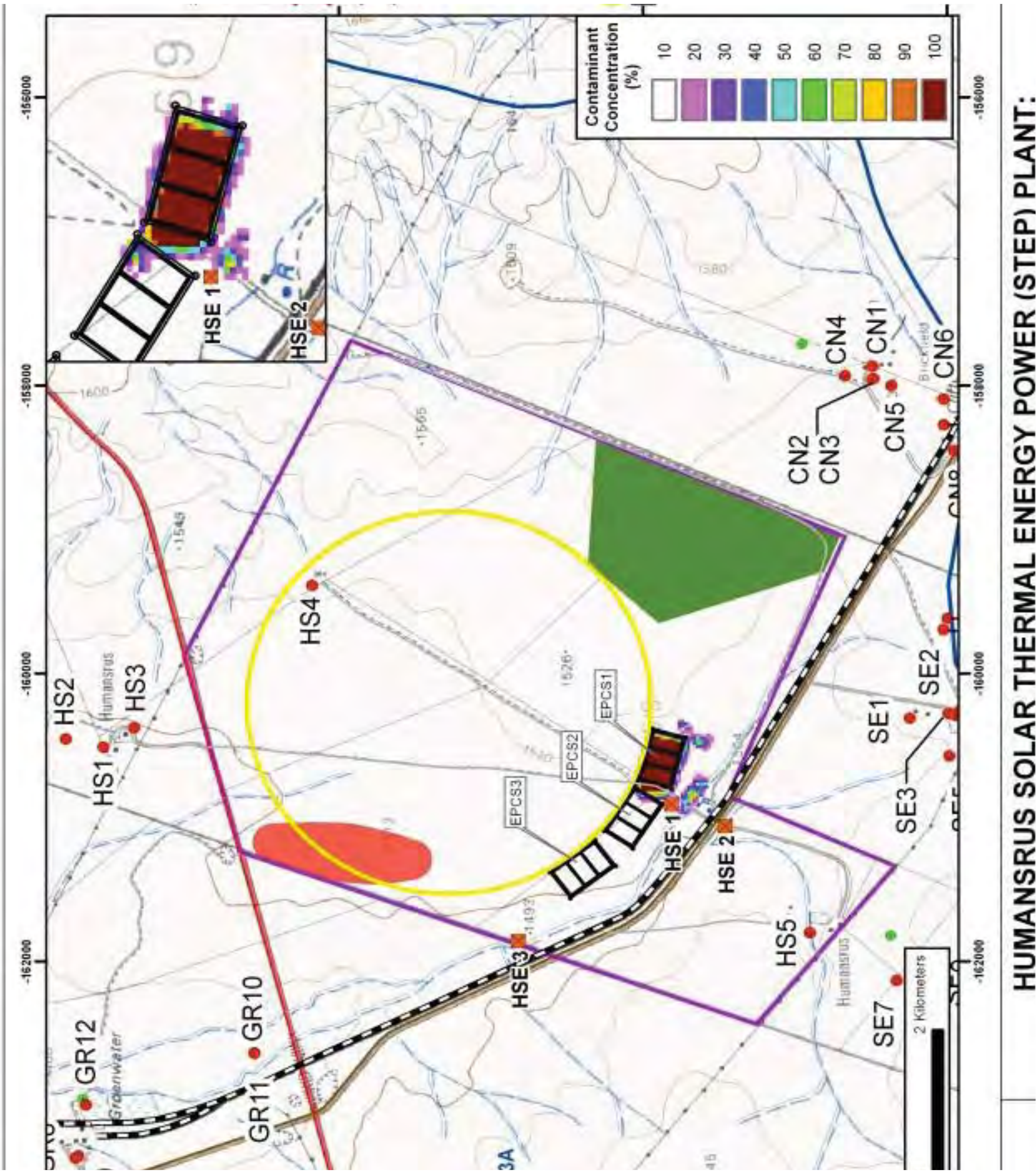


Figure 25: Contamination plume after 15 years with abstraction

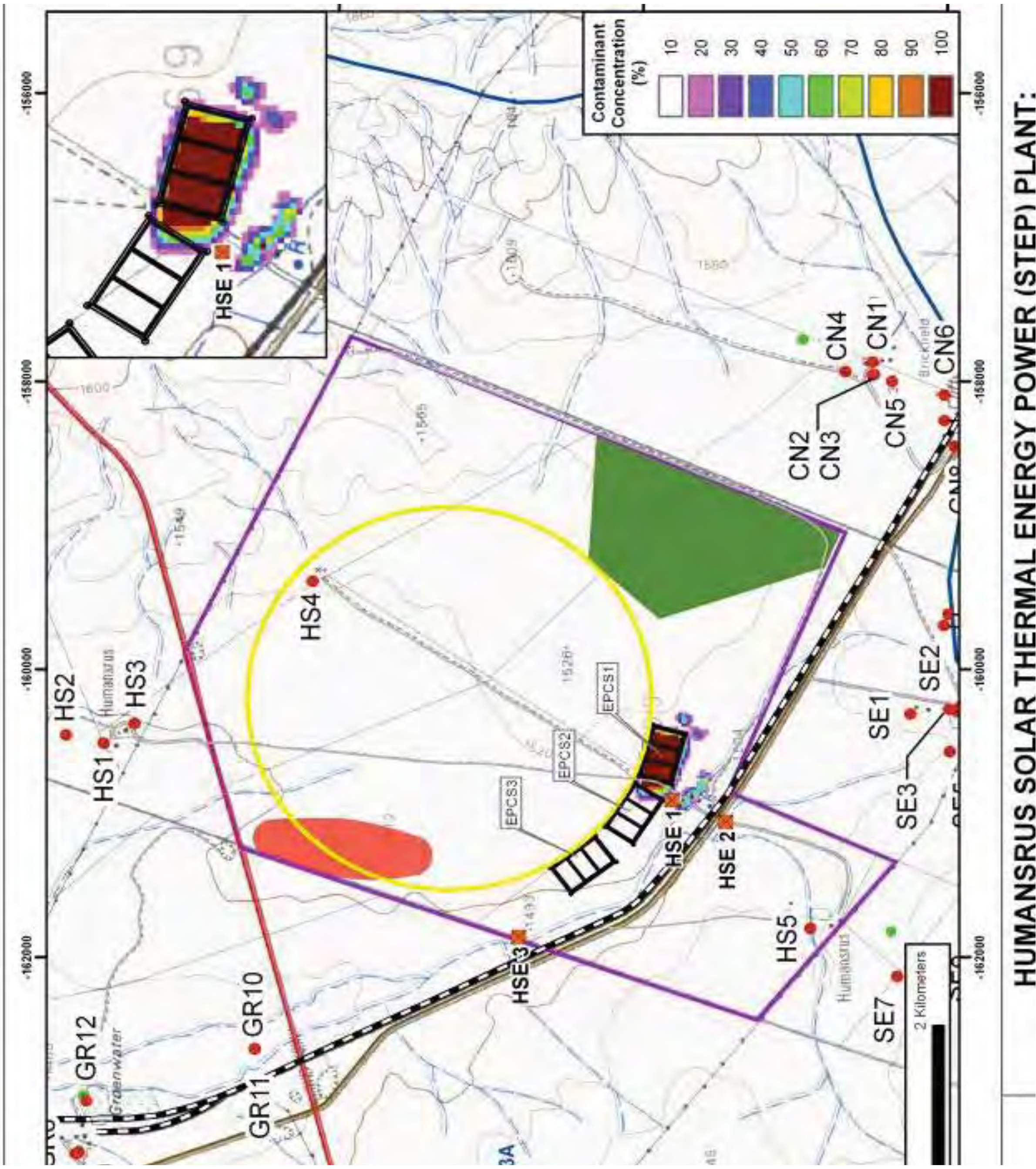


Figure 26: Contamination plume after 30 years with abstraction

5.5.3.3 Scenario 3: Groundwater independent plant – resultant contamination from evaporation pond

In the third scenario the plant is independent of groundwater and no groundwater abstraction occurs in the area. The evaporation dam is assumed to be 100% contaminated. The contamination plumes with time are shown in **Figure 27** to **Figure 29**.

The contamination plumes in this scenario are similar to those described in Scenario 2, except that these plumes migrate faster, at an average speed of approximately 15 m per annum. Contamination reaches the drainage channel shortly after 5 years of operation. At this time the maximum contamination is ~50% of the evaporation pond concentration. The maximum contamination after 15 years of operation is similar to 5-year value, but occurs over a larger area. After 30 years of operation

the south-western contamination plume will have moved across the drainage channel and ~500 m away from the pond. Maximum contamination valuesat this time are ~80% of the evaporation pond concentration.

The groundwater model is based on little data and therefore cannot produce high confidence results. It is recommended that baseline monitoring take place and as more data become available the model be updated.

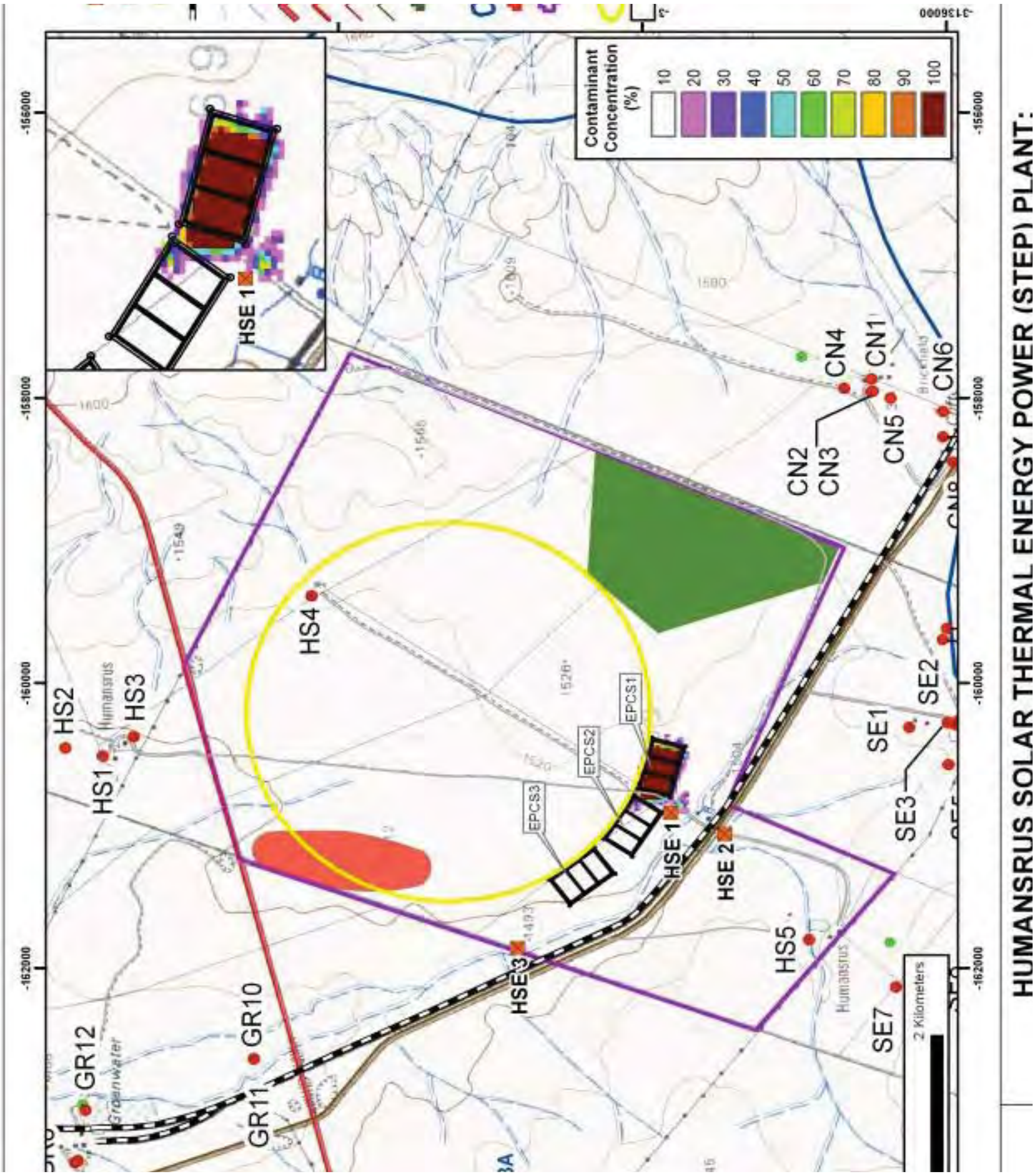


Figure 27: Contamination plume after 5 years with no abstraction

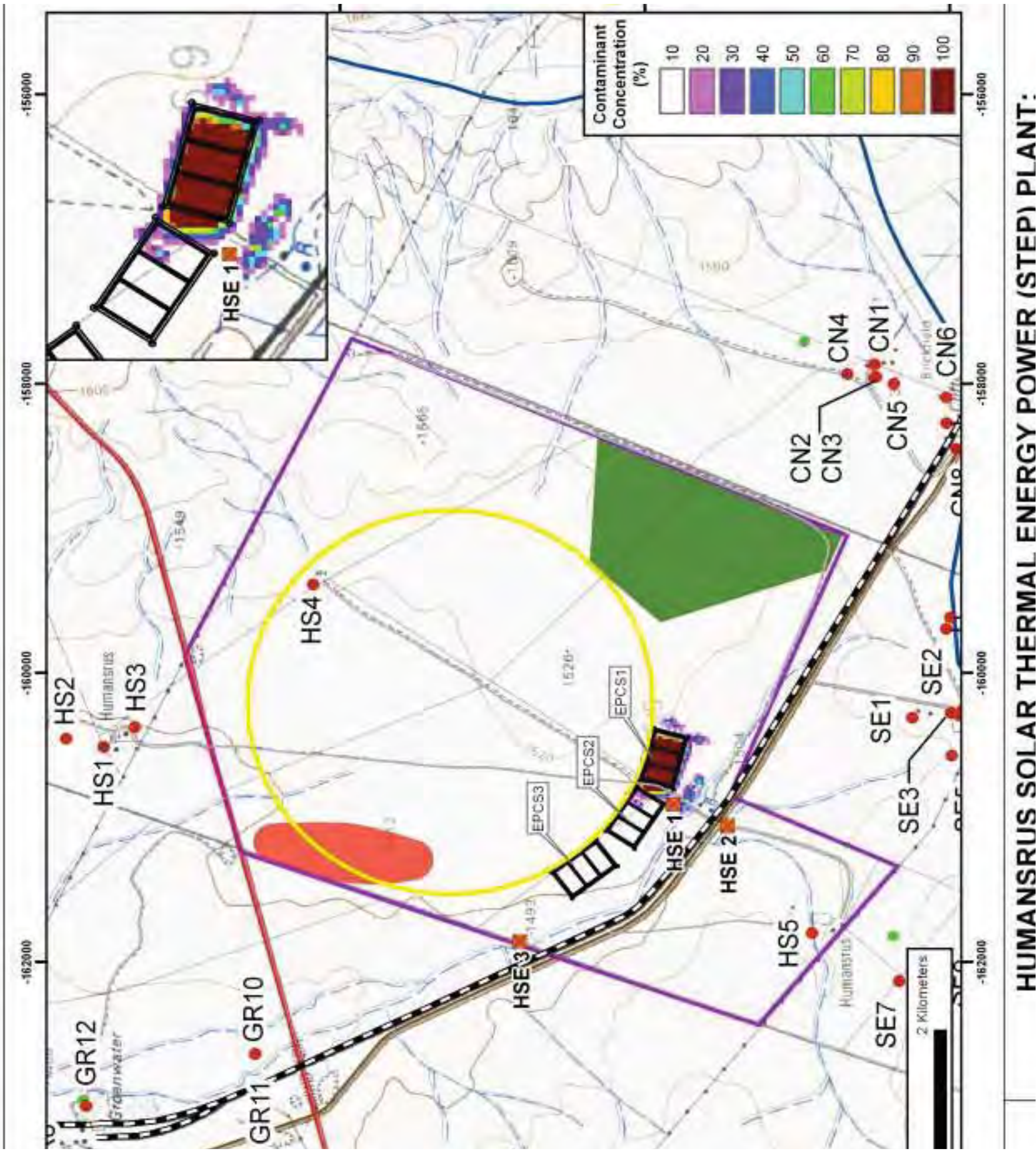


Figure 28: Contamination plume after 15 years with no abstraction

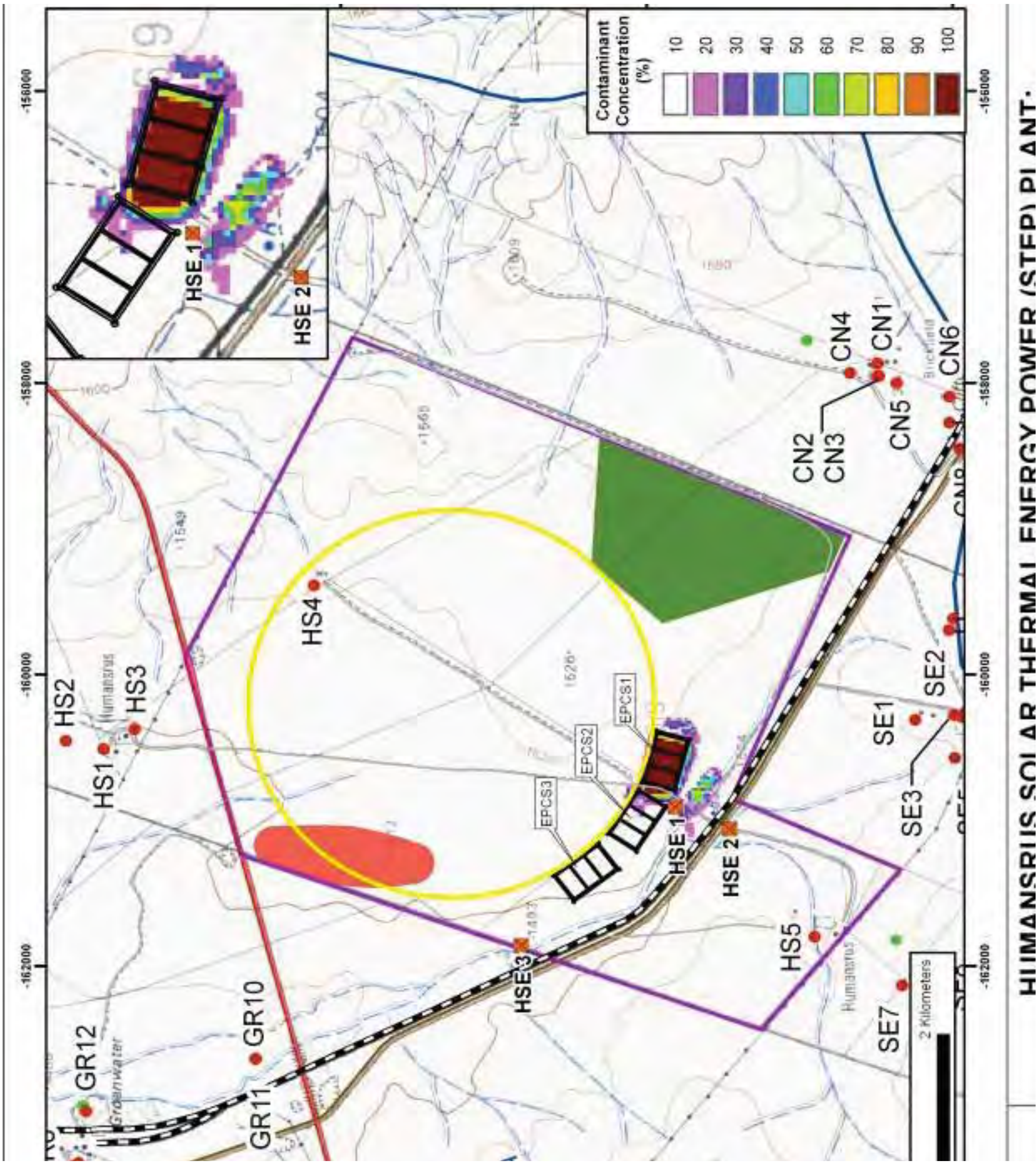


Figure 29: Contamination plume after 30 years with no abstraction

5 Possible Impacts and Mitigation Measures

The following possible groundwater related impacts have been identified for the Humansrus STEP plant:

1. Abstraction ofgroundwater for water supply might negatively impact on the boreholes of other nearby water users; and
2. Contamination of the aquifers by spills, leakages and accidental releases of hazardous substances associated with construction and operationof the STEP Plant. These substances include:

a. Fuel and lubricants, paints, solvents and chemicals such as sodium and potassium nitrate. Humansrus STEP Plant will operate as a zero discharge site andwaste water and liquid effluent will be contained in lined evaporation ponds. There will be no discharge to watercourses.

b. Domestic wastewater, which is water that does not contain a human organic waste component. Sewage is defined as human organic waste, usually within a water suspension. Sources of domestic wastewater and sewage are the toilets, washrooms and offices. Domestic wastewater and sewage will be captured in combined waste streams and directed to a sewage package treatment plant. The sewage package treatment plant will be required to achieve legislated effluent quality discharge standards.Effluent will be pumped to the evaporation ponds. The fully treated solids will be disposed at a suitably licensed waste disposal facility; and

c. Solid waste. The conventional hierarchy of waste reduction and management will be employed and waste materials will be disposed at a suitably licensed waste disposal facility.

Potential pathways that have been identified for contaminants to potentially migrate to the groundwater are:

- Fault zones especially the highly transmissive western and eastern graben faults;
- Zones where the weathered bedrock extents to below the water table; and
- Existing and abandoned boreholes which are not equipped with sanitary seals of bentonite and concrete collars.

Table 11 indicates possible groundwater impacts during the construction, operation and decommissioning phases of the STEP Plant without any mitigation measures taken. Mitigation measures need to be implemented to minimise identified impacts during all phases of the project life-cycle (construction, operation and decommissioning). These measures are also indicated in this table.

Table 12indicates the severity of the impacts with the proposed mitigation measures applied. It is clear that these measures significantly reduce the risk of groundwater contamination. Therefore it is essential that these measures be implemented as part of the normal plant operation.

Table 11: Possible groundwater impacts without mitigation measures

Phase	Impact description	Status of Impacts		Spatial Scale of Impacts		Temporal scale of impacts		Probability of Impacts		Severity of Impacts		Significance of impacts	
		Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating
Construction	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while transporting and filling system with salt	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
Operational	Groundwater abstraction	Negative	-	Medium	2	Low	1	Probable	2	Minor	1	Low	6
	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while transporting and topping system with salt	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
	Accidental spills/leakage from evaporation ponds	Negative	-	Medium	2	Medium	2	Probable	2	Average	2	Medium	8

Construction – Essential mitigation measures:

- Place oil traps under stationary machinery, Only re-fuel machines at fuelling station, Construct structures to trap fuel spills at fuelling station, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only
- Place plastic sheets on surface where salt is uploaded or unloaded to collect spilled salt
- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Ensure vehicles and equipment are in good working order and drivers and operators are trained.
- Ensure that good housekeeping rules are applied.

Operational – Essential mitigation measures:

- Minimise waste water by the appropriate engineering design and re-use for other purposes where possible.
- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Ensure vehicles and equipment are in good working order and drivers and operators are trained.
- Place oil traps under stationary machinery, Only re-fuel machines at fuelling station, Construct structures to trap fuel spills at fuelling station, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only.
- Place plastic sheets on surface where salt is uploaded or unloaded to collect spilled salt.
- Effluent and waste water from the plant must be deposited in evaporation ponds. These ponds must be constructed away from vulnerable areas, fault zones and permeable formations to prevent ponding and ingress of contaminated water. The ponds must be properly lined to prevent vertical infiltration of contaminated water.
- A groundwater monitoring system must be implemented to monitor groundwater quality and water levels.
- Sewerage tanks and/or infiltration pits must be constructed far away from permeable formations and significant aquifer systems.
- Ensure that good housekeeping rules are applied.

Phase		Status of Impacts		Spatial Scale of Impacts		Temporal scale of impacts		Probability of Impacts		Severity of Impacts		Significance of impacts	
	Impact description	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating
Decommissioning	Oil and Fuel spills	Negative	-	Low	1	Low	1	Probable	2	Average	2	Medium	6
	Salt spills while cleaning evaporation ponds	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5

Essential mitigation measures:

- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Ensure vehicles and equipment are in good working order and drivers and operators are trained.
- Place oil traps under stationary machinery, Only re-fuel machines at selected re-fuelling points, construct structures to trap fuel spills at re-fuelling points, Immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only
- Place plastic sheets on surface where salt is uploaded to collect spilled salt
- Evaporation ponds and the Solar Power Tower must be cleaned out, demolished and the area rehabilitated. This material must be disposed at a suitable, licensed waste disposal site.
- Sewerage tanks and/or infiltration pits must be rehabilitated.
- Ensure that good housekeeping rules are applied.

Table 12: Possible groundwater impacts with mitigation measures

Phase		Status of Impacts		Spatial Scale of Impacts		Temporal scale of impacts		Probability of Impacts		Severity of Impacts		Significance of impacts	
	Impact description	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating	Rating	Quan-tative Rating
Construction	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while transporting and filling system with salt	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
Operational	Groundwater abstraction	Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	5
	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while transporting and topping system with salt	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Spills from evaporation ponds	Negative	-	Low	1	Low	1	Improbable	1	Minor	1	Low	4
Decommissioning	Oil and Fuel spills	Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	2
	Salt spills while cleaning evaporation ponds	Negative	-	None	0	None	0	Improbable	1	None	0	Low	1

5.1 No-Go Option

If construction of the proposed STEP Plant does not go ahead the current *status quo* of the groundwater resources will remain, as will the existing sources of contamination, i.e. stock watering points and pens, on-site sanitation facilities at farm dwellings. The contaminants from these sources are unlikely to pose a serious risk to the environment as is confirmed by the baseline data on groundwater chemistry.

6 Groundwater Monitoring Programme

To monitor the potential impact of the development on the groundwater resource, boreholes HSE1, 2 and 3, as well as existing boreholes HS4, should be included in a monitoring programme. Monitoring should include the following:

- Boreholes where a pump is installed must be equipped with a conduit pipe (25 – 35 mm ID class 6 irrigation pipe) attached to the pump’s rising pipes and installed to 1m above the pump inlet. This will prevent the dipmeter probe from becoming stuck around the rising pipes and electrical cables. A water level dipmeter with 1 cm calibration and 100 m cable will have to be purchased by the STEP Plant operator for this.
- The water level and volumes abstracted must also be recorded at all production boreholes on at least a monthly basis. Best results are obtained if automatic flow meters and water level recorders set to take hourly readings are installed.
- Water samples must also be collected at these boreholes on a six-monthly basis and submitted to SANAS accredited laboratories for analysis of the macro-chemistry.
- Rainfall should also be recorded on-site preferably by installation of an automatic rain gauge.
- The monitoring data must be evaluated on an annual basis by a hydrogeologist, the numerical model recalibrated and a monitoring report compiled.
- Monitoring must continue post closure of the facility for at least five years on a six-monthly basis to establish trends and assess the accuracy of the predictions on contaminant transport given in this report. The data must be evaluated on an annual basis by a hydrogeologist and after five years assessed to determine if monitoring needs to continue at six-monthly intervals or can be reduced to an annual basis.

7 Conclusions

Based on the information discussed in this report the following can be concluded regarding the groundwater conditions at Humansrus:

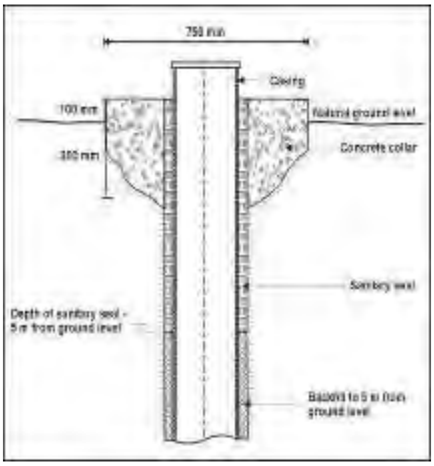
- Local geological observations during the hydrocensus and lineament mapping from Google Earth images indicate that the valley at Humansrus farm is related tograben faulting;
- Maximum immediate yields of boreholes drilled along these two graben faults are very high, but otherwise borehole yields seldom exceed 4 L/s;
- The high yielding borehole HS2 drilled on the eastern graben faultintersected highly fractured lava and tillite in the fault zone and had a reported tested yield of 40 L/s. This borehole is blocked at 60 mbgl by a pump that got stuck and cannot be used;
- Two boreholes (GR11 and GR12) located along the western graben fault at Groenwaterwere previously utilized for irrigation purposes and groundwater was abstracted at a rate of 180 000 m^3/a without an apparent significant negative impact on the aquifer;
- Relatively little groundwater is abstracted from the study area and groundwater is mainly used for stock watering and domestic purposes;
- Most of the calculated groundwater abstraction occurs in the Groenwater rural area with the Groenwater spring being the main contributor;
- Groundwater quality measured as salinity (EC) in the surveyed area is generally good to very good with a mean EC of 59 mS/m. The EC only deteriorates near pollution sources such asstock pens, pit latrines and soak away pits. The best quality groundwater occurs near the recharge areas of the Asbestos Hills Formation in the eastern parts of the Humansrus valley;
- Groundwater exploitation figures for the area indicate that the expected maximum water demand of 246 200 m^3/a for the preferred STEP Plant option is only ~65% of the Exploitation Potential of the HumansrusGRU (D73A-1). Therefore, satisfying the STEP Plant's water demandfrom the local groundwater resources should not have an unacceptable negative influence on groundwater resources of the area;
- The General Authorisation for taking of groundwater from Drainage Region D73A is zero, except for schedule one and small scale industrial purposes. Therefore, if the water demand is to be satisfied from the groundwater resources, aWater Use Licence Application will have to be submitted to the DWA;
- The best areas for future production boreholes for the STEP Plantare the two graben faults at Humansrus with the eastern fault the prime choice;
- For a groundwater dependent plant and equal volumes of groundwater being abstracted along the two graben faults, steady state drawdown conditions will be reached after approximately 15 years, with a maximum radius of influence being 1,500 m. Maximum drawdowns at the production boreholes will be 12 to 13 m;
- From aquifer vulnerability point of view the proposed area for the STEP Plant is favourable as long as possible sources of groundwater pollution are kept away from the two graben faults on the north-eastern and south-western parts of the proposed development.

- The drilling results have indicated that the groundwater level in the area of the proposed evaporation ponds is ~14 mbgl. A 2 m thick clay layer located ~5 m above the groundwater level will give some protection from surface pollution;
- Drilling results obtained at borehole HSE3 indicates that good water bearing fractures can be located in fresh rock types well below the groundwater level. These fractures are normally linked to fault zones.
- Yield test results indicate that S-values for this area are in the order of 1.1 - 3.7 x 10^{-3} with the lower values associated with limited fracturing and the higher values with well fractured aquifers. T-values varied between 3 m^2/d for poorly fractured lava to 65 m^2/d for well fractured lava associated with the south-western fault zone.
- A maximum continuous sustainable yield of 2.2 L/s (190 m^3/d) was calculated for borehole HS2 and 1.2 L/s (104 m^3/d) for borehole HSE2. However, larger diameter production boreholes drilled to intersect the fault zones at a greater depth than the test boreholes, will most likely have much higher yields, as proven by the reported tested yield of 40 L/s at the now partially collapsed borehole HS2.
- The groundwater model indicates that the area contaminated by potential spills and/or leakage at the evaporation pond will be smaller with groundwater abstraction along the western fault than without groundwater abstraction. This is likely due to some contamination being intersected by the production borehole and pumped back into the system. Without groundwater abstraction the maximum distance contamination plumes will have migrated from the ponds, after 30 years of operation, is ~500 m to the west and south-west. Migration of the plumes will be in the order of 15 m/a with no groundwater abstraction. With groundwater abstraction the contamination plume will extent to the western drainage channel and ~300 m from the ponds;
- However, the groundwater model is based on little data and therefore cannot produce high confidence results and monitoring data is needed to update and refine the model;
- Borehole HSE1 is optimally located to intersect contamination that may be caused by spills and/or leakage from the evaporation ponds; and
- Contamination and abstraction impacts on the local aquifers will be negligible if mitigation measures are adopted. Therefore, from a groundwater perspective, there is no obvious reason why construction of the Humansrus STEP Plant should not be authorised.

8 Recommendations

Based on the conclusion of this preliminary report the following is recommended:

1. The Solar Power Tower and evaporation ponds must be placed close to the centre of the valley at Humansrusas far away as possible from the two graben faults.
2. Heliostats can be placed all over the area as these do not pose a groundwater pollution hazard.
3. Future production boreholes must be concentrated on the two graben faults with the eastern fault the primary choice.
4. All existing boreholes must be properly sealed at the surface to prevent surface pollution of the groundwater. This measure will also prevent bees from invading the borehole.
5. Borehole HSE1must be utilized for groundwater level and quality monitoring to identify spills and leakages timeously. The measures indicated in **section**6, i.e. a groundwater monitoring scheme, must be implemented as soon as authorisation for the project has been received.
6. Borehole HSE2, which is located upstream of the planned evaporation ponds, can be utilized as a background monitoring borehole;
7. Borehole HSE3 and HS4 must also be utilized as a groundwater chemistry monitoring borehole to ensure that contamination, if any, does not extend beyond the borders of the property.
8. The high yielding borehole HS2, which is unusable due to a pump stuck in it, should be replaced with a new production borehole drilled adjacent to it. The new borehole must bepump tested according to the DWA requirements. This will provide invaluable information regarding aquifer parameters of the fault zone for use in the groundwater numerical model;
9. In order to safeguard the groundwater supplies from contamination and equipment from theft and damage, two zones of protection should be established around each production borehole.



Inner protection Zone

The inner protection zone is an area of at least 50 m x 50 m, centred on the actual borehole. The following measures must be applied in this protection zone:

- No pit latrines, VIP's, soak-aways or septic tanks – to prevent effluent from percolating into the aquifer and borehole;
- No storage of fuel, lubricants or other hazardous substances without a leak prove;
- Production boreholes for domestic use must be equipped with a sanitary seal – to prevent contaminated surface water and spilled fuel from percolating down the casing into the borehole;

- The concrete collar around borehole casing must be at least 100 mm higher than the floor or surface level to prevent spilled fuel, water from leakages, wash water, etc to enter the borehole;
- No ponding of surface water must be allowed, i.e. the area must be sloped for surface water to drain away from this zone;
- Vegetation, other than trees and large bushes, should be maintained in this zone – Note: Roots of bushes and trees growing near boreholes often grows into the borehole where it can cause considerable problems;
- The borehole and pumping equipment must be housed in a lockable pump house. For this purpose a removable cage manufactured out of galvanised steel mesh and corrugated steel sheets is recommended. This cage, rather than a brick building, is recommended as it can be readily removed in case the borehole is damaged or if it needs to be re-developed and cleaned.
- The production boreholes, as well as other monitoring boreholes in the area, must be properly sealed to prevent entry of reptiles, insects, birds and small rodents.
- The entire area should be properly fenced with a lockable gate to prevent unauthorised entry and to exclude animals. The gate must be positioned and of such a type that allows easy vehicle access.

- A signboard must be erected on the gate warning people of the dangers and that unauthorised entry is not allowed.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted hydrogeological and environmental practices.

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Appendix1: Borehole Logs

Bh No	HSE 1 Start: 17/08/2011 Stop: 17/08/2011	Lat: -28.31267	Long: 23.35948	Elev: 1505 m		
Depth (mbgl)	**Geology**	**Water Strike**	**Yield (ℓ/s)**	**EC (mS/m)**	**pH**	**Comments**
0 - 1	Reddish brown topsoil with lava boulders					
-2	Jointed light grey lava with iron staining					
-4	Greenish grey lava - weakly jointed					
-6	Fractured grey lava - iron staining and weathered					
-7	Weakly jointed greenish grey lava					
-9	Well jointed and partially weathered grey lava - clayish					
-14	Fresh greenish grey lava					
-16	Weakly jointed grey lava	16	Seep			
-33	Fresh light grey lava					
-39	Jointed light grey to dark grey lava with calcite and vein quartz					
-42	Weakly jointed light grey lava					
-48	Fresh light grey lava					
	Water Level = 40.74 mbgl 18/08/2011 14h25					
	CONSTRUCTION					
0 - 6 m	215 mm Air percussion drilling					
6 - 48 m	165 mm Air percussion drilling					
0 - 6 m	165mm ID x 4.5mm wall plain steel casing					

Bh No	HSE 2 Start: 17/08/2011 Stop: 17/08/2011	Lat: -28.31585	Long: 23.35790	Elev: 1504 m		
Depth (mbgl)	**Geology**	**Water Strike**	**Yield (ℓ/s)**	**EC (mS/m)**	**pH**	**Comments**
0 - 1	Reddish brown topsoil					
-3	Yellow to brown well weathered lava with quartz					
-4	Fractured and weathered yellow brown lava					
-12	Reddish brown well weathered and jointed lava					
-16	Brown well jointed and partially weathered lava	16	Mud flow			
-18	Fractured brown lava with quartz	17-18				
-19	Fractured lava with jasper	19	1.0			
-22	Fractured brown lava with quartz	20-22	3.0	123	7.39	
-36	Jointed grey lava with quartz					
	Final blow yield = 3.4 ℓ/s					
	Water level = 14.37 mbgl 17/08/11 17h00					
	CONSTRUCTION					
0 - 24 m	215 mm Air percussion drilling					
24 - 30 m	165 mm Air percussion drilling					
0 - 24 m	165mm ID x 4.5mm wall steel casing, Perforated 18-24 mbgl					

Bh No	HSE 3 Start: 18/08/2011 Stop: 18/08/2011	Lat: -28.30349	Long: 23.34995	Elev: 1490 m		
Depth (mbgl)	**Geology**	**Water Strike**	**Yield (ℓ/s)**	**EC (mS/m)**	**pH**	**Comments**
0 - 1	Dark brown well weathered lava					
-4	Fractured and weathered lava with quartzite					
-14	Yellow brown well weathered and jointed lava					
-16	Fractured and weathered yellow brown lava					
-18	Well jointed and partially weathered grey lava	18	Seep			
-30	Jointed and partially weathered grey lava with iron staining	30	Seep			
-40	Fresh grey lava					
-46	Well jointed grey lava with iron staining	42, 45	0.3	122	7.50	
-50	Jointed grey lava					
-52	Fractured, reddish brown, weathered lava	51	3.8	108	7.52	
-56	Well weathered and jointed lava with iron staining					
-58	Well jointed lava with calcite veins					
-60	Jointed greenish grey lava					
	Water Level = 44.47 mbgl 18/08/11 13h30					
	= 20.72 mbgl 18/08/11 14h15					
	CONSTRUCTION					
0 - 18 m	215 mm Air percussion drilling					
18 - 60 m	165 mm Air percussion drilling					
0 - 18 m	165mm ID x 4.5mm wall plain steel casing					

Appendix2: Yield Test Data Sheets

welltek services
Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 E BOREHOLE TEST RECORD SHEET

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE NO:	HSE 2	CO-ORDINATES:		PROVINCE:	NORTHERN CAPE
ALT BH NO:	0	LATITUDE [S]: 28.31585		DISTRICT:	HUMANSRUS
		LONGITUDE [E]: 23.3579		SITE NAME:	POSTMASBURG
BOREHOLE DEPTH [mbgl]:	37.02	DATUM LEVEL ABOVE CASING (m):	0.42	EXISTING PUMP:	N/A
WATER LEVEL [mbgl]:	13.90	CASING HEIGHT (magl):	0.28	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	26.00	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P115/BP65

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1 RPM
DATE: 31/08/2011 TIME: 12H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.26		1	
2	0.29	1.15	2	
3	0.29		3	
5	0.30		5	
7	0.30		7	
10	0.32		10	
15	0.33	1.15	15	
20	0.33		20	
30	0.34		30	
40	0.35	1.16	40	
50	0.36		50	
60	0.36		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 2 RPM
DATE: 31/08/2011 TIME: 13H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.48	1.44	1	
2	0.54		2	
3	0.56	2.00	3	
5	0.58		5	
7	0.60		7	
10	0.62		10	
15	0.64		15	
20	0.64	2.00	20	
30	0.66		30	
40	0.67		40	
50	0.69		50	
60	0.70		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 3 RPM
DATE: 31/08/2011 TIME: 14H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.77		1	
2	0.86	2.23	2	
3	0.96	2.81	3	
5	1.04		5	
7	1.04	3.00	7	
10	1.06		10	
15	1.09		15	
20	1.01		20	
30	1.01	3.04	30	
40	1.14		40	
50	1.15		50	
60	1.28		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 4 RPM
DATE: 31/08/2011 TIME: 15H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.95		1	
2	2.39	5.93	2	
3	2.34	5.26	3	
5	2.34		5	
7	2.36		7	
10	2.40		10	
15	2.43	5.26	15	
20	2.46		20	
30	2.55		30	
40	2.60		40	
50	2.65		50	
60	2.66		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

DISCHARGE RATE 5 RPM
DATE: 31/08/2011 TIME: 16H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	2.85		1	1.00
2	3.05		2	0.73
3	3.59		3	0.67
5	3.72	7.31	5	0.63
7	3.75		7	0.62
10	3.80		10	0.57
15	3.87		15	0.53
20	3.90	7.30	20	0.50
30	4.01		30	
40	4.13		40	
50	4.18		50	
60	4.30		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

DISCHARGE RATE 6 RPM
DATE: 01/09/2011 TIME: 06H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.46	7.92	1	1.20
2	1.65		2	0.69
3	1.69	8.02	3	0.58
5	2.84		5	0.53
7	3.32		7	0.51
10	3.46	8.01	10	0.49
15	3.63		15	0.45
20	3.84		20	0.42
30	4.07	8.02	30	0.38
40	4.23		40	0.34
50	4.37		50	0.30
60	4.57		60	0.28
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

WAS SAND PUMPED ?	NO	WAS THE WATER CLEAN ?	YES
STATIC WATER LEVEL AFTER STEPPED DISCHARGE TEST?	14.18		

wellTek services

Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 F BOREHOLE TEST RECORD SHEET

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE NO: HSE 2	CO-ORDINATES:	PROVINCE:	NORTHERN CAPE
ALT BH NO: 0	LATITUDE [S]: 28.31585	DISTRICT:	HUMANSRUS
	LONGITUDE [E]: 23.3579	SITE NAME:	POSTMASBURG

BOREHOLE DEPTH [mbgl]:	37.02	DATUM LEVEL ABOVE CASING (m):	0.42	EXISTING PUMP:	N/A
WATER LEVEL [mbgl]:	13.90	CASING HEIGHT (magl):	0.28	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	26.00	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P115/BP65

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				TEST COMPLETED					
DATE:	01/09/2011	TIME:	09H02	DATE:	06/09/2011	TIME:	09H02	TYPE OF PUMP:	BP 65 M

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: SE4			OBSERVATION HOLE 2 NR:			OBSERVATION HOLE 3 NR:		
					Distance:			Distance:			Distance:		
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME MIN	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)
1	0.95		1	3.93	1			1			1		
2	1.10	2.98	2	1.85	2			2			2		
3	1.22		3	1.74	3			3			3		
5	1.85	5.03	5	1.70	5			5			5		
7	2.03		7	1.68	7			7			7		
10	2.34	5.03	10	1.65	10			10			10		
15	2.40		15	1.63	15			15			15		
20	2.48	5.03	20	1.60	20			20			20		
30	2.56		30	1.55	30			30			30		
40	2.63	5.03	40	1.52	40			40			40		
60	2.74		60	1.45	60			60			60		
90	2.88	5.02	90	1.37	90			90			90		
120	2.98		120	1.32	120			120			120		
150	3.05	5.02	150	1.27	150			150			150		
180	3.09		180	1.24	180			180			180		
210	3.19	5.02	210	1.20	210			210			210		
240	3.25		240	1.18	240			240			240		
300	3.36	5.03	300	1.13	300			300			300		
360	3.46		360	1.08	360			360			360		
420	3.54	5.02	420	1.06	420			420			420		
480	3.61		480	1.02	480			480			480		
540	3.70	5.04	540	0.98	540			540			540		
600	3.84		600	0.96	600			600			600		
720	3.85	5.03	720	0.94	720			720			720		
840	4.03		840	0.90	840			840			840		
960	4.17	5.02	960	0.86	960			960			960		
1080	4.30		1080	0.81	1080			1080			1080		
1200	4.43	5.02	1200	0.73	1200			1200			1200		
1320	4.57		1320	0.76	1320			1320			1320		
1440	4.67	5.03	1440	0.74	1440			1440			1440		
1560	4.80		1560	0.71	1560			1560			1560		
1680	4.90	5.02	1680	0.69	1680			1680			1680		
1800	5.02		1800	0.67	1800			1800			1800		
1920	5.20	5.03	1920	0.65	1920			1920			1920		
2040	5.50		2040	0.62	2040			2040			2040		
2160	5.65	5.03	2160	0.59	2160			2160			2160		
2280	5.77		2280	0.56	2280			2280			2280		
2400	5.94		2400	0.52	2400			2400			2400		
2520	6.19	5.06	2520	0.48	2520			2520			2520		
2640	6.32		2640	0.43	2640			2640			2640		
2760	6.58	5.03	2760	0.39	2760			2760			2760		
2880	6.78		2880	0.34	2880	17.23	17.23	2880			2880		
3000	6.86	5.03	3000	0.30	3000			3000			3000		
3120	6.91		3120	0.26	3120			3120			3120		
3240	7.20	5.03	3240	0.23	3240			3240			3240		
3360	7.96		3360	0.20	3360	17.23		3360			3360		
3480	8.50	5.03	3480	0.16	3480			3480			3480		
3600	9.07		3600	0.13	3600			3600			3600		
3720	9.48		3720	0.10	3720			3720			3720		
3840	9.94	5.00	3840	0.07	3840			3840			3840		
3960	10.42		3960	0.05	3960			3960			3960		
4080	11.54	5.06	4080	0.03	4080			4080			4080		
4200	11.81		4200	0.01	4200	18.48		4200			4200		
4320	12.90	5.06	4320	0.00	4320			4320			4320		
Total time pumped(min):						W/L			W/L				
Average yield (l/s):				5.03									

wellTek services
Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 E BOREHOLE TEST RECORD SHEET

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE NO:	HSE 3	CO-ORDINATES:		PROVINCE:	NORTHERN CAPE
ALT BH NO:	0	LATITUDE [S]: 28.30349		DISTRICT:	HUMANSRUS
		LONGITUDE [E]: 23.34995		SITE NAME:	POSTMASBURG
BOREHOLE DEPTH [mbgl]:	61.37	DATUM LEVEL ABOVE CASING (m):	0.4	EXISTING PUMP:	NONE
WATER LEVEL [mbgl]:	13.62	CASING HEIGHT (magl):	0.33	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	42M	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P150

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1 RPM
DATE: 26/08/2011 TIME: 12H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.79		1	
2	0.93		2	
3	1.25		3	
5	1.57		5	
7	1.80		7	
10	2.07	0.57	10	
15	4.09	1.00	15	
20	4.98		20	
30	5.49		30	
40	6.19	1.06	40	
50	6.68		50	
60	7.10		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 2 RPM
DATE: 26/08/2011 TIME: 13H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	7.45	1.26	1	
2	7.63		2	
3	8.40	1.83	3	
5	9.73	2.04	5	
7	10.77		7	
10	12.10		10	
15	13.20	2.04	15	
20	14.60		20	
30	15.00		30	
40	17.20	2.08	40	
50	17.90		50	
60	18.55		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 3 RPM
DATE: 26/08/2011 TIME: 14H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	19.15	2.23	1	
2	19.49		2	
3	20.87	3.06	3	
5	22.60		5	
7	25.14	3.08	7	
10	26.62		10	
15	28.04		15	
20	29.30		20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 4 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

DISCHARGE RATE 5 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

DISCHARGE RATE 6 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	25.68
2			2	23.18
3			3	21.32
5			5	18.62
7			7	16.85
10			10	14.92
15			15	12.71
20			20	10.80
30			30	8.72
40			40	7.03
50			50	6.22
60			60	5.52
70			70	5.01
80			80	4.69
90			90	4.06
100			100	3.91
110			110	3.73
120			120	3.60
			150	2.90
			180	2.54
			210	2.25
			240	2.01
			300	
			360	

WAS SAND PUMPED ?	NO	WAS THE WATER CLEAN ?	YES
STATIC WATER LEVEL AFTER STEPPED DISCHARGE TEST?	15.63		

wellTek services
Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 F BOREHOLE TEST RECORD SHEET

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE NO: HSE 3	CO-ORDINATES:	PROVINCE:	NORTHERN CAPE
ALT BH NO: 0	LATITUDE [S]: 28.30349	DISTRICT:	HUMANSRUS
	LONGITUDE [E]: 23.34995	SITE NAME:	POSTMASBURG

BOREHOLE DEPTH [mbgl]:	61.37	DATUM LEVEL ABOVE CASING (m):	0.4	EXISTING PUMP:	NONE
WATER LEVEL [mbgl]:	13.62	CASING HEIGHT (magl):	0.33	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	42M	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P150

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED DATE: 27/08/2011 TIME: 11H00 | TEST COMPLETED DATE: 01/09/2011 TIME: 11H00 | TYPE OF PUMP: P150

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance:			OBSERVATION HOLE 2 NR: Distance:			OBSERVATION HOLE 3 NR: Distance:		
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME MIN	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)
1	1.83		1	16.53	1			1			1		
2	2.58	1.10	2	15.00	2			2			2		
3	3.05		3	14.22	3			3			3		
5	3.87	1.07	5	13.20	5			5			5		
7	4.57		7	12.86	7			7			7		
10	5.27	1.07	10	12.82	10			10			10		
15	6.35		15	11.92	15			15			15		
20	7.07	1.07	20	11.40	20			20			20		
30	7.94		30	10.50	30			30			30		
40	8.59	1.10	40	9.82	40			40			40		
60	9.60		60	8.80	60			60			60		
90	10.62	1.07	90	7.67	90			90			90		
120	11.32		120	6.75	120			120			120		
150	11.85	1.06	150	6.05	150			150			150		
180	12.29		180	5.49	180			180			180		
210	12.65	1.07	210	4.99	210			210			210		
240	12.92		240	4.56	240			240			240		
300	13.36	1.06	300	3.95	300			300			300		
360	13.83		360	3.48	360			360			360		
420	14.19	1.06	420	3.09	420			420			420		
480	14.63		480	2.82	480			480			480		
540	14.90	1.07	540	2.44	540			540			540		
600	15.15		600	2.16	600			600			600		
720	15.63	1.06	720	1.99	720			720			720		
840	15.69		840	1.72	840			840			840		
960	15.95	1.08	960	1.52	960			960			960		
1080	16.03		1080	1.38	1080			1080			1080		
1200	16.19	1.08	1200	1.24	1200			1200			1200		
1320	16.24		1320	1.13	1320			1320			1320		
1440	16.29	1.08	1440	1.02	1440			1440			1440		
1560	16.32		1560	0.95	1560			1560			1560		
1680	16.35	1.08	1680	0.88	1680			1680			1680		
1800	16.49		1800	0.81	1800			1800			1800		
1920	16.82	1.08	1920	0.75	1920			1920			1920		
2040	16.90		2040	0.69	2040			2040			2040		
2160	16.94	1.07	2160	0.64	2160			2160			2160		
2280	17.02		2280	0.59	2280			2280			2280		
2400	17.10	1.07	2400	0.54	2400			2400			2400		
2520	17.12		2520	0.50	2520			2520			2520		
2640	17.14	1.05	2640	0.48	2640			2640			2640		
2760	17.38		2760	0.46	2760			2760			2760		
2880	17.49	1.06	2880	0.43	2880			2880			2880		
3000	17.53		3000		3000			3000			3000		
3120	17.69	1.06	300		3120			3120			3120		
3240	17.79		3240		3240			3240			3240		
3360	17.91	1.07	3360		3360			3360			3360		
3480	17.99		3480		3480			3480			3480		
3600	18.04	1.06	3600		3600			3600			3600		
3720	18.10		3720		3720			3720			3720		
3840	18.15	1.06	3840		3840			3840			3840		
3960	18.19		3960		3960			3960			3960		
4080	18.24	1.07	4080		4080			4080			4080		
4200	18.37		4200		4200			4200			4200		
4320	18.46	1.08	4320		4320			4320			4320		
Total time pumped(min):				4320		W/L			W/L				
Average yield (l/s):				1.07									

wellTek services

Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 E BOREHOLE TEST RECORD SHEET

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE NO: HSE 2	CO-ORDINATES:		PROVINCE:	NORTHERN CAPE
ALT BH NO: 0	LATITUDE [S]: 28.31585		DISTRICT:	HUMANSRUS
	LONGITUDE [E]: 23.3579		SITE NAME:	POSTMASBURG

BOREHOLE DEPTH [mbgl]:	37.02	DATUM LEVEL ABOVE CASING (m):	0.42	EXISTING PUMP:	N/A
WATER LEVEL [mbgl]:	13.90	CASING HEIGHT (magl):	0.28	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	26.00	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P115/BP65

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1			RPM		DISCHARGE RATE 2			RPM		DISCHARGE RATE 3			RPM	
DATE: 31/08/2011		TIME: 12H00			DATE: 31/08/2011		TIME: 13H00			DATE: 31/08/2011		TIME: 14H00		
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.26		1		1	0.48	1.44	1		1	0.77		1	
2	0.29	1.15	2		2	0.54		2		2	0.86	2.23	2	
3	0.29		3		3	0.56	2.00	3		3	0.96	2.81	3	
5	0.30		5		5	0.58		5		5	1.04		5	
7	0.30		7		7	0.60		7		7	1.04	3.00	7	
10	0.32		10		10	0.62		10		10	1.06		10	
15	0.33	1.15	15		15	0.64		15		15	1.09		15	
20	0.33		20		20	0.64	2.00	20		20	1.01		20	
30	0.34		30		30	0.66		30		30	1.01	3.04	30	
40	0.35	1.16	40		40	0.67		40		40	1.14		40	
50	0.36		50		50	0.69		50		50	1.15		50	
60	0.36		60		60	0.70		60		60	1.28		60	
70			70		70			70		70			70	
80			80		80			80		80			80	
90			90		90			90		90			90	
100			100		100			100		100			100	
110			110		110			110		110			110	
120			120		120			120		120			120	
			150					150					150	
			180					180					180	
			210					210					210	

DISCHARGE RATE 4			RPM		DISCHARGE RATE 5			RPM		DISCHARGE RATE 6			RPM	
DATE: 31/08/2011		TIME: 15H00			DATE: 31/08/2011		TIME: 16H00			DATE: 01/09/2011		TIME: 06H00		
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.95		1		1	2.85		1	1.00	1	1.46	7.92	1	1.20
2	2.39	5.93	2		2	3.05		2	0.73	2	1.65		2	0.69
3	2.34	5.26	3		3	3.59		3	0.67	3	1.69	8.02	3	0.58
5	2.34		5		5	3.72	7.31	5	0.63	5	2.84		5	0.53
7	2.36		7		7	3.75		7	0.62	7	3.32		7	0.51
10	2.40		10		10	3.80		10	0.57	10	3.46	8.01	10	0.49
15	2.43	5.26	15		15	3.87		15	0.53	15	3.63		15	0.45
20	2.46		20		20	3.90	7.30	20	0.50	20	3.84		20	0.42
30	2.55		30		30	4.01		30		30	4.07	8.02	30	0.38
40	2.60		40		40	4.13		40		40	4.23		40	0.34
50	2.65		50		50	4.18		50		50	4.37		50	0.30
60	2.66		60		60	4.30		60		60	4.57		60	0.28
70			70		70			70		70			70	
80			80		80			80		80			80	
90			90		90			90		90			90	
100			100		100			100		100			100	
110			110		110			110		110			110	
120			120		120			120		120			120	
			150					150					150	
			180					180					180	
			210					210					210	
			240					240					240	
			300					300					300	
			360					360					360	

WAS SAND PUMPED ?	NO	WAS THE WATER CLEAN ?	YES
STATIC WATER LEVEL AFTER STEPPED DISCHARGE TEST?	14.18		

welltek services

Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 F BOREHOLE TEST RECORD SHEET

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE NO: HSE 2	CO-ORDINATES:	PROVINCE:	NORTHERN CAPE
ALT BH NO: 0	LATITUDE [S]: 28.31585	DISTRICT:	HUMANSRUS
	LONGITUDE [E]: 23.3579	SITE NAME:	POSTMASBURG

BOREHOLE DEPTH [mbgl]:	37.02	DATUM LEVEL ABOVE CASING (m):	0.42	EXISTING PUMP:	N/A
WATER LEVEL [mbgl]:	13.90	CASING HEIGHT (magl):	0.28	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]:	26.00	DIAM OF CASING AT TOP (mm)	165	TEST PUMP TYPE:	P115/BP65

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				TEST COMPLETED					
DATE:	01/09/2011	TIME:	09H02	DATE:	06/09/2011	TIME:	09H02	TYPE OF PUMP:	BP 65 M

DISCHARGE BOREHOLE					OBSERVATION HOLE 1			OBSERVATION HOLE 2			OBSERVATION HOLE 3		
					NR:	SE4		NR:			NR:		
					Distance:			Distance:			Distance:		
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME MIN	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)	TIME: (min)	DRAWDOWN (M)	Recovery (m)
1	0.95		1	3.93	1			1			1		
2	1.10	2.98	2	1.85	2			2			2		
3	1.22		3	1.74	3			3			3		
5	1.85	5.03	5	1.70	5			5			5		
7	2.03		7	1.68	7			7			7		
10	2.34	5.03	10	1.65	10			10			10		
15	2.40		15	1.63	15			15			15		
20	2.48	5.03	20	1.60	20			20			20		
30	2.56		30	1.55	30			30			30		
40	2.63	5.03	40	1.52	40			40			40		
60	2.74		60	1.45	60			60			60		
90	2.88	5.02	90	1.37	90			90			90		
120	2.98		120	1.32	120			120			120		
150	3.05	5.02	150	1.27	150			150			150		
180	3.09		180	1.24	180			180			180		
210	3.19	5.02	210	1.20	210			210			210		
240	3.25		240	1.18	240			240			240		
300	3.36	5.03	300	1.13	300			300			300		
360	3.46		360	1.08	360			360			360		
420	3.54	5.02	420	1.06	420			420			420		
480	3.61		480	1.02	480			480			480		
540	3.70	5.04	540	0.98	540			540			540		
600	3.84		600	0.96	600			600			600		
720	3.85	5.03	720	0.94	720			720			720		
840	4.03		840	0.90	840			840			840		
960	4.17	5.02	960	0.86	960			960			960		
1080	4.30		1080	0.81	1080			1080			1080		
1200	4.43	5.02	1200	0.73	1200			1200			1200		
1320	4.57		1320	0.76	1320			1320			1320		
1440	4.67	5.03	1440	0.74	1440			1440			1440		
1560	4.80		1560	0.71	1560			1560			1560		
1680	4.90	5.02	1680	0.69	1680			1680			1680		
1800	5.02		1800	0.67	1800			1800			1800		
1920	5.20	5.03	1920	0.65	1920			1920			1920		
2040	5.50		2040	0.62	2040			2040			2040		
2160	5.65	5.03	2160	0.59	2160			2160			2160		
2280	5.77		2280	0.56	2280			2280			2280		
2400	5.94		2400	0.52	2400			2400			2400		
2520	6.19	5.06	2520	0.48	2520			2520			2520		
2640	6.32		2640	0.43	2640			2640			2640		
2760	6.58	5.03	2760	0.39	2760			2760			2760		
2880	6.78		2880	0.34	2880	17.23	17.23	2880			2880		
3000	6.86	5.03	3000	0.30	3000			3000			3000		
3120	6.91		3120	0.26	3120			3120			3120		
3240	7.20	5.03	3240	0.23	3240			3240			3240		
3360	7.96		3360	0.20	3360	17.23		3360			3360		
3480	8.50	5.03	3480	0.16	3480			3480			3480		
3600	9.07		3600	0.13	3600			3600			3600		
3720	9.48		3720	0.10	3720			3720			3720		
3840	9.94	5.00	3840	0.07	3840			3840			3840		
3960	10.42		3960	0.05	3960			3960			3960		
4080	11.54	5.06	4080	0.03	4080			4080			4080		
4200	11.81		4200	0.01	4200	18.48		4200			4200		
4320	12.90	5.06	4320	0.00	4320			4320			4320		
Total time pumped(min):						W/L			W/L				
Average yield (l/s):				5.03									

welltek services
Borehole testing and associated projects

Department of Water Affairs Minimum Standards and Guideline: FORM 5 E BOREHOLE TEST RECORD SHEET

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE NO: HS 4	CO-ORDINATES:		PROVINCE:	NORTHERN CAPE
ALT BH NO: WINDMILL	LATITUDE [S]: 28.29156		DISTRICT:	POSTMASBURG
	LONGITUDE [E]: 23.37531		SITE NAME:	HUMANSRUS
BOREHOLE DEPTH [mbgl]: 73.72	DATUM LEVEL ABOVE CASING (m):	0.41	EXISTING PUMP:	WINDMILL
WATER LEVEL [mbgl]: 32.63	CASING HEIGHT (magl):	0	CONTRACTOR:	WELLTEK SERVICES
DEPTH OF PUMP [m]: 68.00	DIAM OF CASING AT TOP (mm)	155	TEST PUMP TYPE:	P 150

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1 RPM
DATE: 06/09/2011 TIME: 09H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.03		1	
2	1.55	0.18	2	
3	1.66		3	
5	1.75	0.33	5	
7	1.84		7	
10	1.94	0.32	10	
15	2.44		15	
20	4.66	0.33	20	
30	8.50		30	
40	12.54	0.32	40	
50	15.63		50	
60	17.18	0.33	60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 2 RPM
DATE: 06/09/2011 TIME: 10H00

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	17.84		1	
2	18.37	0.62	2	
3	18.78		3	
5	22.00	0.61	5	
7	25.21		7	
10	27.63	0.62	10	
15	29.47		15	
20	30.70	0.62	20	
30	33.49		30	
31	33.49	0.46	40	
32	33.49	0.31	50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 3 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	

DISCHARGE RATE 4 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

DISCHARGE RATE 5 RPM
DATE: TIME:

TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
			150	
			180	
			210	
			240	
			300	
			360	

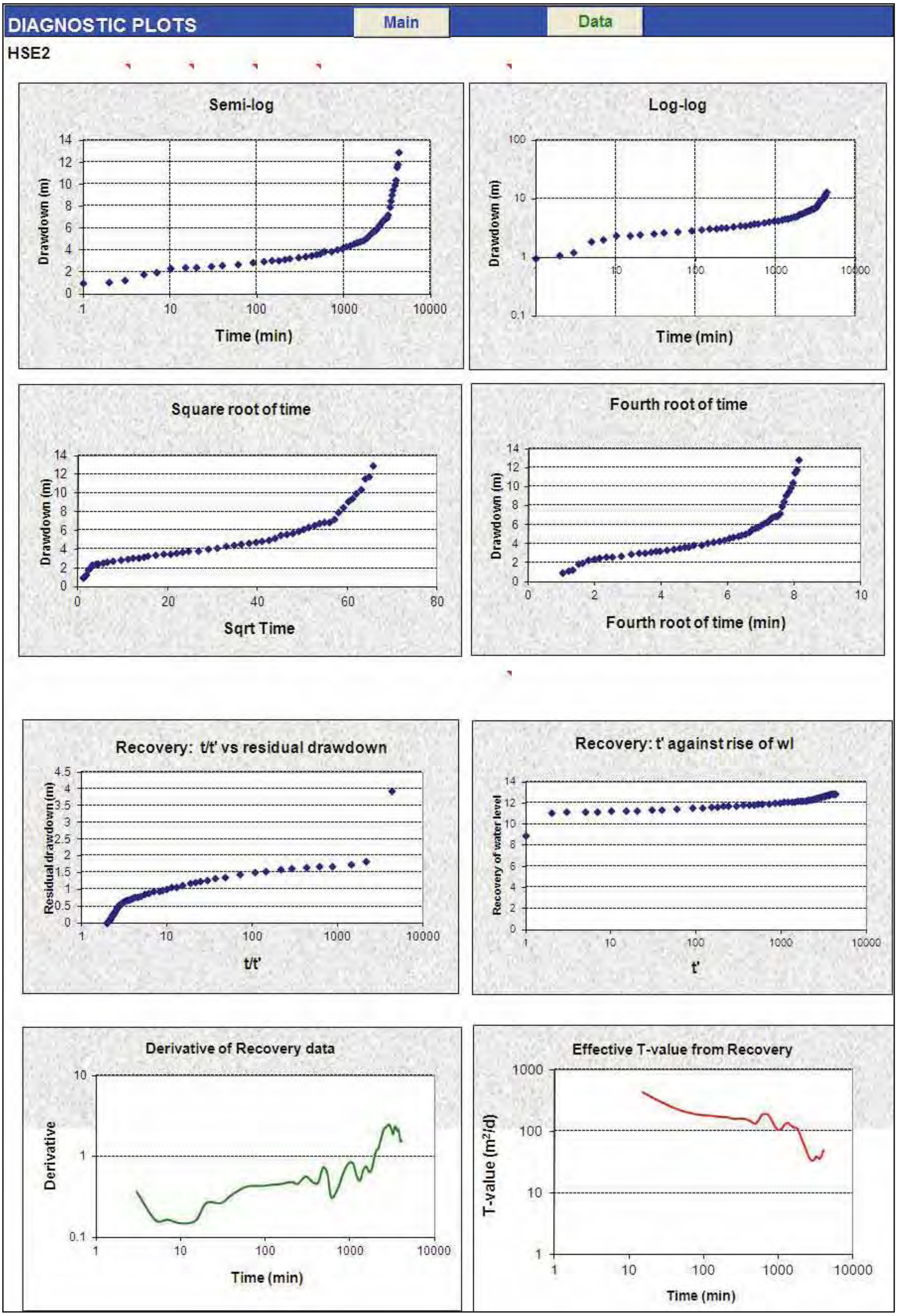
DISCHARGE RATE 6 RPM
DATE: TIME:

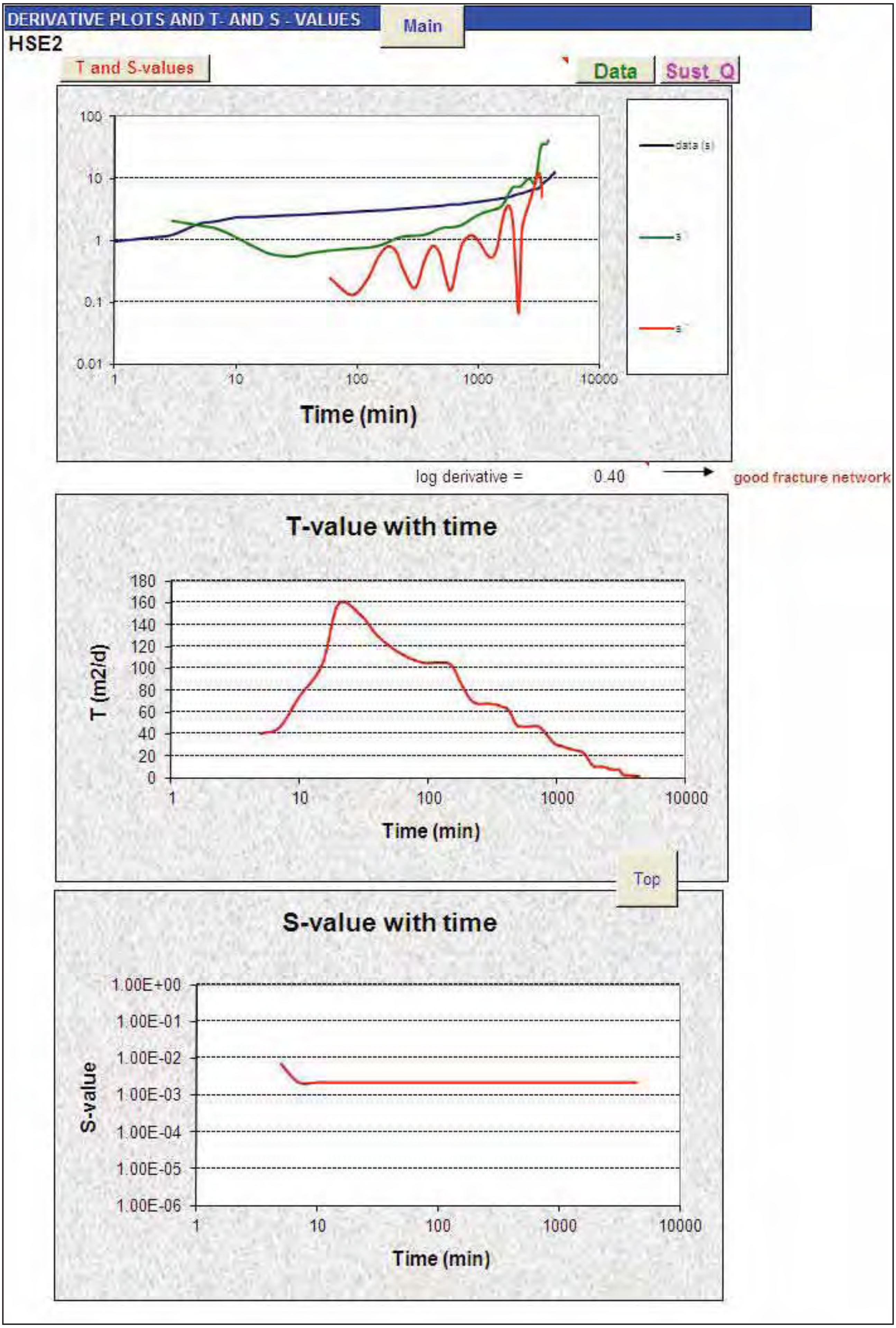
TIME (MIN)	DRAWDOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	27.89
2			2	22.04
3			3	18.04
5			5	13.04
7			7	10.89
10			10	8.44
15			15	7.00
20			20	5.50
30			30	2.52
40			40	1.84
50			50	1.50
60			60	1.30
70			70	1.05
80			80	0.96
90			90	0.84
100			100	0.75
110			110	0.64
120			120	0.54
			150	0.46
			180	0.40
			210	0.36
			240	0.29
			300	0.15
			360	0.09

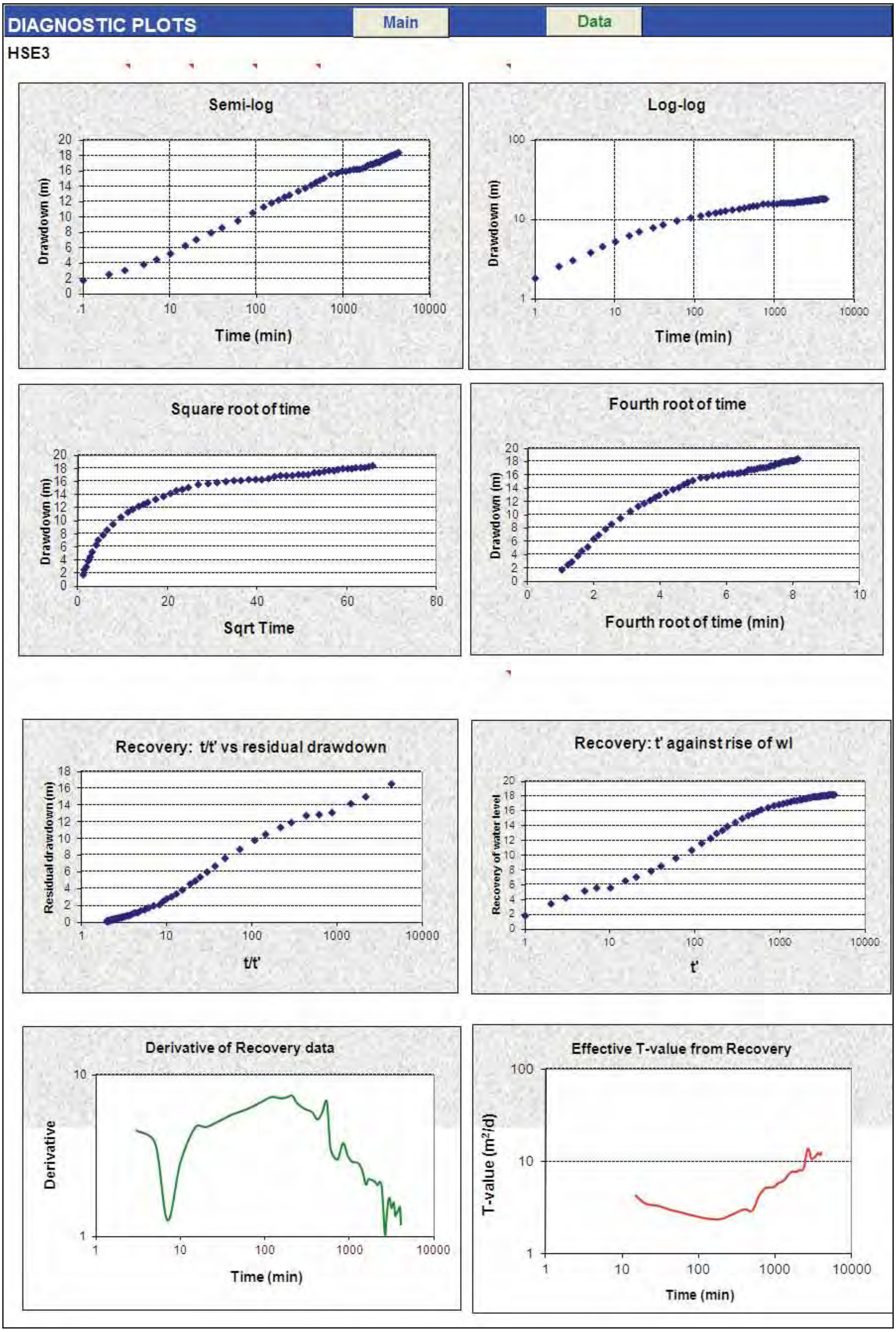
WAS SAND PUMPED ?	NO	WAS THE WATER CLEAN ?	YES
STATIC WATER LEVEL AFTER STEPPED DISCHARGE TEST?	32.72		

No CDT conducted on this borehole.

Appendix3: Diagnostic Plots


DIAGNOSTIC PLOTS
Main
Data
HSE2
Semi-log
Drawdown (m)
Time (min)
Log-log
Drawdown (m)
Time (min)
Square root of time
Drawdown (m)
Sqrt Time
Fourth root of time
Drawdown (m)
Fourth root of time (min)
Recovery: t/t' vs residual drawdown
Residual drawdown (m)
t/t'
Recovery: t' against rise of wl
Recovery of water level
t'
Derivative of Recovery data
Derivative
Time (min)
Effective T-value from Recovery
T-value (m²/d)
Time (min)


DERIVATIVE PLOTS AND T- AND S - VALUES
Main
HSE2
T and S-values
Data
Sust_Q
data (s)
s
s'
Time (min)
log derivative = 0.40
good fracture network
T-value with time
T (m2/d)
Time (min)
Top
S-value with time
S-value
Time (min)



DIAGNOSTIC PLOTS
Main
Data
HSE3
Semi-log
Drawdown (m)
Time (min)
Log-log
Drawdown (m)
Time (min)
Square root of time
Drawdown (m)
Sqrt Time
Fourth root of time
Drawdown (m)
Fourth root of time (min)
Recovery: t/t' vs residual drawdown
Residual drawdown (m)
t/t'
Recovery: t' against rise of wl
Recovery of water level
t'
Derivative of Recovery data
Derivative
Time (min)
Effective T-value from Recovery
T-value (m²/d)
Time (min)

DERIVATIVE PLOTS AND T- AND S - VALUES

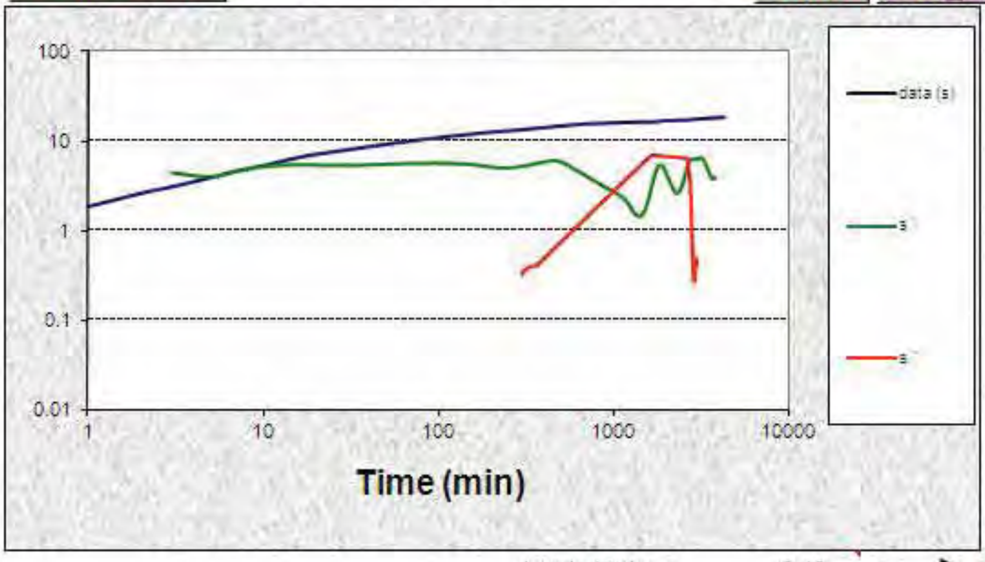
Main

HSE3

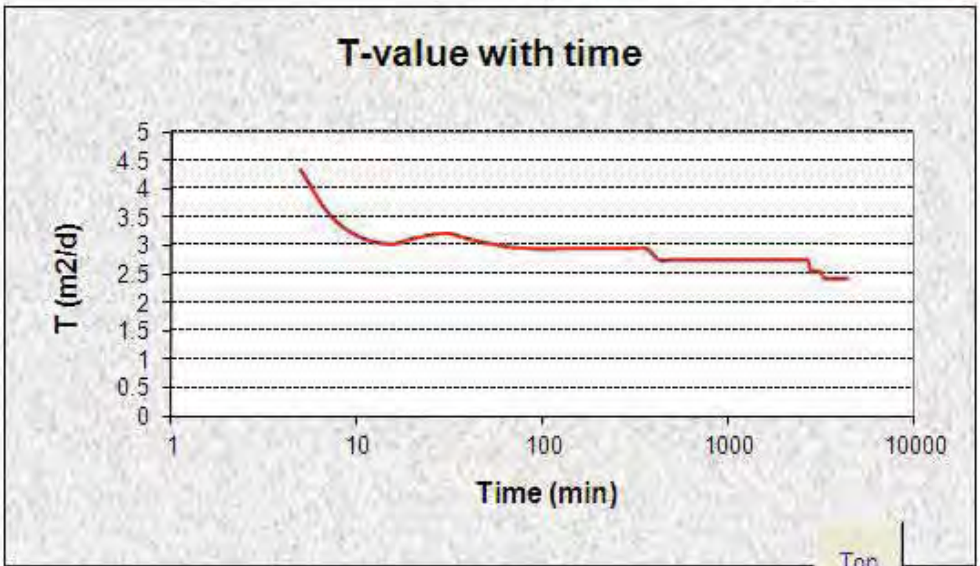
T and S-values

Data

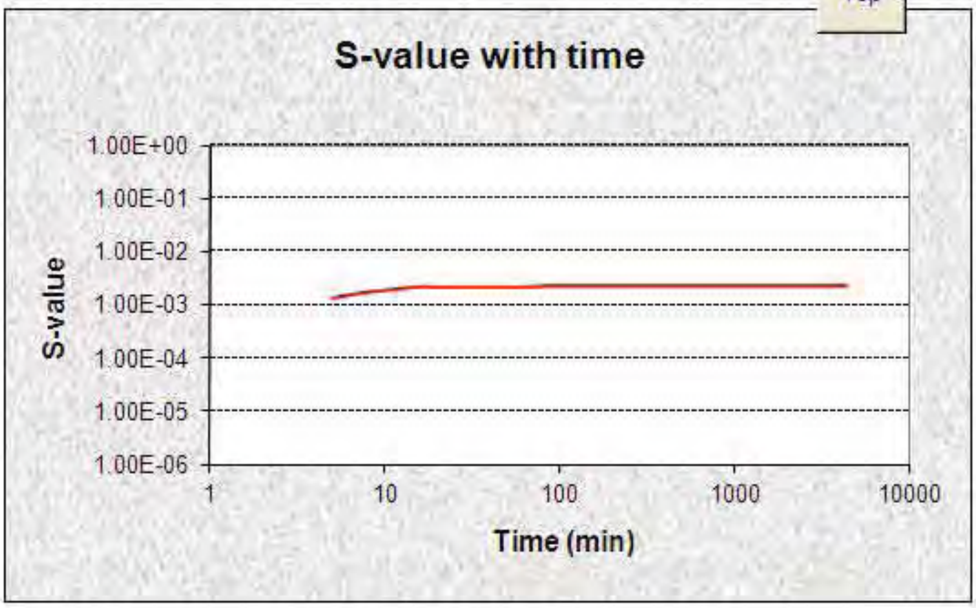
Sust_Q

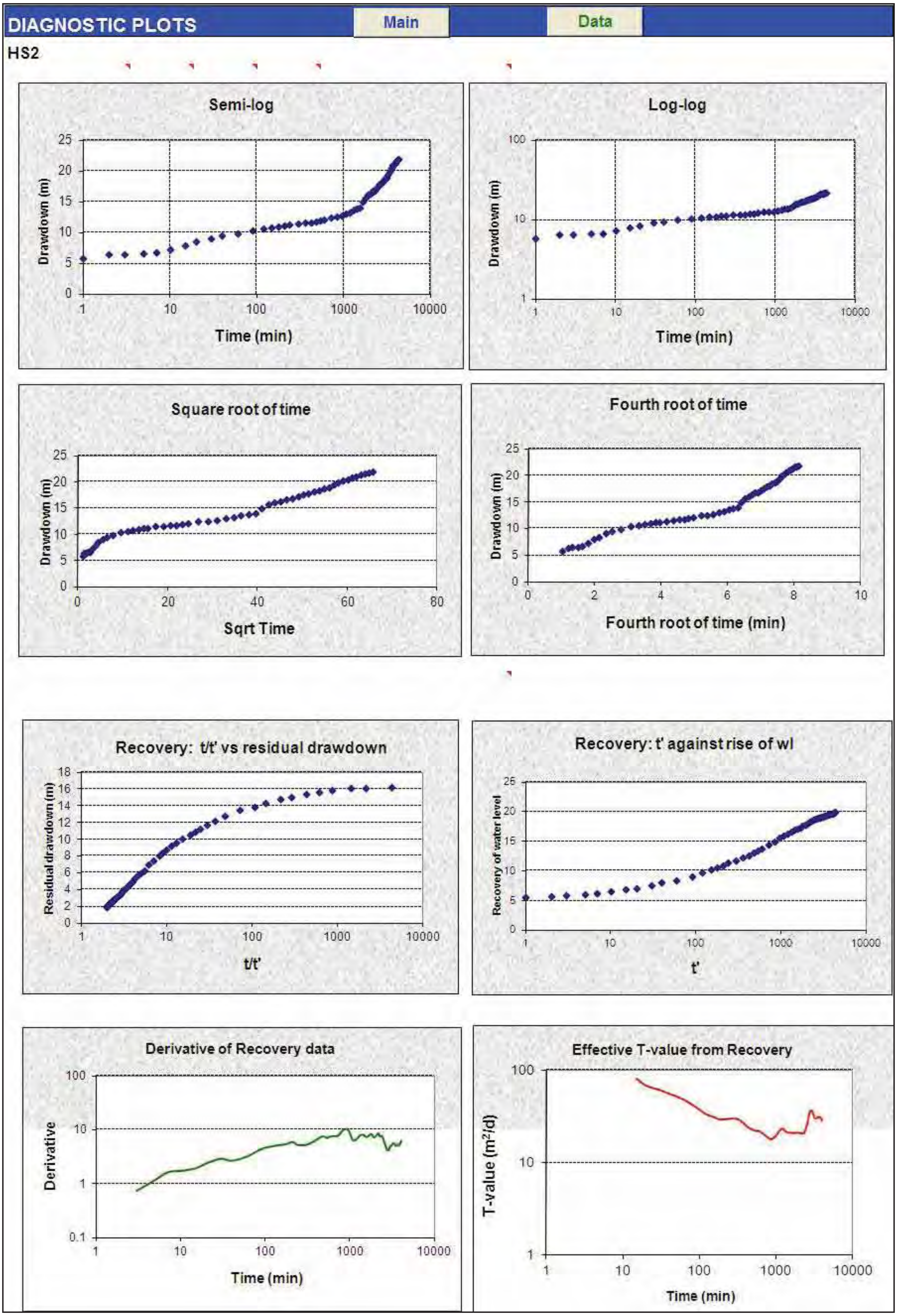


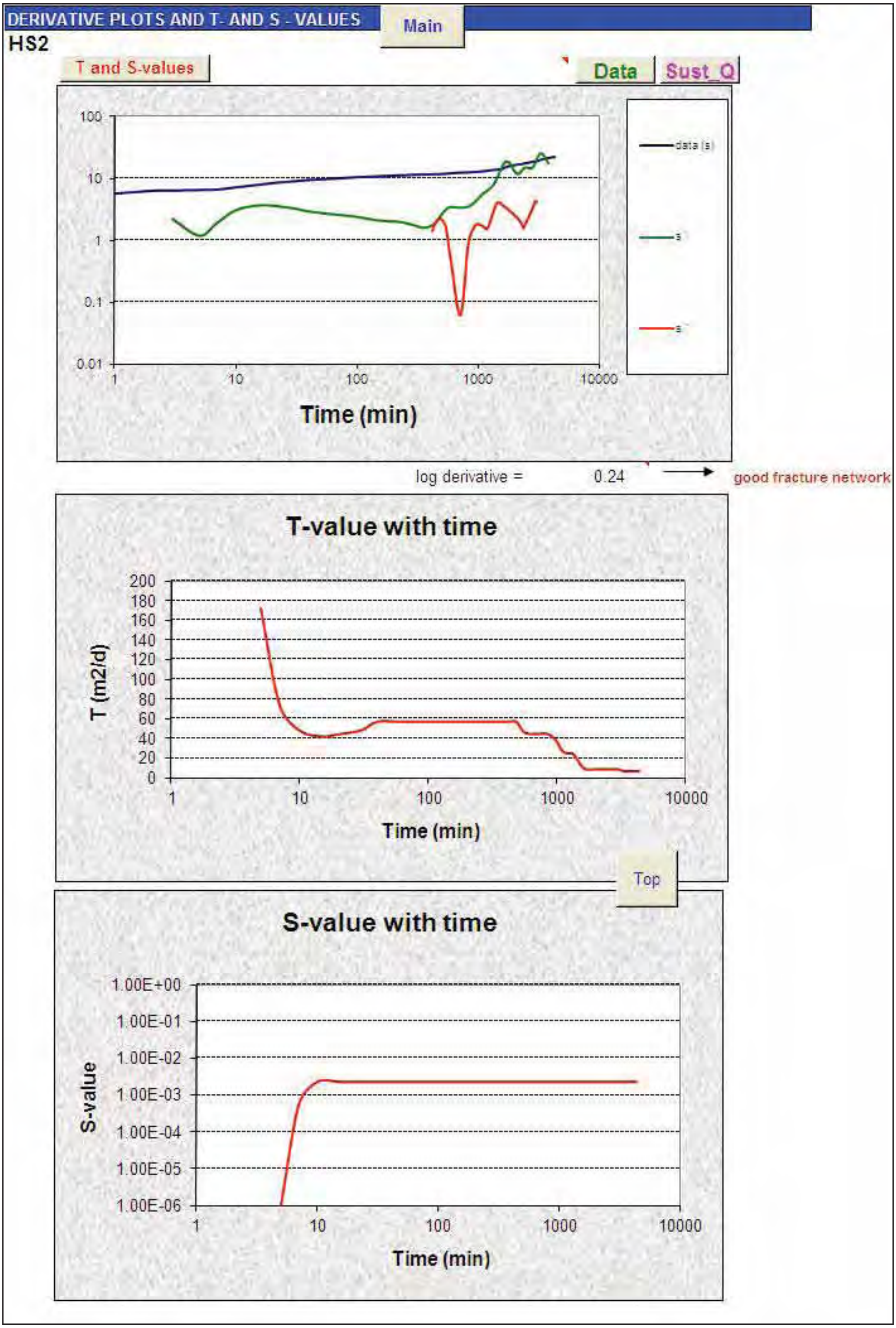
log derivative = 0.18 → good fracture network

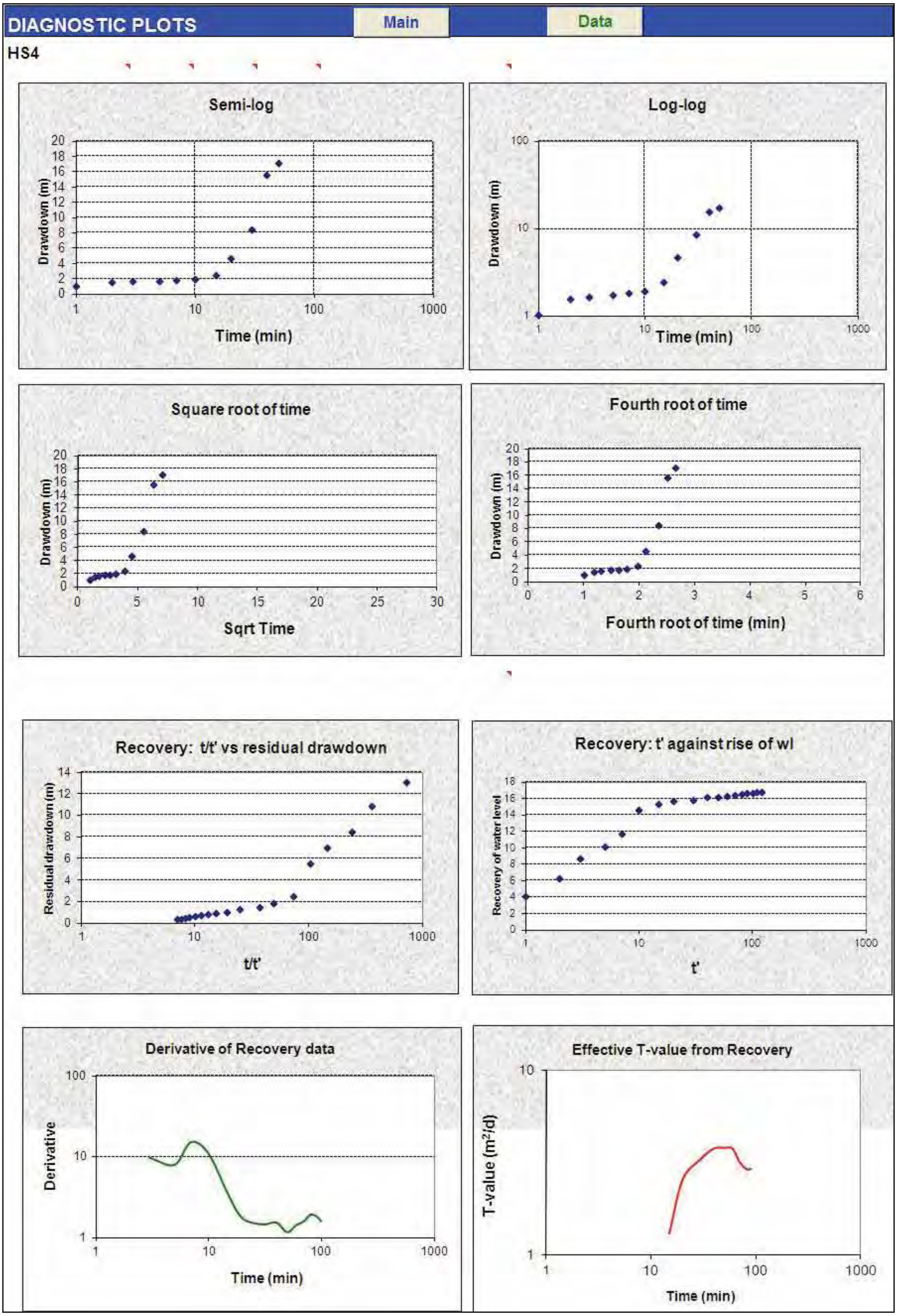


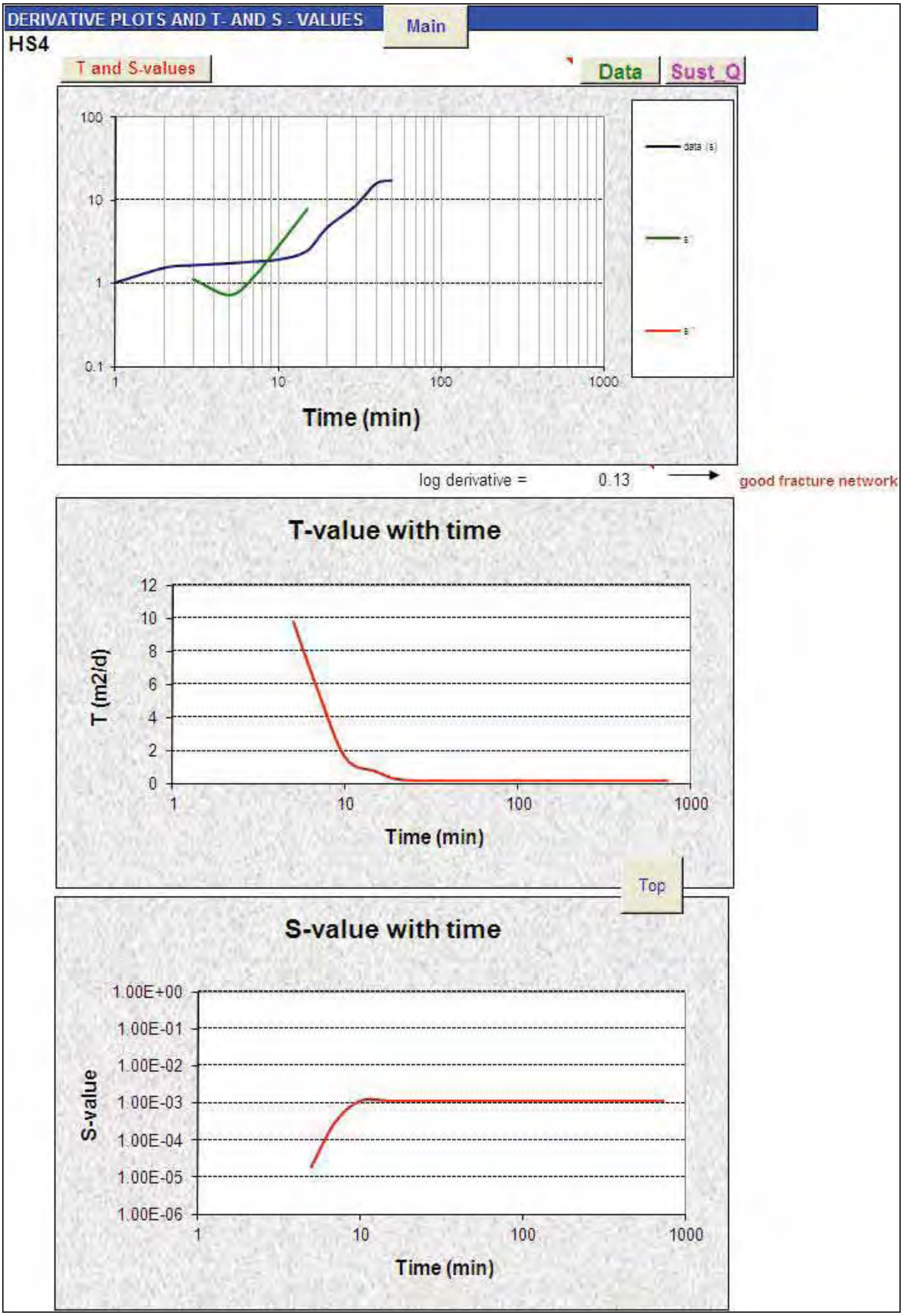
Top




DIAGNOSTIC PLOTS
Main
Data
HS2
Semi-log
Drawdown (m)
Time (min)
Log-log
Drawdown (m)
Time (min)
Square root of time
Drawdown (m)
Sqrt Time
Fourth root of time
Drawdown (m)
Fourth root of time (min)
Recovery: t/t' vs residual drawdown
Residual drawdown (m)
t/t'
Recovery: t' against rise of wl
Recovery of water level
t'
Derivative of Recovery data
Derivative
Time (min)
Effective T-value from Recovery
T-value (m²/d)
Time (min)


DERIVATIVE PLOTS AND T- AND S - VALUES
Main
HS2
T and S-values
Data
Sust_Q
100
10
1
0.1
0.01
1
10
100
1000
10000
Time (min)
data (s)
log derivative = 0.24
good fracture network
T-value with time
T (m2/d)
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
Time (min)
Top
S-value with time
S-value
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1
10
100
1000
10000
Time (min)


DIAGNOSTIC PLOTS
Main
Data
HS4
Semi-log
Drawdown (m)
Time (min)
Log-log
Drawdown (m)
Time (min)
Square root of time
Drawdown (m)
Sqrt Time
Fourth root of time
Drawdown (m)
Fourth root of time (min)
Recovery: t/t' vs residual drawdown
Residual drawdown (m)
t/t'
Recovery: t' against rise of wl
Recovery of water level
t'
Derivative of Recovery data
Derivative
Time (min)
Effective T-value from Recovery
T-value (m²/d)
Time (min)


DERIVATIVE PLOTS AND T- AND S - VALUES
Main
HS4
T and S-values
Data
Sust_Q
100
10
1
0.1
1
10
100
1000
Time (min)
log derivative = 0.13
good fracture network
T-value with time
T (m2/d)
12
10
8
6
4
2
0
1
10
100
1000
Time (min)
Top
S-value with time
S-value
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1
10
100
1000
Time (min)

Appendix 4: Pump Test Analyses Results

Summary	Main	HSE2					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m^2/d)	Late T (m^2/d)	S	AD used
☑	Basic FC	0.80	0.47	145	10.9	2.20E-03	5.0
☐	Advanced FC			145	10.9	2.20E-03	5.0
☑	FC inflection point	0.81	0.54				4.8
☑	Cooper-Jacob	1.66	1.07		64.6	8.54E-03	5.0
☑	FC Non-Linear	1.67	1.48	112.0		2.00E-03	5.0
☑	Barker	1.19	1.48	K_f = 64	S_s =	2.00E-03	5.0
	Average Q_sust (l/s)	**1.22**	**0.43**	b = 1.32	Fractal dimension n =	1.98	

Recommended abstraction rate (L/s) **1.20** for 24 hours per day

Hours per day of pumping 12 — 1.70 L/s for 12 hours per day

Amount of water allowed to be abstracted per month 3110.4 m^3 or 102.3 m^3/day

Summary	Main	HSE3					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m^2/d)	Late T (m^2/d)	S	AD used
☑	Basic FC	0.66	0.33	3	2.8	1.10E-03	26.0
☐	Advanced FC			3	2.8	1.10E-03	26.0
☑	FC inflection point	0.43	0.18				18.0
☑	Cooper-Jacob	0.48	0.31		3.4	2.24E-03	26.0
☑	FC Non-Linear	0.49	0.43	3.0		2.00E-03	26.0
☑	Barker	0.59	0.36	K_f = 6	S_s =	1.34E-03	26.0
	Average Q_sust (l/s)	**0.53**	**0.09**	b = 0.42	Fractal dimension n =	2.10	

Recommended abstraction rate (L/s) **0.50** for 24 hours per day

Hours per day of pumping 12 — 0.71 L/s for 12 hours per day

Amount of water allowed to be abstracted per month 1296 m^3 or 42.6 m^3/day

Summary	Main	HS2					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m^2/d)	Late T (m^2/d)	S	AD used
☑	Basic FC	1.41	0.93	66	8.9	2.20E-03	14.0
☐	Advanced FC			66	8.9	2.20E-03	14.0
☑	FC inflection point	2.00	1.25				13.5
☑	Cooper-Jacob	3.14	2.03		49.8	4.94E-03	14.0
☑	FC Non-Linear	2.25	1.98	41.0		2.00E-03	14.0
☑	Barker	2.28	2.60	K_f = 234	S_s =	1.34E-03	14.0
	Average Q_sust (l/s)	**2.22**	**0.62**	b = 0.41	Fractal dimension n =	1.93	

Recommended abstraction rate (L/s) **2.20** for 24 hours per day

Hours per day of pumping 12 — 3.11 L/s for 12 hours per day

Amount of water allowed to be abstracted per month 5702.4 m^3 or 187.5 m^3/day

Summary	Main	HS4							
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m^2/d)		Late T (m^2/d)		S	AD used
☑	Basic FC	0.05	0.03	7		1.3		1.10E-03	2.4
☐	Advanced FC			7		1.3		1.10E-03	2.4
☑	FC inflection point	0.06	0.04						2.5
☑	Cooper-Jacob	0.05	0.03			3.8		1.06E-03	2.4
☑	FC Non-Linear	0.05	0.05	1.0				1.40E-03	2.4
☑	Barker	0.01	0.00	K_f =	13		S_s =	9.00E-04	2.4
	Average Q_sust (l/s)	0.05	0.00	b =	1.80	Fractal dimension n =		1.30	

Recommended abstraction rate (L/s)	0.05	for 24 hours per day			
Hours per day of pumping 12	0.07	L/s	for	12	hours per day
Amount of water allowed to be abstracted per month	129.6	m^3 or		4.3	m^3/day

Appendix 5: Chemical Analyses Certificates

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2011/09/12

ANALYTICAL REPORT

OUR REF: SRK CONSULTING JHB 13925/11
COMPANY NAME: SRK CONSULTING JHB
CONTACT ADDRESS: 24 SCHMIDTSDRIFT ROAD, VERWOERDPARK, KIMBERLEY, 8301
CONTACT PERSON: CHRIS ESTERHUYSE
SAMPLE TYPE: WATER SAMPLES
DATE SUBMITTED: 2011/08/26

Determinand	Units	Method No	Results	
			13925/11	13926/11
			CN2	GR8
Arsenic*	µg As/l		< 2	< 2
Boron*	µg B/l		33	103
Bromide*	mg Br/l		0.3	0.4
Chemical oxygen demand (total)	mg O_2/l	3	<20	<20
Chloride	mg Cl/l	16	40	19
Colour*	mg Pt-Co/l	48	< 1	< 1
Conductivity at 25°C	mS/m	2	39	67
Dissolved calcium	mg Ca/l	8A	22	51
Dissolved magnesium	mg Mg/l	9A	19	32
Fluoride	µg F/l	18	190	160
Hexavalent chromium	mg Cr/l	68	< 0.0008	< 0.0008
Mercury*	µg Hg/l		< 0.5	< 0.5
Nitrate/Nitrite	mg N/l	65	2.41	10.7
Nitrite*	mg N/l	65	< 0.01	< 0.01
Orthophosphate	mg P/l	66	0.015	0.016
pH at 25°C	pH units	1	6.7	7.1
pHs*	calculation		8.07	7.36
Potassium	mg K/l	7A	2.7	1.4
Selenium*	µg Se/l		< 1.0	< 1.0
Silicon*	mg Si/l		14.16	9.58
Sodium	mg Na/l	6A	11	19
Soluble organic carbon*	mg C/l		1.41**	1.64**
Sulphate	mg SO_4/l	67	6.26	19.9
Suspended solids at 105°C	mg/l	5	22	<10
Total Alkalinity	mg $CaCO_3$/l	10	101	227
Total chromium	mg Cr/l		< 0.11	< 0.11
Total Dissolved Solids at 180°C	mg/l	41	218	362
Total hardness	mg $CaCO_3$/l	calc	133	259
Turbidity	NTU	4	1.1	1.1

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Determinand	Units	Method No	Results	
			13927/11	13928/11
			GR14	SE4
Arsenic*	µg As/l		< 2	< 2
Boron*	µg B/l		59	119
Bromide*	mg Br/l		0.2	1.1
Chemical oxygen demand (total)	mg O_2/l	3	<20	<20
Chloride	mg Cl/l	16	18	287
Colour*	mg Pt-Co/l	48	< 1	< 1
Conductivity at 25°C	mS/m	2	41	145
Dissolved calcium	mg Ca/l	8A	26	100
Dissolved magnesium	mg Mg/l	9A	20	67
Fluoride	µg F/l	18	280	450
Hexavalent chromium	mg Cr/l	68	< 0.0008	< 0.0008
Mercury*	µg Hg/l		< 0.5	< 0.5
Nitrate/Nitrite	mg N/l	65	23.9	3.78
Nitrite*	mg N/l	65	< 0.01	< 0.01
Orthophosphate	mg P/l	66	0.021	0.010
pH at 25°C	pH units	1	7.5	7.1
pHs*	calculation		7.81	6.91
Potassium	mg K/l	7A	2.0	9.5
Selenium*	µg Se/l		< 1.0	< 1.0
Silicon*	mg Si/l		8.32	20.66
Sodium	mg Na/l	6A	12	43
Soluble organic carbon*	mg C/l		1.28**	6.78**
Sulphate	mg SO_4/l	67	27.5	9.27
Suspended solids at 105°C	mg/l	5	<10	<10
Total Alkalinity	mg $CaCO_3$/l	10	152	355
Total chromium	mg Cr/l		< 0.11	< 0.11
Total Dissolved Solids at 180°C	mg/l	41	216	716
Total hardness	mg $CaCO_3$/l	calc	147	526
Turbidity	NTU	4	1.1	2.0

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ICP-MS	13925/11 CN2	13926/11 GR8	13927/11 GR14	13928/11 SE4
DETERMINAND	**ppb**	**ppb**	**ppb**	**ppb**
Lithium	1.57	3.28	1.12	2.46
Beryllium	<1	<1	<1	<1
Boron	33.2	106.1	60.0	119.9
Aluminium	<1	<1	<1	<1
Silicon	23544	30903	15106	40405
Titanium	<1	<1	<1	<1
Vanadium	<1	2.52	<1	12.75
Chromium	<1	<1	<1	0.319
Manganese	5.69	4.46	27.01	0.749
Iron	<1	<1	<1	<1
Cobalt	0.195	0.076	<1	0.037
Nickel	1.22	<1	<1	<1
Copper	<1	<1	0.644	1.26
Zinc	34.8	4.61	4.25	<1
Gallium	0.044	0.137	0.202	21.4
Germanium	0.085	0.062	0.059	0.033
Arsenic	<1	0.016	<1	0.249
Selenium	0.275	1.35	0.430	0.943
Bromine	338.8	365.4	192	1110
Rubidium	13.86	1.13	2.22	0.273
Strontium	124.9	189.1	96.5	582.4
Yttrium	<1	<1	<1	<1
Zirconium	<1	<1	<1	<1
Niobium	<1	<1	<1	<1
Molybdenum	<1	<1	<1	<1
Palladium	0.010	0.090	0.011	0.035
Silver	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1
Tin	<1	<1	<1	<1
Antimony	<1	<1	<1	<1
Tellurium	<1	<1	<1	<1

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ICP-MS	13925/11 CN2	13926/11 GR8	13927/11 GR14	13928/11 SE4
DETERMINAND	ppb	ppb	ppb	ppb
Caesium	0.650	0.009	0.088	0.004
Barium	0.311	1.26	1.50	167.6
Lanthanum	<1	<1	<1	<1
Cerium	<1	<1	<1	<1
Praseodymium	<1	<1	<1	<1
Neodymium	<1	<1	<1	<1
Samarium	<1	<1	<1	<1
Europium	<1	<1	<1	<1
Gadolinium	<1	<1	<1	<1
Terbium	<1	<1	<1	<1
Dysprosium	<1	<1	<1	<1
Holmium	<1	<1	<1	<1
Erbium	<1	<1	<1	<1
Thulium	<1	<1	<1	<1
Ytterbium	<1	<1	<1	<1
Lutetium	<1	<1	<1	<1
Hafnium	<1	<1	<1	<1
Tantalum	<1	<1	<1	<1
Tungsten	<1	<1	<1	<1
Rhenium	<1	<1	<1	<1
Osmium	<1	<1	<1	<1
Iridium	<1	<1	<1	<1
Platinum	<1	<1	<1	<1
Gold	<1	<1	<1	<1
Mercury	<1	<1	<1	<1
Thallium	<1	<1	<1	<1
Lead	<1	<1	<1	<1
Bismuth	<1	<1	<1	<1
Thorium	<1	<1	<1	<1
Uranium	<1	1.24	<1	5.92

TALBOT Laboratories

Belinda Talbot
LABORATORY MANAGER

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- Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.
- Figures reported in () were analysed after preservation according to the laboratory's preservation procedure.
- Note: results marked ** have been sub-contracted to a peer accredited laboratory.
- Note: Estimates of Uncertainty of Measurement may be obtained from the laboratory.

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2011/09/30

ANALYTICAL REPORT

OUR REF: SRK CONSULTING JHB 15145/11
COMPANY NAME: SRK CONSULTING JHB
CONTACT ADDRESS: 24 SCHMIDTSDRIFT ROAD, VERWOERDPARK, KIMBERLY, 8301
CONTACT PERSON: CHRIS ESTERHUYSE
SAMPLE TYPE: WATER SAMPLES
DATE SUBMITTED: 2011/09/14

Determinand	Units	Method No	Results	
			15145/11	15146/11
			HSE3	HSE 2
Arsenic*	µg As/l		< 2**	< 2**
Boron*	µg B/l		523**	479**
Bromide*	mg Br/l		<0.10**	<0.10**
Calcium hardness	mg $CaCO_3$/l	calc	127	130
Chemical oxygen demand (total)	mg O_2/l	3	(<20)	(<20)
Chloride	mg Cl/l	16	20	21
Colour*	mg Pt-Co/l	48	< 1	< 1
Conductivity at 25°C	mS/m	2	65	70
Dissolved calcium	mg Ca/l	8A	51	52
Dissolved iron	mg Fe/l	20A	0.07	0.15
Dissolved magnesium	mg Mg/l	9A	34	33
Dissolved manganese	mg Mn/l	19A	0.18	< 0.02
Fluoride	µg F/l	18	650	830
Hexavalent chromium	mg Cr/l	68	< 0.0008	< 0.0008
Mercury*	µg Hg/l		< 0.5**	< 0.5**
Nitrate/Nitrite	mg N/l	65	4.17	8.32
Nitrite*	mg N/l	65	< 0.01	< 0.01
Orthophosphate	mg P/l	66	0.006	0.008
pH at 25°C	pH units	1	7.6	7.4
pHs*	calculation		7.31	7.15
Potassium	mg K/l	7A	2.7	5.8
Selenium*	µg Se/l		< 1.0**	< 1.0**
Silicon*	mg Si/l		12.25	9.96
Sodium	mg Na/l	6A	24	28
Soluble organic carbon*	mg C/l		1.17**	1.57**
Sulphate	mg SO_4/l	67	16.0	17.5
Suspended solids at 105°C	mg/l	5	48	12
Total Alkalinity	mg $CaCO_3$/l	10	260	272
Total chromium	mg Cr/l		< 0.11**	< 0.11**
Total Dissolved Solids at 180°C	mg/l	41	394	386
Total hardness	mg $CaCO_3$/l	calc	267	266
Turbidity	NTU	4	0.3	0.2

Directors: Dr MMJ-F Talbot, Dr MMB Talbot, Mr FD Urbaniak-Hedley (British)
Talbot & Talbot (Pty) Ltd • Company Registration Number: 2000/021732/07

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Determinand	Units	Method No	Results	
			15147/11	15148/11
			HS2 FARM HOUSE	HS4 WINDMILL
Arsenic*	µg As/l		< 2**	< 2**
Boron*	µg B/l		403**	459**
Bromide*	mg Br/l		<0.10**	<0.10**
Calcium hardness	mg $CaCO_3$/l	calc	127	87
Chemical oxygen demand (total)	mg O_2/l	3	(<20)	(26)
Chloride	mg Cl/l	16	22	24
Colour*	mg Pt-Co/l	48	< 1	< 1
Conductivity at 25°C	mS/m	2	56	50
Dissolved calcium	mg Ca/l	8A	51	35
Dissolved iron	mg Fe/l	20A	0.06	0.07
Dissolved magnesium	mg Mg/l	9A	28	25
Dissolved manganese	mg Mn/l	19A	< 0.02	0.10
Fluoride	µg F/l	18	390	600
Hexavalent chromium	mg Cr/l	68	0.0011	< 0.0008
Mercury*	µg Hg/l		< 0.5**	< 0.5**
Nitrate/Nitrite	mg N/l	65	2.56	1.24
Nitrite*	mg N/l	65	0.29	0.01
Orthophosphate	mg P/l	66	< 0.002	< 0.002
pH at 25°C	pH units	1	7.2	7.3
pHs*	calculation		7.36	7.59
Potassium	mg K/l	7A	3.5	2.5
Selenium*	µg Se/l		< 1.0**	< 1.0**
Silicon*	mg Si/l		6.49	5.31
Sodium	mg Na/l	6A	12	16
Soluble organic carbon*	mg C/l		2.85**	1.37**
Sulphate	mg SO_4/l	67	3.79	12.9
Suspended solids at 105°C	mg/l	5	32	40
Total Alkalinity	mg $CaCO_3$/l	10	226	195
Total chromium	mg Cr/l		< 0.11**	< 0.11**
Total Dissolved Solids at 180°C	mg/l	41	322	278
Total hardness	mg $CaCO_3$/l	calc	243	190
Turbidity	NTU	4	0.9	10.1

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DETERMINAND in µg/l	ICP-MS – SEMI QUANTATIVE SCAN** 15145/11 HSE3	15146/11 HSE 2	15147/11 FARMHOUSE	15148/11 WINDMILL
Lithium *	3	3.2	3.1	5.8
Beryllium *	0.02	0.02	0.01	0.02
Aluminium *	4	3.3	4.1	3
Titanium *	0.34	0.06	0.06	0.19
Vanadium *	2.2	10	0.1	6.3
Chromium *	0.49	0.43	0.17	0.25
Cobalt *	0.08	0.04	0.01	0.53
Nickel *	0.21	0.17	0.07	1.4
Copper *	1.6	1.5	0.93	5.1
Zinc *	67	12	4.5	592
Gallium *	<0.01	<0.1	<0.01	<0.01
Germanium *	0.05	0.07	0.04	0.06

TALBOT *Laboratories*

ICP-MS – SEMI QUANTATIVE SCAN**				
DETERMINAND in µg/l	15145/11 HSE3	15146/11 HSE 2	15147/11 FARMHOUSE	15148/11 WINDMILL
Rubidium *	<0.01	<0.01	<0.01	0.07
Scandium *	0.13	0.08	0.01	0.13
Strontium *	169	255	108	84
Yttrium *	0.02	0.03	0.02	0.01
Zirconium *	0.07	0.11	0.03	0.07
Niobium *	0.05	0.06	0.01	0.07
Molybdenum *	0.32	0.35	0.12	0.85
Palladium *	0.92	0.46	0.3	0.59
Silver *	0.02	0.03	0.04	0.12
Cadmium *	0.09	0.04	0.03	0.06
Indium *	<0.01	<0.01	<0.01	<0.01
Tin *	0.04	0.02	0.02	0.02
Antimony *	0.01	0.02	0.05	0.12
Tellurium *	0.01	<0.02	0.03	0.02
Cesium *	0.19	0.01	0.33	0.07
Barium *	16	76	9.9	14
Lanthanum *	0.02	0.01	0.01	0.01
Cerium *	0.01	0.01	0.01	<0.01
Praseodymium *	<0.01	<0.01	<0.01	<0.01
Neodymium *	0.01	<0.01	0.01	<0.01
Samarium *	<0.01	<0.01	<0.01	<0.01
Europium *	<0.01	0.01	<0.01	<0.01
Gadolinium *	<0.01	<0.01	<0.01	<0.01
Terbium *	<0.01	<0.01	<0.01	<0.01
Dysprosium *	<0.01	<0.01	<0.01	<0.01
Holmium *	<0.01	<0.01	<0.01	<0.01
Erbium *	<0.01	<0.01	<0.01	<0.01
Thulium *	<0.01	<0.01	<0.01	<0.01
Ytterbium *	0.01	<0.01	<0.01	<0.01
Lutetium *	<0.01	<0.01	<0.01	<0.01
Hafnium *	0.02	0.02	0.01	0.02
Tantalum *	0.09	0.03	0.03	0.08

TALBOT Laboratories

DETERMINAND in µg/l	ICP-MS – SEMI QUANTATIVE SCAN** 15145/11 HSE3	15146/11 HSE 2	15147/11 FARMHOUSE	15148/11 WINDMILL
Tungsten *	0.31	0.18	0.09	0.35
Iridium *	0.1	0.04	0.03	0.1
Platinum *	0.08	0.03	0.02	0.09
Gold *	0.06	0.04	0.04	0.06
Thallium *	0.07	0.03	0.03	0.1
Lead *	0.04	0.04	0.04	0.05
Bismuth *	0.02	0.02	0.02	0.02
Thorium *	0.03	0.02	0.01	0.01
Ruthenium *	<0.01	<0.01	<0.01	0.07
Rhodium *	0.05	0.01	0.01	0.03
Uranium *	1.2	2.2	0.16	4.6

Belinda Talbot
LABORATORY MANAGER

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Appendix N

Tourism Impact Assessment

WORLEY PARSONS

Construction of the proposed Humansrus Concentrating Solar Power Plant, Northern Cape Province

Tourism Impact Assessment (EIR)

Issue Date: 28 September 2011
Revision No.: 2
Project No.: 10880

Date:	28 September 2011
Document Title:	Construction of the proposed Humansrus Concentrating Solar Power Plant, Northern Cape Province: Tourism Assessment (EIR Phase)
Author:	Faith Kalibbala, Paul da Cruz
Revision Number:	2
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Approved:	Paul da Cruz
Signature:	
For:	Worley Parsons

WORLEY PARSONS

CONSTRUCTION OF THE PROPOSED HUMANSRUS CSP PLANT

TOURISM ASSESSMENT

Contents **Page**

List of Figures

List of Tables

Appendices

WORLEY PARSONS

CONSTRUCTION OF THE PROPOSED HUMANSRUS CSP PLANT

TOURISM ASSESSMENT

1 INTRODUCTION

Worley Parsons has appointed SiVEST to undertake a specialist tourism assessment for the proposed establishment of a Concentrating Solar Power (CSP) on the Farm 469, Hay RD (Humansrus), approximately 4km south-east of Groenwater and 30km east of Postmasburg, Northern Cape. This study forms part of a wider Environmental Impact Assessment (Scoping and Environmental Impact Assessment) that needs to be undertaken by the project proponent to identify and assess all the potential environmental impacts associated with the proposed project. The Scoping phase has been completed and EIA phase studies are being undertaken.

The EIR phase Tourism report assesses in detail the impact of the proposed development on existing and future tourism resources. However, it must be noted that this report is not intended to be a comprehensive and/or exhaustive analysis of tourism in the study area. The report is solely aimed at providing a basis from which the significance of potential impacts meaning from proposed development on the tourism industry can be reasonably evaluated.

This report provides an overview of the legislative framework of the tourism industry; it also covers the salient points of international, national, provincial, and local tourism. It further describes the proposed impacts and issues of the proposed development on the tourism industry.

1.1 Defining Tourism

Tourism includes all trips away from one's usual environment, not just holiday/leisure trips. It also includes business, visiting friends and/or relatives, medical/health trips, and religious journeys, amongst others. Meanwhile a tourist (overnight visitor) is a visitor who stays at least one night in collective or private accommodation in the place visited (Statistics South Africa, 2009).

2 BACKGROUND

2.1 Acts and Policies

2.1.1 The White Paper on the Development and Promotion of Tourism in South Africa, 1996

The White Paper provides a broad framework to guide the development, planning and management of tourism in South Africa. The context is set through a discussion on the potential and economic role of tourism in the country and the identification of constraints that hinder the realisation of this potential. Some of the key constraints relate to inadequate funding, limited community integration, inadequate education and training, poor environmental management, lack of infrastructure, increased levels of crime, and a lack of national, provincial and local tourism structures.

Identifying tourism as an engine for economic growth, the White Paper builds a rationale and sets a clear vision for responsible tourism development. The vision is supported by a set of guiding principles for responsible tourism development and is underpinned by economic, social and environmental objectives.

To achieve the vision, the following key performance areas for tourism development are sighted in the white paper:

- a safe and stable tourism environment;
- involvement of local communities and previously neglected groups;
- sustainable environmental management practices;
- creating a globally competitive tourism industry;
- ensuring innovative development that meet visitor requirements;
- focus on product development and diversity;
- effective training, capacity building and awareness promotion;
- aggressive and creative marketing and promotion;
- strong economic linkages with other economic sectors;
- appropriate institutional structures; and
- appropriate support infrastructure.

The White Paper goes further by recommending the formulation of a range of key policies and frameworks that will facilitate the role of tourism as an economic driver.

Areas where further policy development is required include:

- safety and security;
- education and training;
- access to finance;
- investment incentives;
- foreign investment;
- environmental management;
- product development;
- cultural resource management;
- transportation - air and ground;
- infrastructure;
- marketing and promotion;
- product quality and standards;
- regional co-operation; and
- youth development.

In addition to its recommendations on specific policy development that will smooth the progress of tourism development, the White Paper broadly defines the roles to be played by various stakeholders involved in tourism, and provides a framework for institutional arrangements for tourism in South Africa.

Although the White Paper was developed at national level, it provides an overarching framework to guide tourism development across South Africa. In this respect it allows for the alignment of National, Provincial and Local tourism development to ensure “that everyone pulls in the same direction”. The White Paper does not address specific requirements on Provincial or Local level, nor does it provide the required strategic direction. Provincial and Local governments therefore need to align to, and take guidance from the National White Paper when developing their own tourism development strategies as it pertains to the specific dynamics present.

2.1.2 Institutional Guidelines for Public Sector Tourism Development and Promotion in South Africa, 1999

The Inter-provincial Technical Committee of MINMEC (a joint forum of ministers responsible for tourism matters) compiled the Institutional Guidelines, published by the Department of Environmental Affairs (DEA) in 1999. It seeks to formulate the institutional system and mechanisms to facilitate synergy in the management of tourism between the various tiers of government. The document further provides clarity on the roles, responsibilities and allocation of funding at National, Provincial and Local Government level to inform intergovernmental co-ordination on matters regarding tourism.

It is recognized in the institutional guidelines that historical development trends, macro conditions, constitutional dispensation and existing tourism structures differ at the various levels of government. Three models of institutional structures have therefore been proposed to accommodate the relevant circumstances at each level. These include:

- differentiated model;
- mainstream model and
- independent model.

One set of guidelines is proposed to ensure effective monitoring and control regardless of the model followed.

Specific guidelines and conditions with regards to the roles and responsibilities at each level of government are provided. The issues addressed and the respective guidelines in terms of the roles and responsibilities of the Municipality at local level include the following:

- introduction of tourism legislation – alignment of local by-laws and regulations with national and provincial tourism policy;
- establishing international relations and agreements – reaching agreements with cities/local authorities in other countries, with the knowledge of national and provincial government;
- international tourism marketing and promotion activities – exposure of local areas within the framework of national marketing strategies and aligned to such;
- domestic tourism marketing activities – develop domestic marketing strategies in line with provincial marketing framework;
- provision of tourism infrastructure – providing local infrastructure taking cognisance of provincial tourism strategies;
- setting of tourism standards – annual inspection, certification and registration of tourism establishments;
- promoting tourism awareness – plan and implement programmes to improve tourism awareness within local authority in line with national and provincial campaigns;
- tourism training – assist in the implementation and promotion of national and provincial training programmes;
- establishing tourism incentives, investment and financing programmes – provide advice and assistance to emerging entrepreneurs in coordination with provincial investment framework;
- tourism information management – provide appropriate information as input to national and provincial systems;
- domestic tourism information dissemination – establish local tourism information offices;

- tourist guiding training – work in collaboration with provincial authorities to ensure representative curriculum content;
- tourism development – lead tourism development in the area of consultation with provincial authorities; and
- tourism safety and security – establish local tourism safety programmes in collaboration with local business, SAPS and communities.

2.1.3 The Tourism Act, 1993 (Act 72 of 1993)

The objective of the Tourism Act is to make provision for the promotion of tourism to and in the Republic; the further regulation and rationalisation of the tourism industry; measures aimed at the maintenance and enhancement of the standards of facilities and services hired out or made available to tourists; and the co-ordination and rationalization, as far as practicable, of the activities of persons who are active in the tourism industry; with a view to the said matters to establish a board with legal personality which shall be competent and obliged to exercise, perform and carry out certain powers, functions and duties; to authorise the Minister to establish a grading and classification scheme in respect of accommodation establishments, the membership of which shall be voluntary; to authorize the Minister to establish schemes for prescribed sectors of the tourism industry, the membership of which shall be voluntary; to make provision for the registration of tourist guides; to prohibit any person to act for gain as a tourist guide unless he has been registered as a tourist guide in terms of the Act; to authorise the Minister to make regulations; and to provide for matters connected therewith.

The Act prompted the establishment of the South African Tourism Board which acts as the juristic person with regards to this Act.

The object of the board shall be, with due regard to the sustainability of environmental resources, to promote tourism by encouraging persons to undertake travels to and in the Republic, and with a view thereto:

- to take measures in order to ensure that services which are rendered and facilities which are made available totourists comply with the highest attainable standards;
- to manage information and conduct research relating to tourism; and
- to advise the Minister on tourism policy, either of its own volition or when requested to do so by the Minister.

2.2 Implications for Development

The legislation outlined above indicates that the proposed development has a number of restrictions, regulations and guidelines that apply to both the construction and operation phases. The tourism related legislation and guidelines encourage environmentally responsible tourism with an emphasis on sustainability.

3 PROJECT OUTLINE

3.1 Project Description

The following chapter provides a detailed overview of the proposed technology to be implemented for the generation of electricity at the CSP Plant. SolarReserve SA (Pty) LTD is a subsidiary of SolarReserve LLC, one of the world's leading companies in the field of renewable energy generation. The renewable energy generation market faces two (2) fundamental problems – the first being scalability and the second the issue of electricity storage. SolarReserve SA (Pty) LTD has managed to bridge these problems with their CSP technology. CSP Plants draw their heat from the sun, an unlimited source of pure clean energy – and unlike wind and photovoltaic, the technology implemented by SolarReserve SA (Pty) LTD can be delivered as and when needed dependent solely on demand and not climatic factors. This feature of the technology allows SolarReserve SA (Pty) LTD to bridge the key barriers pertinent to renewable energy generation – scalability and storage. The technology has been proven and substantiated by one of the world's leading technology conglomerates – United Technologies. Rocketdyne a subsidiary of United Technologies has demonstrated the technology at the Solar One and Solar Two Power Plants in Southern California. SolarReserve SA (Pty) LTD has been granted proprietary technology know-how and an exclusive worldwide license to develop CSP Plants based on this technology. The CSP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) in an area of 1.1 million m2. The tower is erected in an inner circle inside the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt up to580ºC, which then flows into a thermal storage tank for storage (maintaining 99% thermal efficiency). The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankine cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy. In order to reduce project's water

consumption, a dry cooling system has been considered to condense the low pressure (LP) steam exhaust from the turbine.

3.2 Geographical Location of Site

SolarReserve SA (Pty) LTD, a renewable energy developer is proposing the development of a CSP - Thermal Power Plant with an electricity generation of 80 – 100 MW on the portion of Remainder of the remainder of the Farm 469 (Humansrus), Hay RD, within the Tsantsabane Local Municipality and the Siyanda District Municipality in the Northern Cape. The proposed development site is situated approximately30 km east of Postmasburg and 20 km southeast of Danielskuil. The coordinate for the centre of the proposed site is 28°17'50.9399'' S; 23°22'1.0715'' E and it covers an area of 800 ha, which includes all ancillary facilities (Figure 1).

3.3 Surrounding and Existing Land use

The affected land portion where the CSP Plant is proposed is zoned as agricultural. The land is actively used for grazing of horses, cattle and game. The current land owner is actively mining red jasper on small scale on the north-western boundary of the proposed site. The R385 road runs through the affected land portion to the north of the proposed site and a railway line runs through the affected land portion to the southwest of the proposed site. The surrounding land uses also include agricultural activities with the mining village of Owendale 2.5 km from the eastern boundary of the farm portion.

3.4 Site Layout

As mentioned in more detail below the facility will cover an approximate area of 800 ha and will house all the infrastructure mentioned below and related services. The planned layout of the plant is shown in Figure 1 below. The bulk of the surface area of the plant will be covered by the heliostats in a circular configuration. The concentration tower will be the focal point of all the heliostats and will be located slightly off centre to the north of the circular heliostat field, due to the fact that the project is in the southern hemisphere and reflects the solar rays optimally to the tower as such. All the ancillary infrastructure and facilities are to be located adjacent to the tower within the inner circle of the heliostat field.

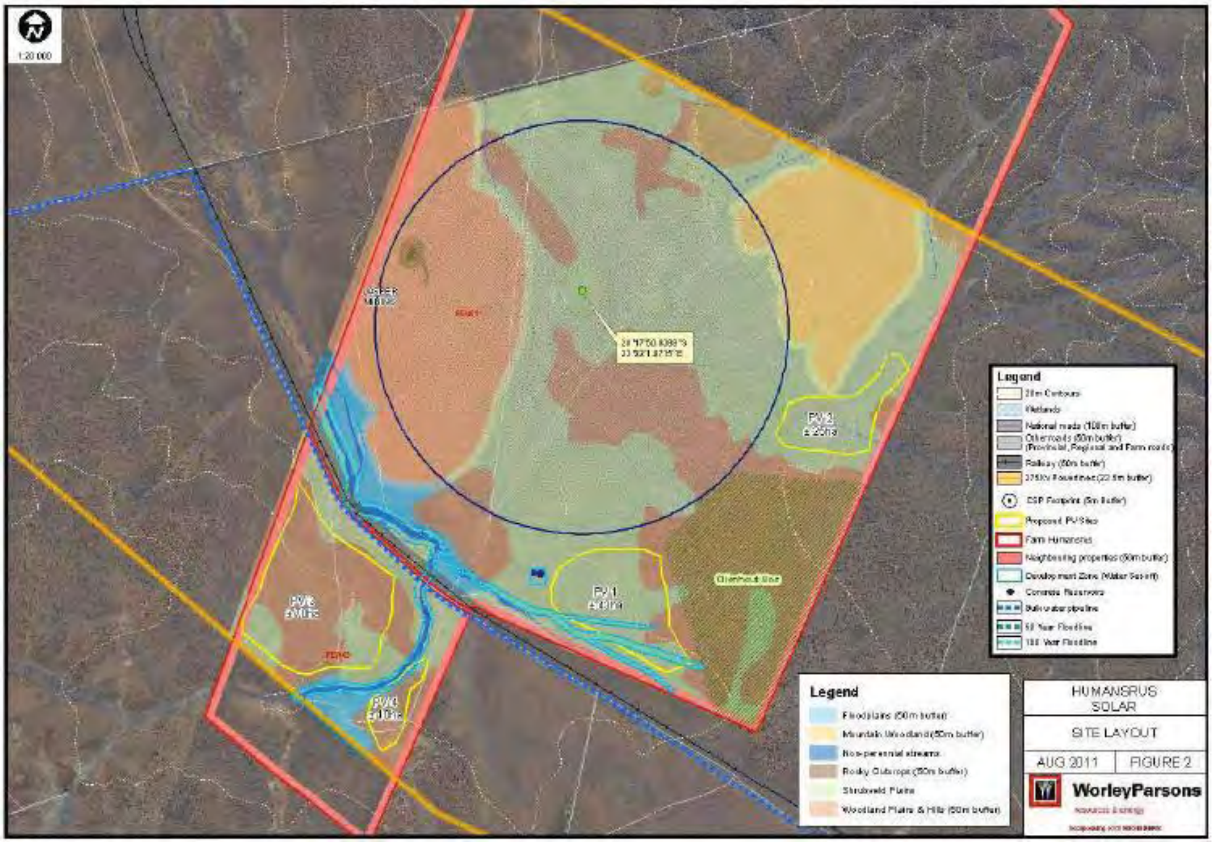

Figure 1: Site layout

4 TECHNICAL PROJECT DESCRIPTION

A detailed technical project description is attached in appendix 2

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a CSP Plant. In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower where a large heat exchanger captures the solar heat.
- A molten salt mixture is pumped from the cold salt thermal storage tank to the central receiver where it is circulated in the heat exchanger until the temperature reaches 566ºC.
- The molten salt concentration is then transported to the hot salt thermal storage tank.
- Hot salt is pumped from the hot salt storage tank to the steam generator where heat is transferred from the salt to water in order to generate high pressure steam.

- The highly pressurised steam is then passed through a steam turbine, which is linked to an electric generator to generate electricity.

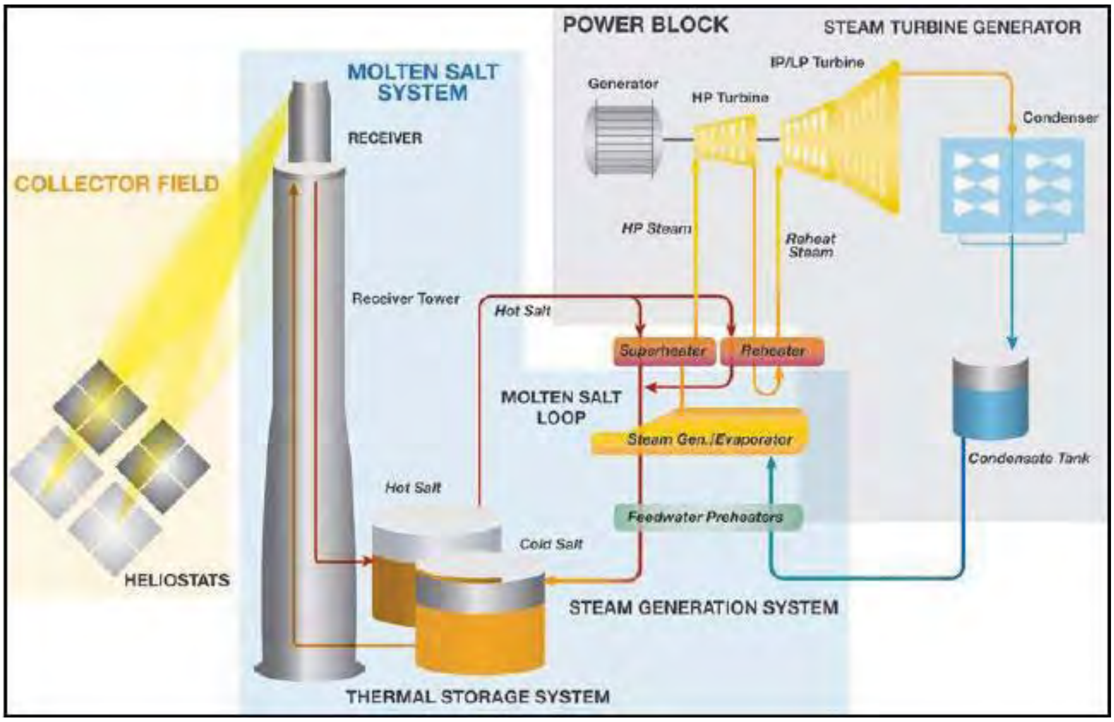

Figure 2: Basic process description

The CSP Plant can be divided into four main subsystems:

- The Collector Field - consists of all services and infrastructure related to the management and operation of the heliostats;
- The Molten Salt System- includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- The Power Block – consists of inter alia the steam turbine where the electricity is generated; and
- The Auxiliary facilities and infrastructure - includes the condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

4.1 Solar Field

The collector field will make use of a large number of mirrors, also called heliostats to reflect the solar radiation towards the solar receiver tower. It is expected that the collector field will be equipped with an estimated 17 350 heliostats, positioned concentrically to the solar receiver

tower. As each of the heliostats occupy roughly $62m^2$ to $75m^2$ of surface area (depending on final design) it is projected that the solar field will have a diameter of approximately 2,620m (2.6km), creating an estimated $1,095,000m^2$ of mirrored surface around the solar receiver tower.

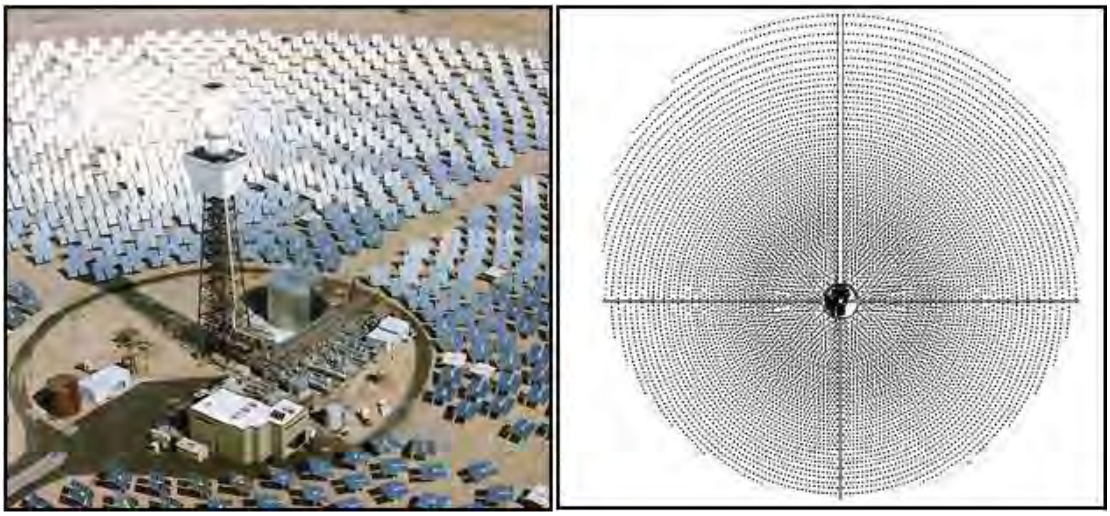

Figure 3: Layout of collector field (left: typical; right: for 17,350 heliostats)

All of the heliostats are automated and are designed to follow the sun's path. The heliostats are controlled from a central control point. Heliostats will be positioned in such a manner that optimum radiation reflection can occur, and so that no interference between heliostats can occur. The collection system comprises the following elements:

- Heliostats;
- Monitoring and control system
- Power and communication connections.

4.1.1 Heliostats

The heliostats are composed of mirror modules, equipped with structural support components and two (2) motors for rotation purposes and a local heliostat controller, fitted at the base of each structure.

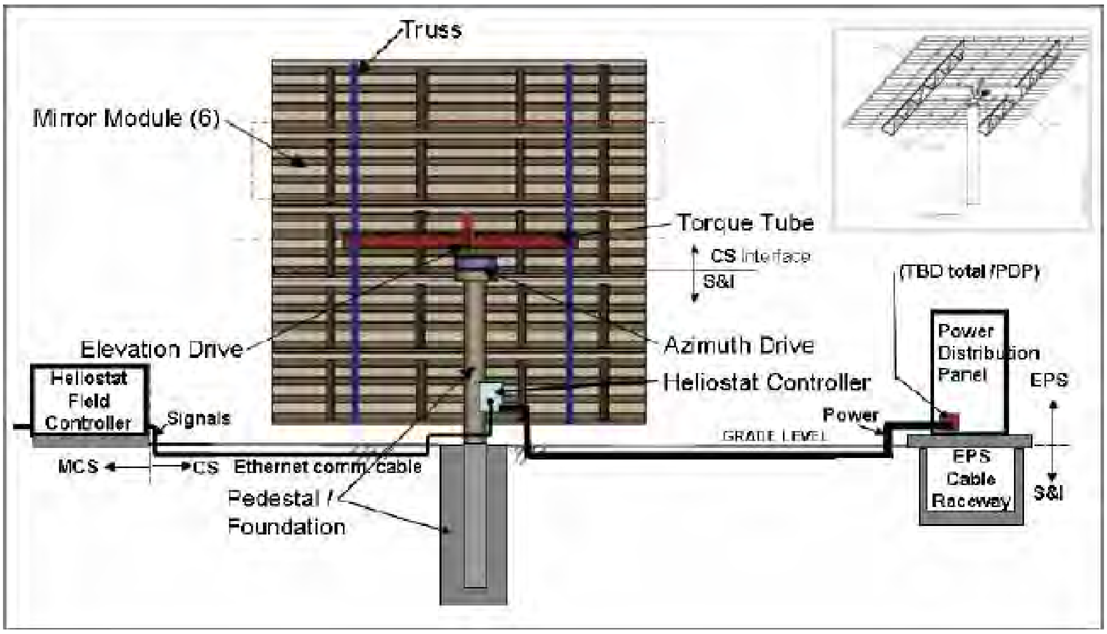

Figure 4: Components of a single heliostat assembly

The heliostat support structures are galvanised steel reinforcements that support the mirror modules and a tubular steel footing structure, planting the heliostat firmly on the ground. The heliostat structure is embedded in a concrete foundation and foundation design parameters will be revealed in the detailed Geotechnical Assessment. In ideal soil and geotechnical conditions the heliostat foundation parameters are 1m in diameter and 4m below surface. The dimensions of each heliostat will be approximately 8.5m (width) x 7. m (height) over a 3.3m tall pedestal.

4.2 Molten Salt Circuit

The molten salt circuit is designed based on gravitation feed principals – in the event of a leak or problem, a valve opens and the molten salt mixture is fed to the respective storage tank. This prevents to possibility that salt can solidify in the circuit if something goes wrong. The molten salt circuit comprises of the following:

- Salt Mixture
- Solar Concentration Tower

The tower has the following dimensions (based on preliminary design):

- Concrete Tower estimated at 164m high.
- Solar receiver and crane – estimated at 36m in height.

- Total Solar Concentration Tower - Height of tower with the solar receiver and crane: 200m. high
  - Size of the round base section: 35.05m.
  - Size of the round section in the upper sections: 26.37m.

- Thermal storage System
- Molten salt pumps
- Auxiliary salt heater (Salt melter)

4.3 Power Block

The function of the power block is to turn the stored solar energy into electrical energy. This will be achieved through a conventional Rankin Cycle, as used on most power plants worldwide.

Steam is generated by means of a steam turbine with an intermediate re-heating application. The components of the re-heaters in terms of the CSP Plant in questions are as follow:

- Pre-heating system

The pre-heating system can be defined as the cycle in which the condensate is heated to the optimum temperature for steam generation purposes. The system comprises of the following:

  - Low pressure water/steam pre-heaters

    i. De-aerator
    ii. Feedwater Pumps
    iii. Feedwater-heaters
- Steam Generator system

The steam generation system components are described more in detail below:

  - Economizer
  - Evaporator
  - Super heaters and Reheaters
- Steam turbine Generator

On exiting the turbine, the steam is directed into the air cooled condenser.

- Steam turbine auxiliary systems

The steam generation system is supported by various auxiliary services which needs to be maintained. These services include the –

Control and shut-down valves for the primary steam generation system and re-heater.

i. Lubrication oil system.
ii. Hydraulic oil system.
iii. Gear box.
iv. Steam sealing system.
v. Turbine and generator control system.
vi. Earthing system and electric protection equipment.

- Steam turbine control system
- Steam bypass system

- Air cooled Condenser
- Auxiliary cooling system
- Generator/Synchronous Motor

4.4 Auxiliary facilities and Infrastructure

Over and above the infrastructure and equipment requirements directly related to the operations of the CSP Plant, several auxiliary facilities and infrastructure also needs to be constructed and implemented. These facilities and infrastructure will support the daily operations of the CSP Plant by their various operation related functions, by producing inputs i.e. water, treating products generated by the plant, facilitating or housing of operations staff etc. Auxiliary facilities and infrastructure include:

- Water treatment plant

    - Multimedia Filter
    - Reverse Osmosis
    - Electrodeionization: The auxiliary equipment needed for water treatment include:
        i. Reagent-dispensing systems;
        ii. Pumps with filters;
        iii. Filters, filter washing pump, blowers for washing filters;
        iv. Cartridge filters and high-pressure pumps;
        v. Measurement systems: flow meters and pressure gauges;

vi. Reverse osmosis support frame;
vii. Membrane cleaning system;
viii. Electro-deionisation module; and
ix. Storage tanks for water of different qualities (stabilised, filtered, osmotically-treated and demineralised waters)

- Wastewater recovery plant

- Wastewater purification plant

The CSP Plant will generate several forms of liquid effluent as part of operations. The primary effluents sources generated include –

- o Wastewater from the evaporation plant;
- o Contaminated surface water i.e. stormwater and rainwater; and
- o Sewage effluent.

- Site Access

Infrastructure located in the vicinity of the proposed development include –

i. The road R385, extends between Lime Acres Mine and Postmasburg, and passes by on the northern boundary of the farm.
ii. A gravel road D3381 which extends to Lime Acres, runs along part of the western boundary of the site.
iii. A railway line runs adjacent to the western boundary of the site;
iv. A level-crossing over the railway line in the southwest of the site; and
v. A 66 kV electricity transmission line runs parallel to the railway on the western boundary of the site.

- o Road Access

The site can be accessed from either the R385 (Postmasburg to Lime Acres) or the D3381 to Lime Acres running along part of the western boundary of the site.

- o Rail Access

- Water Consumption and discharge

- o During Construction: For a 100 MW CSP Plant it is estimated that roughly 117 500m^3 of water will be required for the entire construction phase.The volumes of water required during construction can be divided into the following areas of consumption/uses:
  i. Dust control
  ii. Irrigation
  iii. Heliostat cleaning

iv. Human use and consumption
   - Testing purposes
   - Water demineralised
   - Raw Water
   - Contaminated Water
   - Sewage & Effluent

- o During normal operation: The CSP will require approximately 272,400 m^3 per year with peak consumption of approximately 44.5 m^3/ hr. The plant is also optimized to re-use water where possible and the total system discharge from the plant is fed to an evaporation pond, yearly total approximately 59 600 m^3.

- Administrative Facilities

Additional facilities to be constructed as part of the CSP Plant operational phase include:

- o An office building will be constructed for administrative purpose to serve as a centre for project support staff during operations.
- o Warehousing;
- o Laboratories;
- o Training facilities;
- o Medical Facilities;
- o Ablution facilities;

- Storage facilities
- Security Infrastructure
- Fire protection system
- Control and instrumentation system

4.5 Electric System

The site is currently served by an existing 132 kV transmission line, which traverses the site in an east to west direction. The connection point is at pole number WO189-2 where a 25kVA pole mounted transformer is installed. This connection line and point is however insufficient to serve as either EG feed in point to Eskom or as LPU connection point for the site, thus the following installation as detailed in the next paragraph is proposed.

- Transmission Information: There is an existing 132 kV sub-transmission line running parallel to the railway line on the southern boundary of the site. It is proposed that a 132kV loop in-loop out (LILO) sub-Transmission line be installed by Eskom to a substation which will connect the new facility to the national grid.

- Substation and General Requirements: Currently there are no direct substation access points on the site, and it is proposed that a substation be constructed on the farm Humansrus.
- Earthing Network: The earthing grid system will consist of buried stranded copper conductors, ground rods, and ground wells as required.

5 METHODOLOGY

5.1 Information Gathering

Information was gathered about the tourism industry in the area of the development using the following methods:

- Site visits
- Consultation with key stakeholders e.g. Tsantsabane Local Municipality (IDP, LED department)
- Consultation with various accommodation facilities owners/ managers within the vicinity of the study site e.g. in towns of Postmasburg, Danieslkuil and Lime Acres.
- Internet research
- Reference to other specialist reports

The methodology for impact assessment is attached in appendix 3

5.2 Assumptions and Limitations

This report is not aimed at providing exhaustive tourism statistics for the Northern Cape Province or the study area, but it is rather aimed at providing the EIA team with adequate information to meaningfully inform the proposed development of the solar power plant through the minimisation of potential negative environmental impacts and optimisation of potential positive environmental impacts on the tourism industry throughout the study area.

No comparative assessment of alternatives has taken place due to the lack of location or layout alternatives for the CSP plant. Only one site has been provided for assessment and it is understood that the majority of the site is proposed to be developed, thus not allowing any on-site layout alternatives to be considered.

6 PROVINCIAL TOURISM CONTEXT

6.1 Foreign and Domestic Tourism in the Northern Cape

Apart from business travel, transient travel and visiting friends and relatives, tourists visit the Northern Cape for ecotourism purposes due to its unique variety of natural, historical and cultural attributes. In addition, the annual floral display in the Namaqualand region is a famous characteristic of the province. The concentration of historical sites around the Kimberley area and the Kgalagadi Transfrontier conservation area are also renowned provincial tourist attractions.

Nonetheless, based on several reports by South African Tourism Strategic Research Unit, the Northern Cape is the least visited Province in South Africa in terms of both domestic and foreign tourism. This is perhaps due to the fact that the province has not capitalised on its full potential as a tourist destination and hence is largely undiscovered by both domestic and international markets. However, the province has the potential to become a well-visited adventure and ecotourism destination in South Africa recognised for its cultural heritage and natural resources. This can be achieved through promotion and development of tourism in the Province

In terms of foreign tourism, generally, in 2008, the province attracted 1.3% of foreign tourists and by the end of the year 2009 the figure had increased to 1.4%. In 2010 only 1.2% of foreign tourists visited Northern Cape Province (South African Tourism Strategic Research Unit, 2010; South African Tourism Strategic Research Unit, 2011). Countrywide, these were the lowest proportions of tourists visiting a province (South African Tourism Strategic Research Unit, 2011). While other provinces experienced growth in the number of tourists that visited the province, Northern Cape was the only province that presented a decline in the number of tourists that visited the province (-3.5%) between 2009 and 2010 (South African Tourism Strategic Research Unit, 2011).

The number of bed nights spent by foreign tourists in Northern Cape decreased from 0.9% in the 2009 to 0.8% in 2010. Northern Cape captured, the lowest bed nights compared to other provinces. Majority of foreign tourists visit for leisure and business purposes (South African Tourism Strategic Research Unit, 2011).

In terms of domestic tourists, the travel incidence of day visitors in Northern Cape decreased from 29% in 2007 to 26% in 2010. That year (2010), the Northern Cape presented the second lowest incidence of day visitors. While the lowest incidence was presented by Western Cape Province (25%), the highest was presented by Limpopo Province (58%) (South African Tourism Strategic Research Unit, June 2011). With respect to overnight trips, the Northern Cape was the least visited province between 2007 and 2010. Only 2% of all trips were recorded in the province in 2007, the figure increased to 3% in 2008 and declined to 2% in 2009. By 2010 the province only

recorded 1% of all trips (South African Tourism Strategic Research Unit, June 2011). On the other hand, residents of Northern Cape took the lowest number of day trips between 2007 and 2010. Only 2% of all day trips were taken by residents of Northern Cape in 2010. This figure had increased from 1% in 2009. With regards to overnight trips, the Northern Cape further exhibited the lowest percentages between 2007 (2%) and 2010 (1%). The above figures generally indicate that the Province is neither a popular tourist destination nor a significant source market of domestic tourism (South African Tourism Strategic Research Unit, June 2011).

With regards to intra-province travel (trips taken within the province) and inter-province travel (trips taken to other provinces), the Northern Cape showed an increase (68%) in inter-province travel in 2010 and a decrease (32%) in intra-province travel in the same year. This implies that most of the travel by domestic tourists in 2010 was predominantly taken to other provinces. The increase in inter-province travel could be attributed to the 2010 FIFA World Cup (South African Tourism Strategic Research Unit, June 2011).

The number of bed nights spent by domestic tourists in Northern Cape decreased from 2% in 2009 to 1% in 2010. Generally the province presented the lowest bed nights compared to other provinces (South African Tourism Strategic Research Unit, June 2011).

Generally, the main purpose of travel by domestic tourists in the Northern Cape is Visiting Friends and Relatives (VFR) followed by holiday and business.

These figures enable the contextualisation of any impacts that are identified with the proposed development; i.e. any negative impacts on the tourism environment caused are likely to be of negligible significance at a national level due the low number of visits that are made to the province. The potential effect would be even more greatly diminished if the tourism impacts, as identified below were to only affect a part of the province, thus being of very low significance at a provincial level. However at a more localised level, any potential tourism-related impacts could be more significant, as explored below.

6.2 Tourism Destinations and Routes in Area of the Proposed CSP Plant

The proposed development falls within the Siyanda District Municipality (SDM) which is made up of six local municipalities; the study site is located in Tsantsabane Local Municipality which falls within this district (Figure 5).The regional locality map with a better resolution is attached in appendix 5

Tourism is one of the most important economic sectors in the SDM (SDM, IDP, 2011/ 2012). The SDM with its contrasting landscapes is characterised by a variety of natural resources. These

include National Parks and Nature Reserves as well as eco-adventures and safari lodges. Some of the National Parks and Reserves include the Kgalagadi Transfrontier Park; Spitskop Nature Reserve and Augrabies National Park. According to the SDM, (IDP,2011/ 2012), the Spitskop Nature Reserve and Augrabies National Park are not managed by the SDM but have a critical role in influencing the region's tourism. The nearest Nature Reserve to the study area is the Witsand Nature Reserve located about 90km southwest of the study area. However, this Nature Reserve will not be affected by the proposed development. In terms of tourism routes, there are no major tourism routes within the immediate vicinity of the study area. Thus in the context of the District Municipality, no *existing* tourism operations that are significant in the context of income generation and economic processes in the SDM are likely to be affected, as none of the prominent tourist attractions are located in close proximity to the site. The presence of tourism at a more localised level as well as the potential for future tourism development in the study area is explored below.

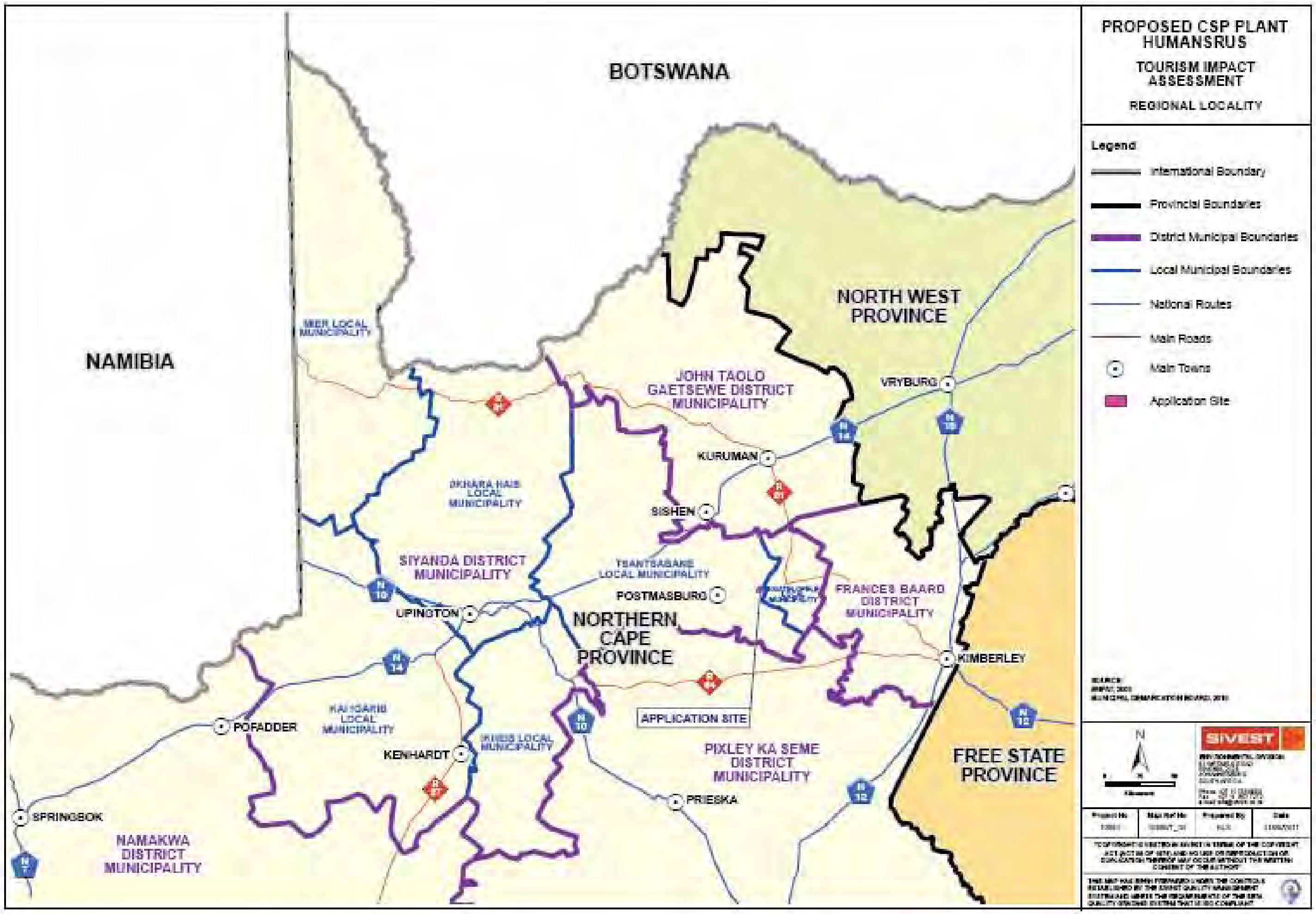

Figure 5: Regional locality

7 TOURISM BASELINE IN THE AREA POTENTIALLY AFFECTED BY THE PROPOSED CSP PLANT

This section describes the tourism baseline for the local area in and around the proposed development that could be affected by it. A wider-scale assessment of the tourism area was undertaken in the scoping phase tourism impact assessment report. This report focuses on the area closer to the site that could potentially be affected by the proposed development.

Where information could not be obtained at a local scale, provincial data is represented in this section. Statistics South Africa classifies tourism regions within provinces i.e. the “Rest of Northern Cape” region which comprises of towns such as Postmasburg, Daniëlskuil and Upington, among others. Most important in a local context are the towns of Daniëlskuil, which is closest to the proposed Humansrus CSP plant (approximately 30km away) and the town of Postmasburg (slightly further than 30km away).

The route tourists may typically use to get to Postmasburg from the Kimberley area (the closest regional centre to the site) is the R31 and R385. The R385 traverses the northern boundary of the study site and is significant as such. The route used to get to Daniëlskuil from Kimberley is the R31. Tourists using this route will not be affected by the proposed development. However, those travelling from Kuruman towards Postmasburg via Daniëlskuil will view the proposed development. Furthermore tourists travelling along R31 and R385 from Kimberley via Postmasburg towards Upington will view the proposed development. The level of impact of the proposed solar power plant on tourists is elaborated in the impacts section below.

7.1 Tourism Trends

The study area is not a popular tourist (leisure) destination due to the limited number of tourist attractions in the area. The closest towns of Postmasburg, Daniëlskuil and Lime Acres present little to no leisure tourist attractions. Details pertaining to the towns’ (Postmasburg and Daniëlskuil) characteristics with respect to land cover class (urban, rural, commercial agriculture/ forest), tourist attractions and tourism growth potential were covered and presented in the scoping phase tourism study.

7.1.1 Leisure Tourism

Leisure tourism which includes VFR (Visiting Friends and Relatives), holiday and shopping for personal use has been the primary purpose of visit by tourists to South Africa. Leisure tourism is made up of a number of sub-groupings, which include ecotourism (game viewing, photographic safaris, family holidays on game farms etc), adventure (4x4 routes and hiking trails) and hunting. Other activities include visiting restaurants. The low number of leisure tourists that visit the area would generally stay in the various accommodation facilities in the area. Furthermore, visitors to the local area (whether leisure-based, business or passing through) would typically also visit local restaurants and pubs. There is no data (statistics) on the number of local and foreign leisure tourists that visit the study area, but it is anticipated that the number of leisure tourists is far outweighed by business tourists.

- Ecotourism

Ecotourism which includes game viewing, photographic safaris, and family holidays on game farms is a major attraction in the context of the province and district municipality, but much less so in the context of the local area. In the wider study area, ecotourism that does take place takes the form of game viewing on the game farms as listed below:

- Mount Carmel Safaris (about 42km northeast of the study site)
- Redlands (about 24km west of the study site)
- Tafelkop (about 12km west of the study site). However, this farm only offers game viewing to friends and relatives. Therefore it's not a commercial tourism facility.
- Selfhelp (near Lime Acres- about 9km southeast of the study site)
- Rocklands and Inglewood - about 27km southeast of the study site (pers. comm. Amanda Claassens).

- Adventure tourism

Adventure tourism (4x4 trails hiking, and caravan parks) takes place to some extent in the surrounding area, although it does not constitute that main driver for tourism in the study area. As mentioned above, the Witsand Nature Reserve located approximately 62km southwest of Postmasburg offers adventure activities such as 4x4 trails, hiking and biking (SA Venues.com, 2011; TourismRSA.com, 2011). Furthermore, hiking takes place at Mount Carmel Safaris. In addition, the annual horse show in Daniëlskuil may boost leisure tourism.

- Hunting

Hunting (as a form of leisure tourism) is a relatively important sector of the tourism industry in this area. There has been a significant increase in game farming around the region and it provides good opportunities for growth in hunting based tourism (Tourism Northern Cape, 2005). For

lodges and other bush accommodation, this appears to be their main source of tourists. In the vicinity of the study area, hunting takes place at lodges such as Mount Carmel Safaris, Klein Papkuil, Bonza, Rocklands, Inglewood, an unspecified game farm to the immediate west of Finsch mine as well as in a game farm in near the Beeshoek mine, west of Postmasburg (refer to Figure 6). The hunting sector is certainly the mainstay of leisure tourism in this area.

- Historical/ Heritage

The greater region of the Northern Cape possesses several historical/ heritage sites that offer the tourism opportunities. Some of these in proximity to the study site are listed below:

- Koegelbeen Caves
- Wonderwerk Caves
- Boesmansgat Sinkhole
- Blinkklikop

Various accommodation facilities near the study area benefit from leisure tourists but to a smaller extent compared to business tourists.

Lastly, visitors from the local area are also noted visiting local restaurants and pubs. There is no statistical data on the number of domestic and foreign leisure tourist arrivals in the area around the proposed study area. However, according to the Tsantsabane Local Municipality LED officer, Mathapelo Mathetsa, a tourism awareness campaign is planned to take place between the 19th of September and the 18th of October 2011 whereby relevant officers from the local municipality will be gathering data on tourism arrivals in the local municipality (pers. Comm., 2011).

7.1.2 Passing Through

Tourism in the area can also be attributed to tourists passing through the area via the R31 on their way to and/or from popular regional centres – i.e. Kimberley, Kuruman, Upington as well to/from regional parks and reserves e.g. Kgalagadi Transfrontier Park etc. The R385 that traverses the northern boundaries of the study site is also a minor route utilised by tourists travelling towards the Witsand Nature Reserve near Postmasburg and the Spitskop Nature Reserve in Upington. Furthermore, the R31 and R385 via Postmasburg is the easiest route for tourists travelling to Namibia from Durban (pers.comm. Amanda Claassen). Also, tourists travelling towards Upington prefer travelling along R385 via Postmasburg as opposed to travelling along N8 via Griekwastad (pers.comm. Mathapelo Mathetsa). This is because the route to Upington along N8 via Griekwastad is no longer safe (pers.comm. Mathapelo Mathetsa).

Tourists passing though spend nights in the various accommodation facilities in the along these routes.

7.1.3 Business Tourism

Business tourism reflects the tourist who visits an area purely to do business. It is defined as a trip which is undertaken with the purpose of attending a conference, meeting, exhibition, event or as part of an incentive (South African Tourism, Tourism Growth Strategy 2008-2010). For the purposes of this report the definition included anyone who visits an area to conduct business. Any other tourism activities such as sight-seeing or game viewing for example, are secondary. It is anticipated that business tourism presents trends for high occupancy during the week and lower occupancies over the weekend. The length of stay of business tourists is in general shorter than for other visitor types such as holiday and VFR (South African Tourism, Tourism Growth Strategy 2008-2010; South African Tourism Strategic Research Unit, June 2011).

Business tourism takes place near the study area in the towns of Postmasburg, Daniëlskuil, and Lime Acres. In a tourism context the local area is dominated by business tourism due to the concentration of mining activities at mines such as Beeshoek Mine, Finsch Diamond Mine, Idwala Limestone Mine and several other opencast mines. The business tourists visit mainly for the purpose of work on the mines, meetings and training (pers. comm. 2011). Owners of various accommodation facilities in the area largely rely on business tourists for the success of their operations. The lengths of stay of business tourists range from weeks to months and even years. Based on field surveys, some guesthouse owners/ managers in Postmasburg indicated that in some cases, mine employees sign contracts of up to two years to stay in specific guesthouses. These would therefore be fully occupied for the duration of the contract. In others cases mine employees occupy about 50% of specific accommodation facilities for one to two years. In general, the average occupancy rate at accommodation facilities in Postmasburg is approximately 85% and this is exhibited throughout the year. It has been indicated by most accommodation facility owners/ managers that due to increased development in terms of business tourism (mainly mining), the demand for accommodation facilities in Postmasburg has exceeded the supply (pers. comm.). As such there is currently a high demand for accommodation facilities in the area, as explored below.

7.2 Tourism Supply

7.2.1 Tourism Facilities in the Vicinity of the Proposed Development

There are no tourism facilities in the immediate vicinity (5km radius) of the proposed development. The closest tourism facilities (which offer hunting activities) are Bonza game farm and an unspecified game farm near Finsch mine in Lime Acres, about 9km southeast of the study site. These facilities mostly attract professional hunters and are likely to be visually affected by the proposed development. The level of impact on these facilities is addressed in the impacts section below. According to ENPAT data, the proposed site is located in an area considered vacant/ unspecified. The site is characterised livestock farming.

7.2.2 Accommodation facilities in and around Postmasburg, Daniëlskuil and Lime Acres

Accommodation facilities are critical to most aspects of tourism in an area, in particular to overnight stays. The density of accommodation facilities in an area is very closely dependent on the tourism demand for accommodation. For this reason it is important to examine the supply of accommodation facilities in the area to understand the nature of the demand and to allow an assessment to be undertaken of how this may change.

The supply of accommodation facilities in the area surrounding is concentrated mainly in and around Postmasburg and Daniëlskuil. Tourist accommodation facilities around the study area are broken up into a number of different categories:

- Bed and breakfasts,
- Guesthouses,
- Hotels/motels/lodges,
- Caravan and Camping sites
- Chalets

Accommodation facilities are important to the tourism in the area, although very importantly the tourism ‘supply’ provided by these facilities is currently low, set against tourism demand being relatively quite high. The high demand is due to the fast rate of development in terms of the mining industry which attracts business tourists.

In total, there are approximately 18 accommodation facilities in and around the area - Postmasburg (7), Daniëlskuil (8) and Lime Acres (3). A list of accommodation facilities in and around these small towns is presented in appendix 1 of this report. All accommodation facilities mangers/ owners were interviewed. The total number of beds in the 18 facilities is 334 and

business tourists are the main guests (pers. comm. 2011). As explored below business tourists are the majority of tourists that stay at these facilities, and as such they visit mainly for the purpose of work, meetings and training on mines such as Beeshoek Mine, Finsch Diamond Mine, Idwala Limestone Mine and several other opencast mines (pers. comm. 2011).

Figure 6 below presents the study site and various attractions in the surrounding area.

7.2.3 Game Farms in the area surrounding the proposed development

The only game farms that offer commercial hunting and are situated in close proximity to the proposed study site include an unspecified farm to the west of Finsch mine (about 9km away) and Bonza farm (about 16km away) (Figure 6). The tourism map with a better resolution is attached in appendix 4

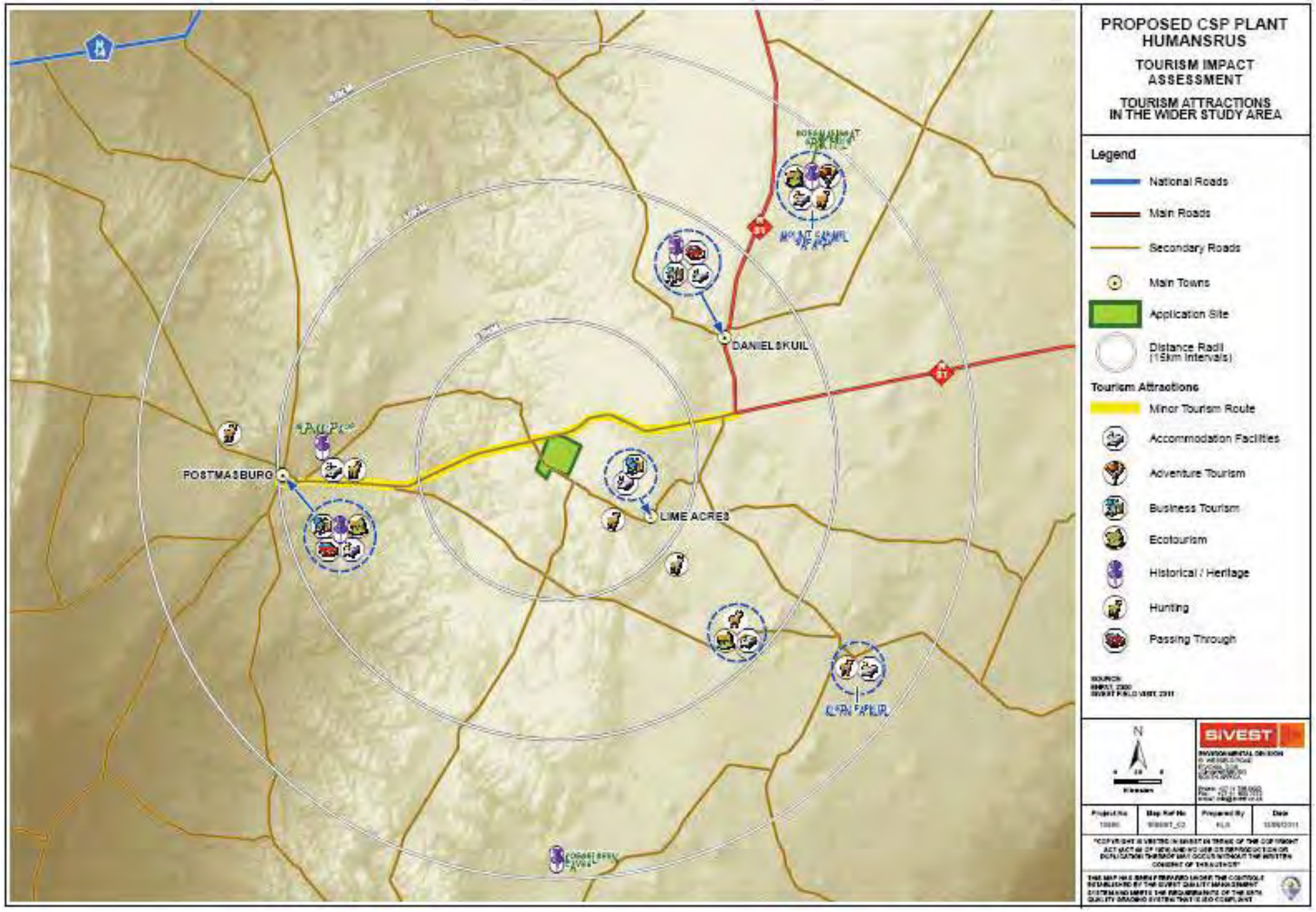

Figure 6: Tourism features within a 45km radius of the study site

7.3 Tourism Demand

For statistical data on tourist arrivals, purpose of visit, lengths of stay and type of accommodation used in the Northern Cape, please refer to the scoping phase tourism study.

7.3.1 Demand for Accommodation in the local area

Based on interviews with all accommodation facilities owners/ managers in the study area, occupancy rates range from 65% to 80% (of all accommodation facilities listed in appendix 1). While some owners/ managers indicated that the seasonality of tourists varied between months (with some months exhibiting more visitors than others), others indicated that they are more or less fully booked most of the year round except towards mid December (pers. comm. 2011). This accommodation demand is primarily driven by business tourism as further explored below. Accommodation bookings in the month of December are particularly low due to the low levels of business which occurs at this time due to most mines closing for the festive (pers. comm. 2011).

Business tourism takes place near the study area in the towns of Postmasburg, Daniëlskuil, and Lime Acres. In a tourism context the local area is dominated by business tourism due to the concentration of mining activities at mines such as Beeshoek Mine, Finsch Diamond Mine, Idwala Limestone Mine and several other opencast mines. Thus mine-related business comprises the majority of tourism demand in the area, with long term stays providing a very important component of the income derived by tourism facility operators.

Very importantly it has been indicated by most accommodation facility owners/ managers that due to increased development in terms of business tourism (mainly mining), the demand for accommodation facilities in Postmasburg has exceeded the supply (pers. comm.). As such there is currently a high demand for accommodation facilities in the area. Further demand that would potentially be created by the proposed development needs to be assessed in this context.

7.4 Future Tourism in and Around the Study Area

According to the Northern Cape Economic Development Agency (NCEDA), (2009) the only planned tourism project in close proximity to the study site is the establishment of an eco-resort at Boesmansgat sinkhole (approximately 42km northeast). The aim of this development is to supported deep diving activities with appropriate facilities and to cater for eco-tourism, hunting, diving, game viewing and holidaying (NCEDA, 2009). The proposed 28 bed upmarket resort will include the following:

- On site accommodation
- Multipurpose conference facility and hall for diver training, training, workshops and corporate meetings
- Dining and bar facility as well as an entertainment area, swimming pool and additional land for game farming, breeding and hunting (NCEDA, 2009)

However this planned projected is too distant (approximately 42km) from the proposed CPS site to be affected.

Furthermore, the planned Sishen South project (12km southwest of Postmasburg) involving the development of a nine million tonnes per annum iron-ore mine is expected to further boost business tourism in the area (NCEDA, 2009).

There are no other reported planned tourism projects near the study site. However, the May 2010, Tsantsabane Local Municipality IDP indicates that a strategic objective is in place to develop a Tourism Development Plan by June 2011 so as to stimulate and enhance Local Economic Development. Therefore, due to the lack of information at a local scale at this stage, this section only presents future tourism information at a district level (i.e. Siyanda District Municipality) that is relevant to the study area.

According to the Siyanda District Municipality Integrated Development Plan (IDP) (5 year Plan), 2011/2012, local tourism should become the most important economic activity in the district in the next ten years (Siyanda District Municipality, 2011/2012). In addition, given that there are a variety of natural resources in the district, the tourism potential for the area is great (Siyanda District Municipality, 2011/2012). The hot water springs and scenic natural areas in parts of the district present good development possibilities. But there is a need for innovative ideas and excellent marketing strategies in order to promote tourism and hence increase income (Siyanda District Municipality, 2011/2012).

Also, as discussed below, future industrial / infrastructural development could increase tourism (i.e. business tourism) development in the area by creating a demand for accommodation facilities for visiting technicians / engineers associated with such a development.

8 POTENTIAL IMPACT OF THE PROPOSED CSP PLANT ON TOURISM

8.1 Impact Assessment Relating to the Tourism Industry

The proposed CSP plant site is located in close proximity to the rural villages of Groenwater and Owendale. The character of the landscape is mainly natural for this locality. The proposed CSP plant therefore could have a major influence on the landscape in terms of the scale, the physical footprint and the aesthetics of the area, considering the spatial extent to the project and the physical size of the infrastructure. The degree to which the proposed development will affect the local area will vary and can be based on both positive and negative aspects. In this light, the four major environmental impacts that are key to how the tourism environment may be affected and that are likely to result from the power plants include visual impacts, noise impacts, land-use change impacts and corporate demand. The manner in which these are likely to affect the tourism environment are elaborated on below.

8.1.1 Visual Impact Relative to Tourism

In general, scenically beautiful areas where leisure tourism is practiced are more likely to be visually affected by large scale industrial developments such as a CSP plant as proposed than areas where there is little scenic value or those areas which exhibit anthropogenic objects associated with the built environment (such as concrete buildings or power lines). Generally, the natural character or scenic beauty of an area plays an important role in attracting tourists to any specific area. Many tourism hotspots in both a national and provincial (Northern Cape) context exist within either scenically beautiful areas, or areas with a highly natural character (such as national parks or nature reserves which offer large areas of largely untouched landscapes and environments). In terms of the aesthetic values, the study site presents a moderate to high value i.e. a moderate rating being the common landscape and a high rating being a distinctive landscape often with a strong sense of place (Humansrus Visual Impact Report, Newtown Landscape Architects). The tourism product offered by a particular tourism facility, or by a wider area may be significantly compromised if a development such is the proposed development alters the visual environment, and importantly the sense of place of that facility / area. Such characteristics ‘sell’ an undisturbed (i.e. highly natural, unlit, and visually unspoilt) area or property as part of the product offered that is central to its attraction to potential visitors. In this way visual impacts associated with an industrial-type development can have a significant adverse impact on leisure-based tourism facilities in particular.

The proposed solar plant will be an artificial anthropogenic structure which contrasts with the otherwise natural landscape. In this sense, the solar plant could detract from the natural aesthetics of the locality. However, as evidenced in earlier sections of this report, most of the

tourism industry in the local area centres on business tourism, hence, the degree of negative impact is expected to be minimal from this perspective since the type of tourists most likely to be affected are not leisure tourists. Due to the nature of their visit, business tourists are expected to be much less likely to be sensitive to, and thus adversely affected by a change in landscape or degradation of the visual environment.

An important component of the attraction for many leisure tourists for either taking the route or visiting a destination is to appreciate the scenic value of an area. Based on field surveys, the R385 and R31 which run close to the site are not scenic tourist routes and thus the enjoyment or experiencing of the aesthetic quality of the routes is unlikely to be adversely affected, as these roads are primarily used as local access routes. Consequently the proposed development is thus not likely to adversely affect any leisure-based tourist activities in the immediate area, as these effectively do not exist.

Although leisure-based tourism is much less significant than business tourism, certain leisure-based tourism facilities do exist in the vicinity of the proposed development, as addressed above. The tourism product at these facilities may thus be adversely affected by the proposed development. The central receiving tower is 200m high and would be visible from an extensive area, it would tend to recede into the background of views beyond 8km from the development site. At 16km away it would be deemed as ‘infrequently’ viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention (Humansrus Visual Impact Assessment Report by Newtown Landscape Architects). Therefore, game farms that offer hunting and game viewing activities that are further away than 16km from the proposed development are not likely to be highly visually affected, and as such are unlikely to experience degradation of their tourism product through this factor. Moreover visual ridge lines block views towards the proposed CSP site (Humansrus Visual Impact Report by Newtown Landscape Architects)

However two game farms located relatively close to the site which offer commercial hunting could be more greatly impacted from a visual perspective - Bonza game farm and the game farm near Finsch mine. Other than hunting, leisure tourists generally visit these game farms to enjoy their natural characteristics or scenic beauty. As such, although the visual impact on the game farms mentioned above is negligible, it is important to mention that visitors to these game farms may perceive the CSP plant as a visual intrusion that could degrade the areas’ natural character. According to the Humansrus Visual Impact Assessment Report by Newtown Landscape Architects, the composite viewshed analysis indicates that only the top section of the tower would be visible from the area around Lime Acres in which the game farms are located. Furthermore the hills that surround the CSP plant site obstruct many views to it. Also, it is anticipated that very minor loss or alteration to key elements /features /characteristics of the baseline (views and scenic quality) would be expected in this case. Therefore the severity of impact on views from Bonza game farm and that near Finsch mine is anticipated to be negligible (Humansrus Visual Impact Assessment

Report by Newtown Landscape Architects). Accordingly the tourism product (especially in terms of the hunting activities) and environment at these two game farms is unlikely to be affected through visual impacts associated with the proposed development.

In a potential positive context, since the proposed development can be considered new technology to the area, it may be viewed as a tourist attraction which could draw tourists to the area along the various regional-connecting routes. However this factor would be strictly dependent on the proponent establishing a visitor information centre associated with the plant, which could then be advertised and draw visitors to the plant and the area. It is not known however, whether any such plans exist. In this instance the impact would be likely to be a positive impact on the study area’s tourism environment.

8.1.2 Noise Impact Relative to Tourism

It is important to avoid noise impacts on sensitive tourism establishments such as the game farms mentioned above in the study area. This is because the sense of place (an important component of which is the absence of noise typically associated with urban areas) characterised by these game farms is important in attracting tourists. As such, residents and visitors to these game farms might perceive the noise from the CSP plant as a nuisance that could distort and adversely affect the areas’ sense of place. As such, the noise impact could potentially compromise the environment in which hunting activities take place on these game farms.

Noise generation could be a factor during the construction phase. This phase will be temporary and it is not likely to be a significant factor impacting the tourism facilities in the area since there are no tourist facilities in the immediate vicinity of the study site. It is likely that noise impacts will only affect farm residences in surrounding farms e.g. Humansrus and Sunnyside (Scoping phase Noise report by Jongens Keet Associates).

Negligible noise impacts are expected during the operational phase. According to the scoping phase noise report, sensitive receptors located beyond 2100m from the CSP plant will not be affected by daytime operations. In case of night operations, sensitive receptors located within 4750m of the CSP plant will be affected (Humansrus Noise Scoping Report, by Jongens Keet Associates). This implies that overall (during day and night operations) receptors situated beyond 4750m from the CSP plant will not be affected. The nearest tourism facility is a hunting game farm located near Finsch mine in Lime Acres, about 9 000m from the CSP plant. Other tourism facilities including accommodation facilities are located in and around Postmasburg (30km away from the study site) and Daniëlskuil (over 20km away from the study site). No tourism facilities will be affected by the proposed development from a noise perspective.

8.1.3 Land-use Change Relative to Tourism

The area in and around the proposed study site is dominated by land uses such as cattle farming and other agricultural practices. The site is traversed by a railway and 275kV power lines in the southern portion. Land uses to the immediate west and east are vacant while the surrounding towns of Postmasburg, Lime Acres, Danielskuil are dominated by mining activities. Given the present land uses in and around the study area it lacks notable scenic beauty (which would potentially attract leisure tourists). As such, the study site and the immediate surrounds would not appear to present significant potential to be developed into a leisure tourism facility. Therefore, the change in land use of the study site in order to construct the proposed development may not be considered negative but rather positive as it may become a tourist attraction with proper marketing.

In addition, as the characteristics of the study area and immediate surroundings do not present the potential for future tourism the proposed development is not considered to be a hindrance to future tourism developments in the area.

8.1.4 Corporate Demand

The corporate demand for tourism facilities is likely to increase in the area as a result of the proposed development (assuming this proposed development is approved and constructed). It is assumed that a total of 339 professionals (highly skilled and skilled) will be employed during the construction phase and about 47 (skilled and semi skilled) during the operation phase, Therefore in total, up to 386 professionals will employed in construction and operation of the proposed CSP plant. These professionals are likely to spend nights at various accommodation facilities in the study area, although it should be noted that these professionals are not likely to visit the area at once.

As indicated above, the area currently supplies a total of 334 beds. When seen in a context of the existing demand for accommodation exceeding supply as described above, this situation will be greatly exacerbated by the increased tourism demand for accommodation in particular that will be likely to be created in the construction phase, as it is expected that a significant portion of the total of 339 professionals will need to stay in the area at any one time during the construction phase.

On a more long term basis (the operational phase) there is a lower number of jobs that will be created. It is unknown how many of these skilled jobs will be permanent that would entail that the professionals would move to the area on a permanent basis rather than simply visit for shorter periods, however a percentage of these jobs are likely to be tied to shorter visits that would

qualify as business tourism. This implies that, should the proposed development be approved and constructed, the supply of accommodation facilities in the wider area over the long term will need to be increased as the existing situation of demand exceeding supply would be exacerbated. This would add further impetus to any ventures to create or upgrade the existing tourism infrastructure in the area, and would make it much more likely to occur. This would result in a positive impact on the tourism industry over the longer period, as these increased stays would have direct and indirect (spin-off effects) in terms of increased contributions to the provincial GDP (Gross Domestic Product) and GDP at a local level due to the additional source of income.

Furthermore, the above teams are expected to visit various restaurants (which is a component of leisure tourism) while in the area. In general, the impact of the proposed development on corporate demand for tourism facilities is anticipated to be medium during the construction phase and operation phase. Although more workers are expected during the construction phase than operation phase, with sufficient marketing and promotion of the CSP plant as a tourism attraction, the arrival of tourists (travelling for education purposes e.g. school tours) during the operation phase could be high. Moreover a group, though small, of professional and maintenance team is expected during the operation phase. From a corporate demand perspective, the impact would be likely to be positive as the proposed development is expected to contribute to additional tourism in the vicinity thereby increasing the area's contribution to the provincial GDP.

8.2 Cumulative Impacts

Cumulative impacts are expected in terms of corporate demand. For instance, if Sishen South project (12km southwest of Postmasburg) is approved business tourists are likely to increase in the wider area. However the level of cumulative impact is anticipated to be low at this stage as the numbers of stays that will be created is likely to be relatively insignificant in a wider context of the study area.

8.3 Rating of Impacts

8.3.1 Visual Impact Relative to Tourism

Visual impacts with respect to the tourism environment would be a negative impact that is, it is considered to be a cost to the receiving environment.

- Construction Phase

Table 1: Rating of Visual Impacts Relative to Tourism (Construction Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
Temporal scale of impacts	Short term; Quickly reversible; 0 – 5years	1
Probability of impacts	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Severity of impacts	The system(s) or party(ies) is marginally affected by the proposed development.	1
Significance of impacts	**Impact is of a low order**	**5**

A low visual impact relative to tourism is expected during the construction phase

- Operation Phase

Table 2: Rating of Visual Impacts Relative to Tourism (Operation Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Temporal scale of impacts	Long term; Approximate lifespan of the project: 16 -30 years.	3
Probability of impacts	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Severity of impacts	The system(s) or party(ies) is marginally affected by the proposed development.	1
Significance of impacts	**Impact is real**	**8**

Based on the rating system a medium visual impact relative to tourism is expected during the operation phase. However the nearest tourism facilities include is a game farm near Finsch mine in Lime Acres (about 9km away) and Bonza game farm (about 16km away) where commercial hunting takes place. As mentioned above, visual impacts on these facilities will be negligible as ridge lines block views towards the proposed CSP site (Humansrus Visual Impact Report by

Newtown Landscape Architects). Furthermore, the central receiving tower would tend to recede into the background of views beyond 8km. At 16km it would be deemed as „infrequently" viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention (Humansrus Visual Impact Report by Newtown Landscape Architects)

8.3.2 Noise Impact Relative to Tourism

Noise is a negative impact considered to be a cost to the receiving environment.

- Construction Phase

Table 3: Rating of Noise Impacts Relative to Tourism (Construction Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
Temporal scale of impacts	Short term; Quickly reversible; 0 – 5years	1
Probability of impacts	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Severity of impacts	The system(s) or party(ies) is marginally affected by the proposed development.	1
Significance of impacts	**Impact is of a low order**	**5**

A low noise impact relative to tourism is expected during the construction phase. This is because there are hardly any sensitive tourism facilities in the immediate vicinity of the proposed development.

- Operation Phase

No Noise impacts relative to tourism are expected during the operation phase. This is because there are no tourism facilities in the immediate vicinity of the proposed development.

8.3.3 *Land use Change Impact Relative to Tourism*

Land use change could be a negative impact, but could also be considered to be a positive impact in the sense of being benefit to the receiving tourism environment.

- Construction Phase

Table 4: Rating of Land use Change Impacts Relative to Tourism (Construction Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Site Specific; Occurs within the site boundary.	1
Temporal scale of impacts	Short term; Quickly reversible; 0 – 5years	1
Probability of impacts	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Severity of impacts	The system(s) or party(ies) is marginally affected by the proposed development.	1
Significance of impacts	**Impact is real**	**6**

Therefore the land use impact relative to tourism is considered medium during construction phase.

- Operation Phase

Table 5: Rating of Land use Change Impacts Relative to Tourism (Operation Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Site Specific; Occurs within the site boundary	1
Temporal scale of impacts	Long term; Approximate lifespan of the project: 16 -30 years.	3
Probability of impacts	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Severity of impacts	The system(s) or party(ies) is marginally affected by the proposed development.	1
Significance of	**Impact is real**	**8**

Criteria	Description	Quantitative Rating
impacts		

The land use impact relative to tourism is considered medium during the operation phase. However this medium impact would only be achieved if development is marketed as a tourist destination by establishing a visitor information centre associated with the plant.

8.3.4 Corporate Demand Relative to Tourism

Corporate demand is a positive impact considered to be a benefit to the receiving environment

- Construction phase

Table 6: Rating of Corporate Demand Impacts Relative to Tourism (Construction Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3
Temporal scale of impacts	Short term; Quickly reversible; 0 – 5years	1
Probability of impacts	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Severity of impacts	Medium or short term impacts	2
Significance of impacts	**Impact is real**	**8**

Corporate demand impact relative to tourism is expected to be medium during the construction phase.

- Operation phase

Table 7: Rating of Corporate Demand Impacts Relative to Tourism (Operation Phase)

Criteria	Description	Quantitative Rating
Spatial scale of impacts	Local; Extends beyond the site boundary	2
Temporal scale of impacts	Long term; Approximate lifespan of the project: 16 -30 years.	3
Probability of impacts	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Severity of impacts	Marginal impact	1
Significance of impacts	**Impact is real**	**8**

Corporate demand impact relative to tourism is expected to be medium during the operation phase.

9 MITIGATION MEASURES

- In order to increase corporate demand, the following measures should be undertaken:
    - Tourism bodies should collaborate with the project proponent and create demand through appropriate marketing of the proposed solar power plant as a tourism attraction as well as other tourism assets in the area (responsibility in the case of other tourism assets is for tourism bodies in the study area).
    - Tourism bodies in the study area should improve tourism infrastructure by establishing an up to date tourism information office in Postmasburg so as to increase tourism demand.
    - Tourism bodies in the study area should identify and develop new tourist attractions.

After mitigation measures, low negative impacts (visual, noise and land use change) will be achieved or persist. As per the positive impact (corporate demand), high positive impacts are likely to be achieved.

10 CONCLUSIONS AND RECOMMENDATIONS

Detailed investigations have revealed that the proposed CSP plant site is not located in close proximity to any major tourist hotspots. In this context the CSP plant will have no impact on a national or provincial level. This study has thus focussed on the local (study area) context – the towns of Postmasburg and Danielskuil and the immediate vicinity.

The tourism environment in the local area is dominated by business tourism to the mines in the area, and this factor is the main driver in terms of tourism demand and supply. Leisure-based tourism is much less important, although a number of primarily hunting-based eco-tourism facilities exist in the area. Most of these hunting farms are located further than 20km from the site, although two facilities are located in closer proximity.

The towns of Postmasburg, Lime Acres, Danielskuil where most of the accommodation facilities and tourism activities are located will not be visually impacted upon by the proposed development as ridge lines block views towards the site. Although the central receiving tower is 200m high and would be visible from a far greater distance, it would tend to recede into the background of views beyond 8km and at 16km it would be deemed as "infrequently" viewed as its scale relative to the viewing envelope would be very small and other features in the landscape would demand visual attention (Humansrus Visual Impact Report by Newtown Landscape Architects). Consequently activities such as hunting offered near the three towns, and importantly at the game farm near Finsch mine in Lime Acres (about 9km away) and Bonza game farm (about 16km away) where commercial hunting takes place would not be impacted visually, or would be subject to negligible visual impacts. As such the tourism product (particularly related to that of the sense of place of at the two hunting farms) would be unlikely to be compromised or adversely affected in a significant manner.

Business-based tourism is unlikely to be sensitive to visual impacts associated with the plant. Due to the number of professional people that are expected to travel to the area to work on the plant in both a construction and operational (to a lesser degree) context, business tourism is likely to be strongly benefitted, and thus be positively impacted by the proposed development in the context of increased tourism demand. The overall numbers of professionals that are expected to visit the area to work on the plant are roughly equal to the supply of beds in the local area. Although these people are not expected to all visit the area at once, in particular the construction and to a lesser degree the operation of the plant is likely to greatly increase the demand for accommodation (by a significant factor) and other tourism-related services in the local area. In the context of a situation where demand from the business sector already outstrips supply of accommodation, this further increased demand is likely to further encourage and facilitate the development of new or upgraded accommodation facilities and other related services, which

would benefit the tourism environment by creating greater supply and choice of accommodation. The increased demand would be likely to bring spin-off socio-economic impacts to the local area.

Overall, the proposed plant is unlikely to exert a significant impact on the local leisure-based tourism environment from either a positive or negative perspective. However the plant is likely to have a strong positive impact on the business tourism environment by increasing demand and thus facilitating the growth of tourism-related infrastructure and other having related socio-economic spin-offs.

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Appendix 1

List of accommodation facilities within the vicinity of the study area

Name of Establishment	Location	Type of Establishment
Postmasburg		
Andrisha Motel	Postmasburg	Motel
Soetfontein Guest farm	Postmasburg	Guest farm/ Dairy
Herberg casa caballero	Postmasburg	Guesthouse
Postmasburg Hotel	Postmasburg	Hotel
Abendruhe Bed and Breakfast	Postmasburg	Bed and Breakfast
Unforgettable Guesthouse	Postmasburg	Guesthouse
Die Duine Guesthouse	Postmasburg	Guesthouse
Danieslkuil		
Plenary Hotel	Daniëlskuil	Hotel
Klein Papkuil Lodge	Daniëlskuil	Lodge
Mount Carmel Safaris	Daniëlskuil	Lodge
Rest a While Guesthouse (Rus 'n bietjie)	Daniëlskuil	Bed and Breakfast
Vaalbos Guesthouse	Daniëlskuil	Guesthouse
Die Lapa Guesthouse	Daniëlskuil	Guesthouse
Idwala Guest House	Daniëlskuil	Guesthouse
Serendipidity Guesthouse	Daniëlskuil	Guesthouse
Lime Acres		
Finch Guesthouse	Lime Acres	Guesthouse
Olien Guesthouse	Lime Acres	Guesthouse
Agape	Lime Acres	Guesthouse

Appendix 2

Technical Project Description

1 TECHNICAL PROJECT DESCRIPTION

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a CSP Plant. In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower where a large heat exchanger captures the solar heat.
- A molten salt mixture is pumped from the cold salt thermal storage tank to the central receiver where it is circulated in the heat exchanger until the temperature reaches 566ºC.
- The molten salt concentration is then transported to the hot salt thermal storage tank.
- Hot salt is pumped from the hot salt storage tank to the steam generator where heat is transferred from the salt to water in order to generate high pressure steam.
- The highly pressurised steam is then passed through a steam turbine, which is linked to an electric generator to generate electricity.

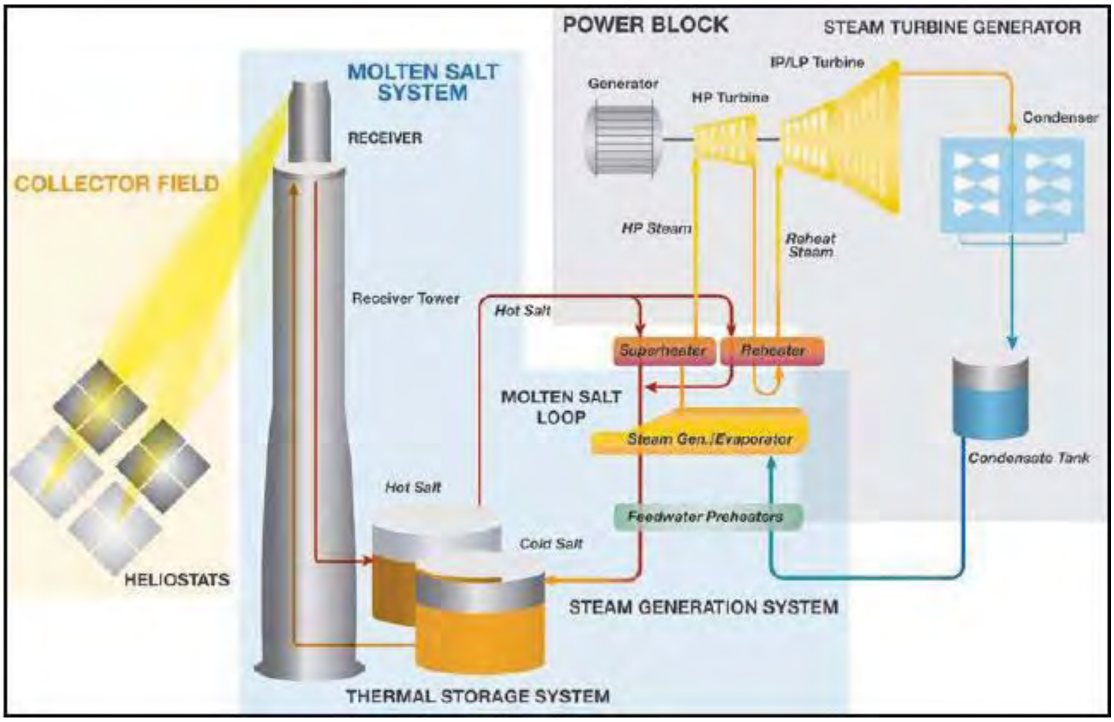


Figure 1: Basic process description

The CSP Plant can be divided into four main subsystems:

- The Collector Field - consists of all services and infrastructure related to the management and operation of the heliostats;
- The Molten Salt System- includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- The Power Block – consists of inter alia the steam turbine where the electricity is generated; and

- The Auxiliary facilities and infrastructure - includes the condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

1.1 Solar Field

The collector field will make use of a large number of mirrors, also called heliostats to reflect the solar radiation towards the solar receiver tower. It is expected that the collector field will be equipped with an estimated 17 350 heliostats, positioned concentrically to the solar receiver tower. As each of the heliostats occupy roughly 62 m^2 to 75 m^2 of surface area (depending on final design) it is projected that the solar field will have a diameter of approximately 2,620 m (2.6 km), creating an estimated 1,095,000 m^2 of mirrored surface around the solar receiver tower.

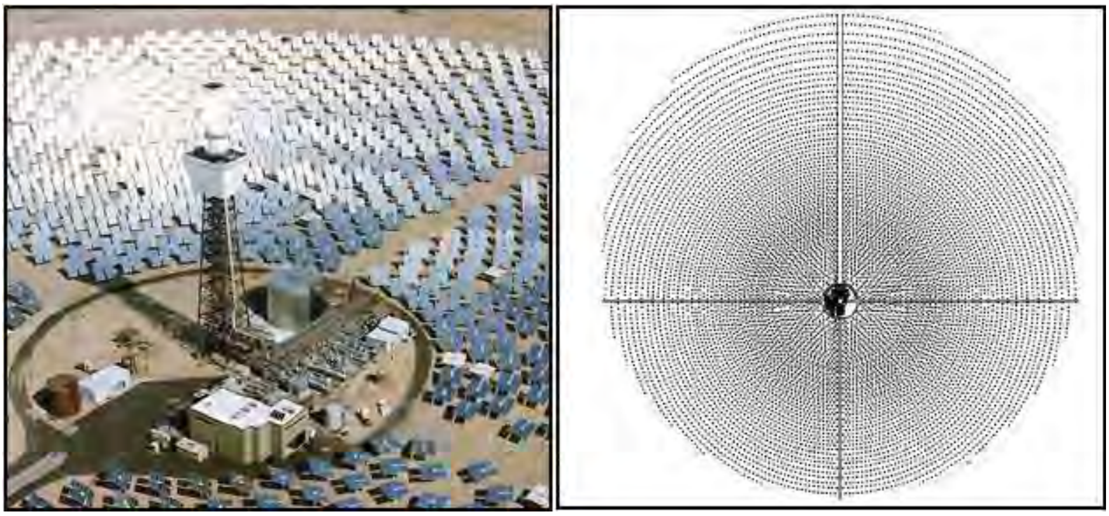


Figure 2: Layout of collector field (left: typical; right: for 17,350 heliostats)

All of the heliostats are automated and are designed to follow the sun's path. The heliostats are controlled from a central control point. Heliostats will be positioned in such a manner that optimum radiation reflection can occur, and so that no interference between heliostats can occur. The collection system comprises the following elements:

- Heliostats;
- Monitoring and control system
- Power and communication connections.

1.1.1 Heliostats

The heliostats are composed of mirror modules, equipped with structural support components and two (2) motors for rotation purposes and a local heliostat controller, fitted at the base of each structure.

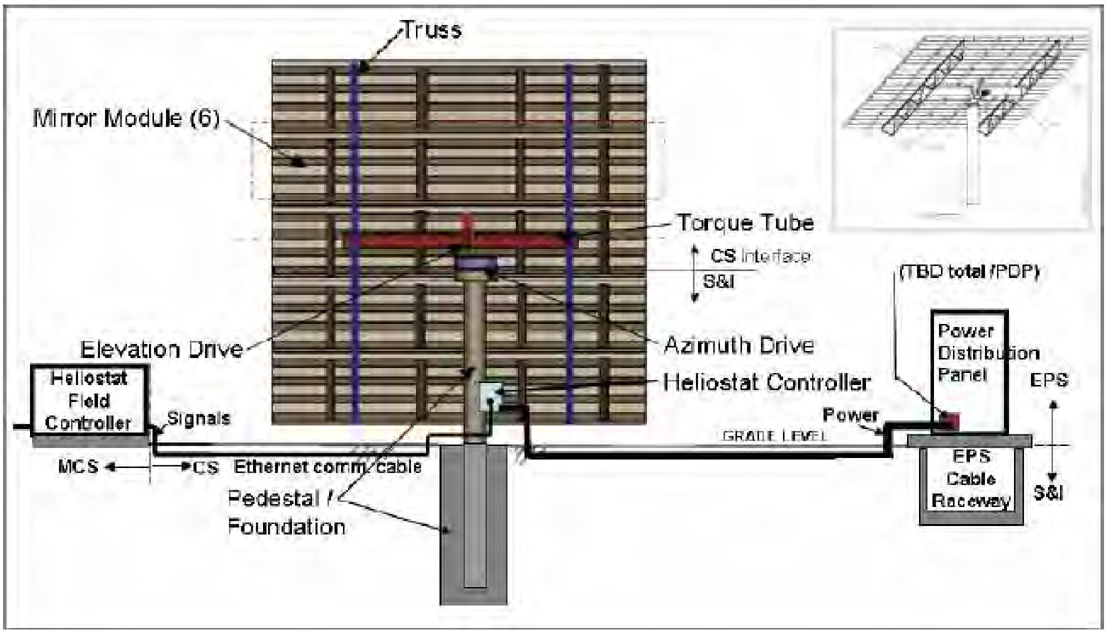


Figure 3: Components of a single heliostat assembly

The heliostat support structures are galvanised steel reinforcements that support the mirror modules and a tubular steel footing structure, planting the heliostat firmly on the ground. The heliostat structure is embedded in a concrete foundation and foundation design parameters will be revealed in the detailed Geotechnical Assessment. In ideal soil and geotechnical conditions the heliostat foundation parameters are 1m in diameter and 4 m below surface. The dimensions of each heliostat will be approximately 8.5 m (width) x 7.3 m (height) over a 3.3 m tall pedestal.

1.1.2 Monitoring Systems

The monitoring and control system comprises of all the various systems and programs required to monitor the collection field – which includes the Heliostat Control Software (HCS) and the Beam Characterisation System (BCS). The HCS can be defined as the active control system which manages the orientation of each heliostat as to ensure optimum solar radiation is reflected towards the solar receiver tower at all times. Orientation positioning is dependent on several factors –

- Time of day;
- Time of the year (day); and
- Operation mode. The operational mode will include Start-up, Normal operation monitoring, Closure and a series of abnormal operational conditions (i.e. loss of heliostat power etc.).

The BCS on the other hand will automatically calibrate the heliostats during plant operations by means of camera system installed in the solar receiver tower. This is done to ensure maximum efficiency of solar heat reflection. A total of 16 BCS cameras are expected to be installed in the solar receiver tower.

1.1.3 Power and communications

The power and communication connections includes the:

- Connection between the HCS and the controllers for the heliostats motors; and
- Electrical supply for the motorised-controllers for each of the heliostats.

1.2 Molten Salt Circuit

The molten salt circuit is a very important part of the CSP plant's design, as it increases the plant's ability to produce electricity all year round, during night and day times. The design of the molten salt circuit ensures that heat collected from the sun's rays can be transferred effectively to the power cycle, but it also ensures that this heat can be stored for relative long periods of time to provide the plant with a source of energy when the sun's rays does not reach the collector filed. This circuit is designed to store up thermal energy during the day time, within the hot salt storage tanks, and then utilise the energy during the night time or periods when it is overcast. The unique properties of the molten salt ensure that it can reach very high temperatures at atmospheric pressures. Its relative high density and heat capacity further ensures that it is an efficient thermal storage medium in large quantities at such high temperatures.

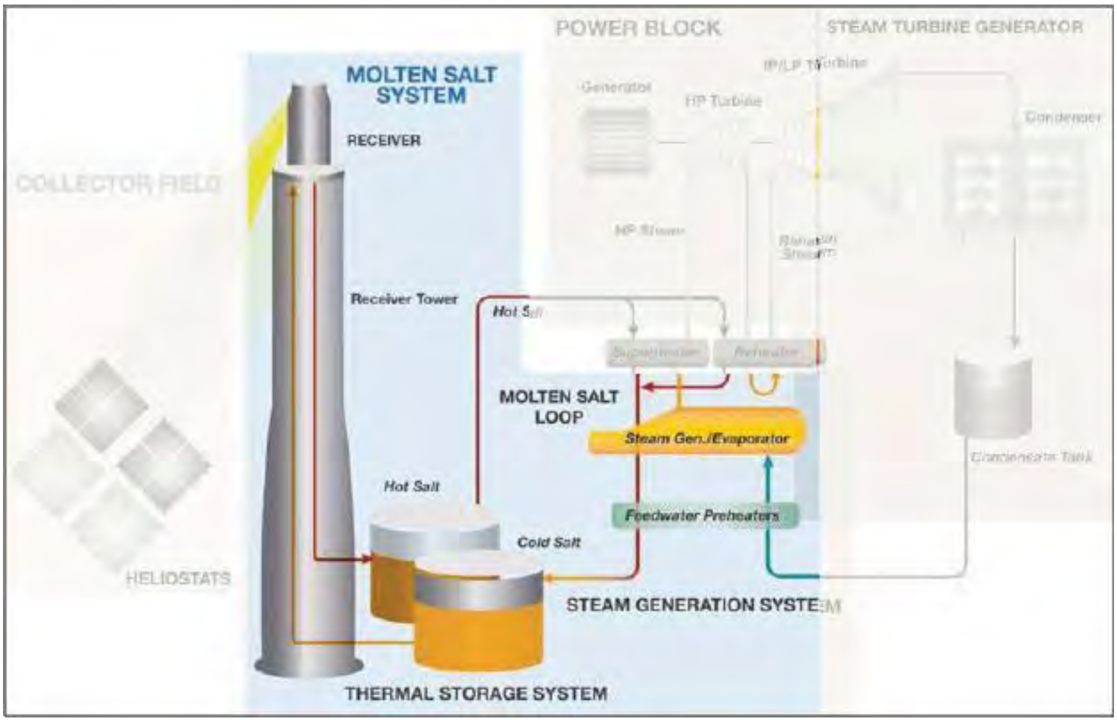


Figure 4: Basic Process description – Molten salt Circuit

During normal operation the salt stored in the cold salt storage tank (at 288°C) is pumped to the top of the solar tower where it passes through a special heat exchanger assembly (this heat exchanger is the central point of focus for the beams of the thousands of heliostats). Within the heat exchanger the salt is heated to very high temperature (566°C) and then flows down the tower to the hot salt storage tank. From the hot salt storage tank it will be pumped to the steam generator to produce steam for the steam turbines. Once the salt passed through the steam generator and other heat transfer devices it has cooled down significantly to about 288°C and is is then pumped back to the cold salt storage tank from where it will repeat the cycle. The molten salt system is a closed circuit system that operates separately to that of the steam generation system. The circuit consists out of all the infrastructure and equipment that is required to heat, mobilise and store the molten salt mixture for power generation. The molten salt circuit is designed based on gravitation feed principals – in the event of a leak or problem, a valve opens and the molten salt mixture is fed to the respective storage tank. This prevents to possibility that salt can solidify in the circuit if something goes wrong.

1.2.1 Salt Mixture

The salt mixture is comprised of sodium nitrate ($NaNO_3$) (60%) and potassium nitrate (KNO_3) (40%).This mixture of salts is used to ensure the salt stays molten at a wide range of temperatures. The salt mixture must be kept well above 238ºC to ensure it stays molten. When the salt is molten it is in a liquid state with a high viscosity and takes on the behaviour of water. It is furthermore very effective with regards to the storing of heat, given its thermal inertia. The plant will require approximately 35 000 tonnes of this salt

mixture for normal operation. After the initial fusion/melting of the salt during start-up, the salt remains in a liquid state and at high temperatures during the plants entire operating life, and is constantly reused in the system.

Table 1: Properties of molten salt (60% NaNO3, 40%KNO3) – from SAND2001-2010

Temp	**Density**	**Specific Heat**	**Absolute Viscosity**	**Thermal Conductivity**
Celsius	**kg/m^3**	**J/ (kg K)**	**Pa s**	**W/(m K)**
260	1924	1,491	0.043	0.493
288	1906	1,499	0.036	0.498
316	1888	1,503	0.029	0.503
343	1870	1,507	0.024	0.509
371	1852	1,511	0.021	0.514
399	1835	• 1,516	• 0.018	• 0.520
• 427	• 1817	• 1,520	• 0.016	• 0.525
454	1799	1,524	0.015	0.531
482	1781	1,532	0.014	0.536
510	1764	1,537	0.013	0.541
538	1746	1,541	0.012	0.547
566	1728	1,545	0.011	0.552
593	1710	1,549	0.010	0.558

1.2.2 Solar Concentration Tower

The Solar Concentration Tower is a tall concrete tower which supports the central receiver. It needs to be of sufficient height to ensure the central receiver is in clear view of all heliostats within the collector field. The tower has the following dimensions (based on preliminary design):

- Concrete Tower estimated at 164 m high.
- Solar receiver and crane – estimated at 36 m in height.
- Total Solar Concentration Tower - Height of tower with the solar receiver and crane: 200 m. high
- Size of the round base section: 35.05 m.
- Size of the round section in the upper sections: 26.37 m.

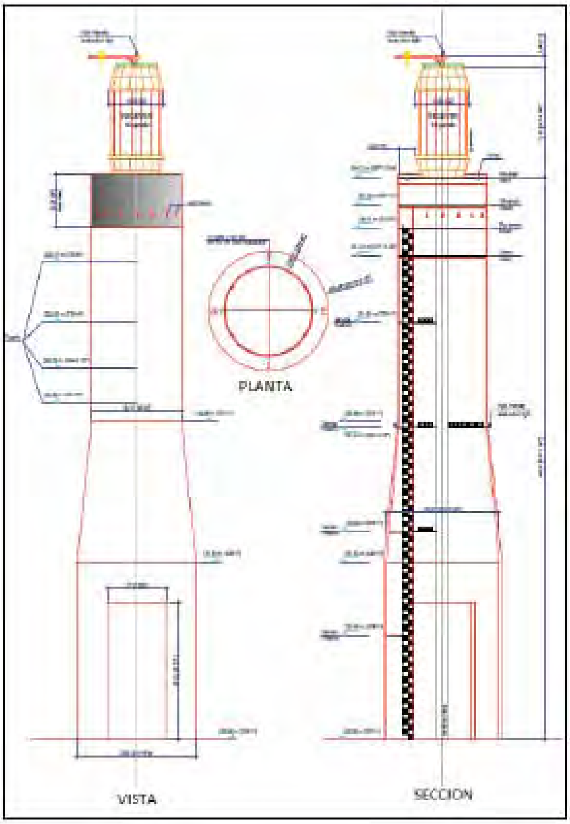


Figure 6: Solar Tower – Preliminary Design

The central receiver is a cylindrical heat exchanger approximately 16 m in diameter and 27 m high, which receives the solar energy as reflected from the heliostats and transfers it to the molten salt mixture. This receiver comprises of 14 panels which are attached to a steel structure. High capacity solar radiation absorption paint is used to cover the sections of the receiver (panels) that are exposed to the solar radiation. It is estimated that the solar receiver will have a thermal yield of approximately 88%. The receiver is furthermore equipped with tube nozzle headers, tube supports, structural supporting frame, control equipment and instruments, piping to mobilise the molten salt to and from the storage tanks, valves, heating cables and an internal lift.

1.2.3 Thermal storage System

The storage system is comprised of two (2) molten salt thermal storage tanks – the hot salt tank and the cold salt tank. The hot salt storage tank is to be constructed from stainless steel, whereas the cold thermal storage tank is to be made of carbon steel. Both facilities have sufficient insulation, as well as electrical heat tracing, to avoid the loss of the salt mixtures thermal energy as it moves through the tanks. Each storage tank has a capacity equivalent to the total volume of the salt stored for the plant, some 35,000 tonnes (based on preliminary calculations). This amount allows for up to 24 hours of electricity generation at the turbine's maximum capacity. The tanks will be situated within a containment basin (or bund) designed to hold110% of the contents of a storage tank in the event of a possible leak. Both tanks

will be constructed on a concrete foundation with passive cooling so that the foundations do not surpass the concrete's temperature limits. Each storage tank is roughly 12 meters high and 38 meters in diameter and has the capacity to store salt mixture for up to 24 hours. The roof of the storage tanks are domed and designed to operate at ambient pressure with an ambient temperature of 38ºC and a salt temperature of 580ºC. The hot storage tank will have a slightly higher capacity to that of the cold storage tank.

1.2.4 Molten salt pumps

The molten salt mixture is circulated through the plant by means of special molten salt pumps. The cold storage tank is equipped with four (4) pumps positioned parallel to one another in the upper section of the tank for the circulation of the molten salt mixture. Three of the pumps are operational whilst the fourth is merely a backup pump. The pumps operate at a flow rate of 4 573 tonne/hour; a temperature of 288ºC and under a pressure of 21 bar. The pumps are rotated on a regular basis to ensure continuity and reliability.

The hot storage tank only has three (3) pumps that circulate the molten salt mixture from the tank to the steam generator. Two (2) of the pumps are operational with the third pump being a backup pump. The pumps used for the hot storage tank, like that of the cold storage tank, are also situated in the upper section of the tank and positioned parallel to each other. The operating conditions for the hot storage tanks are subject to a flow rate of 1 143 tonnes/hour, a temperature of 566□C and a service pressure of 9 bar. Again, as with the cold storage pumps, the hot storage pumps are rotated on a regular basis to ensure continuity and reliability. In the event of pump failure, the reserve pump can be utilised.

All of the salt system pumps have a vertical design, with extended axles of some 15.5 metres and operating with a frequency converter.

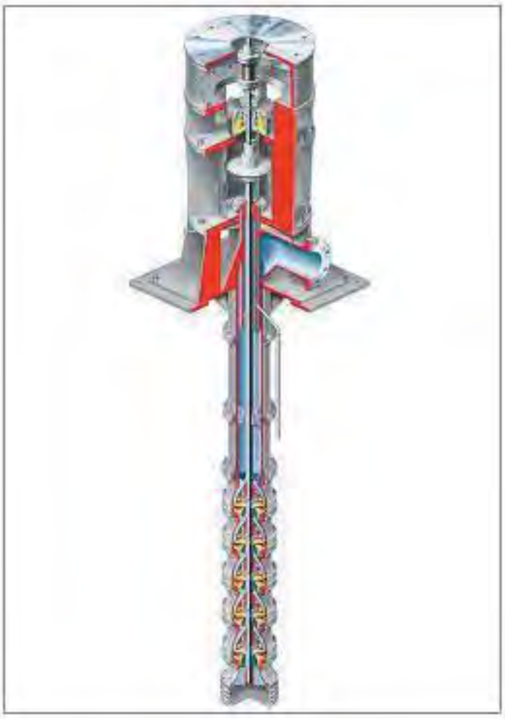


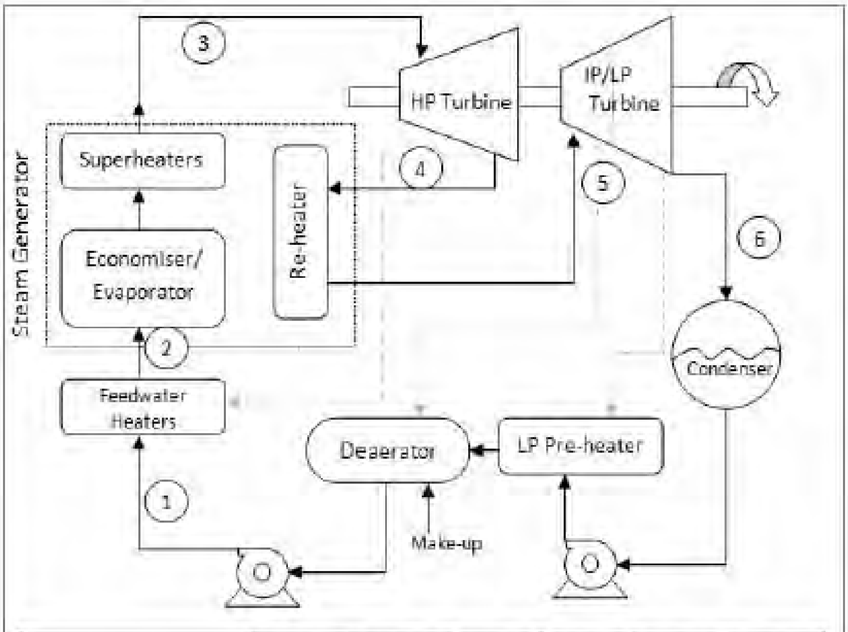
Figure 7: Example of a vertical molten salt pump (from Flowserve)

1.2.5 Auxiliary salt heater (Salt melter)

The salt melter is comprised of an insulated tank that will be heated by combustion of natural gas (or alternatively diesel). During plant commissioning the solid salt mixture is brought to a temperature between 288°C and 370°C (at least 50°C above its melting point of 238°C) and then pumped out of the salt melter into a secondary gas-fired heater and further elevated in temperature to a range required for the final conditioning process. The initial melting and heating process is expected to operate continuously, 24 hours per day and 7 days per week, until the plant's total inventory of approximately 35 000 tons of salt has been melted. Salt melting is expected to take approximately 70 days. After melting and conditioning the salt is pumped to the salt storage tanks. The auxiliary salt heater will potentially also be used as a back-up system that provides additional heat to the plant in severe cases where the salt’s thermal storage is not sufficient to keep generating power.

1.3 Power Block

The function of the power block is to turn the stored solar energy into electrical energy. This will be achieved through a conventional Rankin Cycle, as used on most power plants worldwide.



		1	2	3	4	5	6
Pressure(a)	(Bar)	145	122	116	34	31	0
Temp	(°C)	163	246	540	359	541	51
Flow	(t/hr)	380	380	380	341	341	268

Figure 5: Simplified Rankin Cycle process diagram (preliminary values)

The process starts with water which is fed from a condensate tank and a make-up source into a de aerator which removes all traces of oxygen or entrapped gasses from the water. The water is then pressurized with feed pumps and fed through a number of heat exchangers to transfer as much as possible of the energy stored in the molten salt to the steam cycle. Super heated steam (at ±540ºC and 116 bar) is then passed through the High Pressure turbine. There after the steam is reheated and then passed through the intermediate and low pressure turbine stages. The turbine spins at very high revolutions and drives the electrical generator in order to deliver electricity to the plant's substation. Steam exiting the low pressure turbine is directed through coolers which condense the steam back to water. The main components of the power block are described in more detail. Steam is generated by means of a steam turbine with an intermediate re-heating application. The specifications for aforementioned re-heaters in terms of the CSP Plant in questions are as follow –

1.3.1 Pre-heating system

The pre-heating system can be defined as the cycle in which the condensate is heated to the optimum temperature for steam generation purposes. The system comprises of the following:

- Low pressure water/steam pre-heaters

Three low pressure pre-heaters are positioned in sequence. The pre-heaters are of shell and tube arrangement. These pre-heaters use steam from various specific extraction points on the steam turbine to pre-heat the condensate before it enters the de-aerator.

- De-aerator

The CSP Plant is equipped with a de-aerator in order to remove oxygen and any other entrapped gasses within the feedwater of the steam cycle. Such gasses can cause serious damage to piping and equipment in the long run if not removed. The de-aerator uses extraction steam from the steam turbine for heating and to aid the de-aeration process. The process also serves to preheat the condensate and to store it as source of supply to the steam generator feed pumps. Deionized cycle makeup water is introduced at the inlet of the de-aerator to allow for heating and deaeration. Cycle makeup water is necessary to compensate for system losses, primarily due to steam drum blowdown.

The de-aerator head will be fitted with adequate safety valves to ensure pressure is maintained and that in the event of over pressurising the excess pressure is released. The system is furthermore fitted with a vacuum-breaking valve which guarantees that the feedwater tank never depressurises.

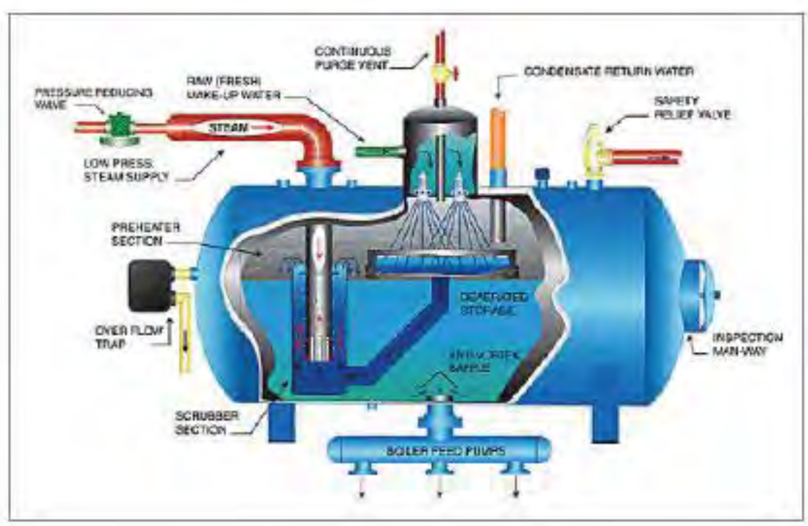


Figure 6: Typical deaerator (from Hurst Boiler)

- Feedwater Pumps

The feedwater pumping system will deliver feedwater to the steam generator and comprises of three horizontal centrifugal pumps, each with a 50% capacity. The pumps will draw feedwater from the de-aerator tank and transfer it to the steam generator by passing it through the three feedwater heaters. These are powerful pumps which need to deliver water at very high pressures.

- Feedwater-heaters

From the outlet of the deaerator the heated condensate is pressurized via feedwater pumps and then passed through 3 high pressure feed water heaters in series. The first 2 heaters are heated with steam extracted from specific extraction points on the high pressure and intermediate pressure turbines, while the third is heated with steam from the steam drums within the steam generator.

1.3.2 Steam Generator system

The steam generation system is the core of the steam supply system for the power block and consists of an economizer, evaporator, two superheaters, and two reheaters. High pressure feedwater enters the system from the feedwater heaters, passes through the economizer, the steam drum, through the evaporator, back to the steam drum, and leaves as saturated steam that subsequently flows to the superheaters. Superheated steam passes through the HP steam turbine and is exhausted to the reheaters. Reheat steam is then directed to the inlet of the IP turbine. Hot salt pumped from the hot storage tank enters the shell side of the steam generation system heat exchangers and flows through the superheaters, reheaters, the boiler and finally the economizer. The salt is then directed to the cold storage tank. The steam generation system components are described more in detail below:

- Economizer –

The economizer is a shell and tube design heat exchanger. High pressure feedwater enters the economizer tubes from the feedwater heaters and is directed from there to the evaporator steam drum.

- Evaporator

Feedwater from the steam drum is transferred by a recirculation pump to the evaporator section to produce saturated steam. Saturated steam from the evaporator section is directed back to the steam drum. Moisture separators in the steam drum help to remove moisture droplets from the steam as it passes on to the superheater. The evaporator tubes receive heated, high pressure feedwater from the steam drum via the recirculation pump and evaporate the water into saturated steam. The evaporator section is a shell and tube design heat exchanger. The saturated steam leaving the evaporator section flows back to the steam drum.

- Super heaters and Reheaters

The saturated steam flows through the tubes of the shell and tube design superheater to heat the steam to the desired temperature and pressure for steam turbine operating conditions. The reheater receives “cold” outlet steam into its tubes from the high pressure turbine exhaust and reheats the steam before being reintroduced into the intermediate pressure turbine.

1.3.3 Steam turbine Generator

The steam turbine generator system consists of a multi-stage, reheat, condensing steam turbine generator (STG) with extraction, a gland seal steam system, lubricating oil system, hydraulic control system, and steam admission and control valving. Once the pressurized steam has reached the optimum temperature in the superheater, it flows to the steam turbine, which converts thermal energy in the steam into mechanical power (rotation), driving an attached power generator. Superheated steam is expanded through the high-pressure stages of the turbine, is routed back to the steam generation system where it is reheated, and then returned to expand through the intermediate and low-pressure turbine sections. On exiting the turbine, the steam is directed into the air cooled condenser.

- Steam turbine auxiliary systems

The steam generation system is supported by various auxiliary services which needs to be maintained. These services include the –
Control and shut-down valves for the primary steam generation system and re-heater.

  - Lubrication oil system.
  - Hydraulic oil system.
  - Gear box.
  - Steam sealing system.
  - Turbine and generator control system.
  - Earthing system and electric protection equipment.

- Steam turbine control system

The turbine set as well as the auxiliary systems will be equipped with its own control system, which is to be integrated into the DCS of the plant. The control system will be a standard control system and will be obtained from the turbine suppliers. The primary functions of this system will be for–

  - Protection and triggering due to over speed.
  - Protection and triggering of the turbine.
  - Oversight of the field instrumentation associated with the turbine.
  - Monitoring of the position of the shaft.
  - Monitoring of the eccentricity of the rotor.
  - Monitoring of the expansion of the casing.
  - Monitoring of thermal fatigue.
  - Monitoring of the temperature of the metal of the bearings.
  - Frequency control.
  - Control of the control valve position.
  - Control of the extractions from the turbine.
  - Maximum and minimum speed limiter.
  - Limitation of maximum admission pressure.
  - Limitation of counter pressure.

    - Maximum and minimum power limiter.
    - Seal steam pressure control.
    - Hydro-electric control system
    - The emergency shut-down valves and the main control valves will regulate the operation of the turbine as per the required operational conditions. The control system is designed to ensure the turbine retains power based on demand, by means of opening and closing the control valves as per the control room instructions.

- Steam bypass system

In the event of the turbine being not operational or has tripped for some reason, the steam generated by the steam generation process will be fed into a bypass steam circuit. This bypass circuit sends the steam directly to the condenser, bypassing the turbine. The bypass circuit consists of a –

    - High pressure bypass turbine, which transfers high pressure steam from the super-heater to the re-heater, and
    - A low pressure bypass turbine, which transfers reheated steam to the cooling system.

Each bypass circuit is fitted with pressure and temperature control valves. The pressure control valves reduce the steam pressure and the temperature control valves control the steam temperature by injecting feed water from the boiler into the high pressure turbine's bypass circuit in order to cool the steam down. The reheated steam on the other hand is cooled down via a diffusion conduit.

1.3.4 Air cooled Condenser

Air cooled condensers are used to cool and condensate steam exiting the low pressure steam turbine. The air cooled condenser is designed to cool the steam cycle with ambient air which is forced across its radiators As steam output is air cooled a difference in air temperature and pressure will be recorded. The steam output will vary according to ambient temperature and the air flow in the air cooler. The condenser consists of the following:

- Packages of tubes with finned heat exchanging surfaces (also called radiators);
- Axial fans, with gearbox, couplings and motors;
- Output conduit for the steam turbine, steam distribution pipes and expansion joints;
- Windbreak between cells and outside enclosure;
- Steel support structure;
- Condensate tank;
- Complete system of accumulation and discharge of the condensate;
- Vacuum pumps and accessories;
- Regulation and measurement equipment;
- Conduit cleaning system;
- Protection systems; and

- Instrumentation and accessories.

1.3.5 Auxiliary cooling system

The CSP Plant will be equipped with a closed circuit cooling system for all auxiliary components. The primary inputs of the cooling system will be a mixture of demineralised water and propylene glycol and will consist of the following component –

- One (1) air-cooler at 100% capacity (fin-fan cooler) (optional);
- One (1) wet-surface air-cooler;
- Two (2) water cooling pumps, each at 100% of the total system capacity; and
- Pipes, valves, instrumentation, etc.

Vitally important to the plant is the fact that the primary cooling system is a dry-based cooling system, which does not require water. The auxiliary cooling system, as specified above, however includes a wet surface air-cooler, and is used for the cooling of all equipment i.e. pumps, alternators etc. that does not form part of the output cycle of the turbine. The pumps will be manufactured from materials that can withstand wear and tear with regards to the liquid being transported therein. The same manufacturing principle will be applied to the motor chosen to drive the pumps – it will be designed and configured in such a manner that is always operating at the most optimal point of the curve without the motor being overloaded. The aforementioned infrastructure will be constructed on a carbon steel base structure which is designed to bear the full weight of the equipment. These will then be cast onto a concrete foundation.

1.3.6 Generator/Synchronous Motor

A synchronous self-exciting brushless generator will be employed, that is suitable for parallel operations. The generator functions by means of an armature winding when excited by a poly-phase (3 phase) supply, creating a rotating magnetic field inside the motor. The field winding locks in with the rotating magnetic field and rotates alongside it. During operation the motor is said to be in synchronisation once the field locks in with the rotating magnetic field. These types of motors are not self-starting and only start functioning once power is supplied to the motor.

The main characteristics of the generator are as follows:

Table 2: Generator characteristics

Generator Characteristics	
Nominal power	±115MVA (preliminary)
Nominal Voltage	11 kV +/-5%
Frequency	50 Hz
Motor protection	IP 44

Generator Characteristics	
Insulation class	F
Temperature increase	F
Power factor	0,9

1.4 Auxiliary facilities and Infrastructure

Over and above the infrastructure and equipment requirements directly related to the operations of the CSP Plant, several auxiliary facilities and infrastructure also needs to be constructed and implemented. These facilities and infrastructure will support the daily operations of the CSP Plant by their various operation related functions, by producing inputs i.e. water, treating products generated by the plant, facilitating or housing of operations staff etc.

1.4.1 Water treatment plant

The technology used for the CSP Plant is highly sensitive and requires that all water used during operations conform to a rigorous water specification. As all raw water entering the plant must be treated prior to use in the plant a water treatment plant will have to be constructed. The main water treatment subsystems will include the following components.

- Multimedia Filter

The Multimedia Filter (MMF) contains multiple types of media with the coarse media layers in the top of the tank to trap large particles, and successively smaller particles trapped in the finer layers of media deeper in the bed. A coagulant will be introduced before the MMF inlet to capture fine particles for ease of filtration in the MMF. The multi-media filter is backwashed using reverse or upward flow of water through the filter bed. The various layers of media retain their stratification because each material has a different density.

- Reverse Osmosis

The Reverse Osmosis (RO) system is a filtration process that works by using pressure to force water through a membrane, retaining the contaminants on one side and allowing the pure water to pass to the other side. The RO will include an additional concentration step for RO serving to treat the waste from the main lines and reduce by a maximum the final waste from the system An anti-scalant and dechlorinator will be injected upstream of the RO skids to reduce the cleaning cycle of the membranes.

- Electrodeionization

Electrodeionization (EDI) is a continuous and chemical-free process of removing ionized and ionizable species from the water using DC power. EDI is used to polish the RO permeate and to replace

conventional mixed bed ion exchange, which eliminates the need to store and handle hazardous chemicals used for resin regeneration and associated waste neutralization requirements. In order to treat the raw water to be used in the CSP Plant several key facilities and infrastructure will have to be constructed and installed. The auxiliary equipment needed for water treatment include –

- Reagent-dispensing systems;
- Pumps with filters;
- Filters, filter washing pump, blowers for washing filters;
- Cartridge filters and high-pressure pumps;
- Measurement systems: flow meters and pressure gauges;
- Reverse osmosis support frame;
- Membrane cleaning system;
- Electro-deionisation module; and
- Storage tanks for water of different qualities (stabilised, filtered, osmotically-treated and demineralised waters)

1.4.2 Wastewater recovery plant

An evaporator unit designed to treat the final waste amount for recovery purposes will be implemented at the end of the stream line. A 6 effect evaporator was selected with a flow rate of 10 m3/h, the evaporator reject will be discharged at the evaporation pond

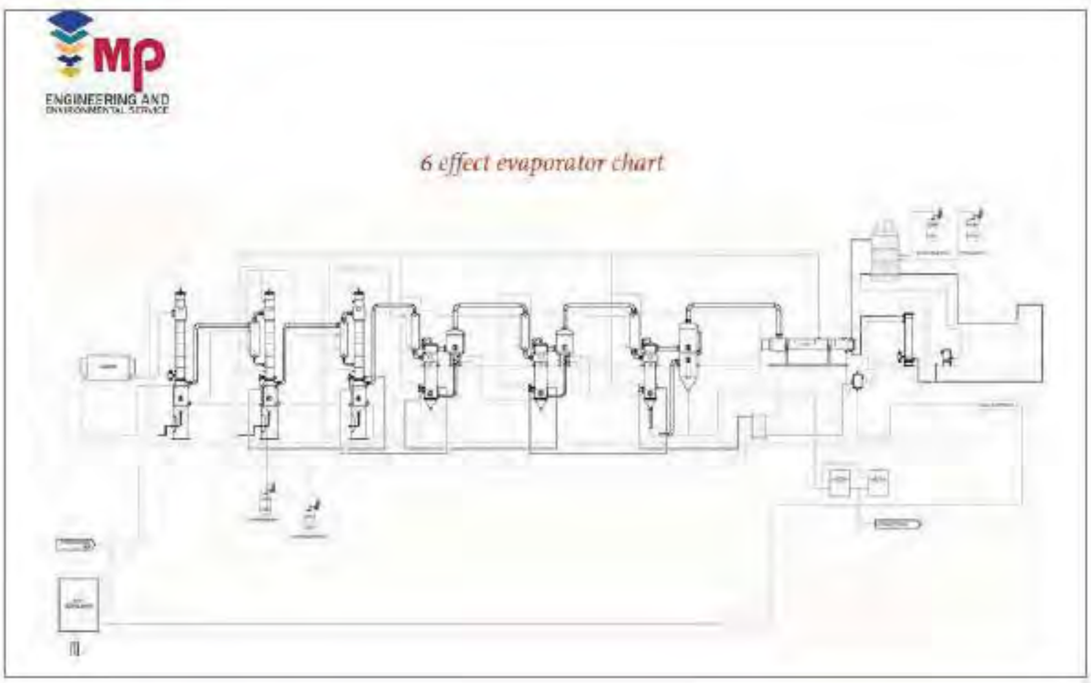


Figure 7: 6 Effect evaporators

1.4.3 Wastewater purification plant

The CSP Plant will generate several forms of liquid effluent as part of operations. The primary effluents sources generated include –

- Wastewater from the evaporation plant;
- Contaminated surface water i.e. stormwater and rainwater; and
- Sewage effluent.

For a 50MW - 100MW plant it is estimated that the total volume of discharge, inclusive of sewage water and evaporation system discharge is roughly 72 700 m^3 per year. As the proposed plant is estimated at generating 30 – 50MW more electricity these volumes can be expected to almost be double. The plant is thus expected to generate between 116 320 and 145 400m^3 per annum. The Wastewater Purification plant will source the wastewater from four independent intake (feeder) systems as per the different types of wastewater.

- System 1 will collect all the containment surface water (stormwater).
- System 2 will be responsible for transporting all sewage effluent to the biological treatment system. This treatment system consists of a septic tank and biological filter.
- System 3 will transport the wastes generated during the evaporation process to a wastewater treatment plant.
- Lastly, a system will be designed to collect stormwater (surface water), which will be sent to a drainage pool before it is discharged.
- The treatment options for the four systems are based on the types of effluent to be treated. The following treatment options have been defined for each source of effluent –
- Contaminated water treatment system will be installed to separate both clean and dirty surface water where after the different types of grease/hydrocarbon products will be treated and clean surface runoff diverted away from site.
- A biological treatment system will be implemented to treat the sewage effluent from the offices.

1.4.4 Site Access

Infrastructure located in the vicinity of the proposed development include –

- The road R385, extends between Lime Acres Mine and Postmasburg, and passes by on the northern boundary of the farm.
- A gravel road D3381 which extends to Lime Acres, runs along part of the western boundary of the site.
- A railway line runs adjacent to the western boundary of the site;
- A level-crossing over the railway line in the southwest of the site; and
- A 66 kV electricity transmission line runs parallel to the railway on the western boundary of the site.

- Road Access

The site can be accessed from either the R385 (Postmasburg to Lime Acres) located on the northern boundary of the site or the D3381 to Lime Acres running along part of the western boundary of the site. Upon entering the property several existing farm roads are noticed. These farm roads require upgrading for project purposes and it is envisaged that several new gravel roads may have to be constructed to facilitate movement of construction and maintenance vehicles.

  - Length of roads (to be confirmed in following design phases)
  - Width of roads 7.14 m
  - Access points (to be confirmed in following design phases)

- Rail Access

A railway line runs adjacent to the western boundary of the site, with a level-crossing over the railway line in the southwest of the site.

1.4.5 Water Consumption and discharge

Water plays a critical role in the day to day operations of the proposed CSP Plant and significant volumes of water will be required during both the construction and operational phase of the proposed development.

- During Construction

During the construction phase water is needed to ensure and maintain soils/surfaces are kept hydrated (wet) during earthmoving operations as to prevent dust generation. For a 100 MW CSP Plant it is estimated that roughly 117 500m3 of water will be required for the entire construction phase, which is estimated to run over a period of 30 months. The volumes of water required during construction can be divided into the following areas of consumption/uses –

  - Dust control: Dust control needs to be administered in the working areas. And estimated 242m3 of water is required per day (precipitation included) for a 100 MW plant. Roughly 42 350m3 of water is required for dust control purposes throughout the entire construction phase.
  - Irrigation: For the compacting of and/or stabilisation of roads and excavations including the power block and heliostat field. A bowser truck will be used when required for the execution of this task. However as the volume of water required is dependent on the soil conditions and more information is required in this regard only an estimation in this regard can be presented. It is estimated that 51 100m3 of water will be required for the execution of this task.
  - Heliostat cleaning: The cleaning of heliostats is vital to the effective operations of the CSP Plant. Heliostats are to be cleaned with demineralised water – and it is calculated

that 76 liters of water is required per heliostat. The heliostat field comprises of 17 350 heliostats each requiring 76 liters of water equating to 1 318 600 liters.

- Human use and consumption: Potable water is required for human consumption during the heliostat construction and erection phase. It is estimated that roughly 3.8 liters of potable water
- Testing purposes
- Water demineralised
- Raw Water
- Contaminated Water
- Sewage & Effluent

- During normal operation

During normal operational conditions the CSP will require approximately 272,400 m3 per year with peak consumption of approximately 44.5 m^3/ hr. The plant operates on dry cooling as well as hybrid cooling depending on power plant operational point and cooling requirements. This provides an optimal solution between achieving required plant efficiencies and using as little as possible water. The plant is also optimized to re-use water where possible and the total system discharge from the plant is fed to an evaporation pond, yearly total approximately 59 600 m3. The balance of water is either evaporated or used in plant washing functions and operational consumption. The table below shows the water usage for both cases, Hybrid cooling and dry cooling.

Table 3: Operational Water Usage (See Appendix 1 for PFD)

Stream No.	Stream Description	Hybrid Cooling (m^3/h)	Dry Cooling (m^3/h)
1	Water Supply - Drinking Water Quality	44.49	11.34
2	Filtered water	43.15	11.00
3	Filter wash water	1.33	0.34
4	Fire Protection Water	0.00	0.00
5	Domestic Water	4.00	4.00
6	Sanitary Consumption	0.16	0.16
7	Septic System	3.84	3.84
8	Service Water	3.00	3.00
9	Process Consumption	0.10	0.10
10	Eyewash/Safety Showers	0.00	0.00
11	Oil Water Separator	2.90	2.90
12	Water Treatment System	17.04	4.00
13	RO Water	12.86	3.39
14	RO Brine	2.31	0.61
15	Demin Water	12.61	3.32
16	EDI Brine	0.25	0.07
17	Solar Field Mirror Wash	3.32	3.32

Stream No.	Stream Description	Hybrid Cooling (m^3/h)	Dry Cooling (m^3/h)
18	Make up	11.77	0.00
19	Steam Loses	2.35	0.00
20	Steam Generator Blow Down	9.42	0.00
21	Quench Water	4.71	0.00
22	Vent to Atmosphere	4.71	0.00
23	Blowdown + Quench to Evaporator	9.42	0.00
24	Septic Water to Evap. Pond	3.84	3.84
25	Oil Water Separator to Evap. Pond	2.90	2.90
26	Water Treatment Brine to Evaporator	2.57	0.68
27	Demin from Evaporator to Demin Tank	2.49	0.66
28	Evaporator Brine	0.08	0.02
29	Evaporation pond	6.82	6.76
30	Cooling Tower Makeup		
31	Cooling Tower Evaporation		
32	Cooling Tower Drift		
33	Cooling Tower Blowdown		

1.4.6 Administrative Facilities

Additional facilities to be constructed as part of the CSP Plant operational phase include –

- An office building will be constructed for administrative purpose to serve as a centre for project support staff during operations.
- Warehousing;
- Laboratories;
- Training facilities;
- Medical Facilities;
- Ablution facilities;

1.4.7 Storage facilities

It is proposed that the storage facility will have a dual function – during construction this facility will be used for assembly and constructing of the heliostats and when the facility is operational it will serve as a storage facility. The storage facilities during operation will serve for the:

- Storage of general materials
- Storage of Hazardous material
- Storage of Salts.

Salts will be delivered in solid form in one-tonne bags and stored in this facility. The salts will be heated and liquefied for use in the plant as and when required.

1.4.8 Security Infrastructure

The site will be secured at all times, day and night. A security or site access office will be located at the entrance of the CSP Plant to restrict access. The entire site will furthermore be fenced off for security purposes.

1.4.9 Fire protection system

A fire protection and prevention plan will be prepared for both the construction and operational phases of the project. The primary aim of this system will be to preserve and protect human life as well as tangible goods and equipment in the event of a fire. The fire protection system will employ measures to reduce the occurrence of fire in the event of an explosion as well as to contain and prevent fires from happing or entering the site/plant. The fire protection and prevention plan will define and delineate the various appropriate emergency exits, identify safe zones (buildings), identify possible sources of combustion as well as to address and present measures of mitigation in the event of a fire. During construction the CSP Plant will be services with an intermediate fire protection system which will entail an auxiliary pressure pump, fire extinguishers and other portable fire-fighting equipment. The fire protection system will consist of a water distribution system which aims to curb and restrict fire, in the event of occurrence. Water will be stored in the fire protection system tank and will be sourced from the raw water storage tank. The raw water tank will be fitted with a safety water level. This water level will serve as indication to the plant as to when no raw water is available for use in the water steam cycle, as it is exclusively assigned for fire fighting and protection measures. The volume of water required for this purpose will be defined by the areas specific character and localities standards. The fire protection system is fed by two (2) water feeding pumps (electrical and diesel), which will supply the pipe network with the allocated and required water. A small jockey pump will maintain the pressure in the pipe network. The diesel pump is a precautionary measure, and will be designed to commence with operation if and when the jockey pump no longer has the capability to maintain pressure in the pipe network. This pipe network will feed the hydrants situated throughout the plant.

1.4.10 Control and instrumentation system

The control and instrumentation system will be based on a SCADA (Supervisory control and Data Acquisition) distributed control system. This SCADA system consists of PLC (Programmable Logic Controllers), hardware and software, field instrumentation, weather stations and communication devices designed for the monitoring and control of the plant's historical data. A control room will be constructed

wherein this system will be housed. Over and above the SCADA the control room will also be equipped with an Ethernet network. All in all the control room will be equipped with the following equipment –

- Web Server;
- SOE Recorder;
- Domain Controller;
- HMI Server Historian;
- Engineering post 1;
- Control room;
- Printers;
- Operation post 1;
- Operation post 2;
- CCTV; and
- Engineering post 2.

The control room will be linked with the fibre optic network of the control equipment of each of the plant's systems via the Human Machine Interface (HMI) Server Historian and two Ethernet switches.

- Turbine system - EHC system
- Steam generation system - DCU system, linked via fibre optics to the control systems for the salt storage tanks, both cold and hot.
- Receiver - DCU system; includes an HMI interface.
- Monitoring of the heat control signal.
- Control system for the electric part, transformer, and protections.
- Control system for the plant's electric production.
- Control system for the air-cooled condenser.

All of the data collected will be sent to the control room via a communication network (fibre optic/copper cabling).

1.5 Electric system

The site is currently served by an existing 132 kV transmission line, which traverses the site in an east to west direction. The connection point is at pole number WO189-2 where a 25kVA pole mounted transformer is installed. This connection line and point is however insufficient to serve as either EG feed in point to Eskom or as LPU connection point for the site, thus the installation as detailed in the next paragraph is proposed.

1.5.1 Transmission Information

There is an existing 132 kV sub-transmission line running parallel to the railway line on the southern boundary of the site. It is proposed that a 132kV loop in-loop out (LILO) sub-Transmission line be installed by Eskom (this will be done via the payment of bulk contributions by the client) to a substation which will connect the new facility to the national grid. A 132/11kV (step-up / step-down) substation will be constructed as close as possible to the generation plant to facilitate the transfer of between 80 to 100 MW of generated power. The new 132kV O/H lines will be constructed along the most direct route (taking environmental constraints into consideration) between the generation plant and the existing 132kV Eskom O/H line; this means that these lines will cross over existing railway lines and roads.

1.5.2 Substation and General Requirements

Currently there are no direct substation access points on the site, and it is proposed that a substation be constructed on the farm Humansrus to provide this service as part of the proposed development. The purpose of this substation is to facilitate connection of the CSP Plant to the national grid via the existing 132kV transmission lines. The substation and LILO lines up to the 132kV metering point will be constructed, maintained and owned by Eskom. The rest of the substation, including 11/132kV step-up transformers (80-100MW, EG feed in point) and 132/11kV step-down transformers (2 x 10MVA, LPU connection point) will be constructed, maintained and owned by the client. It is expected that the substation would incorporate an area of approximately 10 000 m2 and would consist of a control room, operations and maintenance facility, external 132 kV transformers and electrical switchgear and would be fenced for security and safety. The final design of the electrical transformer switchyard will be conducted once the power generation capacity is firmed up. This will influence the number and sizes of transformers to be used. It is currently planned to locate the proposed switch yard next to the power block in the southern part of the property, where it will connect the CSP Plant to the existing 132kV Eskom grid. Medium and low voltage reticulation will be installed to power the CSP plant, equipment and facilities.

1.5.3 Earthing Network

The earthing grid system will consist of buried stranded copper conductors, ground rods, and ground wells as required. Each service area of the network will be interconnected by at least two earthing conductors. The earthing system network will be designed to connect to earth all of the frames, conductive parts (metallic) of the electric equipment, the transformers' neutral, lighting equipment protection, switchboards, MCCs, metal electrical wireways and in accordance with SANS 62305 (1-4) & SANS10313. The design will ensure that the step and contact voltage levels will not be exceeded, whether by staff exposure or external exposure due to voltage transfer. The earthing system consists of a number of conduits which are interconnected in order to create a network to which all metal equipment and structures can be connected, both directly and through interconnection cables. The parts of the tower and the adjacent buildings which are constructed of a metal base will be interconnected to the earthing system through the pylon's own structural columns and its underground substructure. Whilst all of the metal parts that form part of the power block's electric system will be connected via a single point to the

earthing system. In terms of the heliostat field, earthing will be done by means of grouping and earthing. Heliostats will be grouped (the number of heliostats per group will be determined in the detailed engineering) where after they will be connected to a local earthing rod. The heliostats' earthing system will include a rod for each group, as well as an electric switchbox with the corresponding distribution of all of the local earthing cables. The earthing rod of this group will be supplementary, for protection against over-voltages (in the event of lightning) in each group of heliostats. The heliostats' earthing system will be insulated from the earthing network, from the part of the power block, in order to prevent the propagation of voltage failures to earth from the power block itself to the heliostats. All of the non-conductive metal parts in the power block will be insulated from the solar field.

1.6 Emission Control and Monitoring

Diesel-powered equipment includes two fire pumps, and two emergency generators. These will only be operated during bona fide emergencies and periodically for brief periods, as required by relevant codes and standards, for reliability testing or maintenance within strict limitations on acceptable fuels and maximum allowable run hours. Accordingly, these emissions sources will not require monitoring.

1.6.1 NOx Emission Control

NOx will not be generated during operation of the CSP. However, during plant commissioning, the initial melting, heating, and conditioning of the salt will result in limited NOx emissions. For the melting and heating segments of the process, two small boilers each employing ultra low NOx burners and flue gas recirculation, will be used to mitigate emissions from the combustion of LPG or natural gas. For the salt conditioning process, a multi-stage wet scrubber will be used to limit NOx emissions from the decomposition of magnesium nitrate inherent in the salt mixture. This series of operations is limited to a one-time event, resulting in a closed loop system of liquid salt storage and circulation. At no other time will NOx be generated during the operation of the CSP.

1.6.2 Particulate Emission Control

Particulate emissions will only be of concern during the salt melting, heating, and conditioning processes described above. Particulate emissions will be controlled by the use of best combustion practices, including the measures discussed in the preceding paragraph.

1.6.3 Continuous Emission Monitoring

Continuous emission monitoring will not be used at the CSP, as there is no source of emissions once the plant is fully commissioned, or throughout the life of the plant.

Appendix 3

EIA Methodology

To ensure a direct comparison between various specialist studies, six standard rating scales are defined and used to assess and quantity the identified impacts. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on the following criteria:

- The relationship between impacts/issues and impact status (Box 1)
- The relationship between impacts/issues and spatial scale (Box 2)
- The relationship between impacts/issues and temporal scale (Box 3)
- The relationship between impacts/issues and probability (Box 4)
- The relationship between impacts/issues and severity (Box 5)

These five criteria are combined to describe the overall importance rating, namely the significance (Box 6).

Box 1: Status of impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment	+
Neutral	No cost or benefit to the receiving environment	N
Negative	A cost to the receiving environment	-

Box 2: Spatial scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Site Specific; Occurs within the site boundary.	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5km from Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5km and more from Project Site boundary).	3

Rating	Description	Quantitative Rating
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect.	4

Box 3: Temporal scale of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Low	Short term; Quickly reversible; 0 – 5years	1
Medium	Medium term; Reversible over time; 5 – 15 years	2
High	Long term; Approximate lifespan of the project: 16 -30 years.	3
Very High	Permanent; over 30 years and resulting in a permanent and lasting change that will remain	4

Box 4: Probability of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4

Box 5: Severity of impacts

Rating	Description	Quantitative Rating
None	No impact	0
Negligible / Minor	The system(s) or party(ies) is marginally affected by the proposed development.	1
Average	Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction.	2
Severe	Medium to long term impacts on the affected system(s) or party (ies) that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value	3
Very Severe	An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For	4

Rating	Description	Quantitative Rating
	example, the permanent change to topography resulting from a quarry.	

Box 6: Significance of impacts

Impact	Rating	Description	Quantitative Rating
Positive	**High**	Of the highest positive order possible within the bounds of impacts that could occur.	+ 12 – 16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort.	+ 6 – 11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	+ 1 – 5
No Impact	**No Impact**	Zero Impact	0

SiVEST

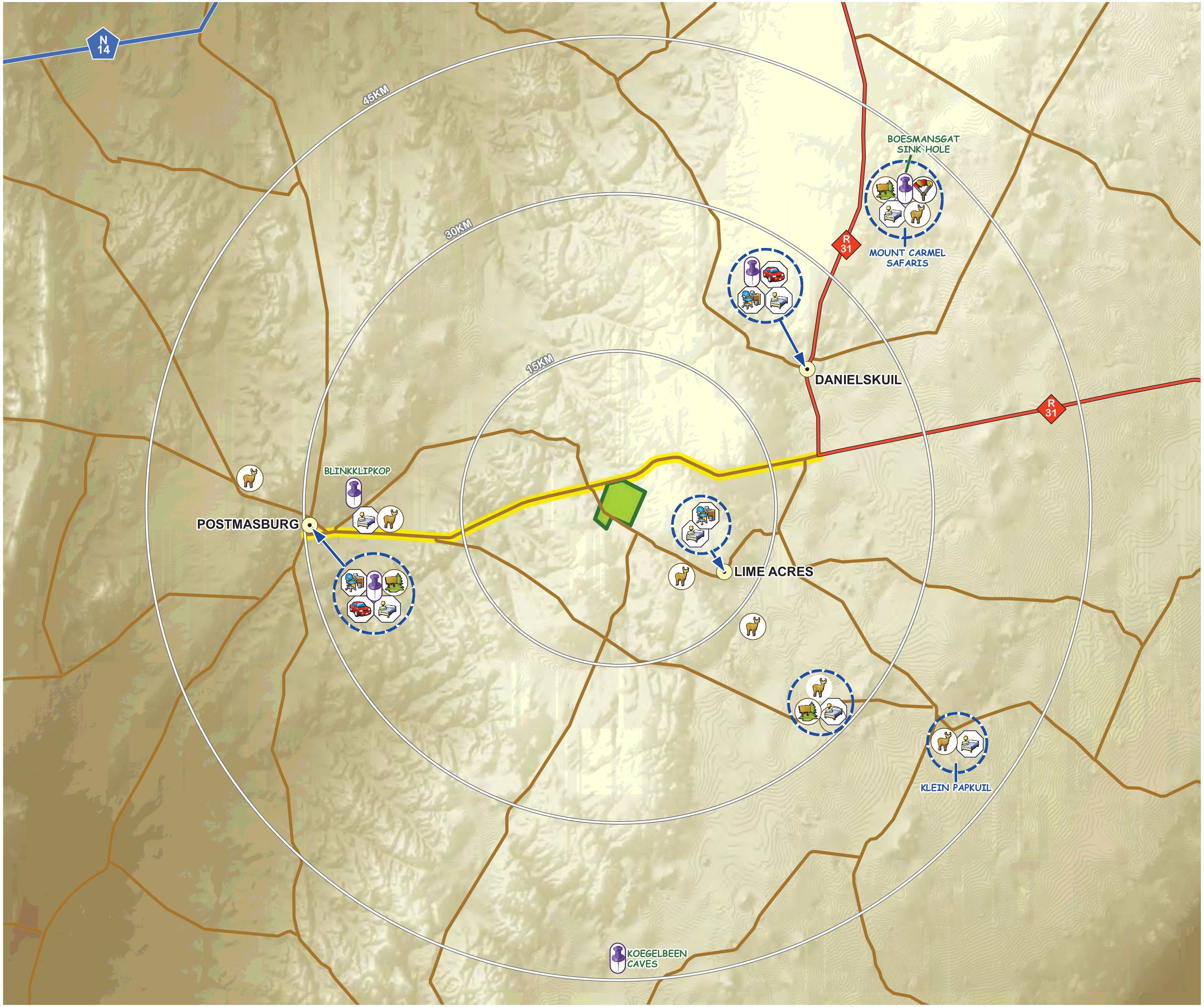
Appendix 4

Tourism Map

PROPOSED CSP PLANT HUMANSRUS

TOURISM IMPACT ASSESSMENT

TOURISM ATTRACTIONS IN THE WIDER STUDY AREA



Legend

- National Roads
- Main Roads
- Secondary Roads
- Main Towns
- Application Site
- Distance Radii (15km Intervals)

Tourism Attractions

- Minor Tourism Route
- Accommodation Facilities
- Adventure Tourism
- Business Tourism
- Ecotourism
- Historical / Heritage
- Hunting
- Passing Through

SOURCE:
ENPAT, 2000
SiVEST FIELD VISIT, 2011

N
0 2.5 5
Kilometers

SiVEST
ENVIRONMENTAL DIVISION
51 WESSELS ROAD
RIVONIA, 2128
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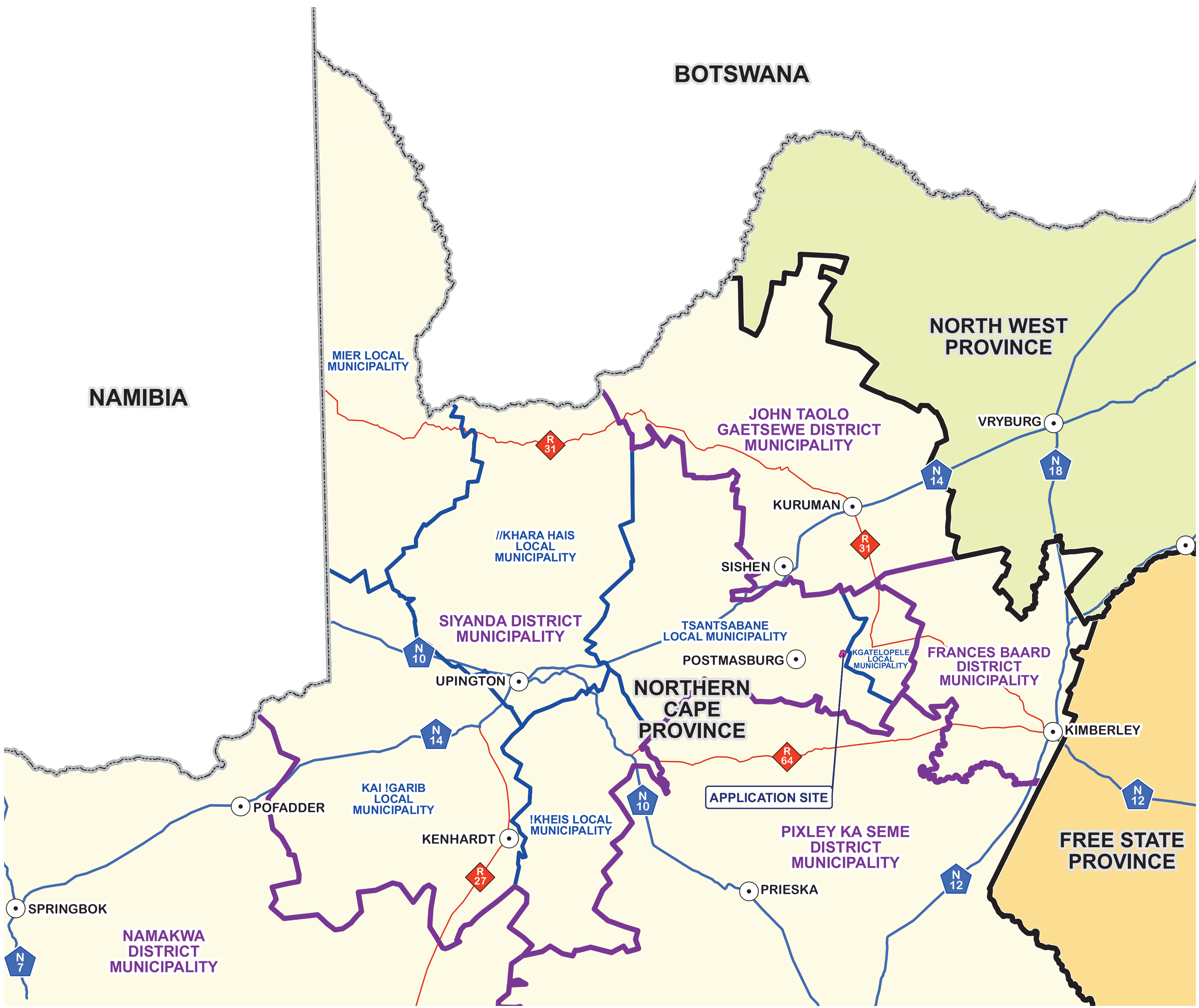
Project No	Map Ref No	Prepared By	Date
10880	10880/T_02	KLS	13/09/2011

Appendix 5

Regional Locality Map



PROPOSED CSP PLANT HUMANSRUS

TOURISM IMPACT ASSESSMENT

REGIONAL LOCALITY

Legend

- International Boundary
- Provincial Boundaries
- District Municipal Boundaries
- Local Municipal Boundaries
- National Routes
- Main Roads
- Main Towns
- Application Site

SOURCE:
ENPAT, 2000
MUNICIPAL DEMARCATION BOARD, 2010

N

0 25 50
Kilometers

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Appendix O

Socio-Economic Impact Assessment

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT DEVELOPMENT ON A PORTION OF THE FARM HUMANSRUS 469 NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

August 2011

Socio-Economic Impact Assessment: Draft

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TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

Urban-Econ Development Economists was appointed by Worley Parsons to undertake a socio-economic impact assessment study for the proposed construction and operation of the Humansrus Solar Thermal Power Plant or otherwise referred to as a Concentrated Solar Power (CSP) Plant outside Postmasburg, the Northern Cape Province. The purpose of this report is to present the results of the socio-economic impact assessment to be used as the economic specialist's input into the Environmental Impact Assessment process for the above-mentioned project.

1.1 Project background and description

Economic development and the ability of the national government to alleviate poverty are indirectly reliant on the supply of electricity in South Africa. The Integrated Resource Plan promulgated on 6 May 2011 (IRP 2010-2030) projected that an additional uncommitted capacity of 42 532 MW will be required to support the development in the country over the next twenty years and ensure adequate reserves. The required expansion is almost two times the size of the existing capacity of the system.

A significant component of the above-mentioned plan is, amongst others, the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity and involvement of Independent Power Producers in these projects. Of the new uncommitted capacity that is required to be established in the next twenty years, 2.4% or 1 000 MW is allocated towards the CSP project. In line with the IRP 2010-2030, SolarReserve South Africa proposed the construction of a Concentrated Solar Thermal Power (CSP) plant, to be known as the Humansrus CSP project. The CSP plant will have an installed capacity of up to 100 MW.

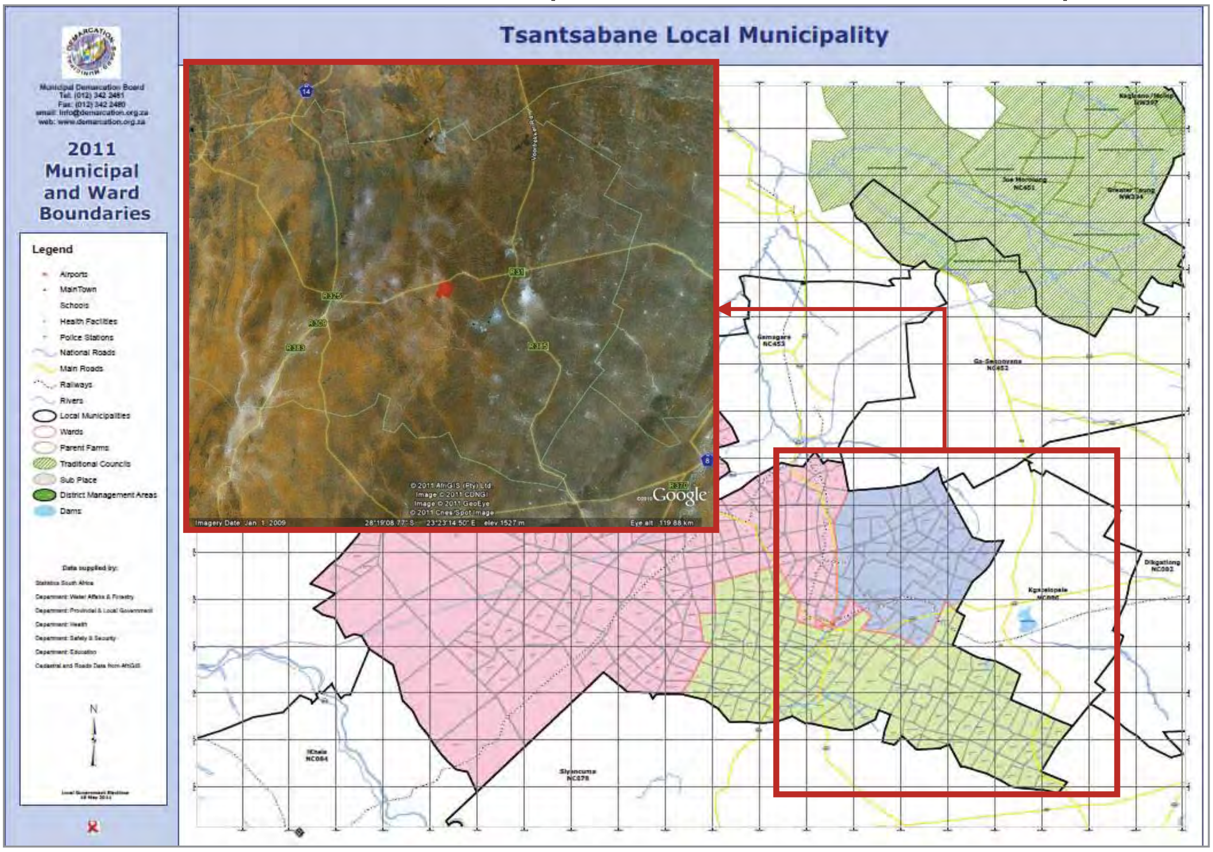
SolarReserve is one of the world's leading companies in the field of renewable energy generation. The renewable energy generation market faces two fundamental problems – (1) scalability and (2) issue of electricity storage. Solar Reserve has managed to bridge these problems with their CSP technology. CSP plants draw their heat from the sun, an unlimited source of pure clean energy; however, unlike wind and photovoltaic the technology implemented by Solar Reserve can be delivered when it is needed dependent solely on demand and not climatic factors. This feature of the technology allows Solar Reserve to bridge the key barriers pertinent to renewable energy generation – scalability and storage.

The unique components in SolarReserve's power towers are the molten salt storage loop and the power tower central receiver. The molten salt storage loop enables the plant to generate electricity whenever it is needed - 24 hours per day or during "peak demand" periods. Molten salt is an efficient and inexpensive medium to store energy. The salt used in the process is an environmentally friendly mixture of sodium and potassium nitrate, the same ingredients used in garden fertiliser.

1.2 Project location

The proposed site for the Humansrus CSP Plant is located on a portion of the farm Humansrus No. 469 situated in the Northern Cape Province approximately 30 kilometres north-east of the town of Postmasburg. The site falls within the Tsantsabane Local Municipality, which in turn forms part of the Siyanda District Municipality - one of the five districts of the Northern Cape Province of South Africa (refer to Map 1-1).

Map 1-1: Site location within the Northern Cape Province



Source: www.demarcation.org.za and Google Map, 2011

In order to delineate the study area, it is important to understand the concept of socio-economic impacts. Socio-economic impacts can be of a different nature and spatial extent. The latter differs significantly depending on the type of activity that is being analysed and the structure and composition of the locality where it is to be established. The more diversified the immediate locality of the project is in terms of its socio-economic variables, the more concentrated the impact will be in that area. It is very rare, though, to find a case when the demands of the proposed activity to be constructed and operated can be fully satisfied within the immediate locality of the project. Therefore, more often than not, economic impacts derived from any activity, are spread throughout various administrative units. Understanding the potential distribution and concentration of impacts throughout the area is important to determine the magnitude and significance of these impacts in the context of spatial units.

The study area's delineation is usually done in terms of three levels – primary, secondary, and tertiary. From a socio-economic impact perspective, the primary study area refers to the locality where the immediate economic effects of the proposed activity will be observed. This is usually defined considering the actual location of the proposed project, proximity to skilled and unskilled labour, and juxtaposition relative to suppliers. The primary study area is usually relatively small and includes administrative units from where the majority of labour for the proposed project will be supplied and where some parts of the capital and operational budgets will be spent, such as a city, town or Local Municipality depending on data availability. The secondary study area is generally far greater than the primary study area. It usually has a relatively diversified economy, which is why it is also characterised as an area where the majority of the domestic expenditure on the project will be distributed. The third tier of a delineated study area is the tertiary study area. From an economic impact perspective, it includes all impacts that would be derived from the project's domestic expenditure.

The proposed project is located within the Siyanda District Municipal area. The closest major town to the site by road is Postmasburg (approximately 30 km). Other towns within 50 kilometres of the proposed site are Danielskuil (approximately 40km) to the north-east and Lime Acres (approximately 27km) to the southeast. It is estimated that some of the people who will be employed by the proposed project will come from the nearby settlements and above-mentioned towns. As far as procurements of services and equipment during construction and operation of the project are concerned, some of these projects will be sourced from the Northern Cape. Given the fact though that its economy is not diversified, it could be argued that a significant portion of these services will be sourced from the rest of South Africa. Given the above, the following delineation of the study areas is assumed:

- primary study area includes the site and the Tsantsabane Local Municipality (LM)
- secondary study area includes the Siyanda District Municipality (DM) and Northern Cape
- tertiary study area is South Africa.

1.3 Scope of the study

The purpose of the Socio-Economic Impact Assessment is to determine the potential positive and negative effects of the proposed CSP plant on the local and regional economies and to compare their effects with the "no go" alternative to determine the net effect of the project. The "no go" alternative assumes that the proposed CSP plant is not established at the intended location, nor anywhere else in the country. The "no go" alternative represents the current status of the environment, including the socio-economic situation.

1.4 Report outline

Besides the introductory chapter, the report is structured as follows:

- The **second chapter** provides the situational analysis of the potentially affected economies. It also indicates the review of service delivery in the Province and the Local Municipalities affected.
- The **third chapter** provides the assumptions regarding the project's construction and operational phases, i.e. information used as an input into the modelling exercise, as well as the information regarding the current activity that takes place on site.
- The **fourth chapter** focuses on the analysis of strategic macroeconomic impacts that are expected to transpire from the project.
- The **fifth chapter** presents the results of the socio-economic impact assessment exercise in the context of the national, provincial, and local economies.
- The **sixth chapter** provides the evaluation of the net effect of the project on various socio-economic parameters using the methodology prescribed by the Independent Environmental Specialist.
- Lastly, **chapter seven** summarises the key points of the study.

CHAPTER 2. BASELINE INFORMATION

This chapter examines key socio-economic characteristics of the study area, as per delineation outlined in the previous chapter. This is essential as it provides both qualitative and quantitative data related to the economies under observation. It should be noted that where possible, information is provided for 2011, which is an estimate based on the historical trends and available statistics.

The following socio-economic indicators are analysed in this chapter:

- Population size and growth
- Average household size
- Income and Expenditure patterns
- Labour Market dynamics
- Production
- Gross Domestic Product (GDP) per Region
- Service delivery and access to tenure.

2.1 Population size and growth

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential to gaining an accurate perspective of those who are likely to be affected by any prospective development or project. This sub-section describes the status quo of the study area's population as estimated for 2011.

In 2011, South Africa's population is expected to be above 50 million (Table 2-1), with 1.1 million people residing in the Northern Cape area. The Siyanda DM is housing 247 611 people, or 22.5% of the provincial population while the Tsantsabane LM has a population of 29 150 people, i.e. just above 10% of the DM's population.

Table 2-1: Population size (2011) and historical growth rates (1995-2011)

Study area	2011	Historical growth rates			
		1995-2000	2000-2005	2005-2010	1995-2011
South Africa	50 430 328	1.7%	1.3%	1.1%	1.4%
Northern Cape	1 101 318	1.2%	0.4%	0.3%	0.6%
Siyanda DM	247 611	1.4%	0.5%	0.4%	0.8%
Tsantsabane LM	29 150	0.7%	0.9%	1.2%	0.9%

Source: Urban-Econ calculations based on Quantec, 2011

As indicated in the table above, the Compounded Annual Growth Rate (CAGR) of the primary study area's population between 1995 and 2011 was 0.9%. It was higher than the CAGR of the Siyanda DM and the provincial population during the same period, but lower than that of South Africa's population. Whilst the population of the Siyanda DM, Northern Cape and South Africa experienced a slowdown in their growth rates, the primary study area's population growth rate has been increasing (Table 2-1). This could be explained due to the fact that mines constitute a prominent land use in the area, which is home to the Assmang Iron Ore Mine at Beeshoek and the newly established Kolomela under Kumba.

2.2 Household numbers and size

Household data enables a richer interpretation of the results of the socio-economic impact analyses. A large increase in household numbers coupled with the increase in disposable income levels result in greater consumption, which in turn stimulate local production and as a result the economy. In addition,

knowledge of the size of the study areas in terms of households is useful for interpretation of the magnitude of the economic impact that could be created by the proposed activity.

South Africa have 13 385 517 households, which means that the average household size in the country is 3.8. The Northern Cape is estimated to have above 281 015 households and a bigger average household size than in the country. The Siyanda DM has 61 453 households and the biggest average household size in all of the study areas (4.1). The primary study area is expected to have 7 485 households and almost the same average household size (3.9) as the rest of the Province and country.

Table 2-2: Household numbers, size and historical growth rates (1995-2011)

Study area	HH number, 2011	Average HH size, 2011	Household number historical growth rates			
			1995/00	2000/05	2005/10	1995/11
South Africa	13 385 51	3.8	4.0%	2.1%	1.0%	2.3%
Northern Cape	281 015	4.0	3.6%	1.1%	-0.2%	1.5%
Siyanda DM	61 453	4.1	3.5%	1.3%	0.3%	1.7%
Tsantsabane LM	7 485	3.9	2.3%	2.0%	1.8%	2.0%

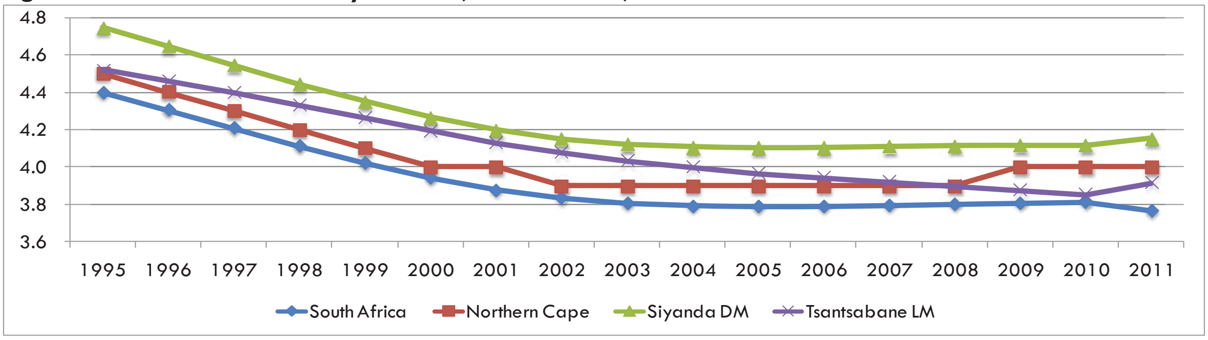
Source: Urban-Econ calculations based on Quantec, 2011

Over the years, as indicated in Table 2-2, the rates at which the numbers of households in the secondary and tertiary study areas were increasing have been slowing down, which mirrors the trend observed with respect to population dynamics in these study areas. In the primary study area, the trend though was different – with the population growth rate increasing, the household growth rate was also slowing down. When compared with population growth rates, it could be noted that the household growth rate in South Africa was on par with the population growth rate between 2005 and 2010. In the Northern Cape and the Siyanda DM, household growth rates were however significantly lower than their population growth rates, which means that the average household size in these areas has been slightly increasing.

The main factors that affect the household growth include, besides the population increase, the change in age structure and incidence rate, or the likelihood of people of a certain age to start a new household. The significant difference between a household growth rate and a population growth rate, though, is usually attributed to the change in age structure.

Household size is also influenced by many other factors such as culture, traditions, education levels, income levels, etc. Over the years, it has been observed that the size of an average household in the country has been declining (Figure 2-1).

Figure 2-1: Household size dynamics (1995 – 2011)



Source: Urban-Econ's calculations based on Quantec, 2011

As illustrated in Figure 2-1, the average household size in South Africa in 1995 was 4.4, whilst in 2011 it was 3.8. In the secondary and primary study areas, the average household size also dropped significantly between 1995 and 2011, although it should be noted that in the Northern Cape, the Siyanda DM and the Tsantsabane LM, the average household size was slightly higher than in South Africa. In the last three years, a slight increase in the average household size in all areas is observed,

which could suggest that the trend of the sharp decline in the household size observed between 1995 and 2002 has been reversed.

2.3 Income and expenditure patterns

Income distribution is one of the most important indicators of social welfare, as income is a primary means by which people are able to satisfy their basic needs such as food, clothing, shelter, health, services, etc. Changes in income inflict changes in the standard of living, more specifically: a positive change in income can assist individuals, households, communities and countries to improve living standards.

There is a direct linkage between the household expenditure and economic growth. Increase in household expenditure means a greater demand for goods and services, which means an increase in production and positive change in the size of an economy. As has been seen in 2005-2006 in South Africa, robust increase in disposable income coupled with low interest rates in the country stimulated an increase in consumption by households, in particular durable and semi-durable goods, which in turn had a positive impact on the country's economy. Knowledge of the volume of the disposable income and the expenditure patterns of households, therefore, can provide vital intelligence with respect to the sectors that are most dependent on the household income and therefore would be most affected in the case of change in household income.

Table 2-2 shows income distribution in study areas as captured in the Community Survey 2007. More recent data, unfortunately, are not available, whilst historical information is not robust and reliable enough to escalate the latest figures and estimate the situation in 2011 with great confidence.

Based on the 2007 figures it could be concluded that the household income situation mirrored some of the patterns observed in the Northern Cape and in the rest of the country. First of all, the percentage of households earning less than R3 200 per month (R38 400 per annum) in the Tsantsabane LM area was slightly higher than in the Siyanda DM and the Province, but lower than in the rest of the country in 2007. Overall, more than half of households earned less than R3 200 per month in all the study areas and the country in 2007. At the same time, though the percentage of households without any income at all was significantly higher in the primary study area than in any other study area analysed. From an average household income perspective, an average household in the primary study area earned more or less the same as an average household in the Siyanda DM, what means that there are more households in the Tsantsabane LM with a higher income, but this average household income is significantly less than households in the Northern Cape and South Africa.

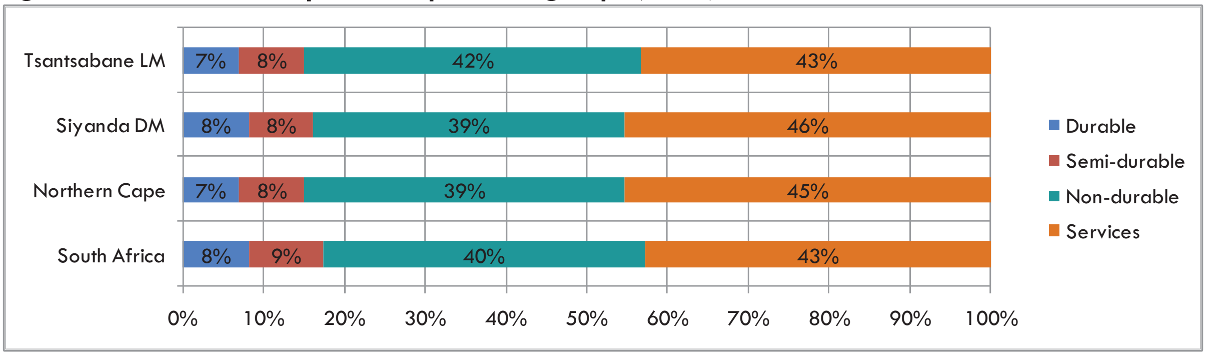
Table 2-2: Income distribution (2007)

<table>
<tr><th>Income category (per annum)</th><th colspan="2">South Africa</th><th colspan="2">Northern Cape</th><th colspan="2">Siyanda DM</th><th colspan="2">Tsantsabane LM</th></tr>
<tr><td>No income</td><td>8.2%</td><td rowspan="5">60.2%</td><td>6.8%</td><td rowspan="5">58.2%</td><td>4.9%</td><td rowspan="5">57.9%</td><td>11.4%</td><td rowspan="5">59.4%</td></tr>
<tr><td>R1 - R4 800</td><td>5.0%</td><td>3.5%</td><td>2.0%</td><td>3.1%</td></tr>
<tr><td>R4 801 - R9 600</td><td>9.0%</td><td>7.9%</td><td>9.3%</td><td>7.9%</td></tr>
<tr><td>R9 601 - R19 200</td><td>18.9%</td><td>20.2%</td><td>22.1%</td><td>16.7%</td></tr>
<tr><td>R19 201 - R38 400</td><td>19.1%</td><td>19.8%</td><td>19.6%</td><td>20.3%</td></tr>
<tr><td>R38 401 - R76 800</td><td colspan="2">11.4%</td><td colspan="2">13.2%</td><td colspan="2">12.3%</td><td colspan="2">15.3%</td></tr>
<tr><td>R76 801 - R153 600</td><td colspan="2">7.6%</td><td colspan="2">8.0%</td><td colspan="2">6.8%</td><td colspan="2">8.9%</td></tr>
<tr><td>R153 601 - R307 200</td><td colspan="2">5.3%</td><td colspan="2">4.7%</td><td colspan="2">3.7%</td><td colspan="2">3.6%</td></tr>
<tr><td>R307 201 - R614 400</td><td colspan="2">2.8%</td><td colspan="2">2.2%</td><td colspan="2">1.7%</td><td colspan="2">2.5%</td></tr>
<tr><td>R614 401 - R1 228 800</td><td colspan="2">0.9%</td><td colspan="2">0.6%</td><td colspan="2">0.6%</td><td colspan="2">0.6%</td></tr>
<tr><td>R1 228 801 - R2 457 600</td><td colspan="2">0.3%</td><td colspan="2">0.2%</td><td colspan="2">0.1%</td><td colspan="2">0.3%</td></tr>
<tr><td>More than R2 457 600</td><td colspan="2">0.2%</td><td colspan="2">0.2%</td><td colspan="2">0.1%</td><td colspan="2">0.1%</td></tr>
<tr><td>No response</td><td colspan="2">11.1%</td><td colspan="2">12.6%</td><td colspan="2">16.8%</td><td colspan="2">9.4%</td></tr>
<tr><td>TOTAL</td><td colspan="2">100%</td><td colspan="2">100%</td><td colspan="2">100%</td><td colspan="2">100%</td></tr>
<tr><td>Weighted av. (2011 prices)</td><td colspan="2">R8 920</td><td colspan="2">R8 048</td><td colspan="2">R6 938</td><td colspan="2">R6 509</td></tr>
</table>

Source: Urban-Econ calculations based on Community Survey 2007, 2011

Figure 2-2 illustrates the expenditure pattern of households in the study areas. It shows that there are slight differences between expenditure patterns of households in the Tsantsabane LM and other study areas, particularly the Siyanda DM. In the primary study area, households tend to spend the same share of their disposable income on services and non-durable goods, whilst in the Siyanda DM and the Northern Cape households tend to spend more on services than on non-durable goods. The share of disposable income spent by the Tsantsabane LM households on non-durable goods is also greater than the share of expenditure on these goods by households residing in the Siyanda DM, the Northern Cape and the rest of the country. The share of expenditure on durable goods and semi-durable goods is almost similar for all the study areas.

Figure 2-2: Household expenditure per main groups (2008)



Source: Quantec, 2011

Table 2-3 provides more detailed information on the items that households spend the largest share of their income on.

Table 2-3: Dominant expenditure items (2008)

Expenditure type	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Food, beverages and tobacco	26.3%	27.0%	26.4%	28.7%
Rent	12.4%	15.2%	15.3%	15.2%
Transport and communication	9.1%	9.1%	9.3%	8.5%
Medical services	5.9%	5.9%	5.9%	5.6%
Personal transport equipment	4.5%	3.9%	4.0%	3.7%
Clothing and footwear	5.0%	4.2%	4.1%	4.2%

Source: Quantec, 2011

As indicated in Table 2-3, expenditure on food, beverages, and tobacco products is the largest expenditure item amongst households in all areas, although households in the Tsantsabane LM tend to allocate a slightly bigger share of their income for these expenses than households in the rest of the province and country. Larger portions of the Northern Cape, Siyanda DM and the Tsantsabane LM households' income has to be allocated towards paying rent than is the case of households in the rest of South Africa. The Tsantsabane LM households also tend to spend a smaller share of their income on transportation than households in the Siyanda DM and the rest of the study areas. Expenditure on personal transport equipment in the primary area is lower than in the secondary and tertiary areas and spending on clothing and footwear is smaller than in South Africa, but the same as in the Northern Cape.

2.4 The labour market

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of angles, including the employment rate and sectoral employment patterns.

Information box: Unemployed as per official definition

Unemployed are people, who:

a) did not work during the seven days prior the interview

b) want to work and are available to start work within a week of the interview, and

c) have taken active steps to look for work or to start some form of self-employment in the four weeks prior to the interview.

The composition of the labour force in the primary study area, Siyanda DM, Northern Cape and the country as reported by the Labour Force Survey is detailed in Table 2-4. Unfortunately, though, since the latest Labour Force survey does not report on the data for the District Municipalities, information for the study areas is sourced from the Quantec database and represents 2009 figures. This allows for a comparison between the study areas.

Table 2-4: Labour force statistics (2009)

Indicators	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Working age population	31 496 936	704 615	163 008	18 707
Non-EA	15 131 133	329 386	71 740	7 811
Labour Force	16 365 803	375 229	91 268	10 896
Employed	*12 260 902*	*271 688*	*68 166*	*6 851*
Unemployed	*4 104 901*	*103 541*	*23 101*	*4 044*
Unemployment rate	25.1%	27.6%	25.3%	37.1%
LF participation rate	52.0%	53.3%	56.0%	58.2%

Source: Quantec, 2011

In 2009, South Africa had about 31.5 million people within the working age population. Of these, about 15.1 million were non-economically active and 16.4 million formed part of the labour force. This means that the labour force participation rate in the country was 52.0%. The number of employed people in South Africa was about 12.3 million, leaving 4.1 million people or 25.1% of the labour force unemployed.

The Northern Cape accounted for 2.3% of the national working age population, or 704 615 people. In 2009, just over 53% of the provincial working age population participated in the economy or were economically active. These people encompassed a labour force, which was divided into 271 688 employed and 103 541 unemployed people, indicating a 27.6% unemployment rate in the province.

Siyanda DM had a bigger percentage of the working age population participating in the economic activities than that of the province and the country. In Siyanda, 56.0% of the working age population were economically active, with 25.3% of these people being unemployed.

The primary study area had a working age population of 18 707 people and a labour force of 10 896 people, of who only 6 851 were employed. This means that in light of the labour force figure, the unemployment rate in the Local Municipality was 37.1% - significantly higher than in the Siyanda DM, the Northern Cape and South Africa. The high labour force participation rate, however, means that a significantly higher percentage of people in the Tsantsabane LM than in all the other study areas were looking for jobs.

2.5 Economic production and GDP-R

Interpretation of economic impacts requires a sound understanding of the size of the economy and its dynamics in the past. A number of indicators exists that can describe the economy of a region or an area. The most common variables that are used for the analysis include production and Gross Domestic Product per Region (GDP-R). The former represents the total value of sales of goods and services, or

the turnover of all economic agents in a region; whilst the latter, using the output approach, means the sum of value added created by all residents within a certain period of time, which is usually a year. The trend at which the GDP-R has been changing in the past is also referred to as an economic growth indicator. It is a measure of both the performance of an area and the well-being of the citizens of an area. Faster economic growth than population growth is taken as an indicator of a healthy economy and an improvement in citizens' well-being.

Table 2-5 provides an indication of the current estimated production and GDP-R values in the study areas. It shows that business sales in South Africa are expected to amount to R5 603 billion in 2011, in 2011 prices which equates to R2 530 billion of gross value added. The Northern Cape accounted for about 2.0% of the national GDP-R in 2011, whilst the Siyanda DM and the Tsantsabane LM contributed 22.4% and 3.3% to the provincial economy respectively.

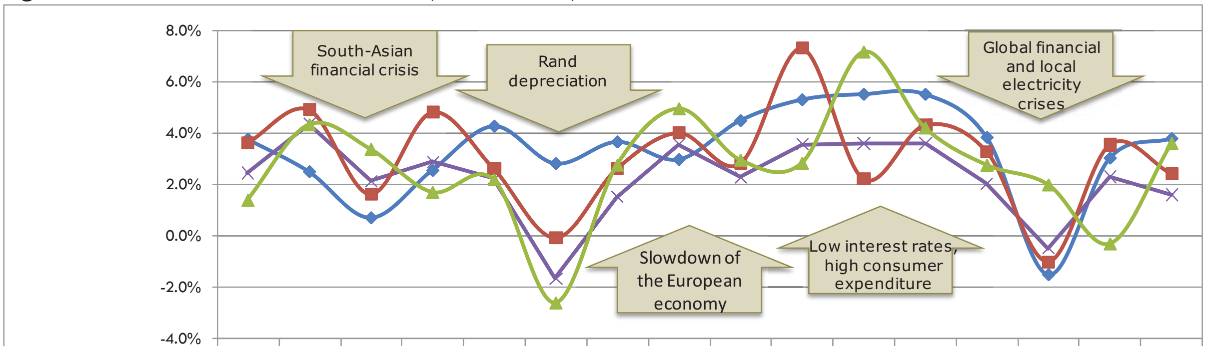
Table 2-5: Production and GDP-R figures (2011)

Study area	Production (R'ml)		GDP-R (R'ml)	
	Current prices	CAGR 1995-2010	Current prices	CAGR 1995-2010
South Africa	5 603 076	4.6%	2 530 484	3.3%
Northern Cape	104 039	3.2%	56 341	2.3%
Siyanda DM	23 380	4.2%	11 776	3.0%
Tsantsabane LM	3 476	3.8%	2 106	2.8%

Source: Quantec, 2011

Figure 2-3 illustrates the dynamics of the study areas and their sensitivity to the global and domestic changes in the economies.

Figure 2-3: GDP-R historical trends (1996-2009)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*	2011*
South Africa	3.8%	2.5%	0.7%	2.6%	4.3%	2.8%	3.7%	3.0%	4.5%	5.3%	5.5%	5.5%	3.8%	-1.5%	3.0%	3.8%
Northern Cape	2.4%	4.3%	2.1%	2.9%	2.2%	-1.7%	1.5%	3.6%	2.3%	3.5%	3.6%	3.6%	2.0%	-0.5%	2.3%	1.6%
Siyanda DM	3.6%	4.9%	1.6%	4.8%	2.6%	-0.1%	2.6%	4.0%	2.8%	7.3%	2.2%	4.3%	3.3%	-1.0%	3.5%	2.4%
Tsantsabane LM	1.4%	4.3%	3.4%	1.7%	2.2%	-2.6%	2.8%	4.9%	2.9%	2.8%	7.2%	4.2%	2.7%	2.0%	-0.3%	3.6%

Source: Urban-Econ's calculations based on Quantec, 2011

As illustrated in Figure 2-3, South Africa's economy has been sensitive to the changes on the global and regional arenas. The South Asian financial crisis in 1997-1998, Rand depreciation in 2001, slowdown of the European economy in 2003, and the major global financial and local electricity crises in 2008 all had an influence on the dynamics of the national economy one way or another. It seems that the Rand depreciation in 2001 had a greater effect on the primary and secondary areas, as this were the time when all of them had significantly lower growth rates than South Africa. Fluctuations in the global and regional economies, as well as the spin-off effects of these trends experienced in the country, also affected the growth prospects of provincial, District Municipality's and local municipality's economies.

The domestic electricity and global financial crises had a negative impact on the study area's economies in 2009. As illustrated in Figure 2-3, all of the analysed economies contracted, except with the Tsantsabane LM still showing positive growth. This could be explained by the fact that a significant

portion of the JT Gaetsewe DM economy comprises of the mining, community and trade industry. The electricity and financial crisis experienced in 2008 had a negative impact on the production volume of the mining industry, therefore the steep decline from 2006. As a result, the size of this industry has shrunk already in 2008. The peak of the aftermath of the global financial crisis reached South Africa in 2009. This coupled with high interest rates and stricter credit policy and had a significant negative impact on the domestic demand. As a result, almost all industries experienced some level of contraction or stagnation which ultimately reduced the demand for their outputs and had a negative impact on their growth. Sectors that continued growing during this period included construction, community and government services, largely due to the investment and activity that took place in preparation for the 2010 FIFA World Cup.

The global economy, as well as South Africa's economy, is slowly recovering from the turmoil of the past few years, although it will take a few years before it reaches the level of economic growth that was observed before 2008.

2.6 Structure of economies

The structure of the economy provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure and trends of specific sectors.

Table 2-6 provides structures of study areas' economies in 2011 illustrating nominal (2011) prices and 2005 prices. It should be noted that the calculation of the structure of the economy in current and constant prices provides different results. This is due to the fact that prices on goods and services do not change proportionally over years. Prices on goods of one sector could grow faster than prices on goods or services in other sectors. The indication of the structure of the economy in basic prices or prices of 2005 as was done in this case illustrates the relative composition of the economy, but excludes the benefits or dis-benefits of that economy that might have been experienced due to price effects. This is why, the presentation of results in nominal prices is also important as it allows the illustration of the economy's structure taking into account the current market prices and therefore the effects thereof on the income or Gross Operating Surplus. The comparison of the structure of the economy in terms of basic and nominal prices also provides valuable insight into the sensitivity of that economy with respect to changes of commodity prices. An economy that generates a significant share of its GDP-R from certain commodities will most likely have a significantly different structure when compared between nominal and basic prices.

Table 2-6: Structure of the study areas' economies in 2011

Sectors	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM		
	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal %	Nominal R'ml
Primary sector	**8.2%**	**11.1%**	**29.6%**	**36.7%**	**32.3%**	**40.2%**	**42.0%**	**49.1%**	**1 035**
Agriculture, forestry and fishing	2.3%	3.7%	6.6%	8.9%	14.7%	19.6%	1.3%	1.8%	37
Mining and quarrying	5.8%	7.4%	23.0%	27.7%	17.6%	20.7%	40.6%	47.4%	997
Secondary sector	**23.2%**	**23.1%**	**7.3%**	**7.1%**	**10.6%**	**10.0%**	**5.5%**	**5.1%**	**107**
Manufacturing	17.6%	17.2%	3.7%	3.6%	5.7%	5.4%	2.8%	2.7%	56
Electricity, gas and water	2.2%	2.0%	1.9%	1.7%	3.1%	2.8%	2.0%	1.7%	36
Construction	3.5%	3.9%	1.7%	1.7%	1.8%	1.8%	0.7%	0.7%	14
Tertiary sector	**68.6%**	**65.6%**	**63.1%**	**56.3%**	**57.1%**	**49.8%**	**52.5%**	**45.8%**	**965**
Trade	13.7%	13.4%	12.4%	11.3%	14.6%	12.6%	6.5%	5.7%	119
Transport, storage & comm..	10.5%	10.7%	10.5%	10.0%	11.8%	10.8%	17.1%	15.7%	330

Sectors	South Africa		Northern Cape		Siyanda DM		Tsantsabane LM		
	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal	2005 prices	Nominal %	Nominal R'ml
Finance, insurance, & business	24.0%	22.8%	15.2%	13.6%	10.8%	9.4%	10.8%	9.4%	197
Com. and gov. services	20.5%	18.9%	25.0%	21.5%	20.0%	16.8%	18.1%	15.1%	318
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**2 106**

Source: Urban-Econ's calculations based on Quantec, 2011

As indicated in Table 2-6, South Africa's economy is a service economy, as the biggest share of its GDP-R is created by tertiary sectors, in particular the finance and business services sector and the community and government services sector. The primary sector that includes agriculture and mining contributes the smallest amount to the national economy, although they are strategically important for ensuring food security in the country and provision of electricity.

The structure of the Northern Cape's economy is entirely different to the composition of the national economy with the tertiary sector accounting for over 60% of its GDP-R and the primary sector playing a prominent role in the economy with just under 30% of its GDP-R. The comparison of the structure of the Northern Cape's economy in basic and nominal terms suggests that price effects have a significant impact on the structure of the economy. This is largely due to the fact that it contains a prominent primary sector, in particular the mining industry, as it is the price of commodities produced by the primary industry that can have a notable effect on the structure of any economy.

The structure of the Siyanda DM's economy is different to that of South Africa, but is quite similar to that of the Northern Cape. It is clear that it is more dependent on the primary and secondary sectors than that in the province. Because of it, its tertiary sector is smaller than the tertiary sector in the Northern Cape.

The Tsantsabane LM's economy, which generates almost half of its GDP-R from the tertiary sector, also has a different structure with respect to primary and secondary sectors than that of the country's economy. In constant prices, the primary sector accounts for 42% of the provincial GDP-R, but in nominal prices its share is significantly higher which indicates that such an economy would be highly sensitive to fluctuations of prices on commodities, particularly those that are being mined in the area. Whilst its primary sector is vast, its manufacturing sector is small which also indicates that limited processing of the raw materials that are being mined in the area is taking place in this Municipality. Following the biggest sector in the municipality namely mining is the community services sector, and the transport and finance sector.

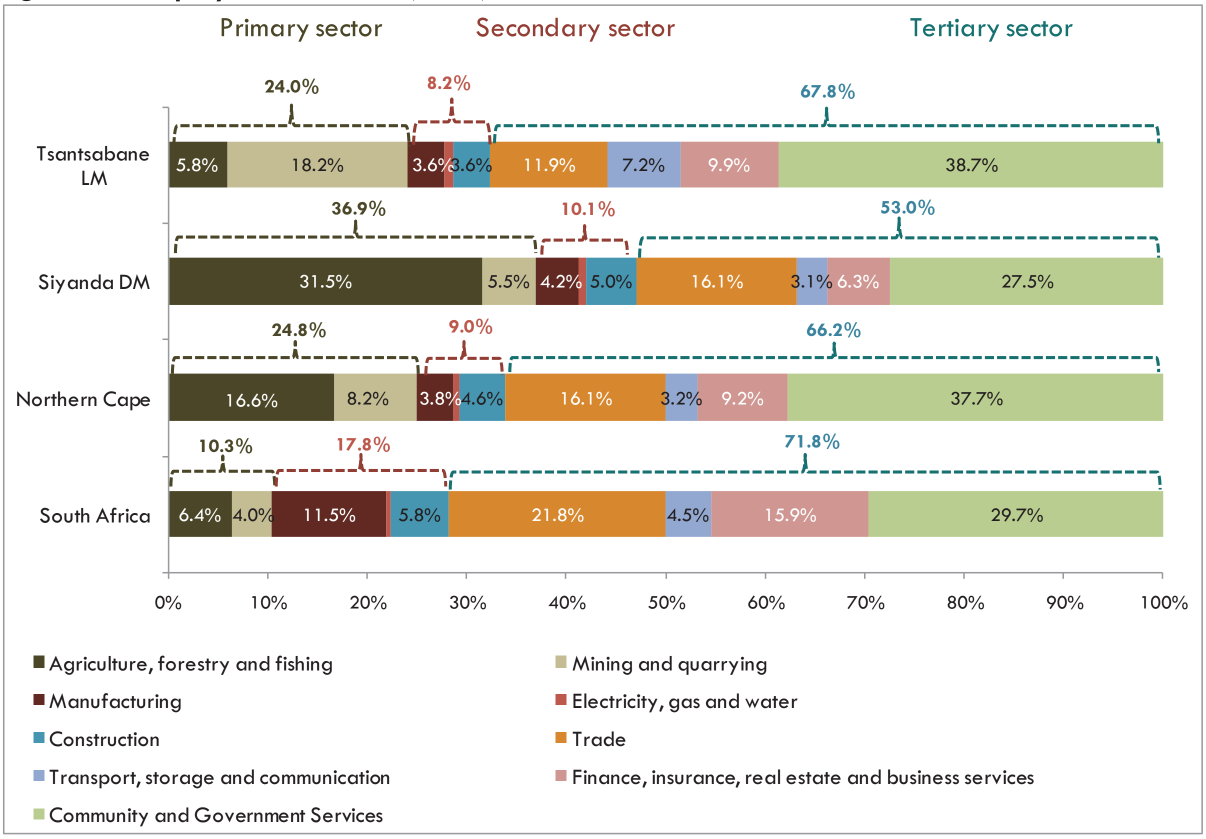
2.7 Employment composition

Figure 2-4 illustrates the structure of South Africa, Northern Cape, the Siyanda DM and the Tsantsabane LM economies from an employment perspective. The employment structure presented largely corresponds with the structure of the economy with the tertiary sector making the largest contribution towards employment creation in all areas under analysis.

- More than two thirds of the people employed in South Africa work in the tertiary sector, in particular the community and government services sector and the trade sector. Agriculture, which accounted for 3% of the national GDP-R in 2011, on the other hand, provided 6.4% of all employment opportunities; whilst the contribution of the mining industry towards the employment in the country was smaller than its contribution towards GDP-R. Nevertheless, both of the sectors are labour-intensive and create a notable number of employment opportunities in the country, particularly in rural areas.

- Employment structure in the Northern Cape is dominated by the number of people who are working in the tertiary sector, specifically in the trade, community and government services. Its secondary sector creates 9.0% of jobs in the Province, whilst its primary sector creates 24.8%.
- Most of the people employed in the Siyanda DM are working in the tertiary sector too, specifically in the community and government services, trade and finance sector. Its secondary sector creates 10.1% of jobs, whilst its primary sector creates 36.9%.
- The employment composition in the Tsantsabane Local Municipality is quite similar to that of the Northern Cape with the sectors providing the largest numbers of jobs being the community and government services, mining and quarrying, trade, and finance sectors. The mining sector, which contributes 53.6% to the GDP-R (in nominal prices), provides only 18.2% of employment opportunities in the area. At the same time, the trade, community and government sector's employment contribution is greater than its contribution towards GDP-R.
- In the Postmasburg area, the main employment driver at present is mining - specifically mining of iron ore, manganese, lime and various semi-precious stones and minerals. The mining houses mostly employ people from Groenwater, Postmasburg, Kuruman, and other surrounding towns for unskilled and semiskilled positions, whereas the contractors and the skilled labour is sourced outside the region. Another main activity in the area is agriculture; mainly livestock farming due to the crop farming that is hindered by the poor soil in the area.

Figure 2-4: Employment structure (2011)



Source: Urban-Econ calculations based on Quantec, 2011

2.8 Basic service delivery and access to tenure

Access to basic service delivery and shelter are the indicators that allow understanding the standard of living of the households residing in the study areas. Comprehension of the extent to which households in the area have access to water, sanitation and electricity assists in understanding of the communities' plight and their needs. At the same time, knowledge of the types of dwellings that households reside in

is valuable in developing a complete profile of the circumstances in which communities are living. All of above creates a baseline against which the potential impacts of the proposed activity could be assessed.

Table 2-7 provides information on the types of dwellings in which households live in the study areas. It indicates that 73% of households in the primary study area were living in formal dwellings and this figure also means that access to formal dwellings in the primary study area was the lowest amongst all study areas analysed. The Tsantsabane LM also had the highest percentage of households living in informal dwellings, such as a shack in a backyard of a formal dwelling or in an informal settlement. This suggests that local communities do require formal housing, for example, the Tsantsabane LM where one out of four households is living in an informal dwelling and that any project that would potentially increase the influx of people into the area could portray up growth of the housing problem, thus housing provision during construction and operation by the project should be received during the EIA phase.

Table 2-7: Dwelling types (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Formal dwelling	80.3%	83.2%	79.0%	73.0%
Informal dwelling	14.0%	10.3%	12.8%	21.5%
Other	5.7%	6.5%	8.1%	3.5%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-8 provides information on the access of households to electricity, using energy for lighting indictor as a proxy. The information presented in this table suggests that the primary study area's households have the least access to electricity compared to the other study areas. Only 78% of households in the Tsantsabane LM use electricity for lighting compared to 84.2% in the Siyanda DM and 85.8% in the Northern Cape. This information correlates with the situation of access to formal dwellings, as a smaller access to formal residence would suggest a smaller access to electricity.

Table 2-8: Energy for lighting (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Electricity	80.8%	85.8%	84.2%	78.3%
Other	19.2%	14.2%	15.8%	21.7%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-9 shows households' access to water. The situation in this case is quite different to that observed with regard to access to electricity and formal dwellings. Almost 75% of households in the primary study area as well as in the Northern Cape have access to water inside their dwellings. This is considerably higher than the 64.3% of households living in South Africa who have access to water inside their dwellings. At the same time, more than 78% of households in the Siyanda DM have access to water from inside their yard. This is not indicative to the rural nature of these regions, where due to the settlement pattern water is quite often provided to the neighbourhood rather than to the dwelling itself. Nevertheless, 4.9% of households in the primary study area and 5.6% of households in the Siyanda DM still have to rely on other sources of water which are not very reliable, such as water vendor, rain water, etc.

Table 2-9: Access to water (2011)

Item	South Africa	Northern Cape	Siyanda LM	Tsantsabane DM
Water inside dwelling or a yard	64.3%	75.0%	78.9%	74.4%
Water from point outside the yard	24.9%	20.0%	15.5%	18.7%
Other water access points	10.9%	5.0%	5.6%	4.9%

Item	South Africa	Northern Cape	Siyanda LM	Tsantsabane DM
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

Table 2-10 provides information on access by households to sanitation. It indicates that 75.9% of households in the primary study area have a toilet, which is significantly higher than the 57.7% reported for South Africa. This is also a higher figure than that reported for the Siyanda DM and is also significantly higher than the percentage calculated for the Northern Cape at 72.2% and 67.6% respectively. This again is not indicative to the rural nature of these regions, where households who have access to toilets largely have access to pit toilets. This access to a chemical or flush toilet emphasises their access to water inside dwellings.

Table 2-10: Access to sanitation (2011)

Item	South Africa	Northern Cape	Siyanda DM	Tsantsabane LM
Chemical or Flush Toilet	57.7%	67.6%	72.2%	75.9%
Pit Toilet	25.8%	13.9%	9.5%	2.7%
Bucket system	2.7%	5.2%	6.1%	7.6%
Other	13.8%	13.3%	12.2%	13.9%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Urban-Econ's calculations based on Quantec, 2011

2.9 Summary

The proposed Humansrus CSP facility is planned to be located in the Tsantsabane Local Municipality about 20 kilometres southeast from Postmasburg in the Northern Cape. The Tsantsabane Local Municipality comprises of 29 150 people and 7 485 households, thus representing 2.6% of the provincial population. Over the last decade, the size of the municipality from a population perspective has been growing at a slightly quicker rate than that observed in the District Municipality and the rest of the Province. Moreover unlike the trend observed in the province and the rest of the country, its population growth has been increasing and not declining.

Households residing in the Tsantsabane Local Municipality have relatively the same level of income as the average household in the Siyanda DM, but it is significantly lower than the average household income in the Northern Cape and even more so in South Africa. A considerably higher percentage of households in the Tsantsabane LM have no income compared to that of the other study areas. This is representative of the fact that the unemployment rate in the Local Municipality is worse than the unemployment rate in the Province and country. All of the above suggests that households residing in the Tsantsabane LM have on average lower access to employment opportunities than households in the rest of South Africa.

Households living in the primary study area have poorer access to formal dwellings and electricity than households living in the rest of the province and the country. The situation with respect to the access to water and sanitation, however, is different. Compared to the percentage of households with access to water and sanitation in South Africa and in the province, a greater share of households in the Tsantsabane LM has access to water and sanitation services in their dwellings or in a yard.

The labour market in the primary study area comprised of 6 851 employed and 4 044 unemployed people in 2009. It had a bigger labour participation rate (58.2%) than in the secondary and tertiary study areas. This could be explained by the fact that a significant number of working age population in the Local Municipality remain active in the labour market, whilst the other areas have a considerable number of people who became discourage job seekers, i.e. people who are not considered to be economically active and are not included in the calculation of the unemployment rate. The fact that a

significant number of people remain to be economically active in the municipality compared to their counterparts in the rest of the province could partially explain the large unemployment rate in Tsantsabane, which stands at about 37.5%. The high unemployment rate, though also shows that the local economy is not able to provide employment opportunities for a significant number of local residents, which means that any investment in the local economy that would create new sustainable jobs would be welcome.

The economy of the Municipality is relatively small (R2 billion of GDP-R) and is highly dependent on the mining sector. Since 1996 its average performance was slightly lower than in other study areas under analysis, particularly the Siyanda DM. The dependency of the local economy on the production of the mining sector makes it extremely sensitive to fluctuations of commodity prices and domestic demand for mineral, which in turn is related to the overall performance of the economy. The global recession in 2009 had exactly such an effect on the economy, when the value added of the mining sector dropped by 19%. The above emphasises the need to diversify the local economy by growing sectors that would be less sensitive to local and global economic changes and that would offer sustainable employment opportunities in other but the mining industry.

From the employment perspective, the sectors that create the majority of jobs in the Municipality are services sectors, such as community and government services, with the mining sector following closely. Given the employment creation targets set by government in its New Growth Path and assuming that it is matched by investment, the economy of the Tsantsabane LM needs to grow at a higher rate in the future than it did in the past few years. In order to achieve these trends, though, a significant investment in the local sectors will need to be made by both private and public sectors. This means that any new development proposed for the area would most likely have a significant positive effect on the structure of the local economy (except if it is mining) and on the ability of the local economy to align itself with the new socio-economic path set up by government.

CHAPTER 3. CURRENT AND PROPOSED ACTIVITIES' ASSUMPTIONS

The purpose of this chapter is to present the key assumptions related to the current and proposed activity. This information is used in the modelling exercise and the assessment of the net socio-economic effect of the project. Much of the project-related information supplied by the investor for the modelling purposes contains proprietary data; therefore it was not included in this report. Where possible, though, interpretation of these data in the context of economic sectors and other modelling aspects was provided.

3.1 Current activities onsite and changes expected from the proposed activity

The following paragraphs describe the current economic activity that takes place on the farm where the proposed CSP plant is to be located. They also provide an indication of the potential changes that are expected to take place on site if the proposed activity were to be implemented. This information is used to determine the net effect of the proposed activity on the affected socio-economic environment.

3.1.1 Description of current activities on site

The proposed facility is to be located on the farm about 30 kilometres from Postmasburg. The farm is approximately 2 340 ha and is split in two parts by the R385. Current activities taking place on the farm include grazing of cattle and horse breeding. The owner indicated that the farm includes about 160 cattle and varying number of Arabian horses that are breed for domestic and export markets. If the facility were to be built, only cattle grazing amongst these two agricultural activities would be affected; therefore further focus is on determining the income derived from grazing only. An informal small-scale mining of jasper also takes place on the farm in direct vicinity of the site. However, due to the informal nature of that activity and its variable scale, no exact data could be sourced.

During the discussion with the farm owner it was determined that the average annual turnover of the farm, considering cattle farming only, is about R0.54 million. With regard to employment, a total of four farm-workers are employed to oversee the livestock and perform daily maintenance tasks on behalf of the owner. The workers are people from the surrounding local areas (e.g. Groenwater, Postmasburg, and Kuruman); however, they reside in farmhouses located on the site and have arranged to do so for the term of their employment. Furthermore, the workers occupy their respective share of the homestead with their families' i.e. a wife and two to three children, on average. About a third of the average annual turnover is allocated towards salaries and wages for the four workers. Another third is spent on operating costs, although they might vary year-on-year. The rest represents owners profit before taxes and other deductions.

3.1.2 Expected changes if the proposed activity is implemented

The site where the proposed facility is planned to be established is located on the southern part of the farm and would take about 500 ha in space. The following table illustrate the turnover and employment changes that are expected to take place as a result of the loss of 500ha to the proposed facility.

Table 3-1: Expected changes to farming activities as a result of the establishment of the CSP plant

Variable	On site activity	Farming
Annual turnover	"No build" option: 2 340ha	R 536 000
	"Build" option: 1 840ha	R 402 000
	Loss/gain	**- R134 000**
Employment (jobs)	"No build" option: 2 340ha	4
	"Build" option: 1 840ha	4
	Loss/gain	**None**

From **Error! Reference source not found.** it is evident that the annual turnover of the site is about R 0.54 million. If the establishment of the proposed plant is successful, 500ha of grasing land will be lost, which equates to about 42 cattle. This in turn would translate into the loss of about R 0.13 million per annum. From consultations with the farm owner it has been established that no loss in employment of farm-workers can be expected as the 25% decrease in livestock does not alter the number of required agricultural labourers. Therefore four farm-workers will continue to work on the site irrespective of the chosen activity onsite and will retain their level of income derived from farm's employment. Operational expenditure is expected to decline but not proportionally to the lost of cattle. About 15% in operating expenses (excluding labour costs) is projected based on the inputs received from the farm owner. All of the above, though, means that the loss in turnover will be absorbed by the owner himself. The profits before tax and other deductions are expected to drop by about 62%.

3.2 Project assumptions

The following sections outline the project assumptions that were used to determine the regional socio-economic and the macro-economic impact of the proposed solar power project. Firstly the construction phase assumptions are brought forth followed by the assumptions applicable to the operational phase. All of the assumptions are provide for a Concentrated Solar Power facility with a net capacity of 100 MW. It is estimated that given the plants expected efficiency factors, about 480 GWh of electricity would be generated by the plant on an annual basis.

3.2.1 Construction phase assumptions

The estimated cost of development of a CSP plant of the suggested size is R5 685 million. Of the total expenditure, approximately one-third (R 1 949 million) will be spent on materials, components, and services which cannot be sourced locally and will be imported. The majority of foreign expenditure will be used to purchase tracking mirrors/heliostats, salt and a receiver for the molten salt circuit, as well as a steam turbine generator. The nature and magnitude of the proposed development necessitates the use of some foreign labour with sufficient expertise and "know-how" in the construction and development of similar projects. The remaining two-thirds of the capital expenditure – R3 737 million - will be spent locally on all other goods and services required for the development of the solar power plant. A summary of the construction phase expenditure assumptions is provided in Table 3-2.

Table 3-2: Construction phase assumptions (2011 figures)

Item	Detail
Capital expenditure (R'ml)	R 5 685
Local expenditure (R'ml)	R 3 737
Imports (R'ml)	R 1 949
Duration of construction (months)	30 months/2.5 years
Expenditure split over duration of construction (%) per annum	40% : 40% : 20%

Source: SolarReserve South Africa, 2011

As illustrated in Table 3-2, approximately 40% of the capital expenditure will be used on acquiring equipment and machinery during the first year of the construction phase; therefore construction will largely be limited to earthworks and other preparatory activities. The second year of the construction phase is most intense with respect to activities on site; during this year, an additional 40% of project expenditure will be spent. The remaining 20% of expenditure will be used during the last six months of the construction period.

About two thirds (65.4%) of the domestic expenditure during construction will be spent on the procurement of manufacturing industry's output. A further 14.4% will be spent in the construction sector through sub-contracting. The rest will be allocated as follows:

- Agriculture – 0%
- Mining – 4.9%
- Manufacturing – 65.4%
- Utilities – 0.4%
- Construction – 14.4%
- Trade – 0.2%
- Transport and communication – 2.2%
- Finance and insurance - 1.7%
- Business services – 6.9%
- Community and personal services – 3.9%.

It is estimated that about 1 202 employment person-years will be created in South Africa during construction (Table 3-3). Of these, 313 person-years will be created in engineering, project management and supervision professions. The rest though will be created for construction workers both skilled and unskilled. Since the local economy is not very diversified, but is facing new mining developments in the past few years, it could be expected that most of the unskilled and some skilled employment positions would be filled with local labour force. The total salary and wage bill for the required domestic labour force will equate to R162.2 million.

Table 3-3: Employment opportunities during construction phase (domestic labour only)

Skills level	Job description	Jobs	Person-years	%
Highly skilled	e.g. Engineers, managers, foreman	125	313	26%
Skilled	e.g. Machine operators, artisans	214	534	44%
Unskilled	e.g. Labourers	142	356	30%
TOTAL		**481**	**1 202**	**100%**

Source: SolarReserve South Africa, 2011

3.1.3 Operational phase assumptions

The operational phase of the proposed project is expected to commence in 2017 provided that the construction of the plant is complete by then. The concentrated solar power plant has an estimated lifespan of 30 years.

Data obtained from Solar Reserve South Africa indicated that the estimated annual average turnover of the facility will be R1 114.7 million in 2011 prices which is based on a renewable energy feed-in-tariff (REFIT) of R 2.31. Of this turnover, approximately 12.8% will be spent locally on operational and maintenance (O&M) expenditure, whilst 2% will be used to remunerate employees. Spending on imported goods and services will account for an equal share to that of salaries and wages. Most of the remaining share, about two-thirds, of the turnover will be used to service the loan and pay monthly instalments towards the loan acquired for building purposes.

During the operational phase, it is expected that 47 people will be employed in operations and maintenance of the plant. The following table outlines the breakdown of employment opportunities at the facility.

Table 3-4: Employment composition during operations

Department	Personnel		Shift(1)
Operations	Plant Operating Personnel	20	Standard 8-hour days, 5 creams of 4 operators per shift
	Plant Chemist	1	
Heliostat Washing	Heliostat Servicemen	8	Standard 8-hour days
Maintenance	Mechanical Technicians	4	4x10 hour shifts or 5x8 hour shifts
	Electrical/I&C Technicians	4	
	Labourers (Semi-Skilled)	4	

Department	Personnel		Shift(1)
Administration	Plant General Manager	1	4x10 hour shifts or 5x8 hour shifts
	Operations Superintendent	1	
	Plant Engineer	1	
	Maintenance Manager	1	
	Maintenance Planner	1	
	Administrative Assistant	1	

Source: SolarReserve South Africa, 2011

CHAPTER 4. STRATEGIC MACROECONOMIC IMPACT ASSESSMENT

The development of the concentrated solar power plant is expected to have numerous social and economic benefits of varying degree. The expected impact can be viewed on two spheres, namely the impact in terms of the current policy environment and the impact on the economies and communities. In this chapter, the strategic impact on a macro-economic level is assessed and can be defined briefly as the impact in the context of selected government policies and international variables. The impact on the economies and communities is analysed in the following chapter.

4.1. Assistance in achieving government objectives

The following sub-sections discuss the relevance of the proposed project to key objectives and strategies set by government. The three main topics in this regard are namely the renewable energy targets; the green economy's potential to create new employment opportunities, and lastly the potential reduction of greenhouse emissions.

4.1.1 Contribution towards achievement of renewable energy targets

The Integrated Resource Plan 2010-2030 promulgated on 6 May 2011 has identified the need of an additional 42 539 MW to support the development in the country over the next 20 years. Given that the required supply of energy is nearly double the current production, it is critical that other forms of energy production apart from coal-based production methods are established and promoted in the country.

One of the key purposes behind the IRP 2010-2030 is to provide a strategy in support of the development of a low carbon energy future by establishing local generating capacity using wind, solar and other renewable energy technologies. The plan indicates that in the next twenty years 9 600 MW should be generated using solar energy, of which 1 200 should be generated using concentrated solar power technology. Of this amount, 200 MW has already been committed through Eskom's build programme, which means that 1 000 MW still needs to be allocated. The roll-out of uncommitted yet CSP plants is planned to start in 2016.

The proposed project will include the establishment of 100 MW of renewable energy with the plant reaching full operational capacity in 2017. This means that the proposed project is in line with the national objectives to diversify the energy resource base, as well as to establish local CSP facilities to meet expected demand in electricity whilst reducing associated carbon emissions. A further benefit of the project is the provision of energy supply in the area that is located relatively far from the power stations in the country, which leads to significant losses in transmission. Establishment of a power generating facility in the Northern Cape would assist in reducing such losses and improving the efficiency of the national grid.

4.1.2 Contribution towards achievement of New Growth Path and IPAP2 targets

The New Growth Path is a strategy established by government to, firstly, tackle the issue of unemployment via the creation of decent employment opportunities by supporting labour-intensive sectors and secondly, to ensure long-term growth through the support of capital-intensive and knowledge-intensive sectors. Key sectors with great potential to stimulate job creation have been prioritised and are expected to create the bulk of the five million jobs targeted over the next decade. The development of the green economy has been identified as one of the key interventions to achieve the job creation target with the potential to create 300 000 employment opportunities by 2020. The proposed solar power project is in line with the aforementioned government goals and can contribute significantly to the achievement of the targets within the green economy.

In order to stimulate and guide the government and the industry towards the achievement of the New Growth Path targets, government continuously updates the Industrial Policy Action Plan. The plan is developed for a three year period at a time and outlines the interventions and millstones that need to be achieved within this period. The latest IPAP (2011/12 - 2013/14) stated that besides the need to increase long-term demand, there is a need to successfully demonstrate the technology and its efficiency in the country. In this context, the successful establishment of the proposed facility and its subsequent operation could contribute to the broader roll out of similar facilities in South Africa and assist in implementing the IRP 2010-2030 targets.

The roll out of CSP facilities in the country would also offer the opportunity to develop a local competitive manufacturing industry. It will assist in curbing high volume imports of necessary components whilst localising potential socio-economic benefits including creation of new employment opportunities and creating wealth. The potential and benefits of developing the new industry in the country are elaborated on later in the chapter.

4.2. Reduced emissions potential savings

Globally, climate change has brought about great change in weather patterns which subsequently impact the livelihoods of millions across the world. Due to the dire effects of change in climate caused by human activity, specifically global warming, nations across the world joined forces and formulated the Kyoto Protocol. The Protocol was adopted on 11 December 1997, but was only enforced on 16 February 2005. The aim of the Protocol is to reduce the emission of four major greenhouse gases (GHG), specifically carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride as far as possible worldwide.

The protocol placed an average reduction of 5.2% on global GHG emissions by 2012, of which only developed nations were requested to partake. Therefore developing countries were not obliged to meet the first period target set; however it is essential that developing countries begin to assume a greater role in the combat against climate change as several of these economies are amongst the highest polluters worldwide. Despite global acknowledgement of the Kyoto Protocol and the 2012 target, it appears that industrialised countries want to replace the deadline whilst emerging economies opt for an extension.

The two main causes of GHG emissions are deforestation and the burning of fossil fuels. The latter is achieved mostly through the operation of vehicles, running of factories, and the production of electricity using conventional methods. Coal has been identified as the leading emitter of carbon dioxide in the world. In 2007, South Africa produced 118 million tons of CO_2, of which 85% was directly from coal. The high emissions volumes qualify the country as the number one emitter on the continent and number 13 in the world.

South Africa is a signatory to the Kyoto Protocol, although due to the fact that it is not a developed country, no emission reduction targets have been imposed on it. Nevertheless, the South African government is committed to reducing carbon emissions in both production and consumption streams. In 2009, during the Copenhagen climate negotiations the country announced that it would volunteer to reduce domestic GHG emissions by 34% by 2020 and by 42% by 2025 below the "business as usual" baseline, subject to the availability of adequate financial, technological and other support. The commitment to reduce emissions is also iterated in the New Growth Path and the latest IPAP. It is also evident in the policy-adjusted scenario adopted for the Integrated Resource Plan 2010-2030 that set an emission constrains of 275 million tons per annum after 2024.

Government has already imposed a R0.02/kWh levy on electricity generation in 2008 and implemented a carbon taxation mechanism on new vehicles in 2010. As a next step, it is currently

reviewing the draft policy that would impose carbon tax on the “polluter pays principle”. Three mechanisms are under consideration at this stage, i.e. a direct tax on greenhouse gases emitted from industrial sources, a fuel tax based on the carbon content of the fuel, and a tax that could be applied to emitters where fuel is burnt. Although no final decision has been made yet, it is estimated though that the carbon tax could vary between R75 and R200 per ton of CO_2 –equivalent. Although such a tax would increase government’s revenue, it would increase prices on certain goods and services too. Therefore, the use of renewable and energy efficient technologies would offer savings benefits.

The proposed facility will be generating about 480 GWh of electricity per annum. Considering an average emission factor for the country of 1.015 kg per kWh, the proposed facility offers savings of 487 200 tons of CO_2 –equivalent per annum. Depending on the mechanism adopted for carbon tax, this could translate into R36 million to R97 million of costs that would not be passed onto consumers.

4.3. Potential to establish a new industries

With reference to the objectives of the New Growth Path and IPAP2 (2011-2014) to support the green economy and renewable energy sources, the establishment of the solar plant is pivotal. These policies aim at promotion of development and expansion of local industries, which not only employ new technologies but also create sustainable job opportunities whilst contributing to long-term economic growth. Through the development of CSP plants in the country lies great potential to develop numerous manufacturing industries, some of which would be expanded whilst others would be relatively new industries to South Africa.

The potential of the local industry to grow is fairly high as the proposed CSP plant is one of a kind in the country; thus the success of the project would likely create positive demand for similar facilities nationwide. From a supply-side perspective, South Africa is one of the most radiated countries in the world; therefore the country is able to support additional projects of this nature.

Once considerable demand for concentrated solar power has been created, it is likely that a CSP plant component manufacturing industry can be established within the country to support the activity. At the same time, certain industries that are already established in the country will grow, whilst others will be newly set up.

- Given the composition of the non-metallical minerals and structural steel industries in the country, manufacturing of some of the required components is already possible in South Africa. These include mirrors, supporting steel structures, the tower, foundation for heliostats, cabling, thermal storage tanks, piping, insulation, fittings and other elements. With the established demand, the greater majority of businesses involved in manufacturing of the materials for the above or components themselves will most likely need to increase their production volumes and expand their facilities, which will translate into new employment opportunities.
- Some of the components though are not currently possible to manufacturing in the country and will need to be imported initially. However, if there is sufficient demand, which could realise if the IRP 2010-2030 is strictly adhered to, there is an opportunity to set these types of industries in South Africa and localise the socio-economic benefits associated with them. Industries that could be established to support the CSP build programme outlined in the IRP 2010-2030 include specialised machinery and equipment, chemicals, and electrical instrumentation.
- The development of supporting industries will require considerable investment in research, testing, and development. This will be essential to ensure continuous improvement of locally produced technologies and increasing the competitiveness of the local businesses internationally. Although the initial funding of such projects appears to be substantial and

relatively expensive for developing countries, the impact on supporting industries and economic development is extensive.

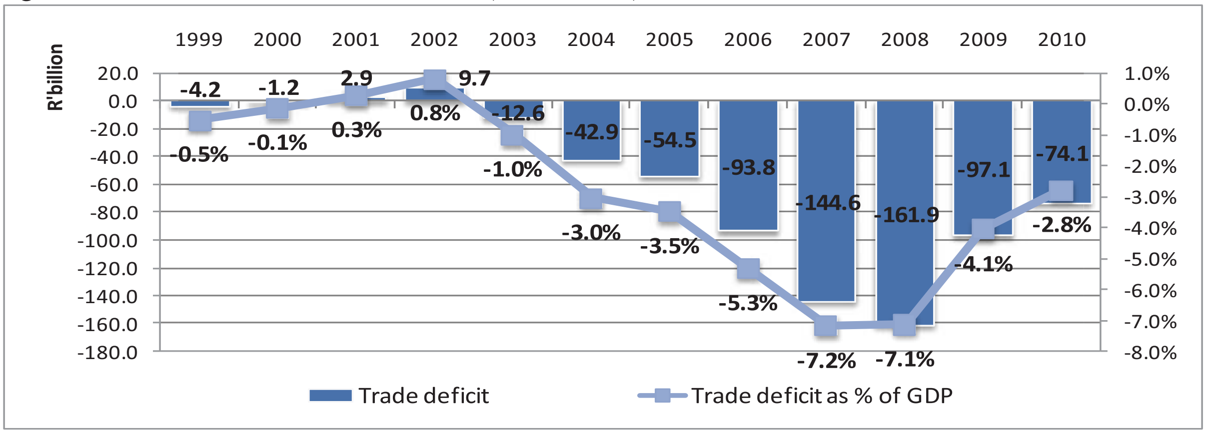
The sustainability of the manufacturing industries would initially be supported by the increasing demand for the components as more CSP plants are established throughout the country. Over the long-term, the manufacturers would sustain their production volumes by providing spare parts and offering maintenance services of specialised equipment, as well as by selling improved/new components and/or technologies to the domestic and international markets.

4.4. Impact on balance of payment

The balance of payments can be described as a summary of all economic transactions between South Africa and all other countries of the world. Two sections make up the balance of payments, namely the current account and the capital account whereby the former refers to trade in the form of export and imports whereas the latter deals refers to Foreign Direct Investment (FDI), Investment Portfolio and other investments which reflect on the national accounts.

The current account, otherwise known as the trade balance, can operate on a deficit or a surplus. A deficit is observed when the value of goods imported into the country exceeds the value of goods exported by the country. A surplus is the opposite of a deficit and it is realised when the value of exported South African goods exceeds the value of all goods imported to the country. South Africa's balance of payments between 1999 and 2010 is illustrated in **Error! Reference source not found.**.

Figure 4-1: South Africa's trade balance (1999-2010)



Source: Quantec with a reference to South Africa Reserve Bank, 2010

From Figure 4-1 it is apparent that the country's trade balance has been at a deficit from 2003 to 2010. The deficit was persistent and enlarging between 2003 and 2007 in which the deficit represented 7.2% of the national Gross Domestic Product (GDP). Thereafter a decline prevailed in the growth and by 2010 the size of the deficit relative to the national GDP was approximately 4.1%. It can be deduced that over the period of decline exports grow sustainably larger than imports into the country.

The current account can be broken down into five items, namely merchandise, services, income receipts/payments, gold and current transfers. A breakdown of each of the main items with regard to export volumes and import volumes is provided in Table 4-1. From the table it can be seen that the income payment transactions are the largest contributor to the deficit followed by a fairly high deficit run on services imported to the country. It can also be seen that only main items is operating at a surplus, namely gold in which domestic exports exceed imports by R 59.5 billion. In total, the national current account deficit was R74.1billion in 2010 which is a substantial decline from 2009.

Table 4-1: Current account breakdown per item (2010, R' billion)

Item	Export		Difference		Import	
Merchandise	R 566.8	74%	-R 31.4	42%	R 598.2	71%
Services	R 102.4	13%	-R 32.5	44%	R 134.8	16%
Income receipts/payments	R 34.1	4%	-R 52.9	71%	R 87.0	10%
Gold	R 59.5	8%	R 59.5	-80%	-	-
Current transfers	-	-	-R 16.8	23%	R 16.8	2%
TOTAL	**R 762.7**	**100%**	**-R 74.1**	**100%**	**R 836.8**	**100%**

Source: Quantec with a reference to South Africa Reserve Bank, 2010

To establish the CSP plant recall that a total investment of R5.7 billion is required of which R1.9 billion will be spent on imported goods and services whilst the remaining R3.7 billion will be spent locally. The required capital will be sourced within South Africa; therefore any expenditure on imported goods can be regarded as a leakage of money from the national economy, which has a negative impact on the trade balance. The impact of the project on the balance of payments will result in an increase in the deficit, i.e. project expenditure on imports will reflect as income payments worth R1.9 billion, which translates to a 2.6% increase in the estimated current account deficit for 2010.

4.5. Synthesis

The proposed project will be amongst the first of this nature and magnitude in South Africa. The project is expected to have a number of benefits to the regional, provincial as well as the national economy. Amongst the most significant macro-economic impacts is the project's contribution towards the establishment of the renewable energy sector that will give stimulus to the development of the green economy, which is a key priority in the growth and employment objectives in the country. In addition, establishing the plant in the country would potentially boost the expansion and development of local manufacturing industries. Furthermore, the project supports the global goal of reducing carbon emissions as stipulated in the Kyoto Protocol. In a more negative regard, the outflow of money used to acquire necessary imported goods and services has a negative impact on the balance of payments; however the benefits of the project tend to outweigh this negative impact, more especially in the long-run if the local manufacturing industry is established and the majority of economic benefits are localised.

CHAPTER 5. LOCAL SOCIO-ECONOMIC IMPACT ASSESSMENT

The purpose of this section in the report is to provide the results of the assessment of the project's potential impact on regional and local economies. Ahead of the presentation of the impact assessment results is a concise introduction to the impact modelling exercise.

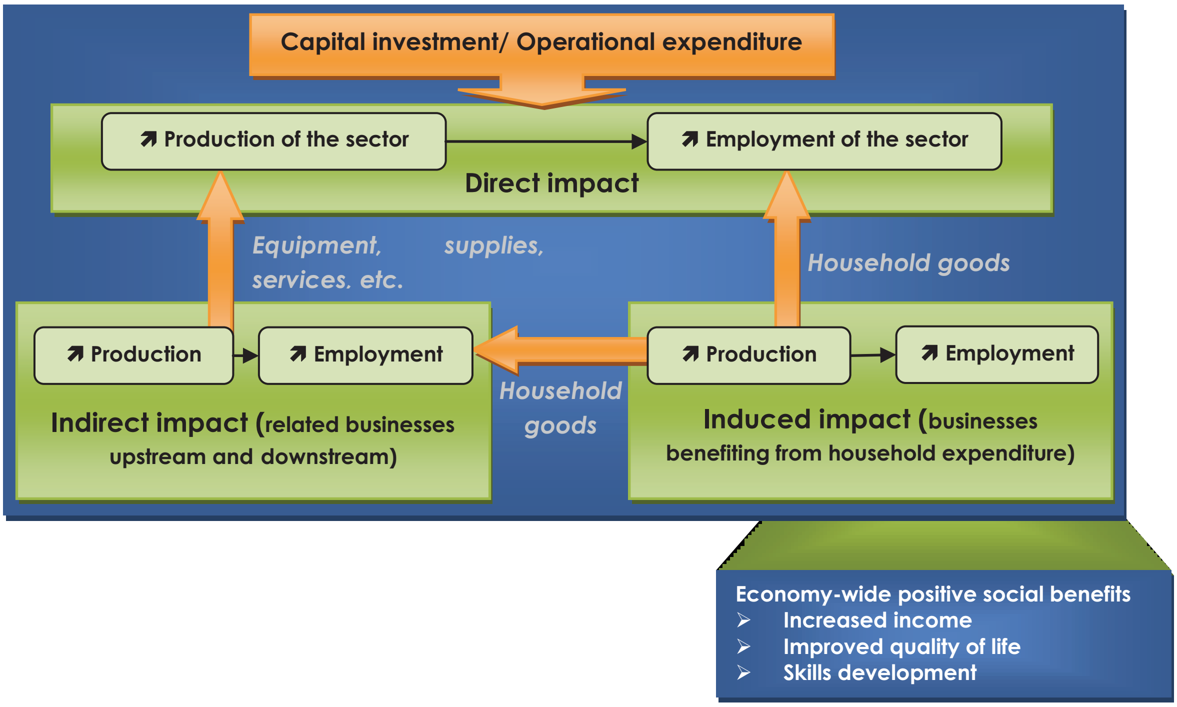
5.1 Background to impact assessment

Socio-Economic Impact Assessment is the study in which the direct benefits and costs of a proposed project affect the local, regional, or national economy and households. Socio-economic impact refers to the effects on the level of economic activity and the welfare of households in a given area because of some form of external intervention in the economy.

- The intervention can be in the form of new investment in infrastructure (as in the case of current assessment), new development, adoption of a new policy or services, expansion of the current operations, etc.
- The types of economic impacts, stimulated by the intervention are generally positive and include creation of additional jobs, generation of business sales and value-added, improved quality of life, increase in disposable income, and growth of government revenue.

Any type of intervention does not only create direct benefits experienced by the investor, but has spill-over effects on the other economic agents (**Table 5-1**).

Figure 5-1: Impact of capital investment/operational expenditure



As illustrated in the figure above, three types of economic impacts are generally assessed:

- The **direct effects** are generated when the new business creates new jobs and purchases goods and services to operate the new facility. Direct impacts results in an increase in job creation, production, business sales, and household income.
- The **indirect effects** occur when the suppliers of goods and services to the new businesses experience larger markets and potential to expand. Indirect impacts result in an increase in job creation, GDP, and household income.

- The **induced effects** represent further shifts in spending on food, clothing, shelter and other consumer goods and services as a consequence of the change in the number of workers and the payroll of directly and indirectly affected businesses, as well as the distribution of business profits through dividends. This leads to further business growth/decline throughout the local economy.

Socio-economic impact can also be viewed in terms of duration, or the stage of the project's lifecycle that is being analysed. Generally two phases are subjected to the economic impact assessment - construction phase and operational phase. The construction phase economic impact is of a temporary nature; therefore it has a temporary effect. On the other hand, the operational phase of the project usually takes place over a long-term; hence, the impact during this stage is of a sustainable nature.

Assessment of socio-economic impact requires knowledge of investment planned to be spent on the construction of the CSP facility and operating costs that would be incurred once the facility is operational. Assumptions with respect to these costs were already provided in Chapter 3. Conversion of these input data into socio-economic impact is done using an economic model.

Two economic models were developed for the project. One was based on the South African Social Accounting Matrix (SAM) updated to 2011 and was used to determine the impacts on the national economy. The other model made use of the Northern Cape Social Accounting Matrix updated to 2011 figures and was used to determine the impact of the project within the provincial boundaries. The SAM is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents in a given economy.

The following assumptions were used with respect to the econometric models developed and the modelling exercise:

- The Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) figures reflect the real situation accurately enough for the purpose of the impact assessment
- The impact assessment assumes that the proposed development concept is financially viable, and both, private and public companies will be involved in its realisation
- Production activities in the economy are grouped in homogeneous sectors
- The mutual interdependence of sectors is expressed in meaningful input factors
- Each sector's inputs are a function of the specific sector's production, comparative advantage, and location
- The production by different sectors is equal to the sum of the production of separate sectors
- No structural changes in the economy are experienced during the analysed period
- The model was closed by households and businesses to determine the induced effects
- When calculating the exogenous inputs, certain assumptions regarding the share of Gross Operating Surplus that would be paid out as dividends to households were made. Capital formation and interest payments were excluded from modelling of induced impacts.

5.2 Impact expected during the construction period

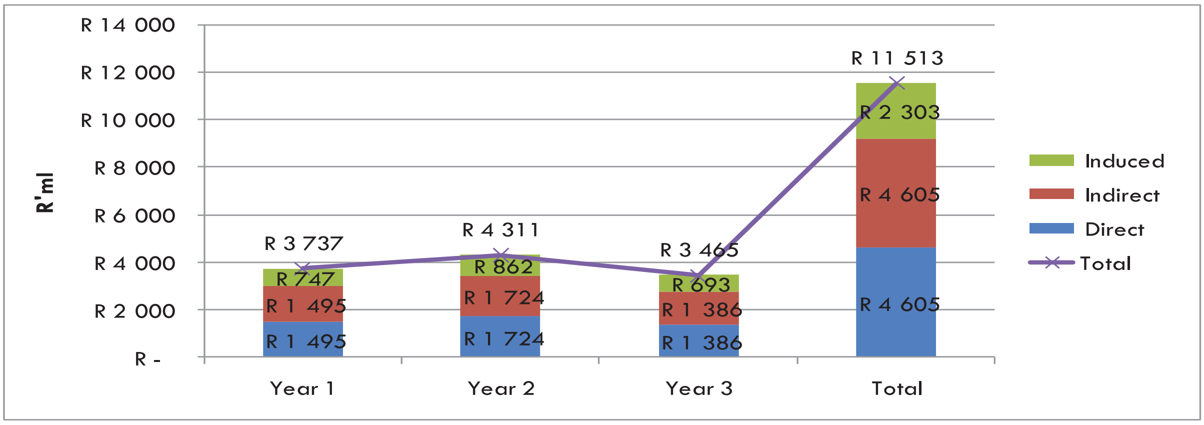
The analysis of the expected impact from the construction phase of the development of the solar plant is presented in the following sections. The analysis covers a number of aspects such as the impact on the volume of production in the Province and the rest of the country, GDP, employment, household income, and government revenue. Most of the materials and services required for the successful establishment of the proposed facility will be sourced outside of the Northern Cape Province, due to the specialised nature of some of the materials required and relatively undiversified provincial manufacturing sector.

Therefore, when impacts during construction are analysed, it is assumed that they will be spill over the entire country depending on where materials and services are procured from.

5.2.1 Impact on production

Overall, the development of the concentrated solar power plant has a positive economic stimulus on the Northern Cape Province as well as on the national economy as a whole. Recall that although some goods and services need to be imported to the country, the greatest share of expenditure (70%) will be spent locally. Approximately R3 737 million - exclusive of expenditure on imports - will be spent locally over the 30-month (two and a half year) construction period. The total impact on business sales in the country over the construction period is presented in **Figure 5-2**.

Figure 5-2: Estimated impact on production during construction (R' ml, 2011 prices)



The total impact of the proposed project on affected economic sectors in the country is estimated at R11 513 million in 2011 prices. Of the total impact, 80% will be created in the first and second year jointly, whilst the remaining 20% will be created in the third year. The business activity over the 30-month period will create a demand for goods and services that are used as inputs for the construction and installation activity; thus resulting in indirect effects of the project. The total indirect impact is estimated at R4 311 million in 2011 prices. Further effects are created through increased household expenditure, which comes as a result of increased household income stimulated through direct and indirect effects of the project. Therefore, the induced impact of the project will be observed through growth in production volumes of businesses in the country to the value of R3 465 million.

The total impact of the proposed project on production per economic sector is tabulated below.

Table 5-1: Sectoral distribution of business sales during construction (R' ml, 2011 prices)

Economic Sector	Direct	Indirect	Induced	Total	% share
Agriculture	R 0.0	R 27.3	R 114.0	R 141.4	1.2%
Mining	R 0.0	R 169.3	R 52.8	R 222.0	1.9%
Manufacturing	R 0.0	R 2 204.6	R 1 063.6	R 3 268.2	28.4%
Utilities	R 0.0	R 49.8	R 117.4	R 167.2	1.5%
Construction	R 3 736.8	R 476.0	R 70.8	R 4 283.6	37.2%
Trade and accommodation	R 0.0	R 409.0	R 463.3	R 872.3	7.6%
Transport	R 0.0	R 255.5	R 445.6	R 701.1	6.1%
Financing	R 0.0	R 212.7	R 465.7	R 678.4	5.9%
Business services	R 0.0	R 437.5	R 336.2	R 773.7	6.7%
Community services	R 0.0	R 69.4	R 335.4	R 404.8	3.5%
Total	**R 3 736.8**	**R 4 311.1**	**R 3 464.9**	**R 11 512.7**	**100.%**

From **Table 5-1** it is evident that the construction sector will benefit the most during the construction phase of the project considering all types of impacts that would be created by the project with respect to production. In addition to the construction sector (37.2%), the manufacturing sector (28.4%) is expected to experience the largest increase in terms of production volumes over the construction period. With regard to this sector, the largest increase in production volumes will be realised amongst businesses operating in the manufacturing of non-metallic mineral products, structural and basic metals, as well as in the manufacturing of transport equipment. Note that the manufacturing sector is the leading sector with regard to indirect effects. As for induced impacts, it appears that the tertiary sector as a whole encapsulates the sectors with the greatest benefit from the project, whereby the largest increase in production volume is observed in the finance services sector followed by the business services sector. More specifically, the finance and insurance, transport services, real estate, and business activities sectors are expected to contribute the most to the boost in output levels of the tertiary sector.

5.2.2 Impact on GDP

A positive relation between production volumes and gross domestic product (GDP) volumes exists such that the increased production levels in affected sectors will temporarily increase their value added and result in the overall growth of the national GDP, albeit for only during of the construction phase. The estimated total impact of the project on the national GDP and specifics economic sectors can be seen in **Table 5-2**.

Table 5-2: Estimated GDP to be generated during construction (R'ml, 2011 prices)

Economic Sector	Direct	Indirect	Induced	Total	% share
Agriculture	R 0.0	R 14.1	R 58.5	R 72.6	1.8%
Mining	R 0.0	R 91.9	R 28.4	R 120.3	3.0%
Manufacturing	R 0.0	R 575.6	R 268.2	R 843.8	21.1%
Utilities	R 0.0	R 26.3	R 57.5	R 83.9	2.1%
Construction	R 896.1	R 143.4	R 17.4	R 1 057.0	26.4%
Trade and accommodation	R 0.0	R 214.1	R 228.0	R 442.1	11.0%
Transport	R 0.0	R 107.1	R 232.3	R 339.3	8.5%
Financing	R 0.0	R 130.9	R 286.6	R 417.4	10.4%
Business services	R 0.0	R 227.8	R 183.6	R 411.4	10.3%
Community services	R 0.0	R 42.5	R 170.9	R 213.4	5.3%
Total	**R 896.1**	**R 1 573.6**	**R 1 531.5**	**R 4 001.3**	**100.00%**

The above table shows that the estimated impact of the proposed project over the 30-month long construction phase is R4 001 million in 2011prices. The direct impact of the project amounts to R896.1 million, which represents about a fifth of the total impact; thus the remaining amount can be attributed to indirect and induced impacts accordingly.

Overall, the construction sector is expected to have the largest increase in GDP during the developmental phase of the concentrated solar power plant. In total, though, the sector is expected to increase by R1 057.0 million, which represents 26.4% of the total impact on GDP. The manufacturing services sector (21.1%) is the second largest benefactor of the capital expenditure on the project. Trade, finance and insurance, as well as business services industries will experience the third largest impact on their GDP, which will amount to more than R400 million in 2011 prices each.

5.2.3 Creation of new employment opportunities

The establishment of the power plant will directly create 1 202 employment man-years during the construction period. This means that if the plant were to be built within a period of one year, 1 202

people would have been employed to do so. Since construction is expected to last for two and a half years, though, the average annual number of jobs created by construction will be 480. Of these, 50 positions will be occupied by engineers and consultants, 75 positions will be taken up by supervisors and foremen, and the rest will be construction workers. This means that on average, 356 people will be working on site throughout the entire construction period. At least a third of these jobs will become available for the local communities, which means that local employment situation in the municipality will improve, albeit temporarily.

As mentioned earlier, 70% of materials and services required for construction will be procured within the country. As a result, an additional 9 659 employment person-years, or 3 864 jobs for two and a half years, will be created through indirect effects (**Table 5-3**). The income generated by households and companies will stimulate another set of impacts and create another 7 328 employment man-years or 2 931 employment opportunities for the duration of the project.

Table 5-3: Estimated employment opportunities to be created during construction (person-years)

Year	Direct	Indirect	Induced	Total
Total: Person-years	1 202	9 659	7 328	18 189
Total: Jobs	480	3 864	2 931	7 275

The distribution of employment impacts amongst various sectors in the economy is outlined in **Table 5-4** below. It is clear that besides the construction sector, a significant number of employment opportunities will be created in the manufacturing sector, followed by trade. The creation of new jobs in the construction and manufacturing industries will have a positive contribution towards achievement of government's objective to create 300 000 employment opportunities in the green economic in the country as set in the New Growth Path.

Table 5-4: Sectoral distribution of employment opportunities created during construction

Economic Sector	Direct	Indirect	Induced	Total	% share
Agriculture	-	290	1 211	1 501	8.3%
Mining	-	510	161	671	3.7%
Manufacturing	-	3 925	1 468	5 393	29.6%
Utilities	-	63	148	210	1.2%
Construction	1 202	2 101	315	3 618	19.9%
Trade and accommodation	-	1 149	1 281	2 430	13.4%
Transport	-	326	568	894	4.9%
Financing	-	371	812	1 183	6.5%
Business services	-	763	586	1 349	7.4%
Services	-	161	777	937	5.2%
Total	**1 202**	**9 659**	**7 328**	**18 189**	**100.00%**

5.2.4 Skills development

The establishment of the CSP plant will offer numerous opportunities for skills transfer and development. This is relevant for both on-site activities and manufacturing activities. CSP projects have not yet been established in the country and depending on the roll out of the Eskom build programme, specialised skills required in the construction of CSP facilities in the country will most likely be imported. Attraction of foreign experts on this particular project and the roll out of similar projects in the future could result in the development of the local expertise and knowledge on both the construction and manufacturing sector. Furthermore, opportunities to develop skills on the R&D level will also be created, particularly if the projects of that kind become an order of the day in the country.

5.2.5 Increase in government revenue

The estimated impact of the proposed development on government revenue is R173 million in 2011 prices. The revenue will be collected through various taxes imposed on the activity and can be used to improve infrastructure in the area such as roads or housing. Furthermore the revenue can assist government in improving service delivery in the Province.

5.2.6 Improved quality of life through the increase in household income

The establishment of the plant results in an increase of employment opportunities; therefore increasing the income received in all affected households. It is estimated that 480 households will benefit directly from the project throughout the construction phase. The total remuneration of the staff over the 30-month development period is estimated at R162.2 million in 2011 prices, which represents 4.3% of the domestic capital expenditure. Through the increased income, the quality of life for the affected households is significantly improved, more especially for households which currently have no source of income. However, this impact is not sustainable as the construction phase is temporary in nature. The overall impact on workers' income over the construction of the plant is indicated in **Table 5-5**. It shows that in addition to direct income benefits during construction, R1 399 million in 2011 prices will be paid out to various employees throughout the country.

Table 5-5: Estimated change in household income during construction (R'ml, 2011prices)

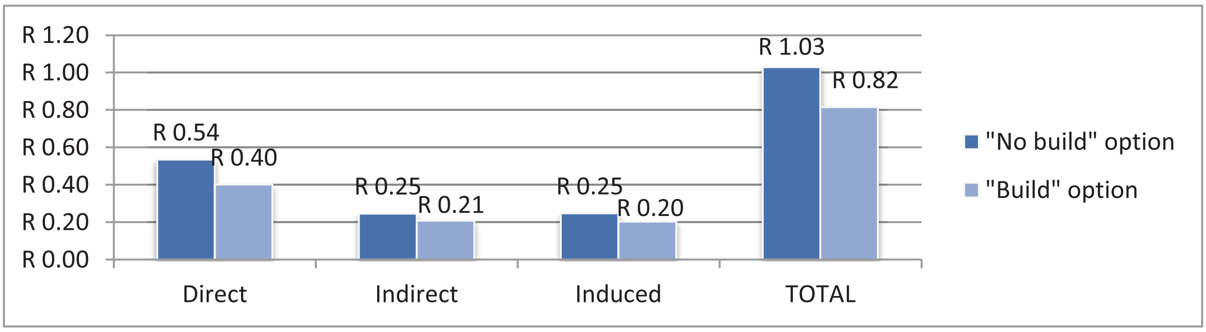
Year	Direct	Indirect	Induced	Total
Total	162.22	718.60	680.41	1 561.23

5.2.7 Impacts associated with the loss of agricultural activity

The establishment of the concentrated solar power plant will result in the reduced output of the farm. It is estimated that 500 hectares of agricultural land that is currently being used for cattle grazing and that will be permanently lost to the CSP plant, will result in the reduced production output of the farm associated with cattle farming and as a result lower value added generated by it. No impact on employment and farm workers income is expected to transpire.

Figure 5-3 shows the direct, indirect, and induced as well as the total impact of the livestock farming activity on the Provincial economy. From the figure it can be seen that there will be a net loss in the total impact of farming from R1.03 million toR 0.82 million. This loss can be explained by the decrease in livestock, which would result in less income however the majority of the expenses related to the cattle farming would not decrease. A total loss of approximately R200 000 which can be interpreted as a 26.3% decrease in farming income is expected if the plant is built.

Figure 5-3: Estimated impact of current farming activity (R' ml, 2011 prices)



The gross value added (GVA) generated from livestock farming is approximately R 0.57 million in total, of which R 0.14 million would be lost if the plant were to be established. With regard to employment, at present the total impact of the farming operations results in five employment opportunities of which four are direct and one is induced in the economy. If the CSP plant is established on site it appears that the total effect of farming on the provincial economy will remain unchanged.

5.2.8 Pressures associated with the increase in demand for housing and better service delivery

The local economy is not sufficiently diversified to supply the entire work force for the construction of the facility. Therefore, it is expected that a significant portion of the construction workers will be coming from outside the area. The influx of workers to the Postmasburg area is will increase the demand for local housing and accommodation facilities in the area. At present there are few accommodation facilities onsite and very few suitable accommodation facilities are available in the areas. The few facilities onsite are the farmhouses in which the farm-workers currently reside. Therefore temporary housing onsite will have to be arranged or else the employees will have to stay in nearby towns. If the latter option were the preferred alternative, daily transport to and from the site would need to be provided as transportation services in the area are not regular.

The developer has expressed interest to establish a temporary camp to house the majority of the 480 workers during construction. Alternative housing options in Postmasburg can be considered as several housing developments are underway at present. The new developments are mainly a result of the mining activity as not enough suitable accommodation is present in the surrounding areas. It is estimated that over 1 000 new houses will be erected in Postmasburg over the next couple of years due to the increased economic activity in nearby towns and farms. Some of the housing developments are already underway and others have reached completion. The houses are mainly urban houses targeting middle to high income earners in the area. The low-income earners, such as the miners and construction workers, have not been adequately accommodated for, which has resulted in informal lease agreements being signed between local homeowners and mine workers, as well as the transformation of houses to hostels/boarding houses.

If the man camp is established then the local economy stands to benefit even further provided some of the necessary equipment and input material is sourced locally. The provision of basic services accompanies any housing developments and should therefore be taken into consideration when the man camp is set up.

5.3 Impact expected during the operational phase

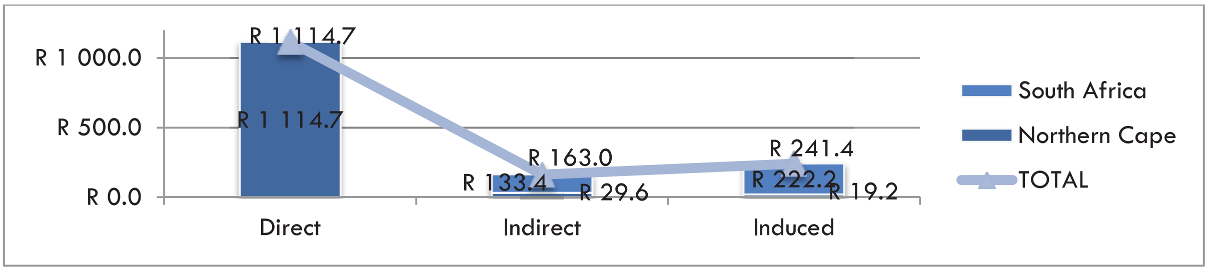
The expected impact of the proposed development throughout the operational phase is presented in the following sub-sections. An estimated project lifespan of 30 years for the facility is expected; therefore the impacts described in this section are of a long-term nature. All estimates, however, are provided for one operational year in 2011 prices and are assumed to be sustained throughout the lifespan of the facility (where applicable).

5.3.1 Stimulation of economic development

Based on a REFIT rate of R 2.31 per kWh, the project is expected to generate a gross output of R1 114.7 million per annum in 2011 prices. Since the facility is to be located in the Northern Cape, it is assumed that all direct impacts derived from its operations will be accounted in the same province and the same local municipality. **Figure 5-4** shows the estimates of the direct, as well s indirect and induced impacts of the project on new business sales in the country and in the Province.

The indirect effects of the project on production are estimated at R 163.0 million of which one-fifth is to be generated within the Provincial economy whilst the remaining amount will be scattered throughout the country. Due to increased business sales in affected sectors and the associated growth in employment, it can be expected that higher expenditure on various goods and services would follow. These induced effects are to the value of R 241.4 million which will be largely realised in other Provinces in the country, as only 8% of the total will be absorbed by the Northern Cape. In total, the estimated impact of the project on the national production is estimated at R 1 379.1 million per annum.

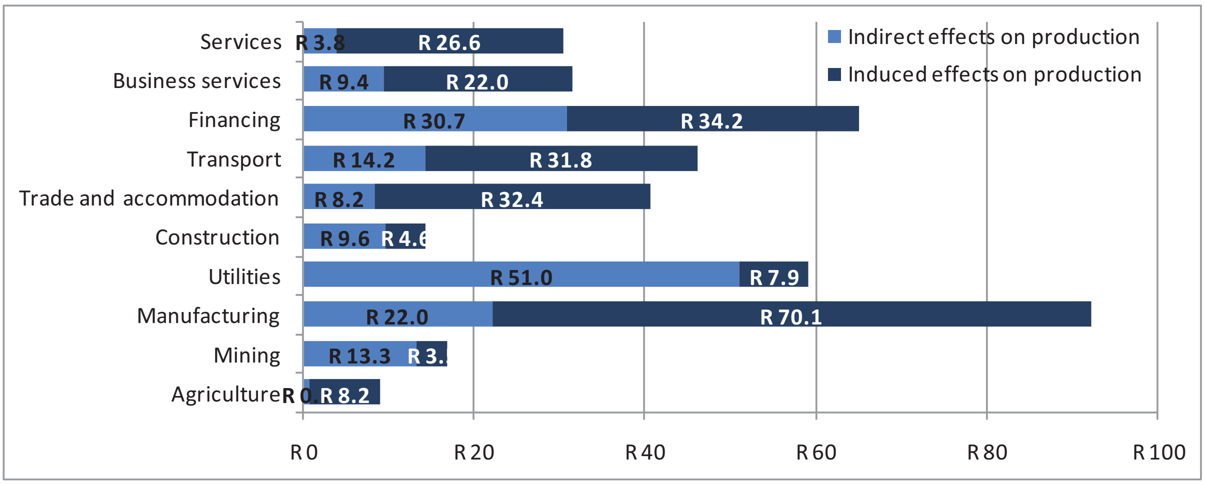
Figure 5-4: Estimated annual impact on business sales (R'ml, 2011 prices)



From **Figure 5-4** it can be seen that the largest impact on business sales in the country (as a whole) is generated through direct impacts of the project - approximately 80% of the total production impact. The direct impact may appear extremely large in comparison to the indirect and induced effects; however it should be noted that a substantial share of the estimated turnover will be used to service the loan acquired from financial institutions and repayment thereof. Given that the total capital expenditure required to establish the plant is high, (R5.7 billion) loan repayments would be significant, which means that a minimal share will be allocated to profits. As a result the local operating expenditure is small compared to the expected turnover; consequently the indirect and induced impact of the project is far less than the direct impact.

With regard to the sectoral breakdown of the production impact, it appears that apart from the utilities sector itself that will benefit from direct impacts, the manufacturing sector followed by the finance services sector benefit the most from the proposed development through the combined indirect and induced effects. Considering the impact separately, though, the utilities will be the greatest beneficiary of indirect effects due to the purchase from this sector of gas. It will be followed by the financing and insurance sector (**Figure 5-5**). With respect to induced effects, manufacturing will be the largest beneficiary of the increased household spending due to the project, which will be followed by finance, trade and transport sectors.

Figure 5-5: Sectoral breakdown of the impact on production during operations



5.3.2 Growth of the Gross Domestic Product

The gross value added in affected sectors of the economy is expected to increase as a result of the increased business sales (discussed in the previous section). During the operations phase, the CSP plant will generate a total direct gross value added of approximately R 733.1 million in 2011 prices per annum. The sole benefactor of the direct impact is the utilities sector. The direct, indirect, and induced effects of the project can be viewed in **Table 5-6**.

Table 5-6: Estimated annual impact on GDP during (R'ml, 2011 prices)

Economic sector	Direct	Indirect	Induced	Total	% share
Agriculture	R -	R 0.3	R 4.2	R 4.5	0.5%
Mining	R -	R 6.5	R 1.9	R 8.3	0.9%
Manufacturing	R -	R 5.4	R 17.6	R 23.0	2.5%
Utilities	R 733.1	R 27.5	R 3.9	R 764.4	83.4%
Construction	R -	R 2.4	R 1.1	R 3.5	0.4%
Trade and accommodation	R -	R 4.1	R 15.8	R 19.9	2.2%
Transport	R -	R 5.5	R 15.9	R 21.4	2.3%
Financing	R -	R 18.8	R 20.8	R 39.6	4.3%
Business services	R -	R 4.9	R 12.0	R 16.9	1.8%
Services	R -	R 1.9	R 13.5	R 15.4	1.7%
TOTAL	**R 733.1**	**R 77.4**	**R 106.6**	**R 917.0**	**100.0%**

Similar to the impact of the project on production, it can be seen from **Table 5-6** that the direct impact of the project on the national GVA exceeds the indirect and induced impact, whereby the majority of the project's total impact on GVA will be created within the utilities sector. With regard to the indirect effects, the proposed project will produce R 77.4 million in GVA, of which slightly over 80% will be generated on a national level and 20% of the increase in GVA will be realised on a provincial level. The induced effect of the project is slightly larger than the indirect effects and is valued at R 106.6 million per annum. In abstract, the proposed project is expected to have a total impact on GVA to the value of R 917.0 million per annum, of which the majority will be realised on the Provincial economy assuming that the direct impact will be accounted in the same economy where it is generated.

The great difference in the effects (refer to **Table 5-6**) can be described in a similar manner to that of the impact on production, i.e. a significantly large portions of the project expenditure is spent on repayment of instalments, financing costs, and payment of dividends to the foreign shareholders; thus there is limited amount of profit that will be generated by the project and that could be distributed in terms of dividends to South Africa's shareholders. Subsequently the actual share of turnover that is allocated to intermediate goods with the potential to stimulate indirect and induced effects is comparatively small; hence minor degrees of the indirect and induced impacts are observed in **Table 5-6**.

As previously discussed, during the operations the project will contribute to the generation of R917 million of value added in 2011 prices on an annual basis. Assuming that the direct impact will be accounted by national accounts in the municipality and the province where that income is earned, i.e. in the Tsantsabane LM and Northern Cape Province, both of these economies will experience a notable growth. Given that the Tsantsabane economy is valued at about R2 106 million in 2011 in 2011 prices, the project will increase the local municipality's economy by about 35% and will significantly alter its structure. Its dependency on the mining sectors, which contributes slightly less than half to its GDP, will be reduced and the economy will become more diversified. Furthermore, given the size of the project, the composition of the Northern Cape economy will also be changed with the electricity sector increasing by three quarters and the entire provincial economy increasing by 1.3% compared to its current size.

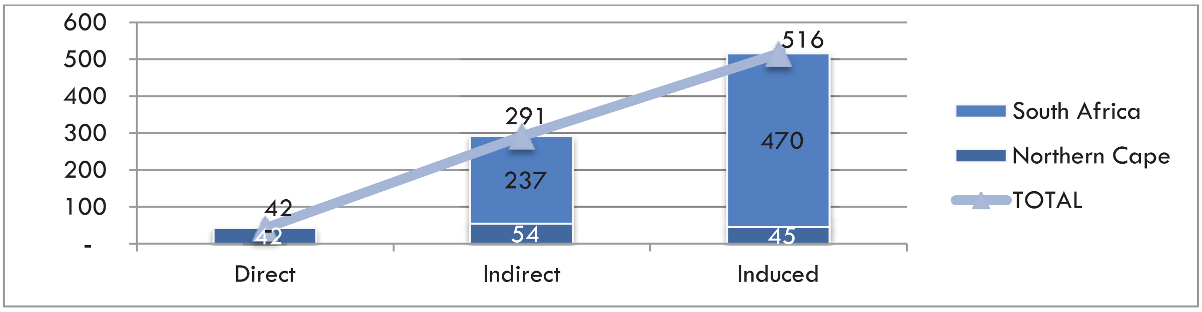
The operational expenditure is likely to grow over time since equipment wears and it will be necessary to replace it to ensure productive business operations. Depending on the frequency of replacement and maintenance as well as the origin of the parts (e.g. produced locally or imported), the increased spending on parts will only benefit the economy, if the parts are those that are currently manufactured locally. On the other hand if the parts that need to be replaced need to be sourced abroad and continue to be imported over the lifespan of the project no positive effects of maintenance will arise. The situation, however, could change if the establishment of the proposed CSP project and other similar solar energy generating facilities transpire, which will create the demand and therefore the opportunities for establishment a local component manufacturing industry to support activity within the industry. If this is achieved then the leakage of money will be prevented and the proposed project will have an even greater positive impact on economic development in the country than presented in **Table 5-6**.

5.3.3 Creation of employment opportunities

During the operational period, the proposed concentrated solar power project will create and support 47 jobs over a 30 year period. However, five of the employment opportunities will be occupied by foreign experts for the first few years of operations. To ensure that the labour force is completely local over time, it is crucial that skills development programmes are implemented such that skills are transferred from the foreign experts to suitable South African nationals. Overall, 42 employment opportunities will be created for the national labour force, some of which could be occupied by residents of the Tsantsabane LM.

A graphical representation of the total impact of the proposed project on employment is provided in Figure 5-6. It can be seen that unlike the impact on production and GVA, the indirect and induced effects of the project on employment exceed the number of direct jobs created. In addition to direct employment opportunities that will be supported by the project throughout its operations life, an additional 807 jobs will be created in the economy of which 291 will be created indirectly and 516 jobs will be induced in the economy. Of the additional jobs created, about 99 will be created within the Province and the rest will be created in other parts of South Africa.

Figure 5-6: Estimated annual impact on employment



Of the additional employment opportunities to be generated the indirect job creation represents a third. The sectors that will experience the highest increase in the number of employment positions available are namely, the non-metallic mineral products industry, structural metal products industry, utilities, transportation, insurance, and trade. The sectors with the greatest support through factor spending (i.e. induced impacts) mostly form part of the tertiary sector and are namely trade, accommodation, transport, financial services, real estate, and community services. With the inclusion of jobs created in the agricultural sector and the aforementioned sectors, the induced impact of employment is about two-thirds of the additional jobs to be created and supported by the project throughout its lifespan.

Additional employment opportunities are likely to arise for local people given the potential of the plant to become a key tourist destination. However it is not possible to quantify the impact at this stage as the extent of the impact on tourism will be determined through a separate study. The study has specific focus on tourism related to the CSP plant and is currently underway.

5.3.4 Impact on skills development

Establishing and operating the plant will result in improved skills amongst the staff as the facility will include a training centre and a certain percentage of its operating expenditure will be allocated to training and development. On the job training is a key element of the staff development as a lot of the required skills during the operational phase will be taught to staff through daily operations. It is also expected that the training programme implemented at the plant will reduce the necessity to acquire foreign expertise in the future. Thus, potentially all employment positions created by the facility will be allocated to South Africa's residents.

5.3.5 Increase in government revenue

The establishment of the CSP project will have a positive impact on government revenue to the tune of R 142.5 million in 2011 prices per annum. The revenue would be collected through rates and taxes and can be used to secure better infrastructure in the region, as well as to provide basic services to people residing in the Local Municipality and the rest of the Province.

5.3.6 Improved quality of life through the increase in household income

As the project has a positive impact on employment that is sustainable throughout its lifespan, it follows that all affected households will experience an improvement in their livelihoods. New employment opportunities translate into an increase of disposable income, which subsequently allows households to improve their present standard of living. The direct impact on household income is to the value of 13.3 million per annum. Since the local staff of the plant comprises of 42 people, it follows that 42 households will directly benefit from the increased income. Furthermore, the average household size in the Northern Cape is 4.0 persons per household therefore between 42 and 168 people (on average) will directly benefit. Through indirect and induced impacts, the proposed project will increase household income to the value of R 33.0 million and R 47.7 million, respectively. Therefore, the total impact of the CSP project on household income in the country is estimated at R 94.0 million. The split of the impact on household income between the Province and the rest of South Africa is shown in Table 5-7.

Table 5-7: Estimated annual impact on household income (R'ml, 2011 prices)

Area	Direct	Indirect	Induced	Total	% share
Northern Cape	R13.3	R 5.2	R 4.0	R 22.5	24.0%
South Africa	R -	R 27.8	R 43.7	R 71.5	76.0%
Total	**R13.3**	**R 33.0**	**R 47.7**	**R 94.0**	**100.0%**

5.4 Synthesis

Renewable energy technologies are not only efficient in terms of reducing hazardous emissions to combat climate change but such technologies are commonly used as a strategy to stimulate job creation and long-term economic development. The CSP plant will have a significant impact on the regional and local economies during the construction and operational phases. The impact during construction is considerable, yet it is not sustainable in the long-term as the construction will last for a 30-month period. The operational phase will last over 30-years and therefore it is regarded as a sustainable contribution to the domestic economy.

For the duration of the construction phase, the project is expected to generate a total estimated impact on business sales to the value of R11 513 million in 2011 prices. This can be translated into a total of R4 001 million of gross value added and 18 189 employment person-years, which is the equivalent of 7 275 temporary employment opportunities (on average). Furthermore, the total impact of the project on household income is estimated at R1 561 million, which can be viewed as a means for all affected households to improve their quality of life.

During the operational phase of the proposed development, an estimated annual turnover of R1 114.7 million in 2011 prices is expected given full operational capacity. The turnover subsequently generates a total impact of R 1 379.1 million in terms of business sales; whilst the estimated total impact on gross value added is to the tune of R 917.0 million. With regard to employment during the operational phase, approximately 47 people will be employed on site of which five will be foreign people with high skills and expertise. The total impact of the project on employment is estimated at 849 jobs and the associated total household income impact is valued at R 94.0 million.

The estimations presented make particular reference to the first couple of years of full operational capacity whereby all equipment is in best condition. Over the years, it can be expected that the operational expenditure of the plant will increase as the need to replace equipment and machinery will rise. If the parts that are currently manufactured abroad continue to be imported as opposed to establishing a local manufacturing industry to produce these parts then the project will continue to have some negative impact on the trade account. However if the industry is developed then these parts can be manufactured locally and sold to established solar power facilities locally and abroad which will extend the positive benefits of the project considerably.

In summary and of great importance, the concentrated solar power project is expected to increase the size of the Tsantsabane LM economy. Although the economy of the region will realise a positive effect, the utilities sector followed the manufacturing capacity within the Province will grow substantially. The projects also possess the potential to grow the tourism industry in the region and through fiscal revenue the government can address the issue of service delivery and extend access to basic services for residents.

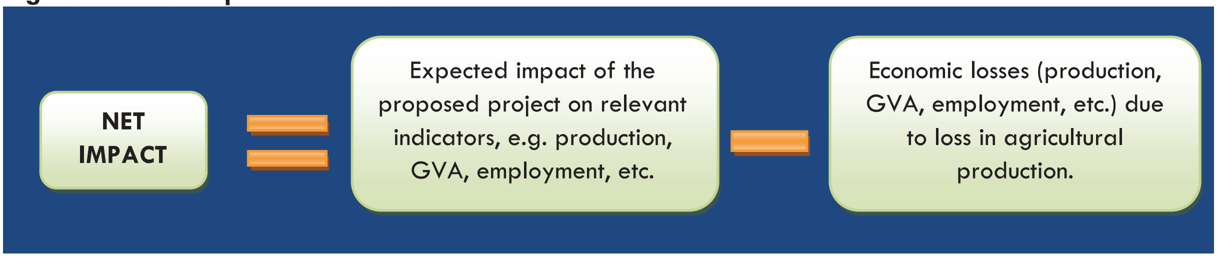
CHAPTER 6. SOCIO-ECONOMIC IMPACT EVALUATION

The purpose of this chapter is to evaluate the socio-economic impact of the proposed CSP project on the regional and local economies. Firstly the net effect of the impact is calculated which is then followed by the evaluation as per the terms of reference and prescribed evaluation method. Ahead of the evaluation is a brief explanation on how to derive the net impact, then the impact during the construction phase and the operation phase are presented in the following sections.

6.1 Evaluation methodology

The net impact takes into account the impact of the "no go" option as well as the impact of the proposed project on indicators of economic and social relevance on a regional and national level. Figure 6-1 illustrates the approach taken to determine net impact.

Figure 6-1: Net impact calculation



For the purpose of this study the following socio-economic indicators will be evaluated accordingly:

- Production/ business sales
- Gross Domestic Product per Region (GDP-R)
- Employment
- Government revenue
- Household income
- Housing provision and basic services.

The impact on each of the above listed indicators will be evaluated for the period of the construction phase and the operational phase. The criteria for the eveluation is outlined in the following table.

Table 6-1: Evaluation criteria and ratings

Criteria	Options	Description	Rating
Status	Positive	Benefit to the receiving economy	+
	Neutral	No cost or benefit to the receiving economy	N
	Negative	Cost to the receiving economy	-
Spatial scale	None	No impact	0
	Low	Site specific	1
	Medium	Local: Extends beyond the site boundary (up to 5km from Project Site boundary)	2
	High	Regional: Extends far beyond the site boundary (5km and more from Project Site)	3
	Very High	National and/or international	4
Temporal scale	None	No impact	0
	Low	Short term: 0 -5 years	1
	Medium	Medium term: 5 – 15 years	2
	High	Long term: 16 – 30 years	3
	Very High	Permanent: over 30 years	4
Probability	None	No impact	0

<table>
<tr><th>Criteria</th><th colspan="2">Options</th><th>Description</th><th>Rating</th></tr>
<tr><td rowspan="4"></td><td colspan="2">Improbable</td><td>Negligible, Chance of occurrence: < 10%</td><td>1</td></tr>
<tr><td colspan="2">Probable</td><td>Likely, Chance of occurrence: 10% - 49.9%</td><td>2</td></tr>
<tr><td colspan="2">Highly Probable</td><td>Expected, Chance of occurrence: 50% - 90%</td><td>3</td></tr>
<tr><td colspan="2">Definite</td><td>Will happen regardless, Chance of occurrence: >90%</td><td>4</td></tr>
<tr><td rowspan="5">Severity</td><td colspan="2">None</td><td>No impact</td><td>0</td></tr>
<tr><td colspan="2">Minor/Negligible</td><td>Marginally affected</td><td>1</td></tr>
<tr><td colspan="2">Average</td><td>Short or medium term impacts on the affected parties</td><td>2</td></tr>
<tr><td colspan="2">Severe</td><td>Medium to long term impacts on the affected parties</td><td>3</td></tr>
<tr><td colspan="2">Very Severe</td><td>Irreversible and permanent change to affected parties</td><td>4</td></tr>
<tr><td rowspan="4">Significance (Spatial + Temporal + Probability + Severity)</td><td rowspan="3">Positive</td><td>High</td><td>Highest possible order</td><td>12 - 16</td></tr>
<tr><td>Medium</td><td>Impact is real but not substantial in relation to other impacts that may occur</td><td>6 - 11</td></tr>
<tr><td>Low</td><td>Impact is of a low order and has a limited effect</td><td>1 - 5</td></tr>
<tr><td colspan="2">No impact</td><td>Zero impact</td><td>0</td></tr>
</table>

6.2 Rating of impacts taking place during construction

The net impact of the proposed project on the aforementioned indicators and economic variables is presented in the following sub-sections. Recall that the bulk of the capital expenditure will be spent on local goods and services therefore in comparison to the onsite agricultural activity, the net impact of the CSP plant on the regional economy is expected to be considerably large during this stage. However, as mentioned in previous chapters, the impact from the construction phase is not sustainable as the duration of this phase is capped at 30 months.

6.2.1 Evaluation of the impact on production

Establishing the plant on site requires that 500 ha of land would need to be reallocated from agricultural activity to the CSP plant. The transfer of grazing land implies that some livestock would have to be moved or sold which translates into a loss of income from the farming activity to the value of R 0.11 million (as shown in the following table). In total, the net impact of the proposed project during construction is R11 512.5 million in 2011 prices (Table 6-2).

Table 6-2: Net impact on production (R'ml, 2011 prices)

	Direct	Indirect	Induced	Total
Impact of proposed project	R 3 736.8	R 4 311.1	R 3 464.9	R 11 512.7
Loss in production of the current activity	R 0.13	R 0.04	R 0.04	R 0.21
Net impact	**R 3 736.7**	**R 4 311.0**	**R 3 464.8**	**R 11 512.5**

Now that the net impact of the project has been established, it is essential to evaluate the impact and refer to mitigation measures (were applicable) such that the impact observed in Table 6-3 is maximised. Thus the evaluation of the impact is tabulated below.

Table 6-3: Evaluation of net impact on production

Impact:	Temporary increase in production in the country (during the construction phase)		
Status	Positive	Spatial scale	Very High (4)
Temporal scale	Low (1)	Probability	Highly probable (3)
Severity	Severe (3)	Significance	MEDIUM - 11
Rationale	The impact of the CSP project on regional production levels is of a positive nature and of a medium degree of significance. In terms of spatial scale as well as probability, the project impact is significantly high, however the total rating is lessened by the low rating assigned to the temporal scale and severity of the project		
Mitigations:	In order to optimise the stimulation of the economy through direct, indirect		

	and induced effects, the following should be applied where possible: • Procurement of construction materials, goods, and products from local suppliers where feasible • Employ local contractors where possible. The proposed mitigation measures, however, although will possibly change the magnitude of the impact are not going to affect the weighting thereof.
Significance after mitigations	**MEDIUM**

6.2.2 Evaluation of the impact on GDP-R

The total contribution to the Gross Domestic Production per Region (GDP-R) in the case of the current agricultural activity is R 0.42 million, of which R 0.14 million will be 'lost' due to the decrease of grazing land. The direct impact of the construction phase on the national GDP is R4 001.3 million in 2011 prices. Considering the potential loss in the agrocultural activitiesm, the net effect of the proposed project on the value added in the country is R4 001.1 million in 2011 prices, which is a significant once-off contribution of approximately 7% to the Northern Cape economy. The net impact on GDP-R is shown in Table 6-4.

Table 6-4: Net impact on GDP-R (R'ml, 2011 prices)

	Direct	Indirect	Induced	Total
Impact of proposed project	R 896.1	R 1 573.6	R 1 531.5	R 4 001.3
Loss in GDP generated by the current activity	R 0.11	R 0.02	R 0.02	R 0.14
Net impact	**R 896.0**	**R 1 573.6**	**R 1 531.5**	**R 4 001.1**

The evaluation of the net impact with regard to GDP-R is presented in Table 6-5.

Table 6-5: Evaluation of net impact on GDP-R

Impact:	**Temporary increase in GDP-R during construction**		
Nature:	The impact is generated through continuous operation of the facility. It stimulates economic activities of directly and indirectly affected businesses, which subsequently leads to the creation of new business sales and generation of value added. Through increased household expenditure, additional round of value adding is created.		
Status	Positive	**Spatial scale**	Very High (4)
Temporal scale	Low (1)	**Probability**	Highly probable (3)
Severity	Severe (3)	**Significance**	**MEDIUM - 11**
Rationale	Similar to the net impact on production, the impact on GDP-R is of medium significance irrespective of the mitigation measures put in place. In this case the suggested mitigation measures would likely boost the local economy however the actual value-added would not increase hence the indifference before and after mitigation. Furthermore, the medium degree of significance is explained by the short duration of construction, which lessens the temporal scale as well as the severity (magnitude) of the impact.		
Mitigations:	The facility should be encouraged to procure materials, goods, services and products required for the operation of their businesses from local suppliers to increase the impact on local and regional economies, without jeopardising its own efficiency and competitiveness. However, this might have an impact on the local economy and will not affect the estimate of the total value-added to be generated by the project. Thus, it will not change the score.		
Significance after mitigations	**MEDIUM**		

6.2.3 Evaluation of the impact on employment

The total contribution of the proposed development to employment opportunities through direct, indirect, and induced effects is estimated at 7 275 temporary employment opportunities, of which 480 will be created directly by the construction, consulting and engineering activities. Given that no job losses will occur on the farm during the construction phase, the employment contribution is absolutely positive to the regional economy. In terms of jobs created, the project is specifically beneficial to the residents of the local municipality as the construction activities could offer temporary employment

opportunities. Therefore, local labour could potentially gain additional experience, whilst improving their skills base. The net impact on labour is shown in Table 6-6.

Table 6-6: Net impact on employment

	Direct	Indirect	Induced	Total
Impact of proposed project	480	3 864	2 931	7 275
Loss in employment of the current activity	0	0	0	0
Net impact	**480**	**3 864**	**2 931**	**7 275**

The following table outlines the evaluation of the net effect.

Table 6-7: Evaluation of net impact on employment.

Impact:	**Creation of employment opportunities during construction**		
Nature:	The impact is generated through capital expenditure that shocks the economy. It involves the creation of direct new job opportunities related to the construction of the proposed development and employment opportunities that will be indirectly created through the increased expenditure in sectors supplying goods and services to the construction activity and in sectors benefiting from the increase of consumer expenditure.		
Status	Positive	**Spatial scale**	High (3)
Temporal scale	Low (1)	**Probability**	Highly probable (3)
Severity	Average (2)	**Significance**	**MEDIUM - 9**
Rationale	It follows from the net impact that the status of the development is positive as the jobs created are strictly a benefit to the receiving economy. The project has medium significance in this regard. Unfortunately the jobs created are not sustainable and will be discontinued once the construction is complete, thus the extremely low temporal scale rating. However, at the time of construction, the unemployed population in the Siyanda DM could decrease by 2.1% depending on the amount of local labour use		
Mitigations:	The following is recommended to enhance the benefits of the created employment in the local area where feasible: • Employ labour-intensive methods in construction where feasible • Employ local residents and communities where possible • Sub-contract to local construction companies where possible • Utilise local suppliers where possible. As in the case of other impacts, the proposed mitigation measures could increase the impact on the local economy but would not change the total impact per se. Therefore, the weights assigned for the impact before mitigations will not be affected.		
Significance after mitigations	**MEDIUM**		

6.2.4 Evaluation of the net impact on household income

The contribution towards household income from the agricultural activity currently in place is comparatively negligible to that of the proposed project. The wages of farm-workers will also not be lessened despite the decrease in cattle farming that would take place during construction. The profiles of the farm owner, on the other hand will be impacted by the project. And although they are not considered as salaries and wages paid out by the activity, the profit margin of the farm should not be disregarded completely. The net impact on household income can be assessed in greater detail in Table 6-8 below.

Table 6-8: Net impact on household income (R'ml, 2011 prices)

	Direct	Indirect	Induced	Total
Impact of proposed project	R 162.2	R 718.6	R 680.4	R 1 561.2
Loss in income from current activity	0	0	0	0
Net impact	R 162.2	R 718.6	R 680.4	R 1 561.2

The evaluation of the impact on household income is similar to that of the impact on employment as the two are indivisibly related. Table 6-9 presents a fairly concise evaluation on the net household income impact.

Table 6-9: Evaluation of net impact on household income

Impact:	**Increase in household income during construction**		
Nature:	The impact will take place as a result of increased employment during the construction phase thus resulting in increased income in affected households. Direct, indirect and induced effects on income levels are taken into consideration for evaluation purposes.		
Status	Positive	**Spatial scale**	Very high (4)
Temporal scale	Low (1)	**Probability**	Highly probably (3)
Severity	Minor (1)	**Significance**	**MEDIUM - 9**
Rationale	The impact on household in the country is of a significant value, although its overall rating is reduced due to the temporary nature of this impact.		
Mitigations:	Considerations of the potential loss of farm owners' profit during construction should be taken into account and the farmer should be adequately reimbursed for this. Such reimbursement should be fair and could be in the form of a once-off payment, land rental or other arrangements made between the owner and the developer.		
Significance after mitigations	**MEDIUM**		

6.2.5 Evaluation of the net impact on government revenue

The local capital expenditure of R 4 546.3 million generates a total increase in government revenue of approximately R 210.9 million in 2011 prices. Irrespective of the specific government objective achieved through this income, it is evident that the increase in government revenue is beneficial to all affected people. The need for improved service delivery is prevalent in the country; thus the project stimulated government income can contribute to attainment of better services in the region. The assessment of the net impact on government revenue is provided in Table 6-10.

Table 6-10: Net impact on government revenue (R' ml, 2011 prices)

Impact:	**Increase in government revenue during construction**		
Nature:	The impact will take place as a result of local expenditure on construction and will be acquired by government through indirect and direct taxes on the project's activity.		
Status	Positive	**Spatial scale**	High (3)
Temporal scale	Low (1)	**Probability**	Highly probably (3)
Severity	Average (2)	**Significance**	**MEDIUM - 9**
Mitigations:	No mitigations		
Significance after mitigations	**MEDIUM**		

6.2.6 Evaluation of the net impact on housing provision and basic services pressures

Although no exact figures for housing and basic services onsite were available at the time of the report, the developer is aware of the need to consider these two essential factors for the development of the plant. Given that during the construction phase about 480 people will be working on site for the 30-month period, suitable and sizeable accommodation will have to be provided. The increasing demand for housing and subsequently basic services such as water and electricity will put pressure on the local municipality and the housing stock.

The evaluation of the net impact on housing is shown in Table 6-11.

Table 6-11: Evaluation of impact on housing and basic service delivery

Impact:	**Increase in housing and basic services during construction**		
Nature:	The impact will take place due to the influx of people to the local area during the construction phase. Housing and provision of utilities is considered on a direct level as opposed to the indirect and induced effect.		
Status	Negative	**Spatial scale**	High (3)
Temporal scale	Low (1)	**Probability**	Definite (4)

Severity	Average (2)	**Significance**	**MEDIUM - 10**
Rationale	Local area does not have sufficient accommodation, particularly given the current development trends. Existing pressure on housing provision will be increased with the start of construction of the proposed facility. This will in turn put more pressure on municipality's service delivery capability.		
Mitigations:	Considering the temporal status of the impact, it is advisable that a temporary camp is set up to accommodate construction workers. The location of such a camp should be guided by the availability of basis services in the area.		
Significance after mitigations	**MEDIUM**		

6.3 Rating of impacts taking place during operations

The evaluation of the net impact of the proposed project during its operational phase is presented in the following sub-sections. The information under analysis is the average impact that can be expected on an annual basis during the operational life of the facility. Due to the longevity of the project, the impacts related to this phase are considered sustainable.

6.3.1 Evaluation of the impact on production

The proposed project is expected to generate, on average, a turnover of R1 114.75 million per annum given that it is operating at full capacity. This turnover translates into the direct impact of the plant operations on regional business sales which, through economic spin-offs, generates a total impact of R1 379.1 million in 2011 prices. At present, the total contribution of the farming activity on site towards production is valued at R 1.03 million; however the loss in land will result in a decrease of total impact to the value of R 0.21 million in 2011 prices. Despite the negative impact on the agricultural activity, the net impact of the project on gross output is estimated at R1 378.8 which is relatively high considering the impact on the economy created by the current activity on site. The net impact translates into a 1.1% increase in the gross output of the Northern Cape economy. This is sustainable and will therefore stimulate the long-term growth throughout the 30-year operational phase. It is evident from Table 6-12 that the net impact on production is positive and relatively large.

Table 6-12: Net impact on production during the operational phase (R' ml, 2011 prices)

Impact	Direct	Indirect	Induced	TOTAL
Impact of proposed project	R 1 114.75	R 162.95	R 241.36	R 1 379.05
Loss in production impact from current activity	R 0.13	R 0.04	R 0.04	R 0.21
Net impact	**R 1 114.62**	**R 162.92**	**R 241.32**	**R 1 378.84**

An evaluation of the net impact on production during the operational phase is provided in Table 6-13. As opposed to the construction phase, the net impact of the project during the operational phase with regard to production is of high significance. This is mainly attributed to the duration of the impact on the affected economy.

Table 6-13: Evaluation of the net impact on production over one year of full operational capacity

Impact:	**Increase in production during operation**		
Nature:	The impact is generated through annual operating expenditure of the commercial components of the proposed development. They stimulate economic activities of directly and indirectly affected businesses, which subsequently leads to the creation of new business sales.		
Status	Positive	**Spatial scale**	Very high (4)
Temporal scale	High (3)	**Probability**	Highly probable (3)
Severity	Severe (3)	**Significance**	**HIGH - 13**
Rationale	The increase of 1.1% to the Provincial economy is a substantial contribution given that the local operating expenditure is R 160.2 million per annum. Should the local operating expenditure be spent within the Siyanda DM then the district's economy has the potential to increase by 4.8% in a 12 month timeframe.		
Mitigations:	The production facility should be encouraged to procure materials, goods		

	and products required for the operation of their businesses from local suppliers to increase the positive impact in the local economy as far as possible. In general terms, however, this will not change the total impact and will only change the distribution of the impact; as a result, the weighting for the impact will not change after mitigations.
Significance after mitigations	**HIGH**

6.3.2 Evaluation of the impact on GDP-R during the operational phase

The net direct impact of the project on GDP is R732.9 million, which will increase the local economy by 35%. Furthermore, the project boosts the value added in the construction, financial services, and manufacturing sectors both in the Province and nationally. In total, the net impact of the project is estimated at R916.8 million which is distributed through direct, indirect, and induced effects from spending the annual turnover.

Table 6-14: Net impact on GDP-R during the operational phase (R' ml, 2011 prices)

Impact	Direct	Indirect	Induced	TOTAL
Impact of proposed project	R 733.06	R 77.36	R 106.58	R 916.99
Loss in production impact from current activity	R 0.11	R 0.02	R 0.02	R 0.14
Net impact	R 732.94	R 77.34	R106.56	R 916.84

A more thorough assessment of the impact is shown in Table 6-15.

Table 6-15: Evaluation of net impact on the GDP-R (operational phase)

Impact:	**Increase in GDP-R during operation**		
Nature:	The impact is generated through continues operation of the facility. It stimulates economic activities of directly and indirectly affected businesses, which subsequently leads to the creation of new business sales and generation of value added. Through increased household expenditure, additional round of value adding is created.		
Status	Positive	**Spatial scale**	Very high (4)
Temporal scale	High (3)	**Probability**	Highly probable (3)
Severity	Very Severe (4)	**Significance**	**HIGH - 14**
Rationale	Assuming that value added of the project will be accounted as part of the provincial economy, the net impact of R732.9 million of value added to be added to the municipal economy would increase the size of that economy by a third and would remain as such through the operational stage of the facility. Given this, the significance of the impact is considered to be as high.		
Mitigations:	The facility should be encouraged to procure materials, goods, services and products required for the operation of their businesses from local suppliers to increase the impact on local and regional economies, without jeopardising its own efficiency and competitiveness.		
Significance after mitigations	**HIGH**		

6.3.3 Evaluation of the net impact on employment creation during the operational phase

During the operational phase about 42 people, excluding foreign labour, will be employed at the plant to oversee daily operations. Through indirect and induced effects on all affected sectors, over 800 additional employment opportunities will be created in the economy. Since no farm-workers will be retrenched during the operational phase, the net impact is simply the increase in jobs as a result of the proposed project as seen in Table 6-16.

Table 6-16: Net impact on employment over one year of full operational capacity

Impact	Direct	Indirect	Induced	TOTAL
Impact of proposed project	42	291	516	849
Loss in production impact from current activity	-	-	-	-
Net impact	**42**	**291**	**516**	**849**

Job creation experienced in the local area has the potential to decrease unemployment in Tsantsabane LM by approximately 1% which is significant to the households that will be alleviated from poverty

through increased income. Furthermore the impact of the project on the construction and manufacturing industries generates relatively high employment opportunities, about 291 and 516, through indirect and induced impacts, respectively. The evaluation of the impact is presented in the table below.

Table 6-17: Evaluation of the impact on employment during operations

Impact:	**Creation of sustainable employment opportunities**		
Nature:	The impact takes place throughout the operational phase and is translated into the creation of new employment opportunities at the facility and the businesses that are affected throughout indirect and induced effects.		
Status	Positive	**Spatial scale**	Very high (4)
Temporal scale	High (3)	**Probability**	Highly probable (3)
Severity	Severe (3)	**Significance**	**HIGH - 13**
Mitigations:	Where possible, the local labour should be considered for employment to increase the positive impact on the local economy, i.e. Tsantsabane LM. However, this will not impact on the total employment opportunities created by the production facility and will therefore not change the weights of the impact.		
Significance after mitigations	**HIGH**		

6.3.4 Evaluation of household income (operational phase)

Household income is expected to experience a strictly positive effect as a result of the increased employment, which is further assisted by the job retention of the farm-workers. The project will support R13.32 million in 2011 prices of direct income. This represents the net impact as no job loss is expected. Overall though, the loss of grazing land will be associated with a decline of support income by agricultural activities to the value of R 0.02 million in 2011 prices.. This loss in income, however, will be counteracted by an increase in income to the value of R 80.7 million, which will be supported y the proposed project and which is far greater than the contribution of the current onsite activities (Table 6-18).

Table 6-18: Net impact on the household income during operational phase (R'ml, 2011 prices)

Impact	Direct	Indirect	Induced	TOTAL
Impact of proposed project	R 13.32	R 32.99	R 47.70	R 94.00
Loss in production impact from current activity	R -	R 0.01	R 0.01	R 0.02
Net impact	R 13.32	R 32.99	R 47.70	R 94.00

A more detailed evaluation on this impact is provided in Table 6-19.

Table 6-19: Evaluation of the impact on household income during operations

Impact:	**Increase in household earnings**		
Nature:	The impact will take place throughout the operational phase however on a lesser scale than during the construction phase as the number of employees decreases substantially.		
Status	Positive	**Spatial scale**	Very high (4)
Temporal scale	High (3)	**Probability**	Highly probable (3)
Severity	Severe (3)	**Significance**	**HIGH - 13**
Rationale	The sustainability of income generated during this phase has a significant impact on affected households in the region and the rest of the country. Considering the net effect on income and the actual growth of income compared to what is supported by current agricultural activity, the significance of the net effect on income is assessed as high.		
Mitigations:	In order to increase the income retention in the local economy, local SMMEs should be employed to provide selected services, such as cleaning, security, transportation, etc.		
Significance after mitigations	**HIGH**		

6.3.5 Evaluation on the net impact on government revenue

The CSP plant, if established, would generate a total impact to the value of R 142.5 on government revenue. Similar to the revenue generated in the construction phase, this income can be used to improve facilities and service delivery in and around the region. By the completion of the 30-year operational phase significant change through increased government expenditure in the region can be expected.

Table 6-20: Evaluation of the impact on government revenue (operational phase)

Impact:	**Increase of government revenue during operation**		
Nature:	The impact takes place mostly with payment of indirect taxes, salaries and wages and profit generation.		
Status	Positive	**Spatial scale**	High (3)
Temporal scale	High (3)	**Probability**	Highly probable (3)
Severity	Average (3)	**Significance**	**HIGH - 12**
Mitigations:	No mitigations measures		
Significance after mitigations	**HIGH**		

6.3.6 Evaluation of the net impact on housing provision and basic services pressures during operations

The provision of housing and services during the operational phase is likely to have a less impact on the economy, since the number of employees in need thereof decrease substantially between the construction and operational phases. Slightly fewer than 50 people will be employed at the plant during operation of which some will come from the immediate local area. With respect to the rest, various accommodation forms will be required varying in terms of cost, convenience and luxury. Given that the current housing situation in the nearby town suffers from shortage of appropriate accommodation, new people arriving to the area will increase the pressure on housing and services provision. Such a pressure would though be temporal and would be released once housing and service delivery issues are addressed.

Table 6-21: Evaluation of the impact on housing and basic services during the operational phase

Impact:	**Increase in housing and basic services during construction**		
Nature:	The impact will take place due to the influx of people to the local area during the construction phase. Housing and provision of utilities is considered on a direct level as opposed to the indirect and induced effect.		
Status	Negative	**Spatial scale**	High (3)
Temporal scale	Low (1)	**Probability**	Definite (4)
Severity	Average (2)	**Significance**	**MEDIUM - 10**
Mitigations:	Given the situation with housing in the local area, consideration should be given to the provision of housing to the workers. Information regarding the project and the potential requirements with respect to water and electricity will also need to be provided to the local municipality and other authorities to allow for adequate planning and timely provision of services.		
Significance after mitigations	**MEDIUM**		

6.4 Synthesis

This chapter outlined the results of the evaluation of net impacts of the project on the affected economies during the construction and operational phase. Despite the short duration of the construction phase, the net impact thereof on production, value added, and employment is vast and of extreme importance to the national economy. In terms of significance ratings for the indicators and variables under assessment, ranks between nine and 11 were allocated. Therefore, the impacts during construction are considered to have a medium significance. With regard to net impacts expected to be observed during the operational phase, scores between 10 and 14 were assigned in terms of significance. Such high ratings were attributed to the sustainability and extent of net effects in the context of the local and provincial economies. Most of net impacts, except for the one associated with the increase in demand for housing and service delivery are positive.

CHAPTER 7. CONCLUSION

The purpose of this report is to assess the impact of the proposed concentrated solar power plant on the national, regional, and local economies. In addition, the contribution of the project to strategic government objectives and national matters of interest were assessed.

The proposed project has negative and positive socio-economic effects with which it is associated. The potential negative impacts of the project are as follow:

- A third of capital expenditure (R1.9 billion in 2011 prices) will be spent on procurement of imported goods and services, which represents a leakage from the country and which would have a negative effect on the trade balance and lead to an increase in the current account deficit Although an increase in the current account deficit would not be critical for the country, its continuous growth could significantly weaken the national currency, increase debt servicing costs, and result in lower foreign direct investment, which in turn means lower economic growth.
- Secondly, some cattle farming needs to be discontinued due to the loss of grazing land upon which the plant will be built. The estimated direct loss in revenue is R0.13 million per annum, whilst the total loss to the economy is valued at R 0.21 million per annum in 2011 prices. No loss in direct employment though will be associated with this.
- Thirdly, increase in economic activity in the area would stimulate the demand for housing and basic service provision in the local municipality. This in turn would put pressure on the local government to deliver and on the developer to look for possible alternatives for accommodation of workers during both construction and operation.

Although negative effects do exist and should be mitigated as far possible, the positive economic impacts of the project far outweigh any negative impacts brought about by the project. All the net economic impacts during construction and operational phases are positive in nature and the ratings associated with relevant indicators and variables are provided in Table 7-1.

Despite the relatively short duration of construction of the project, the impact on the economy is substantial during this phase. The assessment shows that during the establishment phase, the project will stimulate production by R11 512 million in 2011 prices, which translated into R4 001 million of GDP and creation of 7 275 temporary employment opportunities. During the operations phase, the proposed project will further stimulate production to the value of R1 519.1 million per annum which will create 849 sustainable jobs and generate R917. 0 million in value added. Furthermore, the increase in government revenue and household income during both phases of the project is of extreme importance and will assist households in improving their quality of life, whilst government can attend to key objectives with the increased revenue. Analysis of the positive effect of the proposed CSP plant relative to the negative impact discussed previously, shows that the loss in revenue and economic impact is insignificant.

Table 7-1: Summary of economic impacts evaluation

Impact	Status	Spatial scale	Temporal scale	Probability	Severity	Total Score	Significance
Construction phase impact – 2.5 years							
Temporary increase country's production	Positive	4	1	3	3	11	Medium
Temporary increase in country's GDP-R	Positive	4	1	3	3	11	Medium
Temporary increase in employment	Positive	3	1	3	2	9	Medium
Increase in government revenue	Positive	4	1	3	1	9	Medium
Increase in household income	Positive	3	1	3	2	9	Medium
Housing provision and basic services pressure	Negative	3	1	4	2	10	Medium
Operational phase impact – 30 years							
Increase in production	Positive	4	3	3	3	13	High
Increase in GDP-R	Positive	4	3	3	4	14	High

Impact	Status	Spatial scale	Temporal scale	Probability	Severity	Total Score	Significance
Increase in employment	Positive	4	3	3	3	13	High
Increase in household earnings	Positive	4	3	3	3	13	High
Increase in government revenue	Positive	3	3	3	3	12	High
Housing provision and basic services pressure	Negative	3	1	4	2	10	High

In summary, the proposed project, from an economic point of view, is of great value and benefit to the affected economies. Not only will the Tsantsabane LM economy increase immensely, but the nature of the project will assist government in further establishing the green economy and promoting economic industries with high job creation multipliers. Domestically, the proposed project is a fundamental step to establishing a new manufacturing industry to support the development of the CSP build programme and maintain the facilities in the long-term. The project also offers carbon emission savings and associated with it possible future costs savings related to carbon tax. Therefore, in comparison with the “no-go” option, the proposed project is far better in economic and strategic rewards and is the preferred option.

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Appendix P

Sensitivity Analysis

HUMANSRUS SOLAR PROJECT
ENVIRONMENTAL SENSITIVITY MAPPING ANALYSIS

Draft Report. 22 November 2011

Produced for WorleyParsons by D. Jansen van Vuuren, MetroGIS.

1. INTRODUCTION

Sensitivity mapping is essentially a visualised measurement and ranking system where areas of diverse sensitivity are identified and ranked according to a pre-determined classification system. This is applied on selected environmental attributes, each using its own judgement criteria.

The purpose of a sensitivity analysis is to integrate the findings of various specialist studies into a single matrix on the basis of standardised impact ratings. These ratings can be quantified, and linked to the geospatial representation (mapping) of each environmental attribute.

The environmental attributes (specialist areas) that were included in the study are:

- Ecology;
- Wetlands;
- Surface Hydrology;
- Soil Sensitivity;
- Visual Quality.

Avifauna was originally included, but it was decided to incorporate this component under 'Wetlands', due to the overlapping nature of the two attributes (wetlands providing a habitat for bird species).

Overlaid with the footprint of the proposed CSP development, the sensitivity map gives a clear indication of areas that are suitable for development and which areas should be avoided. It therefore informs decision making with regard to the evaluation of alternative layouts and the optimal location of infrastructure.

2. METHODOLOGY

Sensitivity mapping is based on the concept of *cumulative scales* which is the result of integrating individual concepts (environmental attributes), each with varying degrees of sensitivity judgement, into a single sensitivity matrix. The rating scale involves qualitative descriptions of individual environmental attributes (such as ecology) which is judged against criteria specific to that domain. This is spatially enabled by capturing GIS polygons representing these descriptions. The rating scale is standardised to avoid discrepancies between domains. A Likert scale, as shown in Table 1 is used.

Table 1: Impact rating and associated values used in sensitivity mapping

Value	Rating	Description
1	Low	Impact Insignificant - Preferred area for development
3	Moderate	Impact can mostly be mitigated / offset
5	Very High	Impact Severe - Area not developable due to possible fatal flaws

For each environmental attribute a map is produced showing the intrinsic environmental sensitivity values as determined. Each map is generated from a geospatial dataset which has been produced by the respective specialists and which has been imported into a dedicated GIS project by MetroGIS, each as an individual data layer. Each data layer contains a database with sensitivity ratings stored as numeric values. These layers can be integrated into a merged dataset, containing the respective values of each input layer. These values are used to calculate a single sensitivity index (refer to Table 2).

The calculation is essentially the sum of each sensitivity rating per record, each record representing a facet in the geospatial dataset. In the case of 'Ecology' and 'Visual Quality', which are the only datasets representative of the whole study area, the 'moderate' and 'high' values were manipulated by applying weighted criteria, as shown below. This was done to elevate the importance of these values.

Where [ECO_SENS] = 2 ➔ x1.5 ➔ [ECO_CALC]
Where [ECO_SENS] = 3 ➔ x2.0 ➔ [ECO_CALC]

Where [Vis_Sens] = 2 ➔ x1.5 ➔ [VIS_CALC]
Where [Vis_Sens] = 3 ➔ x2.0 ➔ [VIS_CALC]

An extract of the database with sensitivity values and calculated fields is shown in Table 1. This explains the calculation of the sensitivity index, using the following formula:

[SOIL_SENS]+ [Hydr_Sens]+ [ECO_CALC]+ [Wetl_Sens]+[VIS_CALC]

Table 2: Extract from sensitivity index database showing rating and weighted values.

RATINGS					WEIGHTED RATINGS		SENSITIVITY INDEX
Soil_Sens	Hydr_Sens	Wetl_Sens	*Eco_Sens*	*Vis_Sens*	ECO_CALC	VIS_CALC	Total
0	0	3	*2*	*0*	3	0	6
0	0	3	*2*	*0*	3	0	6
3	0	3	*3*	*0*	6	0	12
3	0	3	*3*	*0*	6	0	12
3	0	3	*2*	*0*	3	0	9
3	0	3	*1*	*0*	1	0	7
3	3	3	*3*	*0*	6	0	15
3	3	3	*3*	*0*	6	0	15
0	0	0	*0*	*1*	0	1	1
0	0	0	*0*	*2*	0	3	3
0	0	0	*0*	*3*	0	6	6

3. ANALYSIS OF INPUT SENSITIVITY MAPS.

The sensitivity maps for each of the environmental attributes involved in this study are presented in Annexure A. These should be interpreted together with the relevant specialist reports, especially with regard to ecology, surface hydrology, and wetlands. Although a specialist report for soil has not been produced, the relevance of this component has been realised during a specialists workshop. It was subsequently decided to create a GIS data layer in this regard and include it in the study. With regard to visual quality, which is normally assessed as an off-site impact, it was realised that the intrinsic visual landscape of the site itself, by virtue of topographical features and the occurrence of natural vegetation, should be included in the study as well.

An analysis of the sensitivity maps is briefly described as follows:

Soil:
The following information has been provided by senior specialist researcher, Arthur Chapman:

Two areas (polygons) with different soil characteristics and vulnerabilities have been mapped, indicating moderate and high sensitivity.

Of concern is the erodible nature of the soils within the floodplain with a high sensitivity (3) rating, and the compactable soils in the north with a moderate sensitivity (2). On the ground, the soils demonstrate an erodible nature and downstream of the livestock watering dam there is an erosion channel working its way upstream, but which has limited potential to move beyond the dam because the ground becomes stony and less "vulnerable" and the major source of flows comes from an area off-site.

The CSP footprint area is mostly covered by compactable soils. The CSP development could have an impact on these soils through compaction by heavy machinery, reducing infiltration capacity. This could be mitigated through interventions.

Visual Quality:
The proposed CSP site forms part of a larger landscape with intrinsic visual qualities. Topographical resources with high visual qualities include mountainous terrain, where steep slopes and valleys form an aesthetically pleasing landscape. This is complimented by the occurrence of natural vegetation, the combination of which increases the visual quality of the landscape. This type of landscape occurs to the north and east of the CSP site, forming part of a larger coherent landscape.

A visual quality index was created by extracting raster data from a satellite image (sourced from Google Earth), where the colour values of the image are representative of transformed / eroded landscapes, and where the occurrence of trees and steep slopes can be detected as well. An unsupervised classification of the image provided sufficient data to create three classes representing low, moderate and high visual qualities, as depicted on the map in Figure 2.

Of concern is the north-eastern part of the CSP footprint area, which partly overlays hilly terrain. With slopes steeper than 2 degrees in this area, extreme excavations will be required to level that part of the CSP terrain for construction purposes, thereby exposing deep cuts into the slopes. These cuts, which could be 10 – 13m high in places, will significantly alter the topography, creating contrasting textures and colours that will negatively impact on the visual quality of that part of the landscape.

Wetland

Only one polygon, demarcating an area with a 100m buffer around an identified wetland area, has been mapped. This polygon is associated with a high sensitivity (3). The remainder of the study area is assigned a value of '0' by default for not being a wetland.

Surface hydrology

A floodplain representing surface hydrology, has been mapped as a single polygon. This polygon is associated with a high sensitivity (3). The remainder of the study area is assigned a value of '0' by default for not being part of surface hydrology per definition.

Ecology

The whole of the study area has been mapped out into polygons representing low (1), moderate (2) and high (3) sensitivities. These are associated with habitats and sensitive species distribution, inclusive of fauna and flora.

4. ENVIRONMENTAL SENSITIVITY INDEX

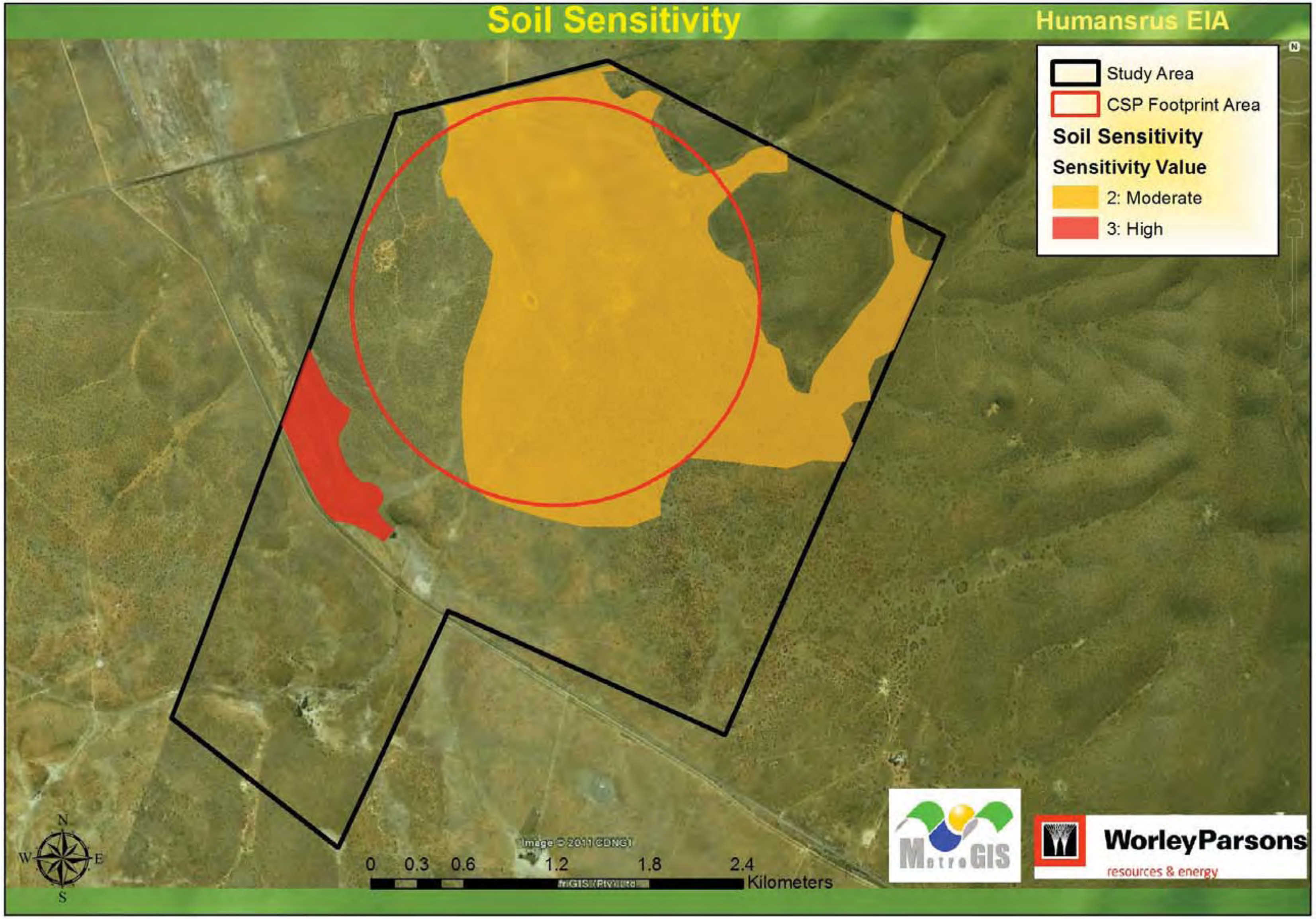
The environmental sensitivity index is the sum of weighted sensitivity data for each environmental attribute, as explained above. The sensitivity map (Figure 6) displays a thematic query of all the values in the index, ranging from very low to very high, and visualised by means of a colour range from green (low) to red (high).

It is evident from the map that very high sensitivity is associated with surface hydrology and Wetland areas. High sensitivity is associated with ecology and visual quality. The CSP footprint is mostly overlaid with very low to moderate sensitivities, except for the hilly terrain in the north-east where high sensitivities occur. The PV plant area in the south has high to very high sensitive areas along the floodplain where wetlands also occur. The remainder of this area has fairly low sensitivities.

The footprint of proposed photovoltaic infrastructure was not available at the time of preparing this report. The capturing of geospatial data in this regard is currently taking place and can be added as soon as it has been received.

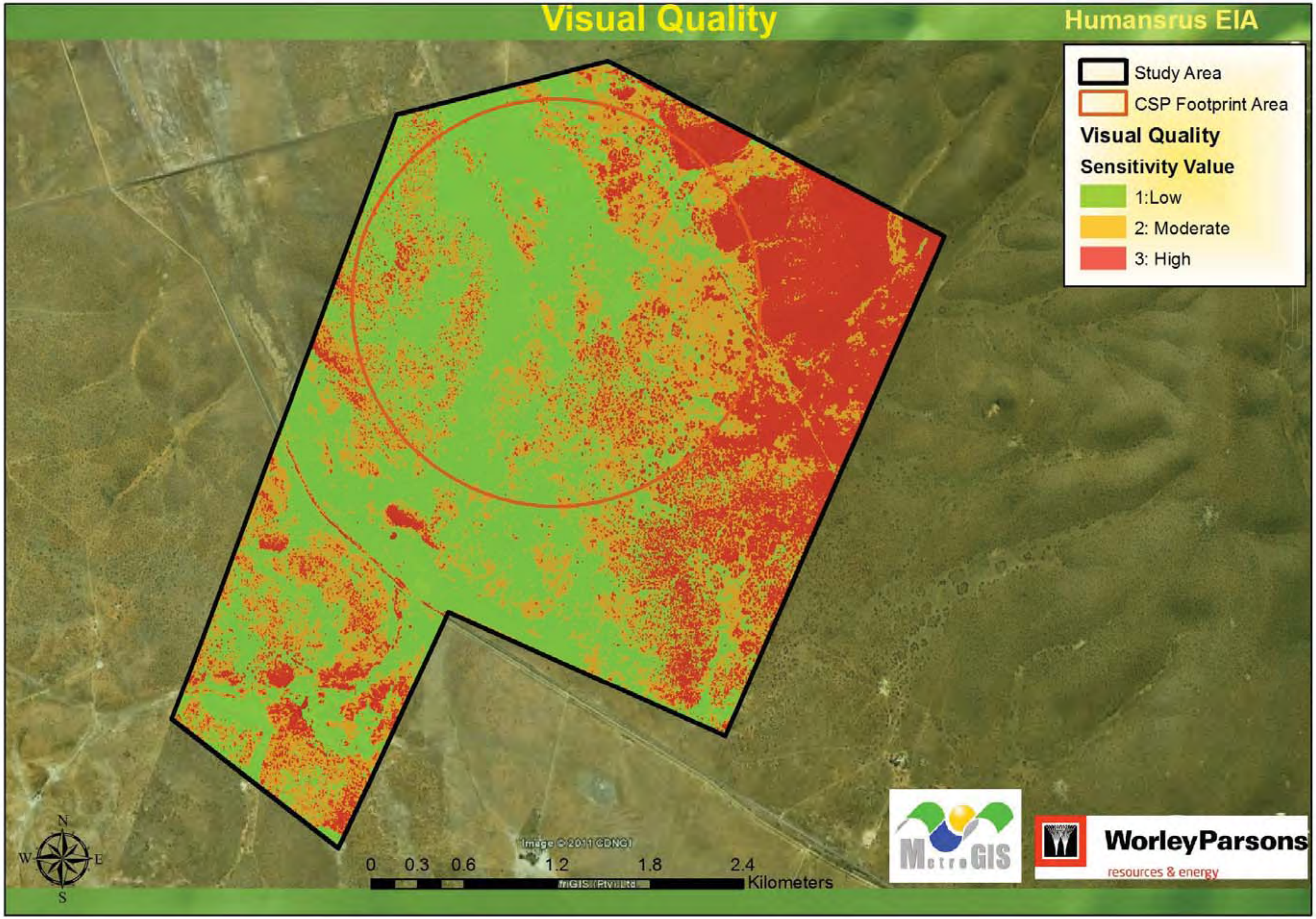
ANNEXURE A: SENSITIVITY MAPS

Figure 1: Soil



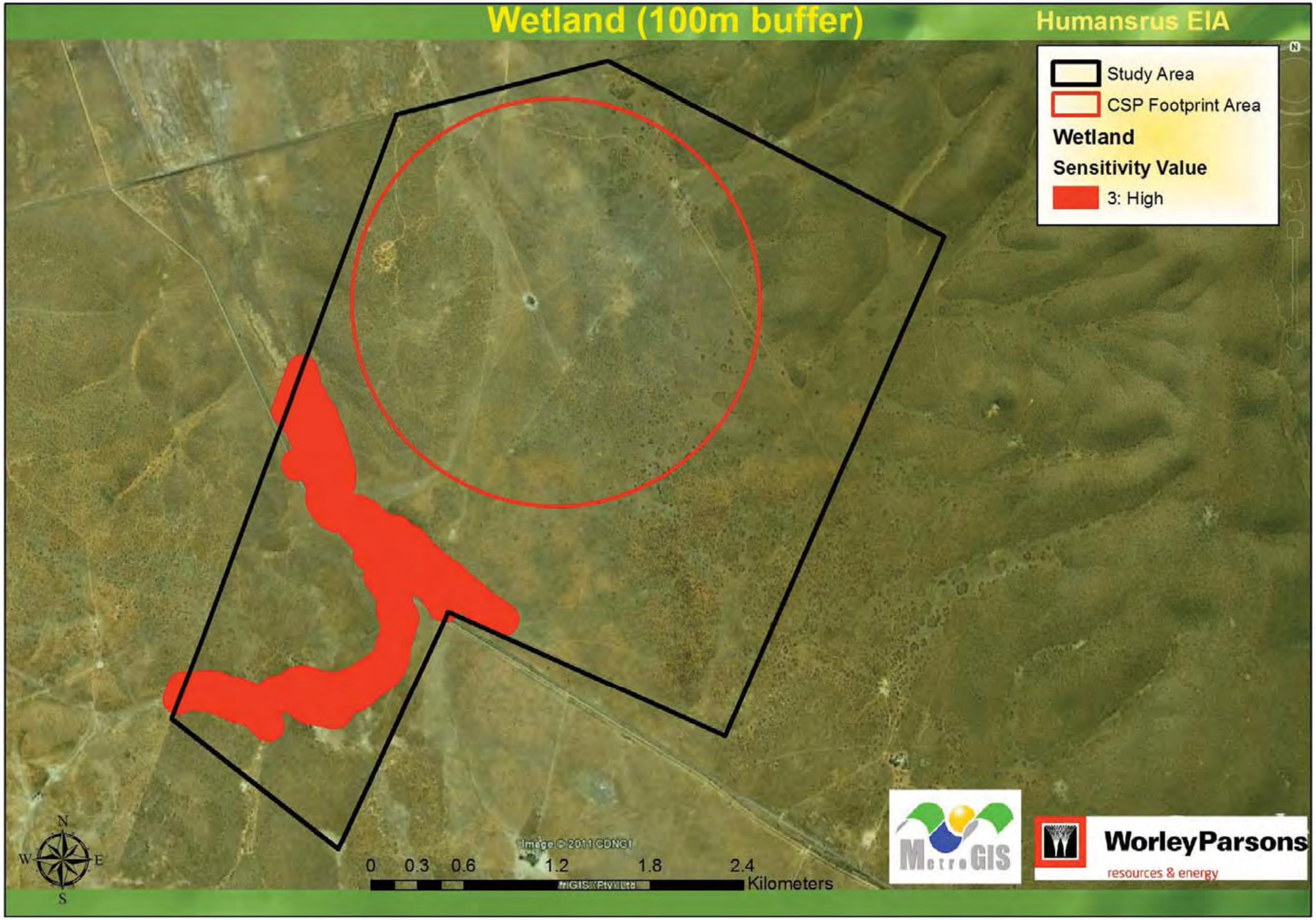
ANNEXURE A: SENSITIVITY MAPS

Figure 2: Visual Quality



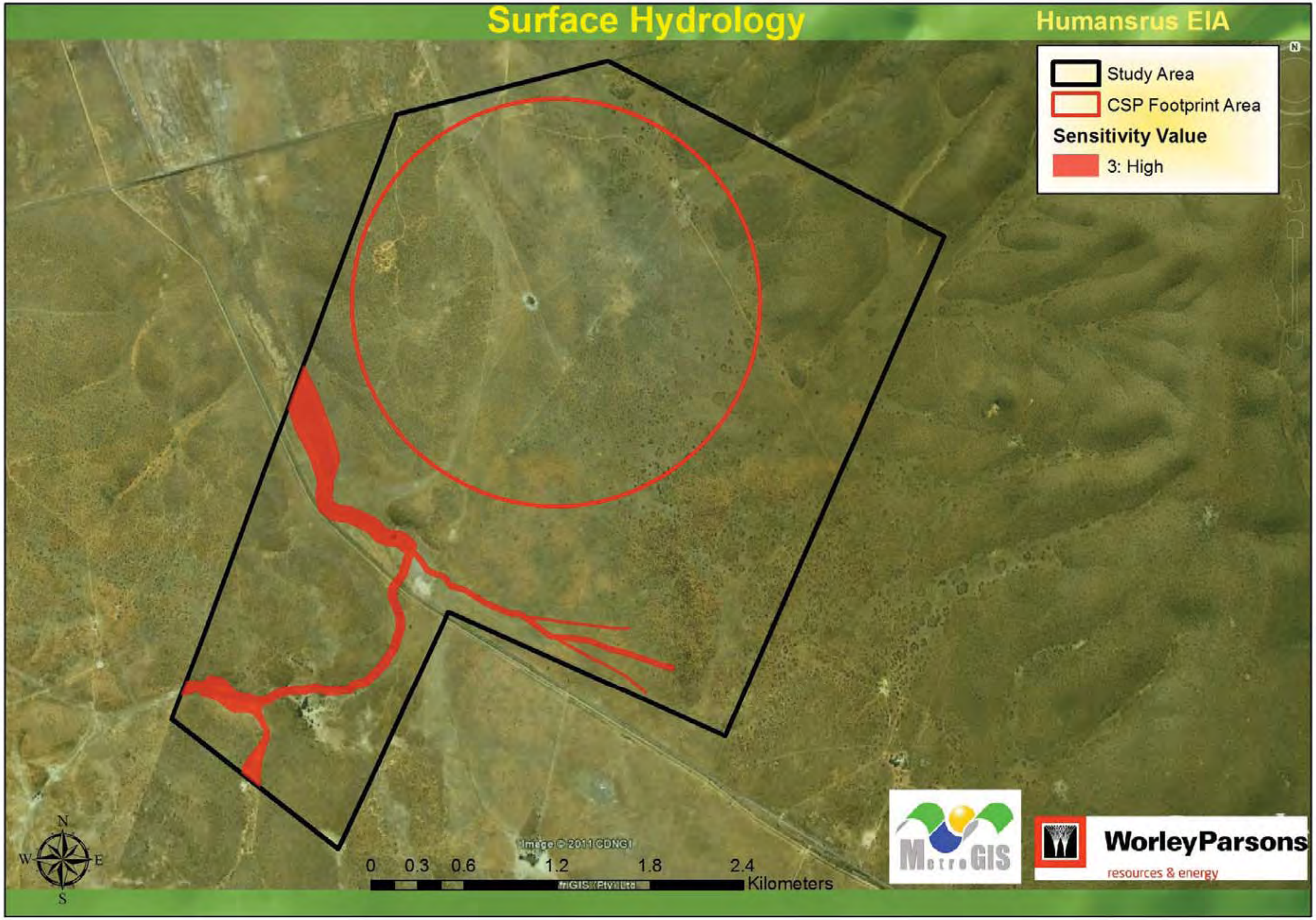
ANNEXURE A: SENSITIVITY MAPS

Figure 3: Wetland



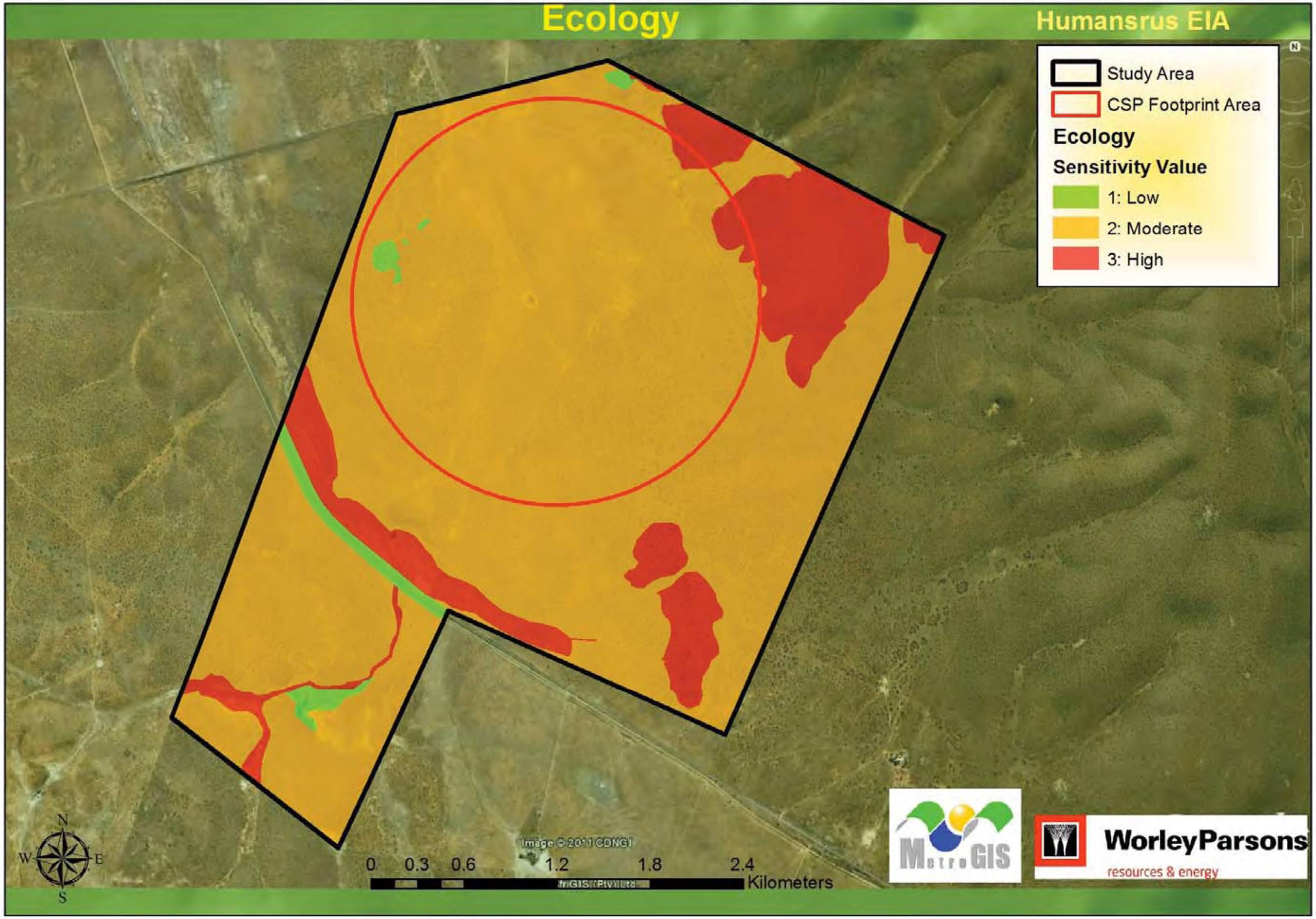
ANNEXURE A: SENSITIVITY MAPS

Figure 4: Surface Hydrology



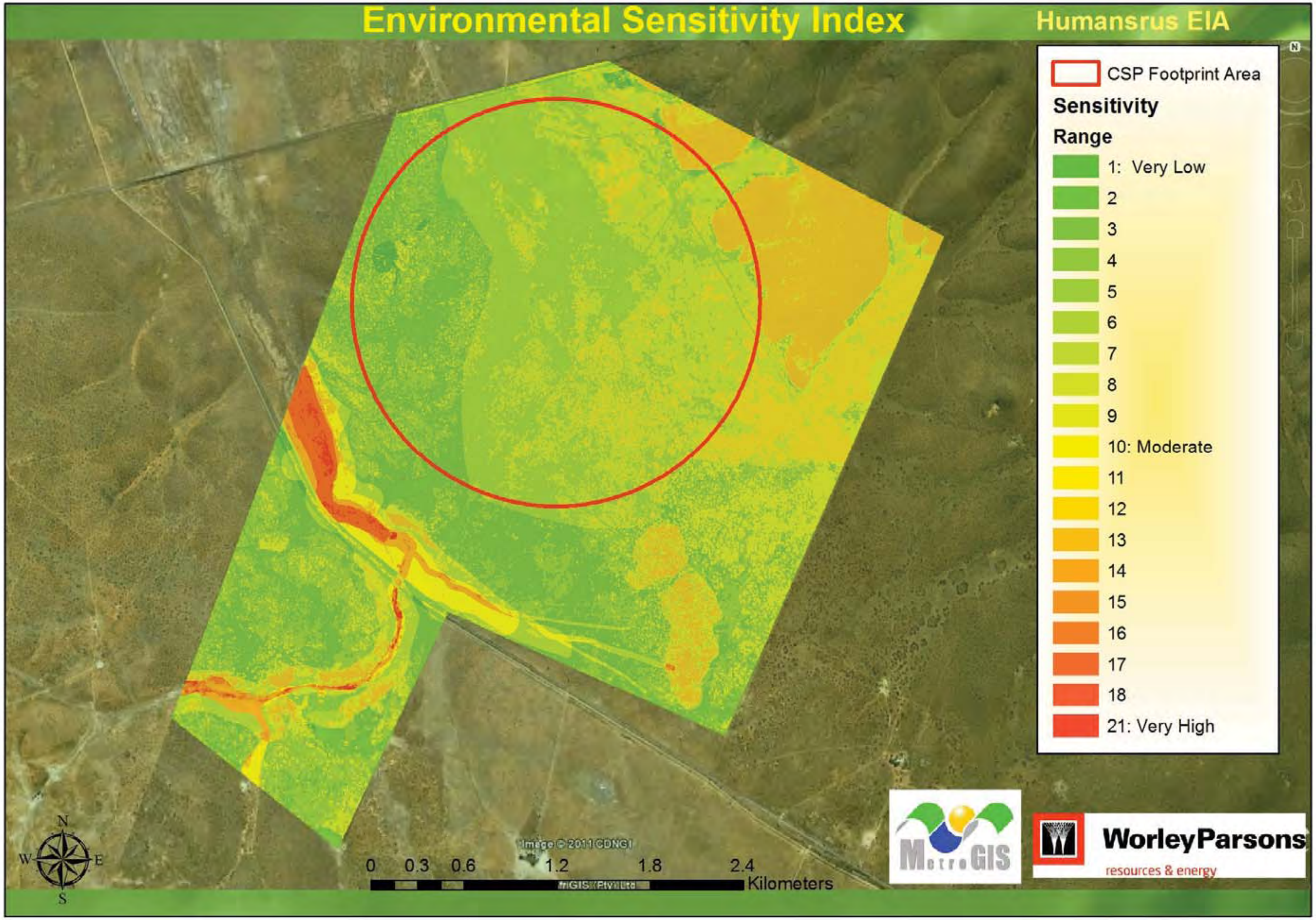
ANNEXURE A: SENSITIVITY MAPS

Figure 5: Ecology



ANNEXURE A: SENSITIVITY MAPS

Figure 6: Environmental Sensitivity Index



Appendix Q

Technical Scope of Work

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TECHNICAL SCOPE OF WORK - HUMANSRUS SOLAR THERMAL ENERGY PLANT, THE FARM 469, THE HAY RD, NORTHERN CAPE

Final Report

257000PWE – 08-008

31 August 2011

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TECHNICAL SCOPE OF WORK - HUMANSRUS SOLAR THERMAL ENERGY PLANT, THE FARM 469, THE HAY RD, NORTHERN CAPE
FINAL REPORT

SYNOPSIS

This document provides a detailed overview of all technical aspects associated with the Concentrated Solar Plant based on preliminary design data..

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PROJECT 257000PWE - TECHNICAL SCOPE OF WORK - HUMANSRUS SOLAR THERMAL ENERGY PLANT, THE FARM 469, THE HAY RD, NORTHERN CAPE

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	L Rautenbach	C Liebenberg	N/A	0	N/A	

CONTENTS

1 CHAPTER 1: PROJECT INTRODUCTION

1.1 Background

The South African economy has shown a significant and rapid growth trend over the past few years. Current infrastructure and service delivery however does not allow for the continuation of this trend. In order for the National Government to create an economic climate which is suitable to their growth targets, and will accommodate the existing economic growth and social development, it was found essential that basic services such as electricity provision be enhanced as a matter of urgency. The current infrastructure and generation capacity of South Africa's power utility, Eskom, is unable to accommodate a rapid growing economy in which reliable electricity provision is essential.

South Africa has experienced electricity blackouts or as it was termed, load shedding, during 2008 and 2009 which dampened investor confidence in South Africa as an investor destination and also hampered industrial development. Ageing power plants and the prevalence of unplanned maintenance to these plants were major contributors to the problem, which caused erratic and unreliable electricity provision to major industries as well as households throughout South Africa.

The bulk of South Africa's power is generated by coal fired power stations and a number of coal fired power stations are being planned to meet the ever increasing demand for power. This makes coal South Africa's primary energy resource. Beyond the fact that coal is not a renewable resource the burning of coal for the generation of electricity also has a very negative impact on the environment from the point of view that vast amounts of CO_2 is being released into the atmosphere and contributing to the ever growing concern of the greenhouse effect and global warming.

South Africa is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) committing to the stabilization of atmospheric greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. With this commitment in place and the ever growing need for power, South Africa is urged to expand its generation capacity but through the development and utilisation of alternative resources, which are renewable and more environmentally sustainable.

1.2 Project Background

Renewable energy is derived from natural resources which are naturally replenished. One such resource is solar energy. The renewable energy potential of solar energy is immense worldwide due to the vast amounts of energy radiated to the surface of the earth from the sun. Numerous studies have shown that harnessing solar radiation has the potential to substitute much of the current non-renewable energy sources as a means of generating electricity. The two primary solar techniques include the use of photovoltaic panels and solar thermal

collectors to harness the sun's energy. Concentrated solar power (CSP) falls within the category of solar thermal collectors and is approximately twice as efficient in terms of converting solar energy to electricity. CSP systems can reach an efficiency of up to 30% and has the ability to generate power over a 24 hour period by means of cost effective thermal storage.

South Africa is in urgent need of additional and sustainable power and is in a favourable position geographically and due to its suitable climatic conditions to tap into the untapped solar energy resource. The provision of power is critical for development and economic growth in the country. This development refers not only to infrastructure development but also socio-economic development which in return will create skills and opportunities, uplift and empower the people of the nation.

South Africa has experienced prolific economic growth in recent years until the economic crisis hit in 2008 and according to Statistics South Africa, GDP rose by 2.7% in 2001, 3.7% in 2002, 3.1% in 2003, 4.9% in 2004, 5% in 2005, 5.4% in 2006, 5.1% in 2007 and 3.1% in 2008. This unprecedented growth has also been seen as a major contributor to the power capacity constraints that the country is facing. Along with this is the problem of unemployment that the International Monetary Fund (IMF) has described in its 2007 annual country assessment as one of the biggest challenges to economic growth in the country.

South Africa is classified as a developing country and is eligible to earn certified emission reduction credits under the Clean Development Mechanism. Emission-reduction (or emission removal) projects in developing countries can earn certified emission reduction credits. These saleable credits can be used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol, which was adopted in 1997.

1.3 Project Introduction

South Africa is primarily reliant on fossil fuels and coal in particular for the generation of power. Given the fact that existing and proposed new power plants have a lifespan in the order of 40 years it is vital that forward planning look beyond this window to ensure reliable power provision for generations to come. Much of the current power plants will need to be upgraded or replaced within the next two decades to uphold and increase the current power supply. The use of coal fired power stations is driven by the fact that it is a more cost effective method of generating power with higher short term cost benefits. In the longer term the coal resources will in time become depleted due to its non-renewable nature and coal fired power stations will become redundant.

South Africa's renewable energy potential and solar energy in particular, is enormous and is able to deliver sustained yields without the depletion of resources and the negative environmental impacts associated to the burning of fossil fuels as a drawback. The utilisation of renewable energy in South Africa to date has been limited to the off-grid sector but it has the potential to play a major role in the grid and this is outlined in the 2002 draft White Paper on Renewable Energy which suggested that an additional 10 000GWh of renewable energy

contribution should be achieved over ten years, i.e. 1000 GWh/yr, to be produced mainly from biomass, wind, solar and small-scale hydro.

SolarReserve SA (Pty) LTD intends to contribute to this target set by National Government with the construction and operation of a 100 MW CSP in the Northern Cape. The facility is intended to connect to the national grid and would deliver power consistently and reliably during peak and off-peak hours. Albeit a commercial venture the proposed CSP will fall within the targets set by National Government, produce clean energy, generate CDM credits in line with the Kyoto Protocol, feed into the national grid, create jobs, develop skills and on the whole assist with the alleviation of unemployment and the improvement of the standard of living for the people of South Africa by providing power which stimulates economic growth and development.

2 CHAPTER 2: PROJECT OUTLINE

2.1 Project Description

The following chapter provides a detailed overview of the proposed technology to be implemented for the generation of electricity at the CSP Plant.

SolarReserve SA (Pty) LTD is a subsidiary of SolarReserve LLC, one of the world's leading companies in the field of renewable energy generation. The renewable energy generation market faces two (2) fundamental problems – the first being scalability and the second the issue of electricity storage. SolarReserve SA (Pty) LTD has managed to bridge these problems with their CSP technology. CSP Plants draw their heat from the sun, an unlimited source of pure clean energy – and unlike wind and photovoltaic, the technology implemented by SolarReserve SA (Pty) LTD can be delivered as and when needed dependent solely on demand and not climatic factors. This feature of the technology allows SolarReserve SA (Pty) LTD to bridge the key barriers pertinent to renewable energy generation – scalability and storage.

The technology has been proven and substantiated by one of the world's leading technology conglomerates – United Technologies. Rocketdyne a subsidiary of United Technologies has demonstrated the technology at the Solar One and Solar Two Power Plants in Southern California. SolarReserve SA (Pty) LTD has been granted proprietary technology know-how and an exclusive worldwide license to develop CSP Plants based on this technology.

The CSP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) in an area of 1.1 million m^2. The tower is erected in an inner circle inside the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt up to580ºC, which then flows into a thermal storage tank for storage (maintaining 99% thermal efficiency).

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankine cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In order to reduce project's water consumption, a dry cooling system has been considered to condense the low pressure (LP) steam exhaust from the turbine.

2.2 Geographical Location of Site

SolarReserve SA (Pty) LTD, a renewable energy developer is proposing the development of a CSP - Thermal Power Plant with an electricity generation of 80 – 100 MW on the portion of Remainder of the remainder of the Farm 469 (Humansrus), Hay RD, within the Tsantsabane

Local Municipality and the Siyanda District Municipality in the Northern Cape. The proposed development site is situated approximately30 km east of Postmasburg and 20 km southeast of Danielskuil. The coordinate for the centre of the proposed site is 28°17'50.9399" S; 23°22'1.0715" E and it covers an area of 800 ha, which includes all ancillary facilities.

2.3 Surrounding and existing land use

The affected land portion where the CSP Plant is proposed is zoned as agricultural. The land is actively used for grazing of horses, cattle and game. The current land owner is actively mining red jasper on small scale are on the north-western boundary of the proposed site. The R385 road runs through the affected land portion to the north of the proposed site and a railway line runs through the affected land portion to the southwest of the proposed site. The surrounding land uses also include agricultural activities with the mining village of Owendale 2.5 km from the eastern boundary of the farm portion.

The fact that the affected farm portion is zoned agricultural hampers the subdivision or the rezoning thereof. In all likelihood a special consent use will be obtained for the operation of the CSP Plant on the affected portion due to the prohibition of the subdivision or rezoning of any agricultural land.

2.4 Site layout and infrastructure requirements

Infrastructure required for the construction and operation of the proposed CSP Plant includes *inter alia* the following:

2.4.1 Equipment and Facilities

- High voltage transmission line
- Access road from the R385
- Piping from [water wells/water utility company] to water treatment plant
- Control/Operations Building
- Administration/Maintenance Building
- Power Distribution Centre (Main Electrical Building)
- Steam Turbine Generator Building
- Steam Generator Building
- Molten Salt Storage Tanks
- Molten Salt Receiver System and molten salt pumps
- Concrete Tower

- Heliostats with Solar Field Control System
- Water Treatment Plant Building
- Generator Step-Up Transformer 11kV/132kV ~ 118 MVA
- Station Service Transformer
- Unit Aux Transformer
- 2 uninterrupted power supply (UPS) 3.5 MVA emergency diesel generators
- Balance of Plant (BOP) DC battery system
- Low voltage / Medium voltage (LV/MV) switchgear
- Revenue Meters and associate controls/relays
- Power and Control Cable from Power Distribution Centre to all heliostats
- Air Cooled Condenser [Hybrid], with air removal equipment, condensate collection systems, interconnecting piping and instrumentation
- Boiler Feedwater Pumps
- High Pressure feedwater heaters
- Low Pressure condensate heaters
- Deaerator and Storage Tank
- Condensate Pumps
- Auxiliary Cooling water systems; including Fin Fan Cooler, Wet service Air Cooler (WSAC)
- Close Loop Cooling water pumps
- Steam Cycle Chemical feed system
- Demineralized water storage tank and transfer pumps
- Combined service water/fire water storage tank and water transfer pumps
- Fire Protection pump skid for Power Block area includes electric and diesel fire pumps and electric jockey pump
- Demineralized Water treatment system
- Evaporation unit
- Potable water storage tanks and potable water pumps
- Plant Sampling system

- Surface water drainage system
- Evaporation ponds
- Oil/Water Separator and Plant Drain System
- Plant instrument and service air systems
- N2/Ar gas storage bottles and distribution manifold
- Plant worker safety equipment including showers and eye washes
- Fire Protection System
- Plant communications
- Plant Decentralized control system (DCS)
- Plant lighting
- Fencing
- Meteorological Station
- Visitor Center
- [Workers mancamp for operation]

2.4.2 Construction Services

- Any demolition work within site perimeter
- Construction safety equipment
- Construction trailers and service area
- Site lay-down, storage space
- Site security including temporary fencing
- Temporary construction power
- Temporary communication services
- Construction water from water wells/utility
- Startup and commissioning fuel and fluids
- Workers mancamp for construction
- Wash bays;
- Batch plant;
- Potential borrow pits for gravel for the access road construction.

As mentioned the facility will cover an approximate area of 800 ha and will house all the mentioned infrastructure and related services. The planned layout of the plant is shown in figure 1 below. The bulk of the surface area of the plant will be covered by the heliostats in a circular configuration. The concentration tower will be the focal point of all the heliostats and will be located slightly off centre to the north of the circular heliostat field, due to the fact that the project is in the southern hemisphere and reflects the solar rays optimally to the tower as such. All the ancillary infrastructure and facilities are to be located adjacent to the tower within the inner circle of the heliostat field.

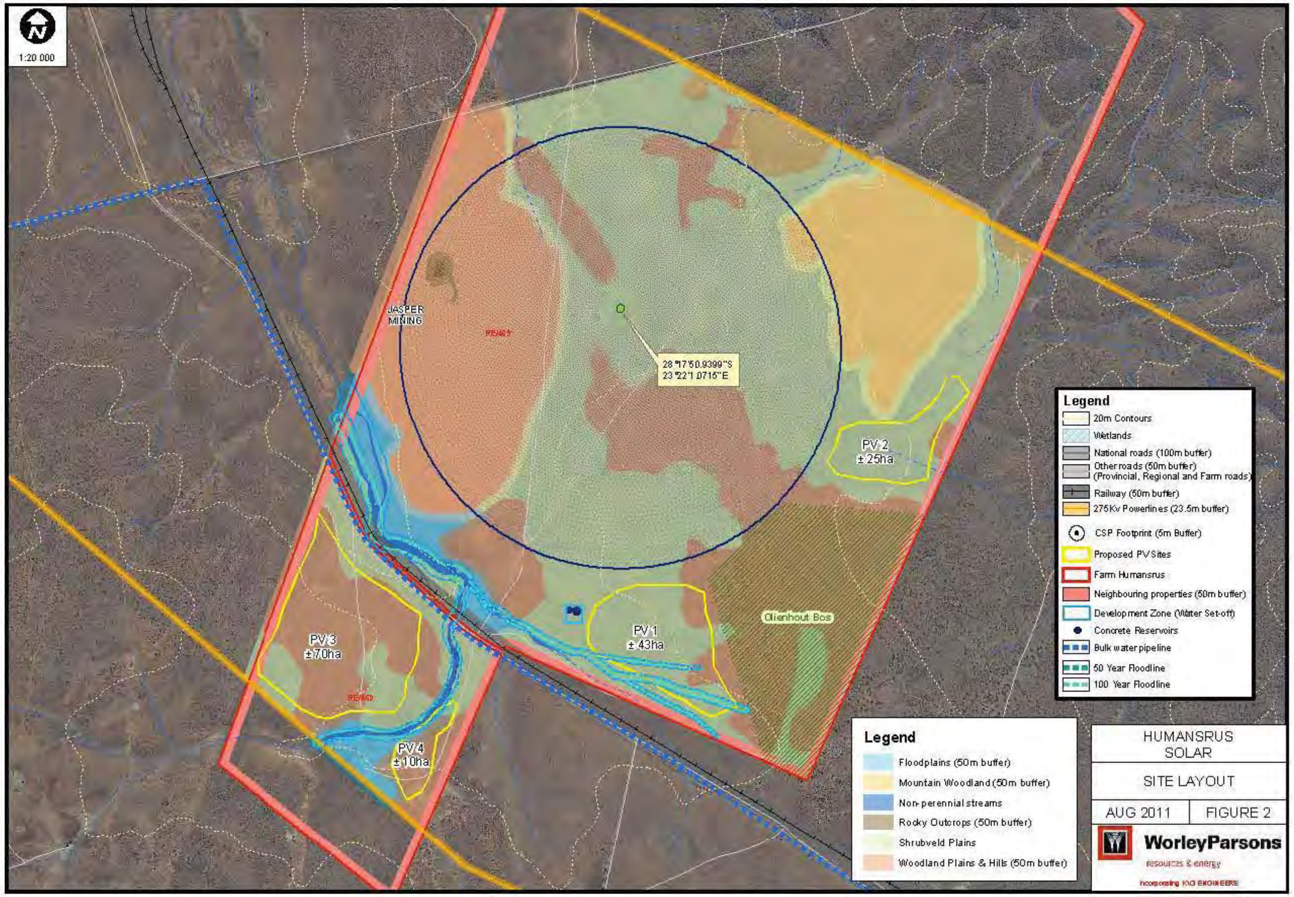


Figure 1: Site layout

3 CHAPTER 3: TECHNICAL PROJECT SPECIFICATIONS

The proposed project can be defined as a solar thermo-electric power plant that is embodied in the form of a CSP Plant. In short the electricity generation process can be summarised as follows:

- Heliostats reflect the solar radiation towards the central receiver tower where a large heat exchanger captures the solar heat.
- A molten salt mixture is pumped from the cold salt thermal storage tank to the central receiver where it is circulated in the heat exchanger until the temperature reaches 566ºC.
- The molten salt concentration is then transported to the hot salt thermal storage tank.
- Hot salt is pumped from the hot salt storage tank to the steam generator where heat is transferred from the salt to water in order to generate high pressure steam.
- The highly pressurised steam is then passed through a steam turbine, which is linked to an electric generator to generate electricity.

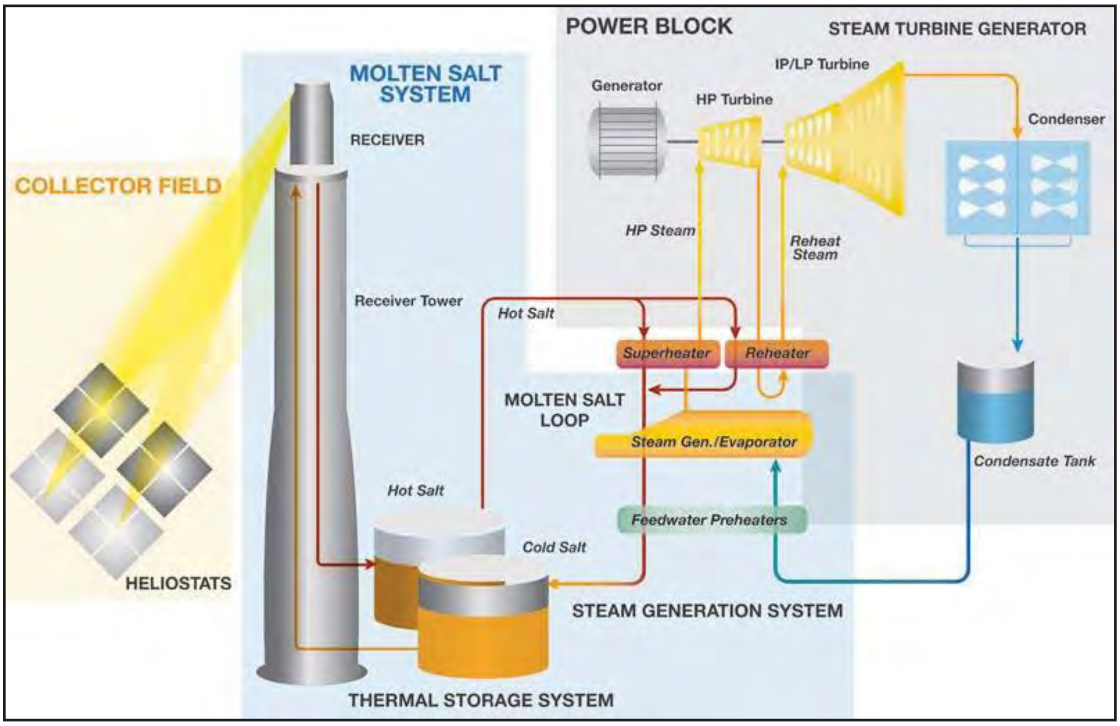


Figure 2: Basic process description

The CSP Plant can be divided into four main subsystems:

– The Collector Field - consists of all services and infrastructure related to the management and operation of the heliostats;

– The Molten Salt System- includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;

– The Power Block – consists of inter alia the steam turbine where the electricity is generated; and

– The Auxiliary facilities and infrastructure - includes the condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

3.1 Solar Field

The collector field will make use of a large number of mirrors, also called heliostats to reflect the solar radiation towards the solar receiver tower. It is expected that the collector field will be equipped with an estimated 17 350 heliostats, positioned concentrically to the solar receiver tower. As each of the heliostats occupy roughly 62 m^2 to 75 m^2 of surface area(depending on final design) it is projected that the solar field will have a diameter of approximately 2,620 m (2.6 km), creating an estimated 1,095,000 m^2 of mirrored surface around the solar receiver tower.

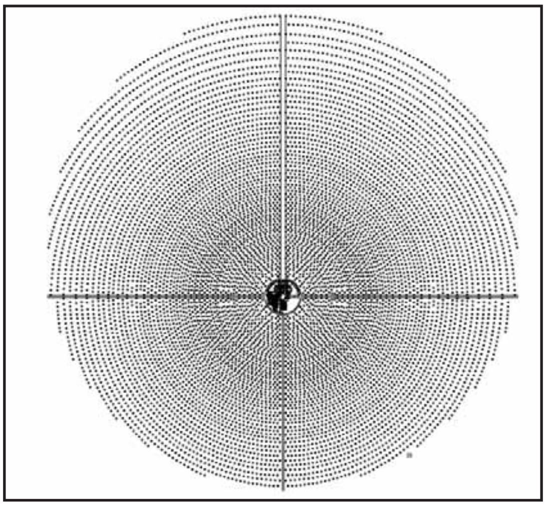


Figure 3: Layout of collector field (*left:* typical; *right*: for 17,350 heliostats)

All of the heliostats are automated and are designed to follow the sun’s path. The heliostats are controlled from a central control point. Heliostats will be positioned in such a manner that

optimum radiation reflection can occur, and so that no interference between heliostats can occur.

The collection system comprises the following elements:

- Heliostats;
- Monitoring and control system
- Power and communication connections.

3.1.1 Heliostats

The heliostats are composed of mirror modules, equipped with structural support components and two (2) motors for rotation purposes and a local heliostat controller, fitted at the base of each structure.

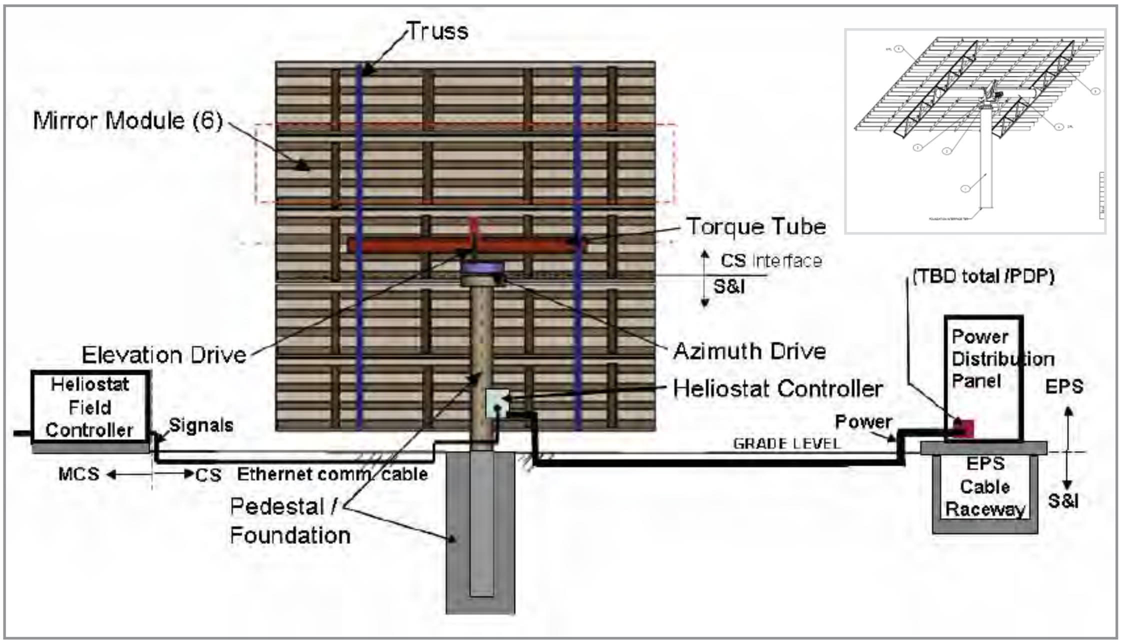


Figure 4: Components of a single heliostat assembly

The heliostat support structures are galvanised steel reinforcements that support the mirror modules and a tubular steel footing structure, planting the heliostat firmly on the ground. The heliostat structure is embedded in a concrete foundation and foundation design parameters will be revealed in the detailed Geotechnical Assessment. In ideal soil and geotechnical conditions the heliostat foundation parameters are 1m in diameter and 4 m below surface.

The dimensions of each heliostat will be approximately 8.5 m (width) x 7.3 m (height) over a 3.3 m tall pedestal.

3.1.2 Monitoring Systems

The monitoring and control system comprises of all the various systems and programs required to monitor the collection field – which includes the Heliostat Control Software (HCS) and the Beam Characterisation System (BCS).

The HCS can be defined as the active control system which manages the orientation of each heliostat as to ensure optimum solar radiation is reflected towards the solar receiver tower at all times. Orientation positioning is dependent on several factors –

- Time of day;
- Time of the year (day); and
- Operation mode. The operational mode will include Start-up, Normal operation monitoring, Closure and a series of abnormal operational conditions (i.e. loss of heliostat power etc.).

The BCS on the other hand will automatically calibrate the heliostats during plant operations by means of camera system installed in the solar receiver tower. This is done to ensure maximum efficiency of solar heat reflection. A total of 16 BCS cameras are expected to be installed in the solar receiver tower.

3.1.3 Power and communications

The power and communication connections includes the:

- Connection between the HCS and the controllers for the heliostats motors; and
- Electrical supply for the motorised-controllers for each of the heliostats.

3.2 Molten Salt Circuit

The molten salt circuit is a very important part of the CSP plant's design, as it increases the plant's ability to produce electricity all year round, during night and day times. The design of the molten salt circuit ensures that heat collected from the sun's rays can be transferred effectively to the power cycle, but it also ensures that this heat can be stored for relative long periods of time to provide the plant with a source of energy when the sun's rays does not reach the collector filed.

This circuit is designed to store up thermal energy during the day time, within the hot salt storage tanks, and then utilise the energy during the night time or periods when it is overcast. The unique properties of the molten salt ensure that it can reach very high temperatures at atmospheric pressures. Its relative high density and heat capacity further ensures that it is an efficient thermal storage medium in large quantities at such high temperatures.

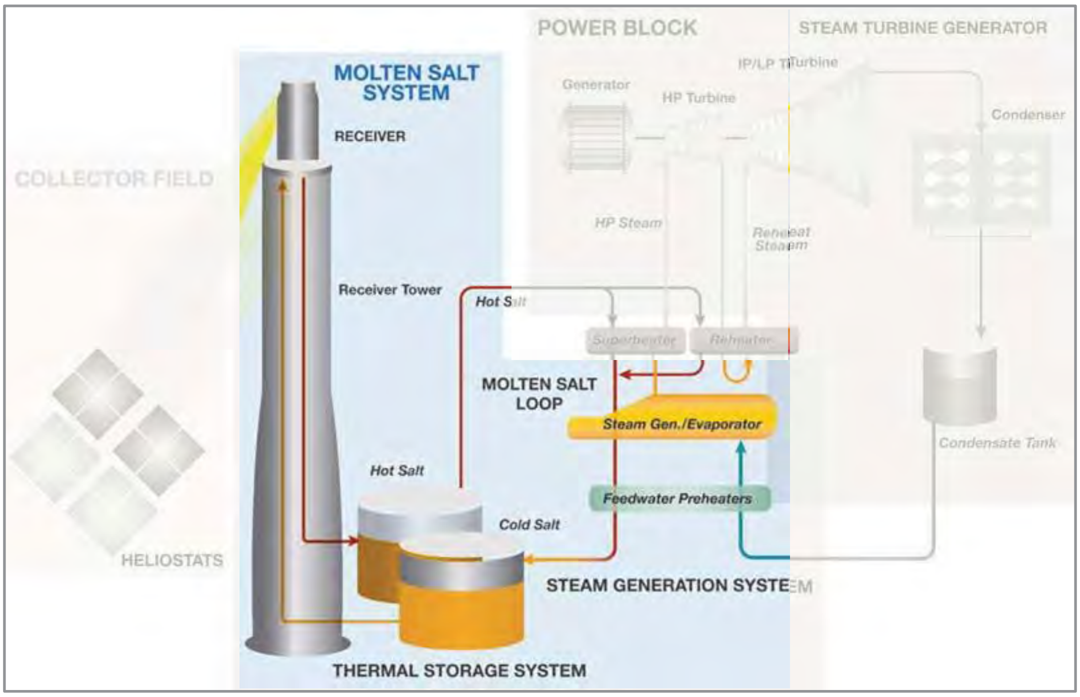


Figure 5: – Basic Process description – Molten salt Circuit

During normal operation the salt stored in the cold salt storage tank (at 288°C) is pumped to the top of the solar tower where it passes through a special heat exchanger assembly (this heat exchanger is the central point of focus for the beams of the thousands of heliostats). Within the heat exchanger the salt is heated to very high temperature (566°C) and then flows down the tower to the hot salt storage tank. From the hot salt storage tank it will be pumped to the steam generator to produce steam for the steam turbines. Once the salt passed through the steam generator and other heat transfer devices it has cooled down significantly to about 288°C and is is then pumped back to the cold salt storage tank from where it will repeat the cycle.

The molten salt system is a closed circuit system that operates separately to that of the steam generation system. The circuit consists out of all the infrastructure and equipment that is required to heat, mobilise and store the molten salt mixture for power generation. The molten salt circuit is designed based on gravitation feed principals – in the event of a leak or problem, a valve opens and the molten salt mixture is fed to the respective storage tank. This prevents to possibility that salt can solidify in the circuit if something goes wrong.

3.2.1 Salt Mixture

The salt mixture is comprised of sodium nitrate ($NaNO_3$) (60%) and potassium nitrate (KNO_3) (40%).This mixture of salts is used to ensure the salt stays molten at a wide range of temperatures. The salt mixture must be kept well above 238ºC to ensure it stays molten. When the salt is molten it is in a liquid state with a high viscosity and takes on the behaviour of water. It is furthermore very effective with regards to the storing of heat, given its thermal inertia. The plant will require approximately 35 000 tonnes of this salt mixture for normal operation.

After the initial fusion/melting of the salt during start-up, the salt remains in a liquid state and at high temperatures during the plants entire operating life, and is constantly reused in the system.

Table 1: Properties of molten salt (60% $NaNO_3$, 40%KNO_3) – from SAND2001-2010

Temp	Density	Specific Heat	Absolute Viscosity	Thermal Conductivity
Celsius	kg/m^3	J/ (kg K)	Pa s	W/(m K)
260	1924	1,491	0.043	0.493
288	**1906**	**1,499**	**0.036**	**0.498**
316	1888	1,503	0.029	0.503
343	1870	1,507	0.024	0.509
371	1852	1,511	0.021	0.514
399	1835	• 1,516	• 0.018	• 0.520
• 427	• 1817	• 1,520	• 0.016	• 0.525
454	1799	1,524	0.015	0.531
482	1781	1,532	0.014	0.536
510	1764	1,537	0.013	0.541
538	1746	1,541	0.012	0.547
566	**1728**	**1,545**	**0.011**	**0.552**
593	1710	1,549	0.010	0.558

3.2.2 Solar Concentration Tower

The Solar Concentration Tower is a tall concrete tower which supports the central receiver. It needs to be of sufficient height to ensure the central receiver is in clear view of all heliostats within the collector field. The tower has the following dimensions (based on preliminary design):

– Concrete Tower estimated at 164 m high.

– Solar receiver and crane – estimated at 36 m in height.

- Total Solar Concentration Tower - Height of tower with the solar receiver and crane: 200 m. high
- Size of the round base section: 35.05 m.
- Size of the round section in the upper sections: 26.37 m.

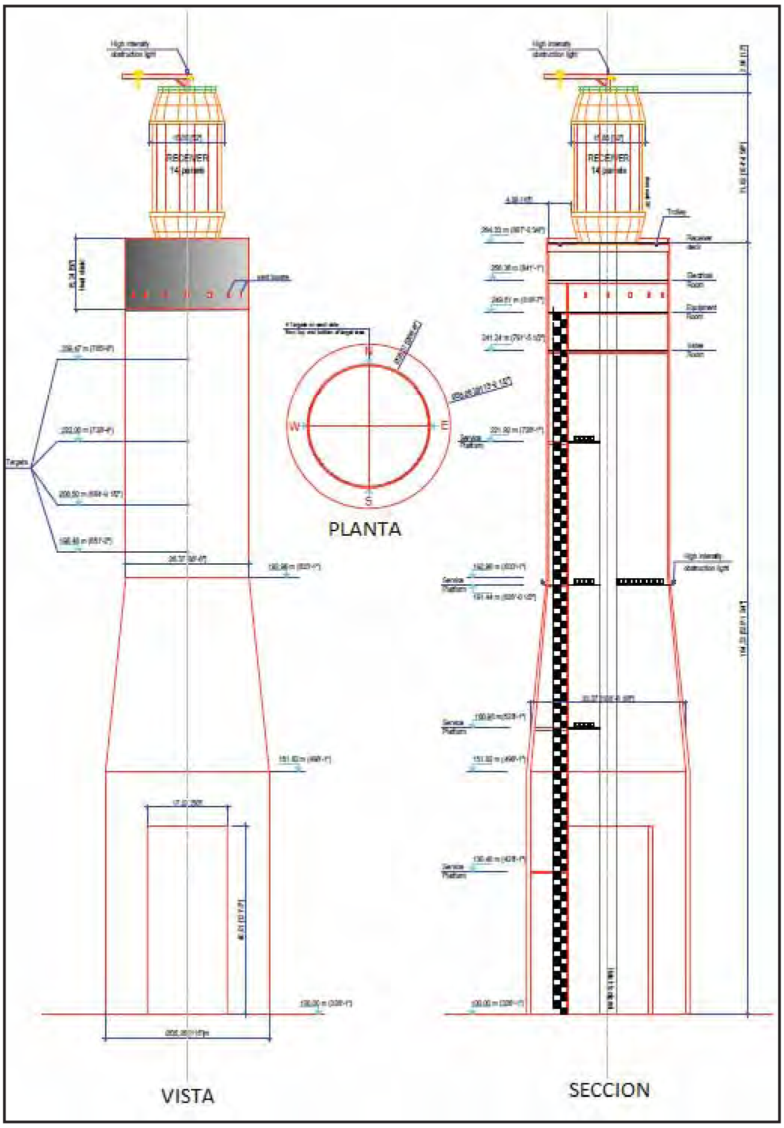


Figure 6: Solar Tower – Preliminary Design

The central receiver is a cylindrical heat exchanger approximately 16 m in diameter and 27 m high, which receives the solar energy as reflected from the heliostats and transfers it to the molten salt mixture. This receiver comprises of 14 panels which are attached to a steel structure.

High capacity solar radiation absorption paint is used to cover the sections of the receiver (panels) that are exposed to the solar radiation. It is estimated that the solar receiver will have a thermal yield of approximately 88%. The receiver is furthermore equipped with tube nozzle headers, tube supports, structural supporting frame, control equipment and instruments, piping to mobilise the molten salt to and from the storage tanks, valves, heating cables and an internal lift.

3.2.3 Thermal storage System

The storage system is comprised of two (2) molten salt thermal storage tanks – the hot salt tank and the cold salt tank. The hot salt storage tank is to be constructed from stainless steel, whereas the cold thermal storage tank is to be made of carbon steel. Both facilities have sufficient insulation, as well as electrical heat tracing, to avoid the loss of the salt mixtures thermal energy as it moves through the tanks.

Each storage tank has a capacity equivalent to the total volume of the salt stored for the plant, some 35,000 tonnes (based on preliminary calculations). This amount allows for up to 24 hours of electricity generation at the turbine’s maximum capacity. The tanks will be situated within a containment basin (or bund) designed to hold110% of the contents of a storage tank in the event of a possible leak.

Both tanks will be constructed on a concrete foundation with passive cooling so that the foundations do not surpass the concrete's temperature limits.

Each storage tank is roughly 12 meters high and 38 meters in diameter and has the capacity to store salt mixture for up to 24 hours. The roof of the storage tanks are domed and designed to operate at ambient pressure with an ambient temperature of 38ºC and a salt temperature of 580ºC. The hot storage tank will have a slightly higher capacity to that of the cold storage tank.

3.2.4 Molten salt pumps

The molten salt mixture is circulated through the plant by means of special molten salt pumps.

The cold storage tank is equipped with four (4) pumps positioned parallel to one another in the upper section of the tank for the circulation of the molten salt mixture. Three of the pumps are operational whilst the fourth is merely a backup pump. The pumps operate at a flow rate of 4 573 tonne/hour; a temperature of 288ºC and under a pressure of 21 bar. The pumps are rotated on a regular basis to ensure continuity and reliability.

The hot storage tank only has three (3) pumps that circulate the molten salt mixture from the tank to the steam generator. Two (2) of the pumps are operational with the third pump being a backup pump. The pumps used for the hot storage tank, like that of the cold storage tank, are also situated in the upper section of the tank and positioned parallel to each other.

The operating conditions for the hot storage tanks are subject to a flow rate of 1 143 tonnes/hour, a temperature of 566°C and a service pressure of 9 bar. Again, as with the cold storage pumps, the hot storage pumps are rotated on a regular basis to ensure continuity and reliability. In the event of pump failure, the reserve pump can be utilised.

All of the salt system pumps have a vertical design, with extended axles of some 15.5 metres and operating with a frequency converter.

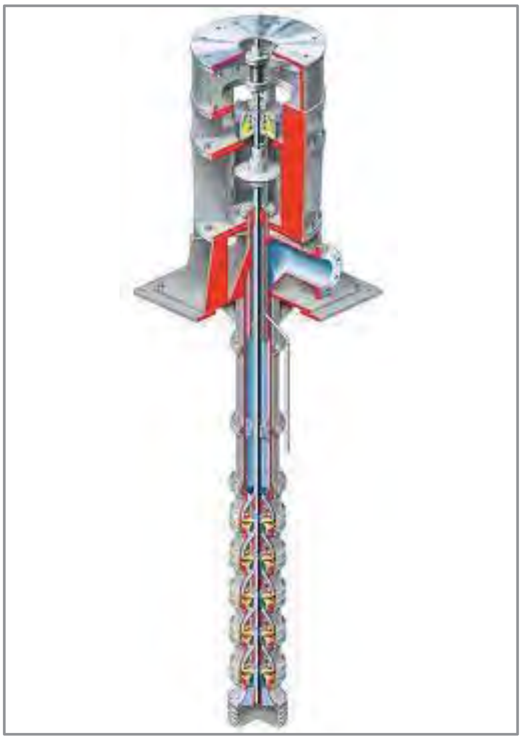


Figure 7: Example of a vertical molten salt pump (*from Flowserve*)

3.2.5 Auxiliary salt heater (Salt melter)

The salt melter is comprised of an insulated tank that will be heated by combustion of natural gas (or alternatively diesel). During plant commissioning the solid salt mixture is brought to a temperature between 288°C and 370°C (at least 50°C above its melting point of 238°C) and then pumped out of the salt melter into a secondary gas-fired heater and further elevated in temperature to a range required for the final conditioning process. The initial melting and heating process is expected to operate continuously, 24 hours per day and 7 days per week,

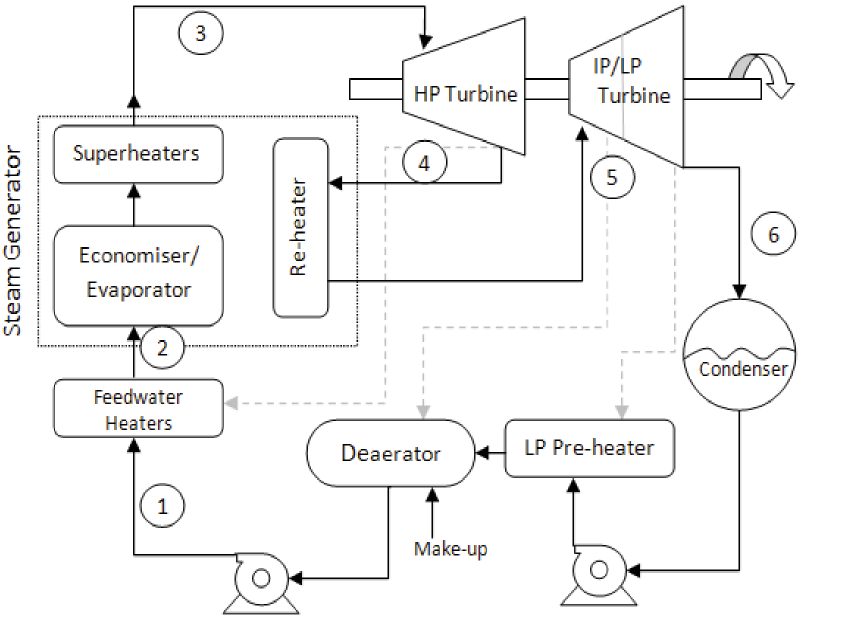
until the plant's total inventory of approximately 35 000 tons of salt has been melted. Salt melting is expected to take approximately 70 days.

After melting and conditioning the salt is pumped to the salt storage tanks.

The auxiliary salt heater will potentially also be used as a back-up system that provides additional heat to the plant in severe cases where the salt’s thermal storage is not sufficient to keep generating power.

3.3 Power Block

The function of the power block is to turn the stored solar energy into electrical energy. This will be achieved through a conventional Rankin Cycle, as used on most power plants worldwide.



		1	2	3	4	5	6
Pressure(a)	(Bar)	145	122	116	34	31	0
Temp	(°C)	163	246	540	359	541	51
Flow	(t/hr)	380	380	380	341	341	268

Figure 8: Simplified Rankin Cycle process diagram (preliminary values)

The process starts with water which is fed from a condensate tank and a make-up source into a de-aerator which removes all traces of oxygen or entrapped gasses from the water. The water is then pressurized with feed pumps and fed through a number of heat exchangers to

transfer as much as possible of the energy stored in the molten salt to the steam cycle. Super heated steam (at ±540ºC and 116 bar) is then passed through the High Pressure turbine. There after the steam is reheated and then passed through the intermediate and low pressure turbine stages. The turbine spins at very high revolutions and drives the electrical generator in order to deliver electricity to the plant's substation. Steam exiting the low pressure turbine is directed through coolers which condense the steam back to water.

The main components of the power block are described in more detail.

Steam is generated by means of a steam turbine with an intermediate re-heating application. The specifications for aforementioned re-heaters in terms of the CSP Plant in questions are as follow –

3.3.1 Pre-heating system

The pre-heating system can be defined as the cycle in which the condensate is heated to the optimum temperature for steam generation purposes. The system comprises of the following:

a) Low pressure water/steam pre-heaters

Three low pressure pre-heaters are positioned in sequence. The pre-heaters are of shell and tube arrangement. These pre-heaters use steam from various specific extraction points on the steam turbine to pre-heat the condensate before it enters the de-aerator.

b) De-aerator

The CSP Plant is equipped with a de-aerator in order to remove oxygen and any other entrapped gasses within the feedwater of the steam cycle. Such gasses can cause serious damage to piping and equipment in the long run if not removed. The de-aerator uses extraction steam from the steam turbine for heating and to aid the de-aeration process. The process also serves to preheat the condensate and to store it as source of supply to the steam generator feed pumps.

Deionized cycle makeup water is introduced at the inlet of the de-aerator to allow for heating and deaeration. Cycle makeup water is necessary to compensate for system losses, primarily due to steam drum blowdown.

The de-aerator head will be fitted with adequate safety valves to ensure pressure is maintained and that in the event of over pressurising the excess pressure is released. The system is furthermore fitted with a vacuum-breaking valve which guarantees that the feedwater tank never depressurises.

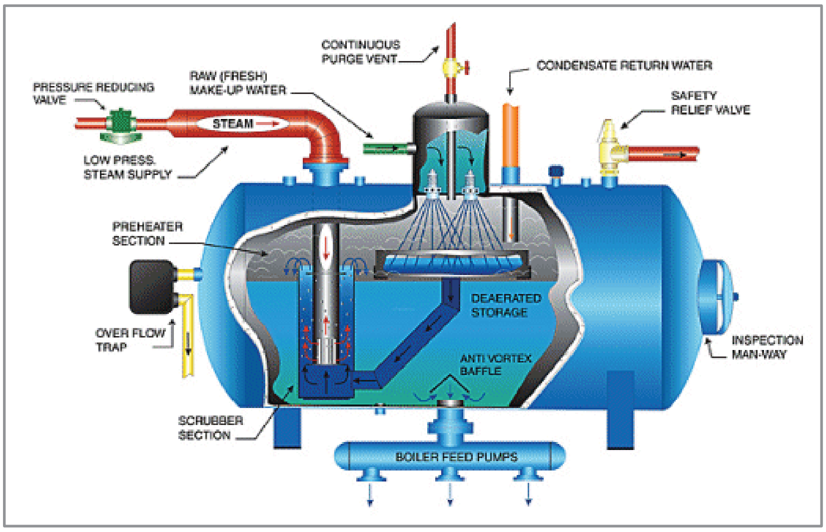


Figure 9: Typical deaerator (*from Hurst Boiler*)

c) Feedwater Pumps

The feedwater pumping system will deliver feedwater to the steam generator and comprises of three horizontal centrifugal pumps, each with a 50% capacity. The pumps will draw feedwater from the de-aerator tank and transfer it to the steam generator by passing it through the three feedwater heaters. These are powerful pumps which need to deliver water at very high pressures.

d) Feedwater-heaters

From the outlet of the deaerator the heated condensate is pressurized via feedwater pumps and then passed through 3 high pressure feed water heaters in series. The first 2 heaters are heated with steam extracted from specific extraction points on the high pressure and intermediate pressure turbines, while the third is heated with steam from the steam drums within the steam generator.

3.3.2 Steam Generator system

The steam generation system is the core of the steam supply system for the power block and consists of an economizer, evaporator, two superheaters, and two reheaters. High pressure feedwater enters the system from the feedwater heaters, passes through the economizer, the

steam drum, through the evaporator, back to the steam drum, and leaves as saturated steam that subsequently flows to the superheaters. Superheated steam passes through the HP steam turbine and is exhausted to the reheaters. Reheat steam is then directed to the inlet of the IP turbine. Hot salt pumped from the hot storage tank enters the shell side of the steam generation system heat exchangers and flows through the superheaters, reheaters, the boiler and finally the economizer. The salt is then directed to the cold storage tank.

The steam generation system components are described more in detail below:

a) Economizer –

The economizer is a shell and tube design heat exchanger. High pressure feedwater enters the economizer tubes from the feedwater heaters and is directed from there to the evaporator steam drum.

b) Evaporator

Feedwater from the steam drum is transferred by a recirculation pump to the evaporator section to produce saturated steam. Saturated steam from the evaporator section is directed back to the steam drum. Moisture separators in the steam drum help to remove moisture droplets from the steam as it passes on to the superheater. The evaporator tubes receive heated, high pressure feedwater from the steam drum via the recirculation pump and evaporate the water into saturated steam. The evaporator section is a shell and tube design heat exchanger. The saturated steam leaving the evaporator section flows back to the steam drum.

c) Super heaters and Reheaters

The saturated steam flows through the tubes of the shell and tube design superheater to heat the steam to the desired temperature and pressure for steam turbine operating conditions. The reheater receives “cold” outlet steam into its tubes from the high pressure turbine exhaust and reheats the steam before being reintroduced into the intermediate pressure turbine.

3.3.3 Steam turbine Generator

The steam turbine generator system consists of a multi-stage, reheat, condensing steam turbine generator (STG) with extraction, a gland seal steam system, lubricating oil system, hydraulic control system, and steam admission and control valving. Once the pressurized steam has reached the optimum temperature in the superheater, it flows to the steam turbine, which converts thermal energy in the steam into mechanical power (rotation), driving an attached power generator. Superheated steam is expanded through the high-pressure stages of the turbine, is routed back to the steam generation system where it is reheated, and then returned to expand through the intermediate and low-pressure turbine sections. On exiting the turbine, the steam is directed into the air cooled condenser.

a) Steam turbine auxiliary systems

The steam generation system is supported by various auxiliary services which needs to be maintained. These services include the –

- Control and shut-down valves for the primary steam generation system and re-heater.
- Lubrication oil system.
- Hydraulic oil system.
- Gear box.
- Steam sealing system.
- Turbine and generator control system.
- Earthing system and electric protection equipment.

b) Steam turbine control system

The turbine set as well as the auxiliary systems will be equipped with its own control system, which is to be integrated into the DCS of the plant. The control system will be a standard control system and will be obtained from the turbine suppliers. The primary functions of this system will be for–

- Protection and triggering due to over speed.
- Protection and triggering of the turbine.
- Oversight of the field instrumentation associated with the turbine.
- Monitoring of the position of the shaft.
- Monitoring of the eccentricity of the rotor.
- Monitoring of the expansion of the casing.
- Monitoring of thermal fatigue.
- Monitoring of the temperature of the metal of the bearings.
- Frequency control.
- Control of the control valve position.
- Control of the extractions from the turbine.
- Maximum and minimum speed limiter.
- Limitation of maximum admission pressure.
- Limitation of counter pressure.

– Maximum and minimum power limiter.

– Seal steam pressure control.

– Hydro-electric control system

– The emergency shut-down valves and the main control valves will regulate the operation of the turbine as per the required operational conditions. The control system is designed to ensure the turbine retains power based on demand, by means of opening and closing the control valves as per the control room instructions.

c) Steam bypass system

In the event of the turbine being not operational or has tripped for some reason, the steam generated by the steam generation process will be fed into a bypass steam circuit. This bypass circuit sends the steam directly to the condenser, bypassing the turbine.

The bypass circuit consists of a –

– High pressure bypass turbine, which transfers high pressure steam from the super-heater to the re-heater, and

– A low pressure bypass turbine, which transfers reheated steam to the cooling system.

Each bypass circuit is fitted with pressure and temperature control valves. The pressure control valves reduce the steam pressure and the temperature control valves control the steam temperature by injecting feed water from the boiler into the high pressure turbine's bypass circuit in order to cool the steam down. The reheated steam on the other hand is cooled down via a diffusion conduit.

3.3.4 Air cooled Condenser

Air cooled condensers are used to cool and condensate steam exiting the low pressure steam turbine. The air cooled condenser is designed to cool the steam cycle with ambient air which is forced across its radiators As steam output is air cooled a difference in air temperature and pressure will be recorded. The steam output will vary according to ambient temperature and the air flow in the air cooler. The condenser consists of the following:

– Packages of tubes with finned heat exchanging surfaces (also called radiators);

– Axial fans, with gearbox, couplings and motors;

– Output conduit for the steam turbine, steam distribution pipes and expansion joints;

– Windbreak between cells and outside enclosure;

– Steel support structure;

– Condensate tank;

– Complete system of accumulation and discharge of the condensate;
– Vacuum pumps and accessories;
– Regulation and measurement equipment;
– Conduit cleaning system;
– Protection systems; and
– Instrumentation and accessories.

3.3.5 Auxiliary cooling system

The CSP Plant will be equipped with a closed circuit cooling system for all auxiliary components. The primary inputs of the cooling system will be a mixture of demineralised water and propylene glycol and will consist of the following component –

– One (1) air-cooler at 100% capacity (fin-fan cooler) (optional);
– One (1) wet-surface air-cooler;
– Two (2) water cooling pumps, each at 100% of the total system capacity; and
– Pipes, valves, instrumentation, etc.

Vitally important to the plant is the fact that the primary cooling system is a dry-based cooling system, which does not require water. The auxiliary cooling system, as specified above, however includes a wet surface air-cooler, and is used for the cooling of all equipment i.e. pumps, alternators etc. that does not form part of the output cycle of the turbine. The pumps will be manufactured from materials that can withstand wear and tear with regards to the liquid being transported therein. The same manufacturing principle will be applied to the motor chosen to drive the pumps – it will be designed and configured in such a manner that is always operating at the most optimal point of the curve without the motor being overloaded.

The aforementioned infrastructure will be constructed on a carbon steel base structure which is designed to bear the full weight of the equipment. These will then be cast onto a concrete foundation.

3.3.6 Generator/Synchronous Motor

A synchronous self-exciting brushless generator will be employed, that is suitable for parallel operations. The generator functions by means of an armature winding when excited by a poly-phase (3 phase) supply, creating a rotating magnetic field inside the motor. The field winding locks in with the rotating magnetic field and rotates alongside it.

During operation the motor is said to be in synchronisation once the field locks in with the rotating magnetic field. These types of motors are not self-starting and only start functioning once power is supplied to the motor.

The main characteristics of the generator are as follows:

Table 2: Generator characteristics

Generator Characteristics	
Nominal power	±115MVA (preliminary)
Nominal Voltage	11 kV +/-5%
Frequency	50 Hz
Motor protection	IP 44
Insulation class	F
Temperature increase	F
Power factor	0,9

3.4 Auxiliary facilities and Infrastructure

Over and above the infrastructure and equipment requirements directly related to the operations of the CSP Plant, several auxiliary facilities and infrastructure also needs to be constructed and implemented. These facilities and infrastructure will support the daily operations of the CSP Plant by their various operation related functions, by producing inputs i.e. water, treating products generated by the plant, facilitating or housing of operations staff etc.

3.4.1 Water treatment plant

The technology used for the CSP Plant is highly sensitive and requires that all water used during operations conform to a rigorous water specification. As all raw water entering the plant must be treated prior to use in the plant a water treatment plant will have to be constructed. The main water treatment subsystems will include the following components (These are also depicted on the water balance PFD in Appendix 1):

a) Multimedia Filter

The Multimedia Filter (MMF) contains multiple types of media with the coarse media layers in the top of the tank to trap large particles, and successively smaller particles trapped in the finer layers of media deeper in the bed. A coagulant will be introduced before the MMF inlet to capture fine particles for ease of filtration in the MMF. The multi-media filter is backwashed using reverse or upward flow of water through the filter bed. The various layers of media retain their stratification because each material has a different density.

b) Reverse Osmosis

The Reverse Osmosis (RO) system is a filtration process that works by using pressure to force water through a membrane, retaining the contaminants on one side and allowing the

pure water to pass to the other side. The RO will include an additional concentration step for RO serving to treat the waste from the main lines and reduce by a maximum the final waste from the system An anti-scalant and dechlorinator will be injected upstream of the RO skids to reduce the cleaning cycle of the membranes.

c) Electrodeionization

Electrodeionization (EDI) is a continuous and chemical-free process of removing ionized and ionizable species from the water using DC power. EDI is used to polish the RO permeate and to replace conventional mixed bed ion exchange, which eliminates the need to store and handle hazardous chemicals used for resin regeneration and associated waste neutralization requirements.

In order to treat the raw water to be used in the CSP Plant several key facilities and infrastructure will have to be constructed and installed.

The auxiliary equipment needed for water treatment include –

- Reagent-dispensing systems;
- Pumps with filters;
- Filters, filter washing pump, blowers for washing filters;
- Cartridge filters and high-pressure pumps;
- Measurement systems: flow meters and pressure gauges;
- Reverse osmosis support frame;
- Membrane cleaning system;
- Electro-deionisation module; and
- Storage tanks for water of different qualities (stabilised, filtered, osmotically-treated and demineralised waters)

3.4.2 Wastewater recovery plant

An evaporator unit designed to treat the final waste amount for recovery purposes will be implemented at the end of the stream line. A 6 effect evaporator was selected with a flow rate of 10 m^3/h, the evaporator reject will be discharged at the evaporation pond

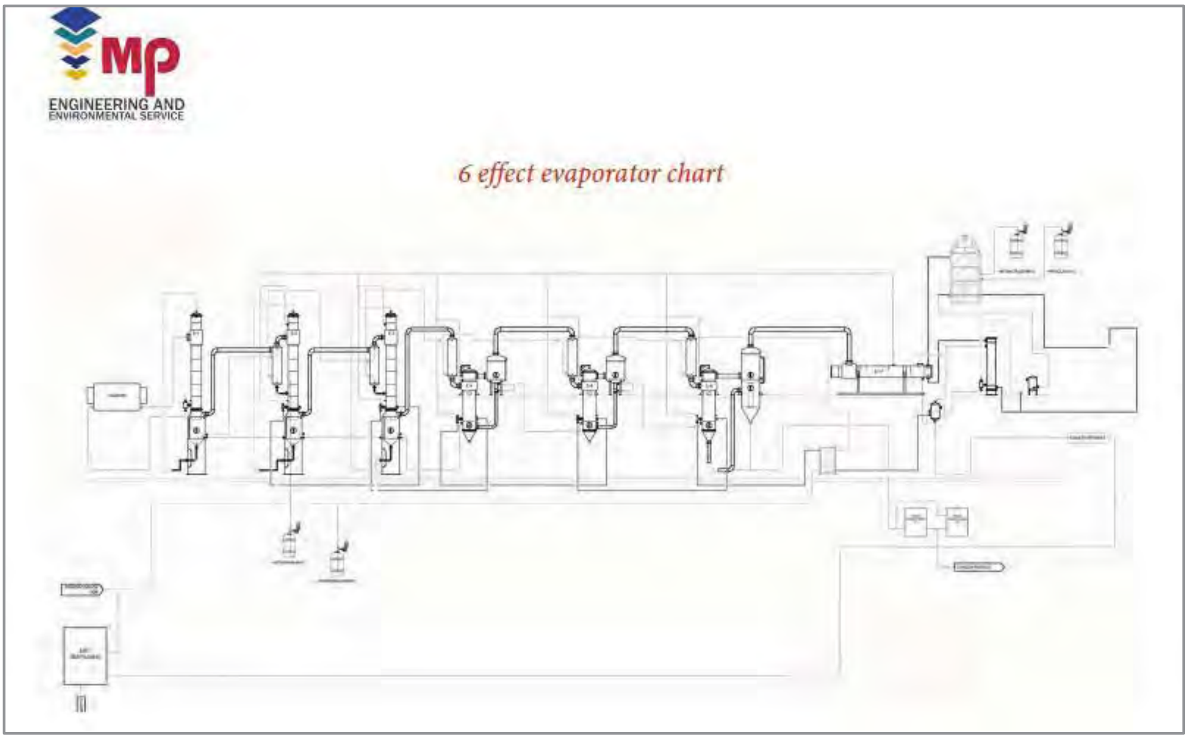


Figure 10: 6 Effect evaporators

3.4.3 Wastewater purification plant

The CSP Plant will generate several forms of liquid effluent as part of operations. The primary effluents sources generated include –

– Wastewater from the evaporation plant;

– Contaminated surface water i.e. stormwater and rainwater; and

– Sewage effluent.

For a 50MW - 100MW plant it is estimated that the total volume of discharge, inclusive of sewage water and evaporation system discharge is roughly 72 700 m^3 per year. As the proposed plant is estimated at generating 30 – 50MW more electricity these volumes can be expected to almost be double. The plant is thus expected to generate between 116 320 and 145 400m^3 per annum.

The Wastewater Purification plant will source the wastewater from four independent intake (feeder) systems as per the different types of wastewater.

– System 1 will collect all the containment surface water (stormwater).

- System 2 will be responsible for transporting all sewage effluent to the biological treatment system. This treatment system consists of a septic tank and biological filter.
- System 3 will transport the wastes generated during the evaporation process to a wastewater treatment plant.
- Lastly, a system will be designed to collect stormwater (surface water), which will be sent to a drainage pool before it is discharged.

The treatment options for the four systems are based on the types of effluent to be treated. The following treatment options have been defined for each source of effluent –

- Contaminated water treatment system will be installed to separate both clean and dirty surface water where after the different types of grease/hydrocarbon products will be treated and clean surface runoff diverted away from site.
- A biological treatment system will be implemented to treat the sewage effluent from the offices.

3.4.4 Site Access

Infrastructure located in the vicinity of the proposed development include –

- The road R385, extends between Lime Acres Mine and Postmasburg, and passes by on the northern boundary of the farm.
- A gravel road D3381 which extends to Lime Acres, runs along part of the western boundary of the site.
- A railway line runs adjacent to the western boundary of the site;
- A level-crossing over the railway line in the southwest of the site; and
- A 66 kV electricity transmission line runs parallel to the railway on the western boundary of the site.

a) Road Access

The site can be accessed from either the R385 (Postmasburg to Lime Acres) located on the northern boundary of the site or the D3381 to Lime Acres running along part of the western boundary of the site.

Upon entering the property several existing farm roads are noticed. These farm roads require upgrading for project purposes and it is envisaged that several new gravel roads may have to be constructed to facilitate movement of construction and maintenance vehicles.

- Length of roads (to be confirmed in following design phases)
- Width of roads 7.14 m

– Access points (to be confirmed in following design phases)

b) Rail Access

A railway line runs adjacent to the western boundary of the site, with a level-crossing over the railway line in the southwest of the site.

3.4.5 Water Consumption and discharge

Water plays a critical role in the day to day operations of the proposed CSP Plant and significant volumes of water will be required during both the construction and operational phase of the proposed development.

a) During Construction

During the construction phase water is needed to ensure and maintain soils/surfaces are kept hydrated (wet) during earthmoving operations as to prevent dust generation. For a 100 MW CSP Plant it is estimated that roughly 117 500m^3 of water will be required for the entire construction phase, which is estimated to run over a period of 30 months. The volumes of water required during construction can be divided into the following areas of consumption/uses –

– Dust control: Dust control needs to be administered in the working areas. And estimated 242m3 of water is required per day (precipitation included) for a 100 MW plant. Roughly 42 350m3 of water is required for dust control purposes throughout the entire construction phase.

– Irrigation: For the compacting of and/or stabilisation of roads and excavations including the power block and heliostat field. A bowser truck will be used when required for the execution of this task. However as the volume of water required is dependent on the soil conditions and more information is required in this regard only an estimation in this regard can be presented. It is estimated that 51 100m3 of water will be required for the execution of this task.

– Heliostat cleaning: The cleaning of heliostats is vital to the effective operations of the CSP Plant. Heliostats are to be cleaned with demineralised water – and it is calculated that 76 liters of water is required per heliostat. The heliostat field comprises of 17 350 heliostats each requiring 76 liters of water equating to 1 318 600 liters.

– Human use and consumption: Potable water is required for human consumption during the heliostat construction and erection phase. It is estimated that roughly 3.8 liters of potable water

– Testing purposes

– Water demineralised

– Raw Water

– Contaminated Water

– Sewage & Effluent

b) During normal operation

During normal operational conditions the CSP will require approximately 272,400 m^3 per year with peak consumption of approximately 44.5 m^3/hr. The plant operates on dry cooling as well as hybrid cooling depending on power plant operational point and cooling requirements. This provides an optimal solution between achieving required plant efficiencies and using as little as possible water.

The plant is also optimized to re-use water where possible and the total system discharge from the plant is fed to an evaporation pond, yearly total approximately 59 600 m^3. The balance of water is either evaporated or used in plant washing functions and operational consumption.

The table below shows the water usage for both cases, Hybrid cooling and dry cooling.

Table 3 Operational Water Usage (See Appendix 1 for PFD)

Stream No.	Stream Description	Hybrid Cooling (m^3/h)	Dry Cooling (m^3/h)
1	Water Supply - Drinking Water Quality	44.49	11.34
2	Filtered water	43.15	11.00
3	Filter wash water	1.33	0.34
4	Fire Protection Water	0.00	0.00
5	Domestic Water	4.00	4.00
6	Sanitary Consumption	0.16	0.16
7	Septic System	3.84	3.84
8	Service Water	3.00	3.00
9	Process Consumption	0.10	0.10
10	Eyewash/Safety Showers	0.00	0.00
11	Oil Water Separator	2.90	2.90
12	Water Treatment System	17.04	4.00
13	RO Water	12.86	3.39
14	RO Brine	2.31	0.61
15	Demin Water	12.61	3.32
16	EDI Brine	0.25	0.07
17	Solar Field Mirror Wash	3.32	3.32

Stream No.	Stream Description	Hybrid Cooling (m^3/h)	Dry Cooling (m^3/h)
18	Make up	11.77	0.00
19	Steam Loses	2.35	0.00
20	Steam Generator Blow Down	9.42	0.00
21	Quench Water	4.71	0.00
22	Vent to Atmosphere	4.71	0.00
23	Blowdown + Quench to Evaporator	9.42	0.00
24	Septic Water to Evap. Pond	3.84	3.84
25	Oil Water Separator to Evap. Pond	2.90	2.90
26	Water Treatment Brine to Evaporator	2.57	0.68
27	Demin from Evaporator to Demin Tank	2.49	0.66
28	Evaporator Brine	0.08	0.02
29	Evaporation pond	6.82	6.76
30	Cooling Tower Makeup	14.40	0.00
31	Cooling Tower Evaporation	12.47	0.00
32	Cooling Tower Drift	0.06	0.00
33	Cooling Tower Blowdown	1.87	0.00

3.4.6 Administrative Facilities

Additional facilities to be constructed as part of the CSP Plant operational phase include –

– An office building will be constructed for administrative purpose to serve as a centre for project support staff during operations.

– Warehousing;

– Laboratories;

– Training facilities;

– Medical Facilities;

– Ablution facilities;

3.4.7 Storage facilities

It is proposed that the storage facility will have a dual function – during construction this facility will be used for assembly and constructing of the heliostats and when the facility is operational it will serve as a storage facility. The storage facilities during operation will serve for the:

– Storage of general materials
– Storage of Hazardous material
– Storage of Salts.

Salts will be delivered in solid form in one-tonne bags and stored in this facility. The salts will be heated and liquefied for use in the plant as and when required.

3.4.8 Security Infrastructure

The site will be secured at all times, day and night. A security or site access office will be located at the entrance of the CSP Plant to restrict access. The entire site will furthermore be fenced off for security purposes.

3.4.9 Fire protection system

A fire protection and prevention plan will be prepared for both the construction and operational phases of the project. The primary aim of this system will be to preserve and protect human life as well as tangible goods and equipment in the event of a fire. The fire protection system will employ measures to reduce the occurrence of fire in the event of an explosion as well as to contain and prevent fires from happing or entering the site/plant.

The fire protection and prevention plan will define and delineate the various appropriate emergency exits, identify safe zones (buildings), identify possible sources of combustion as well as to address and present measures of mitigation in the event of a fire.

During construction the CSP Plant will be services with an intermediate fire protection system which will entail an auxiliary pressure pump, fire extinguishers and other portable fire-fighting equipment.

The fire protection system will consist of a water distribution system which aims to curb and restrict fire, in the event of occurrence. Water will be stored in the fire protection system tank and will be sourced from the raw water storage tank. The raw water tank will be fitted with a safety water level. This water level will serve as indication to the plant as to when no raw water is available for use in the water steam cycle, as it is exclusively assigned for fire fighting and protection measures.

The volume of water required for this purpose will be defined by the areas specific character and localities standards.

The fire protection system is fed by two (2) water feeding pumps (electrical and diesel), which will supply the pipe network with the allocated and required water. A small jockey pump will maintain the pressure in the pipe network. The diesel pump is a precautionary measure, and will be designed to commence with operation if and when the jockey pump no longer has the capability to maintain pressure in the pipe network. This pipe network will feed the hydrants situated throughout the plant.

3.4.10 Control and instrumentation system

The control and instrumentation system will be based on a SCADA (Supervisory control and Data Acquisition) distributed control system. This SCADA system consists of PLC (Programmable Logic Controllers), hardware and software, field instrumentation, weather stations and communication devices designed for the monitoring and control of the plant's historical data. A control room will be constructed wherein this system will be housed. Over and above the SCADA the control room will also be equipped with an Ethernet network. All in all the control room will be equipped with the following equipment –

- Web Server;
- SOE Recorder;
- Domain Controller;
- HMI Server Historian;
- Engineering post 1;
- Control room;
- Printers;
- Operation post 1;
- Operation post 2;
- CCTV; and
- Engineering post 2.

The control room will be linked with the fibre optic network of the control equipment of each of the plant's systems via the Human Machine Interface (HMI) Server Historian and two Ethernet switches.

- Turbine system - EHC system
- Steam generation system - DCU system, linked via fibre optics to the control systems for the salt storage tanks, both cold and hot.
- Receiver - DCU system; includes an HMI interface.
- Monitoring of the heat control signal.
- Control system for the electric part, transformer, and protections.
- Control system for the plant's electric production.
- Control system for the air-cooled condenser.

All of the data collected will be sent to the control room via a communication network (fibre optic/copper cabling).

3.5 Electric system

The site is currently served by an existing 132 kV transmission line, which traverses the site in an east to west direction. The connection point is at pole number WO189-2 where a 25kVA pole mounted transformer is installed. This connection line and point is however insufficient to serve as either EG feed in point to Eskom or as LPU connection point for the site, thus the installation as detailed in the next paragraph is proposed.

3.5.1 Transmission Information

There is an existing 132 kV sub-transmission line running parallel to the railway line on the southern boundary of the site.

It is proposed that a 132kV loop in-loop out (LILO) sub-Transmission line be installed by Eskom (this will be done via the payment of bulk contributions by the client) to a substation which will connect the new facility to the national grid. A 132/11kV (step-up / step-down) substation will be constructed as close as possible to the generation plant to facilitate the transfer of between 80 to 100 MW of generated power. The new 132kV O/H lines will be constructed along the most direct route (taking environmental constraints into consideration) between the generation plant and the existing 132kV Eskom O/H line; this means that these lines will cross over existing railway lines and roads.

3.5.2 Substation and General Requirements

Currently there are no direct substation access points on the site, and it is proposed that a substation be constructed on the farm Humansrus to provide this service as part of the proposed development. The purpose of this substation is to facilitate connection of the CSP Plant to the national grid via the existing 132kV transmission lines. The substation and LILO lines up to the 132kV metering point will be constructed, maintained and owned by Eskom. The rest of the substation, including 11/132kV step-up transformers (80-100MW, EG feed in point) and 132/11kV step-down transformers (2 x 10MVA, LPU connection point) will be constructed, maintained and owned by the client.

It is expected that the substation would incorporate an area of approximately 10 000 m^2 and would consist of a control room, operations and maintenance facility, external 132 kV transformers and electrical switchgear and would be fenced for security and safety.

The final design of the electrical transformer switchyard will be conducted once the power generation capacity is firmed up. This will influence the number and sizes of transformers to be used. It is currently planned to locate the proposed switch yard next to the power block in the southern part of the property, where it will connect the CSP Plant to the existing 132kV Eskom grid.

Medium and low voltage reticulation will be installed to power the CSP plant, equipment and facilities.

3.5.3 Earthing Network

The earthing grid system will consist of buried stranded copper conductors, ground rods, and ground wells as required. Each service area of the network will be interconnected by at least two earthing conductors.

The earthing system network will be designed to connect to earth all of the frames, conductive parts (metallic) of the electric equipment, the transformers' neutral, lighting equipment protection, switchboards, MCCs, metal electrical wireways and in accordance with SANS 62305 (1-4) & SANS10313.

The design will ensure that the step and contact voltage levels will not be exceeded, whether by staff exposure or external exposure due to voltage transfer.

The earthing system consists of a number of conduits which are interconnected in order to create a network to which all metal equipment and structures can be connected, both directly and through interconnection cables. The parts of the tower and the adjacent buildings which are constructed of a metal base will be interconnected to the earthing system through the pylon's own structural columns and its underground substructure. Whilst all of the metal parts that form part of the power block's electric system will be connected via a single point to the earthing system.

In terms of the heliostat field, earthing will be done by means of grouping and earthing. Heliostats will be grouped (the number of heliostats per group will be determined in the detailed engineering) where after they will be connected to a local earthing rod. The heliostats' earthing system will include a rod for each group, as well as an electric switchbox with the corresponding distribution of all of the local earthing cables. The earthing rod of this group will be supplementary, for protection against over-voltages (in the event of lightning) in each group of heliostats.

The heliostats' earthing system will be insulated from the earthing network, from the part of the power block, in order to prevent the propagation of voltage failures to earth from the power block itself to the heliostats. All of the non-conductive metal parts in the power block will be insulated from the solar field.

3.6 Emission Control and Monitoring

Diesel-powered equipment includes two fire pumps, and two emergency generators. These will only be operated during bona fide emergencies and periodically for brief periods, as required by relevant codes and standards, for reliability testing or maintenance within strict limitations on acceptable fuels and maximum allowable run hours. Accordingly, these emissions sources will not require monitoring.

3.6.1 NOx Emission Control

NO_x will not be generated during operation of the CSP. However, during plant commissioning, the initial melting, heating, and conditioning of the salt will result in limited NO_x emissions. For the melting and heating segments of the process, two small boilers each employing ultra low NO_x burners and flue gas recirculation, will be used to mitigate emissions from the combustion of LPG or natural gas. For the salt conditioning process, a multi-stage wet scrubber will be used to limit NO_x emissions from the decomposition of magnesium nitrate inherent in the salt mixture.

This series of operations is limited to a one-time event, resulting in a closed loop system of liquid salt storage and circulation. At no other time will NO_x be generated during the operation of the CSP.

3.6.2 Particulate Emission Control

Particulate emissions will only be of concern during the salt melting, heating, and conditioning processes described above. Particulate emissions will be controlled by the use of best combustion practices, including the measures discussed in the preceding paragraph.

3.6.3 Continuous Emission Monitoring

Continuous emission monitoring will not be used at the CSP, as there is no source of emissions once the plant is fully commissioned, or throughout the life of the plant.

3.7 CSP Operational Requirements

3.7.1 Plant Start-up Procedure

During the construction phase, diesel/fuel/trucked in LPG will be used for plant start-up and the salt melting process.

During the operational phase, diesel/fuel/trucked in LPG gas will be used for the initial salt heating process and oil for operating of the salt pumps.

A diesel operated stand-by generator will be implemented on site – however it is not expected that this will be used.

Fuel consumption estimations for a 100 MW plant are as follow –

1. ***Salt Melting Process:***

   It is estimate that 50 to 70 days are required for initial salt melting for the 100 MW plant. During this period an estimated 35 400 m^3 of natural gas (final volume of fuel to be confirmed) will be consumed for the melting process.

2. ***Salt Heating Process:***

It is estimated that roughly 15 000 m^3/hour of natural gas is required for auxiliary heating of the salt, with an added 2 015 liters of fuel per day for operating the molten salt pumps.

3.7.2 Plant Operations

The 100 MW plant is designed to maximize solar energy collection during daylight hours while enabling a highly efficient steam turbine power generation cycle to operate during hours of highest system demand, which generally occur during afternoons and early evenings. The process is more efficient than other solar-thermal processes by enabling a highly controllable generation platform that is highly responsive to system load conditions. The project will be dispatchable, load-following, and operated at an annual capacity factor of approximately 70 to 80 percent (to be confirmed in following design phases).

a) Operating Modes

It is anticipated that all the electricity produced by the plant will be up taken by Eskom. The exact operational profile of the plant will be dependent on weather conditions, and generation controlled by the power purchaser's economic dispatch decisions and portfolio resource scheduling, transmission constraints and other factors. Given the inherent properties of the thermal energy storage system, the power plant can participate in the day-ahead scheduling market controlled by Eskom with the power purchaser acting as Scheduling Coordinator for the generating unit.

On a daily basis, however, the facility would be operated in the following modes:

- ***Long-Term Hold.*** The facility is shut down with the heliostats in the stow position, the salt pumps off, the receiver panels, riser, and downcomer are drained, electric heat trace set to trickle heat, and positive air flow is established through the salt side of the receiver. The salt side of the steam generation modules is drained, with heat trace set to low temperature or off on the heat exchangers and associated piping for maintenance, as applicable. The feedwater side of the steam generation modules is also depressurized and drained, with a nitrogen blanket maintained to preclude corrosion inside the system. Salt in the storage tanks is maintained in a liquid state by means of installed electrical heat trace. The ACC is at atmospheric pressure, the steam turbine is shutdown, cold, and off the turning gear. This condition is expected to occur only during periods of extended maintenance outage (more than about 7 days).
- ***Short-Term Hold.*** This is a transition mode from Long-Term Hold to Standby as the facility is prepared for operation. The heliostats remain in the stow position. Heat trace on the salt side of the steam generation modules and associated piping is energized. A condensate pump is started to fill the water side of the steam generation modules. A cold salt pump is started to fill the salt side of the steam generation modules and bring the temperatures up to 285°C. The receiver panels, riser, and downcomer remain drained; however, air flow through the salt side of the receiver is terminated in preparation for filling. The feed booster pump is started in preparation to supply feedwater for seal steam

demand. The steam turbine is placed on the turning gear in preparation for startup, and the ACC remains at atmospheric pressure.

– ***Standby.*** The heliostats are moved from the stow position to standby aim points, and salt flow is established to the tower. Salt is pumped from the cold salt tank, up the riser, through the upper bypass, the downcomer, the lower bypass and back into the cold salt tank. The heat trace is fully energized. The condensate and the feed booster pumps are running to supply feedwater for seal steam demand. The steam turbine remains on the turning gear, and seal steam is admitted to the turbine gland seals as soon as steam conditions permit. Vacuum is established in the ACC.

– ***Preheat.*** Heliostats are moved from standby aim points to the receiver panels to preheat the receiver. Salt flow is diverted to fill the receiver panels. Hot salt flow is now initiated and blended with cold salt to bring the steam generation modules up to operating temperature. Hot salt out of the receiver passes through the downcomer and is redirected into the hot salt tank once the salt temperature reaches 565°C. Steam from the superheater is admitted to the steam system to preheat the piping and begin heating the steam turbine. The heat trace cycles off. The steam turbine is on the turning gear, seal steam is maintained to the turbine gland seals, and vacuum is maintained in the ACC.

– ***Normal Operation.*** Cold salt flow from the riser is directed through the receiver panels, the downcomer, and to the hot salt tank. The heliostats are focused on the panels, and salt flow control is set to limit salt temperature exiting the receiver to 565°C, and the heat trace is de-energized. Hot salt is now flowing through the steam generating modules and steam flow is being generated in the steam system. As steam temperature, pressure, and flow steadily increase, the steam turbine is taken off the turning gear, and the unit rolled with steam. Once the steam parameters are sufficient, and the turbine metal temperatures have stabilized, the steam turbine generator is ramped to full speed, synchronized to the transmission network, and load increased to rated (dispatched) output.

– ***Cloud Standby.*** The salt flow is taken off automatic control. Cold salt flow from the riser continues through the receiver panels, the downcomer, and to the hot salt tank until the salt temperature exiting the receiver drops below 370°C. At the operator's discretion, salt flow from the downcomer may then be redirected back to the cold salt tank. The heliostats remain focused on the panels, and the heat trace remains de-energized. This is intended to be a short-term condition. If cloud cover persists and will not allow further solar collection, the stored energy in the hot salt may be used to continue to produce steam and operate the steam turbine. Once the hot salt temperature drops and steam quality cannot be maintained, the plant can be placed back into a Standby or Overnight Hold mode, depending on the ambient conditions at that time.

– ***Supplemental Gas.*** When hot salt inventory is low, less than six (6) hours, at the operator's discretion additional hot salt can be produced by operating the two natural

gas-fired supplemental heaters. These heaters are sized to run at 100% and one or both units can be activated. During periods of frequent use, these units will be kept warm with pilot heating in order to limit thermal stressing the systems. A small tri-function pump will take salt from the cold tank and route it through the natural gas fired convection heaters and deliver it to the hot salt storage tank.

– ***Reduced Load.*** During periods when the hot salt inventory is low, at the operator's discretion the steam turbine generator may be turned down to part load level to as much as 20% of design level. The principal purpose to produce sufficient electricity to support plant auxiliary loads and to keep the steam turbine generation system hot and ready for full load without cycling through the start up process. When operating at this mode, the steam cycle efficiency is reduced substantially.

– ***Overnight Hold. The*** facility is partially shutdown with the heliostats in the stow position, a limited number of cold salt pumps running for attemperation to reduce heat exchanger temperatures and maintain the steam generation modules at or near 285°C. The receiver panels, riser, and downcomer are drained to the cold salt tank, and electric heat trace is energized as needed. A condensate pump and the feed booster pump are running to supply feedwater for seal steam demand. The steam turbine, once disconnected from the transmission network and steam flow stopped, is placed on the turning gear. Seal steam is maintained to the turbine gland seals, and vacuum is maintained in the ACC.

b) Operations and Maintenance Personnel

The plant is expected to employ up to 47 full-time employees. Anticipated job classifications are shown below.

Table 4 Typical Plant Operation & Maintenance Workforce

Department	Personnel	Shift*	Workdays
Operations	(20) Plant Ops Personnel (1) Plant Chemist	Standard 8-hour days, 4 operators per shift (5 crews of 4)	7 days per week, 24 hours per day
Heliostat Washing	(8) Heliostat Servicemen	Standard 8-hour days	5 days a week, with additional coverage as required by seasonal and other effects
Maintenance	(4)Mechanical Technicians (4)Electrical/I&C	4x10 hour shifts or 5x8 hour shifts	Monday through Friday (Maintenance crews may also work

Department	Personnel	Shift*	Workdays
	Technicians (4) Laborers (Semi-Skilled)		unscheduled days and hours as needed to support plant outages)
Administration	(6)Total. (1) Plant General Manager (1)Ops Superintendent (1) Plant Engineer (1) Maintenance Manager (1) Maintenance Planner (1) Administrative Assistant	4x10 hour shifts or 5x8 hour shifts	Monday through Friday with additional coverage as needed
* O&M shifts may include nighttime work routines particularly during conditions of extreme summer heat.			

The plant operating personnel are responsible for the overall operation of the facility. A shift supervisor, a control room operator, and two field operators will attend to the plant around the clock. Maintenance technicians will attend to the plant equipment maintenance schedule daily, and will be available as needed to attend to urgent needs during evening and night shift operations. The Plant General Manager will be responsible for the plant and all activities associated with operations and maintenance. The Operations Superintendent will be responsible for all matters pertaining to plant operations and report to the Plant General Manager. The Maintenance Manager, with the aid of the Maintenance Planner, will be responsible to the Plant General Manager for maintenance of the plant. The Plant Engineer will also report to the Plant General Manager, and provide engineering support for maintenance and operations needs. The Administrative Assistant will report to the Plant General Manager and provide administrative support as directed.

A separate crew dedicated solely to heliostat washing will report to the Maintenance Manager. Heliostat washing is accomplished by filling a number of diesel-fueled tank trucks specially fitted with high-pressure washers. The trucks are filled with demineralized water and then driven slowly through the heliostat field, spraying high pressure water onto the heliostat mirrors effectively removing any accumulated dust or foreign matter. The trucks will be fueled by a separate onsite 38,000-liter diesel storage tank. They will draw water from the

demineralized water storage tank via a gravity-fed filling station located adjacent to the power block perimeter road.

c) Unplanned Outages

In the unlikely event of an unplanned (forced) outage situation that causes a long-term cessation of facility operations, security of the facilities will be maintained on a 24-hour basis, and the regional authority will be notified. Depending on the length of shutdown, a contingency plan for the long-term cessation of operations may be implemented. Such contingency plan will be in conformance with all applicable Laws, Ordinances, Regulations and Standards (LORS) and protection of public health, safety, and the environment. The plan, depending on the expected duration of the shutdown, could include the draining of all chemicals from storage tanks and other equipment and the safe shutdown of all equipment. Salt in the storage tanks would be maintained in a liquid state through means of the installed electrical heaters. All wastes from equipment shutdown will be disposed of according to applicable LORS. If the cessation of operations becomes permanent, the plant will be decommissioned

3.7.3 Water blow down Process

The boiler blowdown stream consists of water purged continuously from the boiler during normal operations to control the concentration of dissolved solids, silica and pH in the boiler following accepted practices and guidelines for corrosion control. Boiler blowdown flow is purged directly from the boiler steam drum and discharged to a flash tank. Demineralized water is injected into the blowdown flow to limit the temperature of (quench) the blowdown water to prevent rapid flashing and over-pressurization when the blowdown water reaches the flash tank, which is vented to atmospheric pressure. The flash tank collects and retains a minimum volume of water and drains excess volumes in equilibrium discharging to the evaporation ponds in a relatively continuous flow. When the power plant is operating normally under steady-state conditions, cycle feedwater makeup rate and boiler blowdown rate is equal. Flows may vary during transient conditions such as startup, load-changes and shut-down.

4 CHAPTER 4: CSP ACTIVITIES REQUIRING ENVIRONMENTAL AUTHORISATION

The primary triggers of the EIA process are sanctioned by the various activities to be executed as part of the CSP Plant construction, operation and decommissioning. The primary triggers identified per the EIA regulations of 2010 are listed below along with the applicable activities pertaining to the CSP Plant operational phase.

The table below aims to align the activities proposed for the development of the aforementioned CSP Plant with the relevant environmental legislation.

Table 5 Environmental requirements and associated activities

Environmental Requirement			Applicable CSP Activities	
Regulation	No.	Regulated activity	CSP Activity	CSP Subsystems
GNR. 544, 18 June 2010	(9)	The construction of facilities or infrastructure exceeding 1 000 meters in length for the bulk transportation of water, sewage or stormwater – (i) with an internal diameter of 0,36 meters or more; or (ii) with a peak throughput of 120 litres per second or more.	Provision of raw water to the CSP Plant.	Subsystem 4: Auxiliary Services & Infrastructure
	(10)	The construction of facilities or infrastructure for the transmission or distribution of electricity – (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.	Transmission or transfer of electricity generated to the substation.	Subsystem 4: Auxiliary Services & Infrastructure

Environmental Requirement				Applicable CSP Activities	
	(13)		The construction of facilities or infrastructure for the storage, or for the storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic meters;	Storage of materials – hazardous nature – for operations and plant start up	Subsystem 4: Auxiliary Services & Infrastructure
	(22)	(i)	Construction of a road, outside urban areas; where no reserve exists where the road is wider than 8 meters.	Routes to access site and plant.	Subsystem 4: Auxiliary Services & Infrastructure
	(23)	(ii)	The transformation of undeveloped, vacant or derelict land to – residential, retail, commercial, recreational, industrial or institution al use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares;	Development of entire site and CSP Plant.	Subsystem 1 - 4
	(24)		The transformation of land bigger than 1 000 meters in size, to residential, commercial, industrial or institution use, where at the time of the coming into effect of this Schedule such land was zoned open space, conservation or had an equivalent zoning.	Development of entire site and CSP Plant.	Subsystem 1 - 4
GNR. 546,			Not applicable.	Not applicable	Not applicable

Environmental Requirement				Applicable CSP Activities	
18 June 2010					
GNR. 545, 18 June 2010	(1)		The construction of facilities for the generation of electricity where the electricity output is 20 megawatts or more.	Transmission or transfer of electricity generated to the substation.	Subsystem 1 - 4
	(3)		Construction of facilities or infrastructure for the storage, or storage and handling of dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic meters;	Storage of materials – hazardous nature – for operations and plant start up.	Subsystem 4: Auxiliary Services & Infrastructure
	(6)	(i)	The construction of facilities or infrastructure for the bulk transportation of dangerous goods – in gas form, outside an industrial complex, using pipelines, exceeding 1 000 meters in length, with a throughput capacity of more than 700 tons per day;in liquid form, outside an industrial area, using pipelines exceeding 1 000 meters in length with a throughput of 50 cubic meters per day.	Storage of materials – hazardous nature – for operations and plant start up.	Subsystem 1 - 4
	(15)		Physical alteration of undeveloped, vacant or derelict land for residential, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.	Development of entire site and CSP Plant.	Subsystem 1 - 4

5 CHAPTER 5: ALTERNATIVE CONSIDERATION

In August 2010, a new set of regulations were promulgated under the National Environmental Management Act (Act 107 of 1998) to guide the undertaking of the EIA process. GNR 543 defines the various steps to be taken with regards to the undertaking of a full scale Scoping and EIA or Basic Assessment, and within the methodology for each of these processes the assessment of alternatives are highlighted as crucially important. When referring to alternatives the following definition applies as per the GNR 543:

“Alternatives”, in relation to a proposed activity, means the different means of meeting the general purpose and requirements of the activity, which may include alternatives to –

a) The property on which or location where it is proposed to undertake the activity;

b) The type of activity to be undertaken;

c) The design or layout of the activity;

d) The technology to be used in the activity;

e) The operational aspects of the activity; and

f) The option of not implementing the activity.

For the purpose of the proposed EIA only options(c), d) and (f) will have relevance in terms ofproject alternatives.

In terms of (c) various plant design or layout positions on the proposed site will be assessed as alternatives. For the purpose of the EIA application and in terms of (d) three (3) possible technology alternatives have been identified as development options and will be considered and assessed. In relation to (f) the no-go alternative will also be assessed in order to reflect the potential impact if the proposed project will not be implemented.

5.1 No-go alternative

In relation to the EIA Regulations the no-go alternative must be investigated in some degree of detail to determine in very simplified terms how the environment (biophysical and social) would be impacted on should the proposed project not be implemented. The current *status quo* would be maintained by not implementing the proposed CSP Plant. The current farming activities will continue and the land use will not change. No new jobs will be created and no skills development or infrastructure development will be resultant from the current activities on the land. The impact on natural vegetation will remain unchanged with the continuance of current livestock grazing practices and the mining of red jasper. The extraction of groundwater from a borehole on the site for watering livestock will remain unchanged.

5.2 Location options

The options for the proposed location of the CSP are limited to the Remainder of the remainder of the Farm 469 (Humansrus), Hay RD. However more than one design or layout option of the proposed plant on the selected site will be investigated. The selection of the proposed site and the different plant design or layout positions are driven by various technical and operational factors pertinent to the development of the CSP Plant.

5.3 Technology options

The three (3) technology alternatives that are being considered relates to the water consumption of the plant and particularly the consumption of the cooling systems. The cooling system is the only variable in terms of water consumption. The three cooling system options are dry, wet and hybrid cooling. The estimated water consumption during the construction phase remains constant irrespective of the cooling option chosen. The consumption during operation however will be influenced by the selected cooling system. The dry system consumes approximately 90% less water than the wet system and moderately less than the hybrid cooling system and the availability of water will be a determining factor of the option to be selected.

5.3.1 Condensate System – Wet cooling System

A wet cooling tower is a conventional design and is the most common and economic alternative. This form of technology application and system design is based on the one hand by convective heat transfer, and on the other hand, evaporation of the water (increase in the air's humidity). As a result, the cooling water temperature that can be obtained from a wet cooling tower isn't solely operative from the ambient temperature but also from the air humidity (air with 100% humidity). This type of technology results in severe water loss of which the primary reasons for loss of water in the cooling tower include:

– Evaporation

  The required water supply represents approximately 2.4% of the total quantity of water circulating through the system.

– Loss due to Solid Impurities

  The solid impurity losses in the tower can be controlled by special droplet separation equipment.

– Purging

  Water purging is necessary to maintain the mineral content in the water below a certain level and to eliminate other impurities from the system. The quantity of water purges varies significantly depending on the quality of the water supply and the level of impurities that are tolerated in the system (materials from the heat exchanger and pipes).

In addition to purging, it is necessary to add certain chemical products to the system to prevent corrosion.

- Condenser

  The condenser is a steam/water heat exchanger. In order to attain the maximum production capacity of electricity, it works with the greatest depression possible in order to reach the maximum contents of water permitted at the end of the turbine.

- Condensation Pumps

  The pumps will extract the condensate from the condenser and send it to the deaerator, passing through the corresponding preheaters for the low pressure feed water.

  Characteristics of the Condensate Pumps:

  - Type: Vertical Can
  - Number of pumps: 3
  - Capacity per Pump: 65 m^3/h
  - Voltage (V/Hz): 400 / 50
  - Power: T.B.D.
  - Level of Protection: IP 55

5.3.2 Hybrid Cooling System

In order to reduce project's water consumption, a hybrid cooling system has been considered to condensate the LP steam exhaust from the turbine. The hybrid cooling system is a combination of wet and dry cooling. This kind of cooling system is also called parallel condensing system (PCS) in order to clarify that the system is made up with a wet cooling tower and a surface condenser and an air cooled condenser (ACC) in a parallel configuration. In this system the heat duty from steam turbine is split in both cooling ways. The split between both systems can be adjusted to different ratios.

5.3.3 Dry Cooling System

This cooling system consists of an exhaust transfer duct (extending between the exhaust flange of the steam turbine and the condenser inlet), an ACC, a condensate collection tank, and a condensate pumping system. The ACC receives exhaust steam from the steam turbine exhaust duct into the bundled finned-tube sections of the condenser. Fans located beneath the condenser force ambient air across the heat transfer fins, cooling and condensing the steam into condensate. The finned tubes are usually arranged in the form of an A frame (or delta) above the forced draft fans, which minimizes the overall footprint of the ACC and optimizes air flow and heat transfer. Condensed steam is manifolded to a condensate

collection tank from which the condensate pumps take suction, pumping the condensate back into the cycle.

The ACC can condense steam to within 15°C to 28°C of the ambient dry-bulb temperature depending on actual operating conditions. This air-cooled system does not require any water for cooling and condensing the steam back into a liquid state. Liquid-ring vacuum pumps or steam jet air ejectors will be used to initially draw and maintain vacuum on the condenser for startup and during normal operation.

5.3.4 Auxiliary Cooling System - Dry Cooling

A closed-circuit cooling system for the plant's auxiliary components will be installed. The system will use a mixture of demineralised water and propylene glycol.

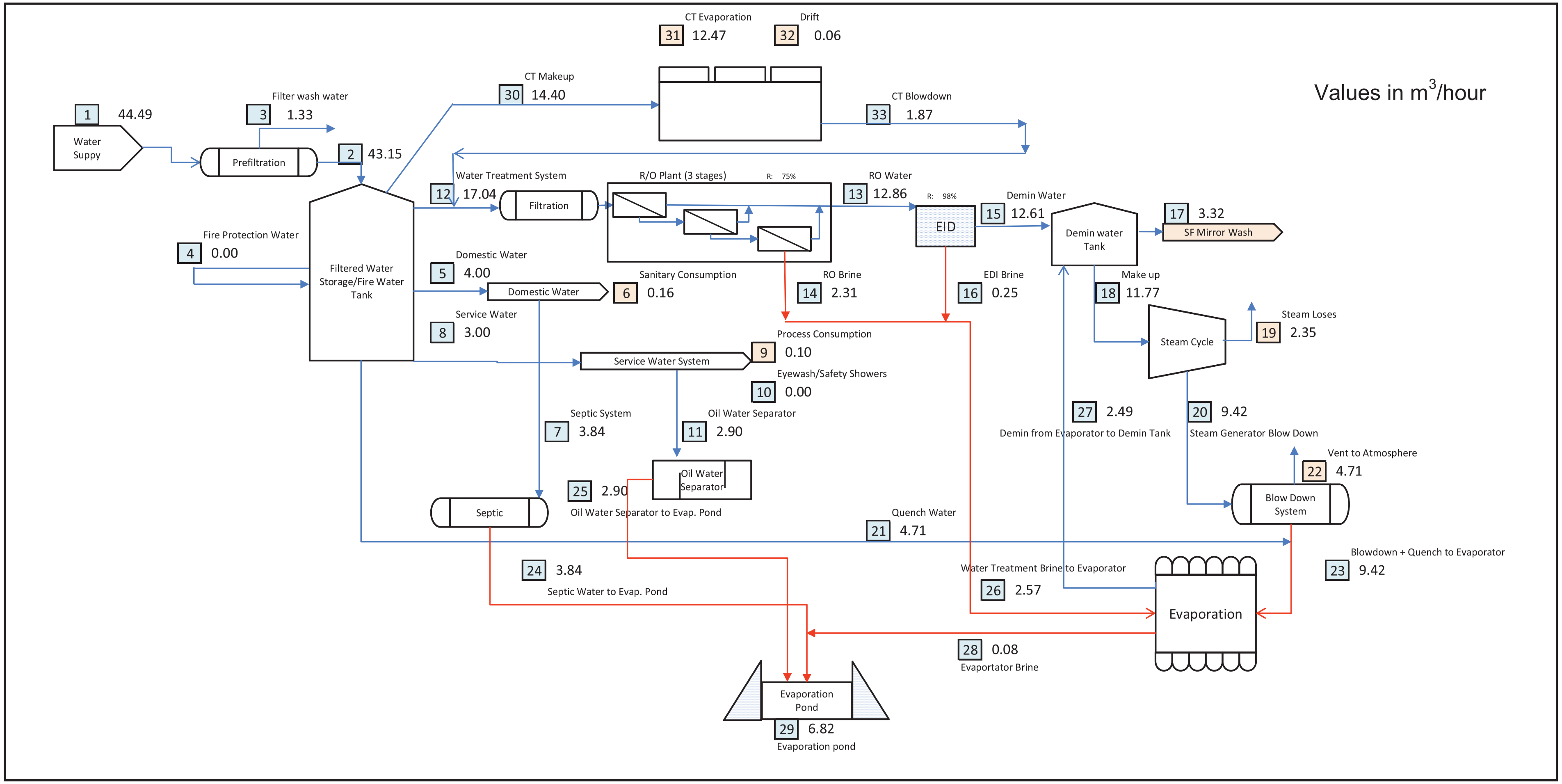
The cooling system will include the following elements:

- One (1) air-cooler at 100% capacity (fin-fan cooler)
- One (1) wet-surface air-cooler
- Two (2) water cooling pumps, 100% capacity each
- Pipes, valves, instrumentation, etc.
- Connections to the equipment to be cooled,

The materials the pumps are manufactured of will be appropriate for the fluid being pumped. In addition, the power of the chosen motor will allow for the pump to function at any point of its curve without the motor being overloaded.

The motor-pump group will also include a carbon steel base structure designed to bear the weight of the equipment. The entire set of equipment will be installed on an appropriately-sized concrete foundation.

Appendix 1 Water Balance - preliminary values for maximum usage of Hybrid cooling


Values in m3/hour
1 44.49
Water Suppy
3 1.33 Filter wash water
Prefiltration
2 43.15
Filtered Water Storage/Fire Water Tank
4 0.00 Fire Protection Water
30 14.40 CT Makeup
31 12.47 CT Evaporation
32 0.06 Drift
33 1.87 CT Blowdown
12 17.04 Water Treatment System
Filtration
R/O Plant (3 stages)
R: 75%
13 12.86 RO Water
14 2.31 RO Brine
EID
R: 98%
15 12.61 Demin Water
16 0.25 EDI Brine
Demin water Tank
17 3.32
SF Mirror Wash
18 11.77 Make up
Steam Cycle
19 2.35 Steam Loses
20 9.42 Steam Generator Blow Down
Blow Down System
22 4.71 Vent to Atmosphere
23 9.42 Blowdown + Quench to Evaporator
27 2.49 Demin from Evaporator to Demin Tank
5 4.00 Domestic Water
Domestic Water
6 0.16 Sanitary Consumption
8 3.00 Service Water
Service Water System
9 0.10 Process Consumption
10 0.00 Eyewash/Safety Showers
11 2.90 Oil Water Separator
Oil Water Separator
7 3.84 Septic System
Septic
25 2.90 Oil Water Separator to Evap. Pond
21 4.71 Quench Water
24 3.84 Septic Water to Evap. Pond
26 2.57 Water Treatment Brine to Evaporator
Evaporation
28 0.08 Evaportator Brine
Evaporation Pond
29 6.82 Evaporation pond

Appendix R

Environmental Management Programme

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, POSTMASBURG, NORTHERN CAPE PROVINCE

DEA EIA REFERENCE: 12/12/20/2316

PREPARED FOR: SOLARRESERVE®

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JANUARY 2012

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

ENVIRONMENTAL MANAGEMENT PROGRAMME

TABLE OF CONTENTS

Appendix List

Acronyms

ARC-ISCW	Agricultural Research Council Institute for Soil, Climate and Water
ARI	Acute Respiratory Infections
BID	Background Information Document
CAGR	Compounded Annual Growth Rate
CAR	Co-ordinated Avifaunal Road-count
COPD	Chronic Obstructive Pulmonary Disease
CSP	Concentrated Solar Power
CWAC	Co-ordinated Waterbird Count
DEA	Department of Environmental Affairs
DNI	Direct Normal Irradiance
DTEEA	Department of Economic Development, Tourism and Environmental Affairs
EC	Electrical Conductivity
ECO	Environmental Control Officer
EDI	Electro-deionization
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Programme
ERM	Environmental Resources Management
GDP	Gross Domestic Product
GHG	Green House Gas
GN	Government Notice
GRU	Groundwater Resource Units
I&APs	Interested & Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer

NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NGOs	Nongovernmental Organizations
NGDB	National Groundwater Database
QDGS	Quarter Degree Square
RO	Reverse Osmosis
SAHRA	South African Heritage Resources Agency
SANBI	South African Biodiversity Institute
SDF	Spatial Development Framework
ToR	Terms of Reference
WUL	Water Use License

Abbreviations

CA:	Competent Authority
CEMP:	Construction Environmental Management Programme
CER:	Contractor’s Environmental Representative
EMP:	Environmental Management Programme
ECO:	Environmental Control Officer
SAHRA:	South African Heritage Resources Association
SE:	Site Engineer
IAP:	Interested and Affected Party
MSDS:	Material Safety Data Sheet
OEMP:	Operational Environmental Management Programme
WMCO:	Waste Management Control Officer
WML:	Waste Management License
CA:	Competent Authority
CER:	Contractor’s Environmental Representative
EMP:	Environmental Management Programme

Definitions and Terminology

AUDIT:

A systematic and objective evaluation in terms of the conditions set out in the Site Documentation on a regular (periodic) basis. The degree of compliance is recorded in monthly audit reports. An audit aims to ensure that all regulatory requirements are adhered to.

BUILDING AND DEMOLITION WASTE:

Refers to waste, excluding hazardous waste, produced during the construction, alteration, repair or demolition of any structure, and includes rubble, earth, rock and wood displaced during that construction, alteration, repair or demolition *(NEM: WA, Act No. 59, 2008).*

BUND:

An artificial containment wall (embankment) designed to contain spillages of a hazardous nature such as chemicals and hydrocarbons.

BATCH PLANT:

A containment area centrally located where cement, water and other related aggregates are mixed to produce concrete and / or cement. The design of this area has to adhere to the specifications set out in the Draft EMP.

COMPETENT AUTHORITY

The Competent Authority is the authority responsible for the issuing of the Waste Management License of the site in terms of Section 20(b) of the National Environmental Management: Waste Act (Act 59 of 2008). In this instance, the “Competent Authority” means the Head of Department (HoD) of the Mpumalanga Department of Economic Development, Environment and Tourism, or someone within the Department designated by the HoD or the Member of the Executive Council responsible for Environment in the Mpumalanga Provincial Government as the competent person.

CONTRACTOR’S ENVIRONMENTAL REPRESENTATIVE (CER):

The CER is employed by the contractor to ensure the contractor complies with the environmental standards, specifications, as well as the conditions and stipulations contained

within the Site Documentation. The CER is available on site at all times and has the experience and/or knowledge to deal with environmental issues.

CONTAMINATION

The release/spillage of a substance into an environment where it is not normally found, which is detrimental to that environment, its ecosystems and to humans.

CONTAMINATED:

Means the presence in or under any land, site, buildings or structures of a substance or micro-organism above the concentration that is normally present in or under that land, which substance or micro-organism directly or indirectly affects or may affect the quality of soil or the environment adversely *(NEM: WA, Act No. 59, 2008).*

CONTRACTOR:

The individual and/or company that are responsible for the development and/or construction activities related to the proposed project.

The Contractor is further responsible for the implementation of and compliance with the conditions and stipulations contained within the in Site Documentation.

CONSTRUCTION SITE CAMP:

The construction site camp refers to the designated area where the contractor's offices (temporary), and associated infrastructure will be located during the construction period of the proposed project.

CORRECTIVE (OR REMEDIAL) ACTION:

Reactive response required to address an action that is in conflict with the requirements of the Site Documentation. The need for corrective action may be determined through monitoring, audits or management review.

DOMESTIC WASTE:

Means waste, excluding hazardous waste that emanates from premises that are used wholly or mainly for residential, educational, health care, sport or recreation purposes; *(NEM: WA, Act No. 59, 2008).*

ENVIRONMENT:

Means the surrounding within which a human exist and that are made up of:

- The land, water and atmosphere of the earth;
- Micro-organism, plant and animal life;
- Any part or combination of (i) and (ii) and the interrelationships among and between them; and
- The physical, chemical aesthetical and cultural properties and conditions of the foregoing that influence human health and wellbeing *(NEMA Act107 of 1998)*:

ENVIRONMENTAL AUDIT:

Means work done to identify and evaluate compliance of the statement and the residual environmental impact of an existing activity, the effectiveness of mitigation measures and the functioning of monitoring mechanisms; *(Environmental Impact Assessment Act 6 of 2005 - Chapter 65:07)*

ENVIRONMENTAL CONTROL OFFICER (ECO):

The ECO is an independently appointed person that will operate independently to objectively monitor the implementation of the EMP and the conditions as stipulated in the RoD on a regular basis.

ENVIRONMENTAL IMPACT:

Change in an environment resulting from the effect of an activity on the environment, whether positive or negative. Impacts may be the direct consequence of an individual's or organisation's activities or may be indirectly caused by them *(DEAT, 1998)*.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA):

The process of examining the environmental effect of development *(DEAT, 1998).*

The EIA assesses the possibility, range and impact that a specific type of development may have on the natural environment during the design, planning and implementation of a project.

GENERAL WASTE:

Waste that does not pose an immediate hazard or threat to the environment or health, and includes:

- domestic waste;
- building and demolition waste;
- Business waste: and
- inert waste. *(NEM: WA, Act No. 59, 2008).*

HARM:

Means interference with the ecological systems of which the living organisms form part and in case of a living person includes harm, distress or annoyance to any of his senses or damage to his property. *(Waste Management Act, Act 15, 1998. CHAPTER 65:06)*

HAZARD:

Means a source of or exposure to danger *(NEMA Act107 of 1998)*

HAZARDOUS WASTE:

Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment *(NEM: WA, Act No. 59, 2008).*

SITE DOCUMENTATION

In this document, “Site Documentation” refers to all relevant documentation pertaining the licensing, operation and management of the site:

- Waste Management License;
- Site Operation, Management and Maintenance Plan (latest approved version);
- Site Design Documentation (latest approved version);
- Environmental Management Programme; and
- Written instructions from the CA.

SOLID WASTE:

All waste, including construction debris, chemical waste, excess cement/concrete, wrapping material, timber, tins and cans, drums, wire, nails, domestic , dead organic waste, asphalt products *(City of Cape Town: Standard Environmental Specification Version 6:2007)*.

INTERESTED AND AFFECTED PARTY (I&AP):

Individuals and/or peer groups that are and/or maybe affected albeit positive or negative by the proposed activity. IAP's include authorities, local communities, environmental interest groups, and the general public.

MITIGATION:

Measures designed to avoid, reduce or remedy the proposed adverse impacts (DEAT, 1998).

MONITORING:

The repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures *(DEAT, 1998).*

PREVENTATIVE ACTION:

A predetermined action to address potential problems before they develop into situations which would be contrary to the requirements of the EMP. Preventative action is most often determined from the results of monitoring and audits during management review.

PROJECT APPRAISAL:

The collection and evaluation of detailed information concerning a proposed project, usually to assess risk associated with it.

POLLUTION:

Means any contamination or change in the environment caused by:

– Substances;
– Radioactive or other waves; or
– Noise, odours, dust or heat

Emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or organ of state, where that change has an adverse effect on human health or wellbeing or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future (*NEMA Act107 of 1998)*.

SITE ENGINEER/RESIDENT ENGINEER (SE):

The SE is the Consulting Engineers'/Project Proponents' representative onsite. Has the authority to issue instructions and oversees the operations of the contractor. Upon request from the EO/ECO the SE has the mandate whereby, in emergency circumstances, he may override the instructions of the contractor.

Humansrus Solar Thermal Energy Power Plant

ENVIRONMENTAL MANAGEMENT PROGRAMME

1 Introduction

The Environmental Management Programme (EMP) specifies all the potential environmental impacts, control and mitigation measures, performance criteria and relevant reporting and monitoring procedures. The Draft EMP forms a crucial part of the conditions for approval and ensures that the project proponent remains accountable for compliance issues. It must form part of the construction contractual agreements by means of inclusion in the environmental specifications that form part of the contract between the client and the contractor.

The Draft EMP aims to facilitate appropriate environmental input during all phases of the project, during the construction activities as well as the future operational activities associated with the proposed project. To achieve this, the Draft EMP must define the management measures required to promote positive environmental consequences and reduce adverse environmental impacts of the project and the Draft EMP defines the objectives of such measures and describes how they will be achieved. This is achieved by making recommendations for the planning and design, specify the limitations the contractor must abide by during construction, detail the issues that should be taken cognisance of and indicate specific actions that must be undertaken so as to ensure that the environment is not unnecessarily damaged.

In addition the Draft EMP provides a clear indication of the environmental management requirements of each of the role players involved during the construction phase of the development. Guidance for the implementation of the Draft EMP is provided including the management of method statements which are required to be implemented to achieve compliance with the Environmental Specifications. Corrective actions and penalties in the event of non-compliance with the Draft EMP are also defined.

2 Institutional Matters

This document aims to identify and allocate responsibility to the various persons responsible for ensuring environmental compliance is achieved. This section of the document will delineate the function and responsibility of each designation that plays a role in terms of managing the environment.

2.1 Environmental Manager

The Environmental Manager (EM) is the primary person responsible for monitoring and ensuring compliance and correct implementation of all mitigation measures and provisions contained within the Site Documentation on a daily basis. The EM has to ensure that all the necessary authorisations/permits/licenses are in place.

2.2 Environmental Control Officer

The ECO will be responsible for ensuring that all conditions as stipulated in the Site Documentation is adhered to. It is the responsibility of the License Holder to appoint an ECO. The ECO will operate independently to objectively monitor the implementation of the conditions and stipulations contained within the Site Documentation.

It is the responsibility of the ECO to monitor the degree of compliance to environmental legislation and the conditions stipulated in the Site Documentation by means of regular compliance audits.

The ECO has the authority to stop works if in his/her opinion the operation imposes a serious threat to the environment or if an incident has occurred due to neglect or disregard. Any non-compliance recorded in terms of the conditions and stipulations of the Site Documentation, constitutes as a breach of Contract allowing the ECO to suspend part or all of the works, as required.

The ECO will be the official liaison between the Authorities and the applicant, and must handle all sensitive information originating from whistle blowers and incidents and report these to the regulating authorities.

In order for the ECO to perform his/her tasks accordingly, he/she needs to be suitably qualified / experienced.

2.3 Site Engineer

The Site Engineer (SE), a registered professional engineer appointed by the Proponent, is the license holder's representative on site. The SE has the authority to issue instructions and oversees the operations of the contractor. Upon request from the EM/ECO the SE has the mandate whereby, in emergency circumstances, he may override the instructions of the contractor.

2.4 Contractor's Environmental Representative

The CER is employed by the contractor to ensure the contractor complies with the environmental standards, specifications, as well as the conditions and stipulations contained within the Site Documentation. The CER is available on site at all times and has the experience and/or knowledge to deal with environmental issues. It is furthermore the responsibility of the CER to communicate the contents of the Site Documentation to all staff working for and / behalf of the contractor.

The person appointed as CER will have to be knowledgeable in the concepts of integrated environmental and waste management, have a sound background on environmental and waste management legislation and be suitably qualified / experienced.

The CER needs to ensure that all personnel working for and/or on behalf of the contractor understands the concept of integrated environmental and waste management and the various issues specific to the site they are working on. The CER has the prerogative to issue non-conformances to the contractor, hazard and risk certificates and fines if deemed suitable.

3 General Environmental Specifications

3.1 Environmental Compliance Record

The CER has to develop and implement an environmental control system on site whereby records will kept on all matters environmental. Records need to include the following:

3.1.1 Induction & Environmental Awareness Training register

It is the responsibility of the Contractor to ensure that any and all staff undergo training and understand the requirements of the Site Documentation. This allows staff to keep the environmental obligations in check.

Induction/training may take the form of toolbox talks, demonstrations, media or a written test – whereby the employees' understanding of issues pertaining to his/her job is explained and assessed. The degree of specialised training/induction is dependent on the function performed by the employee and will be determined by the CER. This training must be presented at the level of the employees.

If new personnel are appointed the induction must be done with them before they commence duties on the site.

All levels of management and employees need to undergo environmental training and training attendance record needs to be kept and available for review by the ECO. Copies/samples of the toolbox talks/induction material also need to be available for review by the ECO. It is proposed that a graphic list of potentially dangerous animals be compiled and presented to all workers as part of site induction.

3.1.2 Complaints Register

A Complaints Register needs to be on site at all times. This register has to be easily accessible to all stakeholders and IAP's and made available for review to the ECO during Audits. The Register has to illustrate what measures have been implemented / taken in order to address the complaint as well as indicate what the timeline was in resolving the complaint.

3.1.3 Stakeholder Liaison & Communications

Copies of all documents referring to stakeholder liaisons need to be kept on record (preferably signed) and maintained. Stakeholders need to be informed of any large scale construction activities i.e. blasting in advance and in writing. These communications need to be made available to the ECO during Auditing.

3.1.4 Legal Register

A legal register needs to be onsite – accessible to any and all personnel whose actions may have a significant impact on the environment. It is the responsibility of the CER to ensure that the legal register is kept updated with regards to each piece of legislation that has relevance on site.

3.1.5 Site Instructions

The Environmental Compliance Record furthermore has to capture all site instruction issued by the CER that relates to EMP matters. These instructions will also be used for the issuing of stop-work-orders and or fines by the ECO and CER.

3.1.6 Method Statements

The Contractor shall provide Method Statements for approval by the ECO and the Engineer prior to work commencing on aspects of the project deemed or identified to be of greater risk to the environment and/or which may not be covered in sufficient detail in the construction phase of the Draft EMP, when called upon to do so by the Engineer or ECO. A Method Statement is a "live document" in that modifications are negotiated between the Contractor and the ECO/project management team, as circumstances unfold. All Method Statements will form part of the construction phase of the Draft EMP documentation and are subject to all terms and conditions contained within the construction phase of the Draft EMP.

Note that a Method Statement is a 'starting point' for understanding the nature of the intended actions to be carried out and allows for all parties to review and understand the procedures to be followed in order to minimise risk of harm to the environment.

Changes to, and adaptations of Method Statements can be implemented with the prior consent of all parties.

A Method Statement describes the scope of the intended work in a step-by-step description in order for the ECO and the Engineer to understand the Contractors intentions. This will enable them to assist in devising any mitigation measures, which would minimize environmental impact during these tasks.

For each instance where it is requested that the Contractor submit a Method Statement to the satisfaction of the Engineer and ECO, the format should clearly indicate the following:

- What - a brief description of the work to be undertaken;
- How - a detailed description of the process of work, methods and materials;
- Where - a description/sketch map of the locality of work (if applicable); and
- When - the sequencing of actions with due commencement dates and completion date estimates.
- Who – The person responsible for undertaking the works described in the Method Statement;
- Why – a description of why the activity is required.

All Method Statements are to be to the satisfaction of the ECO, Engineer and, where practical and deemed necessary, should be endorsed as being acceptable by the environmental representative of the Relevant Authority.

3.1.7 Archaeological Artefacts

Should any archaeological artefacts be exposed during excavation, the construction and or operation in the vicinity of the finding must be stopped. Artefacts may not be destroyed. The archaeological site shall be marked and fenced off and the South African Heritage Resource Agency must be contacted within 48 hours.

3.1.8 Emergency Preparedness Plan

The EM has to ensure that there is an Emergency Preparedness Plan on site that provides a detailed explanation of what should be done in the various emergency situations. This plan has to be known to all persons working on site and has to also provide emergency contact information. The plan is to be reviewed annually and after each emergency and or accident. The plan needs to address, amongst other the following:

- Vehicle/Machinery Fire & Malfunction
- Veld fire
- Destruction of habitat or animal fatalities
- Natural Disasters such as floods
- Industrial action

3.1.9 Site Documentation

A copy of the Site Documentation has to be available on site and easily accessible to any and all persons working for and or on behalf of the contractor. Issues and conditions of the Site Documentation need to be explained to employees.

3.2 Non-Compliance

Any non-compliance with the EMP, the Operation and Maintenance Plan and Site Design (as amended and approved by the CA from time to time), the recommendations and conditions contained in the WML, and any written instruction issued by the CA will be treated as serious. Liability rests with the proponent - for non-compliance with the said documentation. A penalties schedule will be developed by the CER in conjunction with the license holder and be implemented in the instance of non-compliance by any contractor working on site, such that the license holder has a means to ensuring that their risk in respect of non-compliance by these contractors can be managed.

4 Construction Phase EMP

The Construction Environmental Management Plan (CEMP) serves as the Contractors' guideline for environmental management pertaining to all construction activities which are to be undertaken. The CEMP will specify the control measures that need to be implemented by the contractor and project team prior and during the construction phase. These measures will be implemented where practical based on the scale and complexity of the construction activities associated with a power plant.

4.1 Site Camp Establishment

The construction site camp is a dedicated area which will house all buildings, offices, lay down yards, vehicle wash areas, fuel storage areas, batching areas and other infrastructure that is required for the execution of the project.

4.1.1 Site Demarcation and Layout Plan

The Location, design and layout of the construction camp has to be determined by the Site Engineer and the Contractor alongside the CER in order to ensure a minimal impact on the environment.

Prior to commencement of any activity, the entire affected area must be visited by an Environmental Officer qualified to rescue significant indigenous species of flora and these should be transplanted to areas that will not be disturbed.

The site camp has to be established in an area with no or negligible environmental impact (i.e. in an area that has a low sensitivity rating according to the sensitivity analysis conducted on the site).

The site will be clearly demarcated by means of a fence. The demarcated area needs to be indicated on the site layout plans. The Contractor shall take all reasonable measures to limit the extent of the area of disturbance due to construction activities (the area must be earmarked for construction activities, and the activities must be confined to that).

All areas identified as no-go areas needs to be clearly cordoned off and indicated as such on the site layout plans.

4.1.2 Fencing & Security

The contractor shall maintain in good order all fencing and or barriers during the construction period. A photographic record has to be kept of the site before site camp is established. The construction site will be properly demarcated and fenced and people will not be allowed to move outside the demarcated areas.

4.1.3 Site Access

Access to the construction site camp needs to be controlled and restricted at all times. The entrance to the site camp needs to be manned by a guard and a lockable gate is to be supplied. Unauthorised entry to the camp site must be prohibited.

No additional access roads may be constructed without the consent of the CER, landowners and SE – only existing roads and access road planned for the proposed facility are to be used. If temporary roads are created during the construction phase of the project they have to be decommissioned by the SE upon project completion and rehabilitated to natural state.

4.1.4 Construction Camp Structures & Facilities

No permanent structures will be permitted within the construction site camp – only prefabricated structures such as containers and prefabricated living, dining and ablution quarters will be allowed. The modular sewer treatment facility will be installed and maintained by a reputable service provider. It will be installed in an area of low aquifer vulnerability as indicated by the geohydrological assessment. Cement slabs are allowed as foundation for these structures – however upon decommissioning these slabs have to be removed and the compacted soils ripped and rehabilitated. The Contractor will be held accountable for the implementation of these measures.

4.2 Dedicated Area Specifications

4.2.1 Workshop

Any workshops or maintenance or production area must be located inside the demarcated construction camp area and be provided with an impermeable surface to ensure that no contamination of the soil takes place. For the control of surface water runoff, the area must be constructed with bunded walls and sloped to a catchment drain. When servicing equipment, drip trays must be used to collect the waste oil and other lubricants. All waste material must be disposed of in accordance with national, regional and local laws, regulations and by-laws. The

waste material must be stored and removed off site in terms of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste and disposed of at an approved waste disposal site. Where possible, appropriate material shall be re-used or recycled. Wash water must also be collected if the possibility exists that lubricants and solvents will be transported by the wash water.

4.2.2 Vehicle Service Area & Wash-Bay

This designated area will be assigned for the purpose of servicing and washing of construction vehicles – vehicles/equipment will only be serviced within this area. This area has to have an impermeable surface, and be enclosed. The area has to be equipped with a drainage system – whereby the spilled hydrocarbons are channelled into a sump, to be treated or gathered for disposal at a licensed hazardous waste disposal site. All vehicles / equipment need to be kept in good working order to ensure that there are no oil/fuel leakages. Drip trays will be used during vehicle servicing at all times. Emergency spill response kits need to be on site at all times – and all personnel needs to have a complete understanding of their function and how to use them.

4.2.3 Batching and Cement Mixing Area

The batching plant needs to be designed by the SE along with the CER inputs in order to ensure that the plant is not placed in an area of low aquifer vulnerability in line with the findings from the Geohydrological Assessment. The batching area shall furthermore be located in a low environmentally sensitive area.

Measures need to be put in place to mitigate possible contamination originating from the batching plant – by means of berm or bund walls. The contractor has to ensure that a designated area is cordoned off as a batching area. Under no circumstances is contaminated water allowed to leave the confines of the containment system. Only uncontaminated surface runoff is allowed to leave the site.

Concrete and or cement are under no circumstances to be mixed on raw soil – plastic liners and / or mixing trays will be used at all times. The batching area has to be indicated on the site layout plan and batching will only occur here. Accidental spillage of cement/concrete has to be cleaned up immediately and remediation measures implemented.

4.2.4 Eating Areas

The Contractor's employees shall only eat in designated areas indicated by the Contractor and approved by the Engineer.

Food preparation shall be done in a specifically demarcated area on site and no open fires are permitted, without exception. Adequate heating and food preparation sources/areas have to be provided for employees in order to ensure no fires will be made on site.

The Contractor shall provide adequate scavenger-proof and weatherproof refuse bins in this area.

4.2.5 Ablution Facilities

The location of the portable chemical latrines, prefabricated ablution facilities and modular sewer treatment facility must be approved by the Engineer prior to establishment. There must be at least one latrine per 20 employees on site. The Contractor must provide the toilets in terms of the Health and Safety By-laws which will dictate on the number of toilets to be provided and is responsible for their maintenance and servicing on a daily basis. The contractor must take all reasonable precautions to ensure that no spillages occur when the toilets are cleaned or emptied. Any disposal of waste from toilets on site is strictly prohibited. The toilets must be maintained and kept clean at all times.

It is strictly prohibited to perform bodily functions anywhere other than in toilets. Toilets must be inspected for leaks daily and leaking toilets must be repaired immediately or removed from site.

4.2.6 Equipment Maintenance & Storage

All vehicles, plant and equipment shall be kept in good working order and serviced regularly in line with manufacturer's specifications. Leaking equipment must be repaired immediately or removed from the site. All maintenance of equipment and vehicles shall be performed in the workshop or other suitable designated area.

The Contractor shall demarcate an area in which equipment and vehicles may be stored. The location of this area shall be approved by the Engineer. The Contractor must take measures to ensure that the surface of the designated area is not contaminated as a result of hydrocarbon leaks from any machinery or vehicles. These areas need to be covered and protected by means of gravel.

The construction vehicles must be operated in compliance with Regulation 21 of the Construction Regulations, 2003.

4.3 Material Storage & Handling

4.3.1 General Storage & Handling

The contractor needs to ensure that an area is cordoned off as the designated materials delivery, handling and storage area, within the site camp.

Materials need to be protected from the elements by means of cover. Products such as cement need to be stored in a covered area on an impermeable surface to prevent spillage and wastage.

All materials need to be stored within the construction site camp, with the lay-down area adhering to the specifications stipulated by the CER and SE. The material lay-down/storage area needs to be clearly marked and indicated on the site map.

The Contractor is responsible for ensuring that any materials delivery service providers and/or construction vehicle operators are informed of all procedures and restrictions (e.g. which access roads to use, "no go" areas, speed limits, dust control, etc) required to comply with the EMP before they arrive at site and off load any materials. The Contractor shall ensure that the service providers and/or construction vehicle operators are supervised during off-loading by someone with an adequate understanding of the requirements of the EMP. The person must be authorised to take the necessary actions if the service providers do not adhere to the requirements of the EMP.

4.3.2 Hazardous materials Handling & Storage

The Contractor shall comply with all relevant national, regional and local legislation with regard to the transport, use and disposal of hazardous materials.

The Contractor shall provide the Engineer with a list of all hazardous materials that may be used on site, together with the storage, handling and disposal procedures of the materials. This information shall be made available to everyone on site.

The location of the hazardous material store shall be within the demarcated construction camp area or other suitable designated area. Prior to establishment the Engineer shall approve the location and design of the store. It should preferably be located within an area of low aquifer vulnerability.

All materials classified as hazardous need to be stored in a locked down storage area/container and access needs to be controlled.

The temporary storage area for spent hazardous materials needs to be enclosed by walls (bunded), under cover (roof) and located on an impermeable surface. The relevant Material Safety Data Sheets (MSDS) needs to be on site and accessible to all parties working with or near the hazardous materials. The contractor needs to keep record of all hazardous material on site. A Standard Operating Procedure (SOP) for the handling, storage and disposal of hazardous materials needs to be implemented and enforced by the CER. It is the responsibility of the contractor to ensure that all applicable SOP are drafted, signed off and implemented on site. The contractor will after drafting of the SOP's submit these to the RE for approval and sign-off before implementation.

In the event of an emergency, all personnel working for and on behalf of the contractor needs to be aware of and trained with regard to the Emergency Remediation Procedure.

4.3.3 Fuel (Petrol & Diesel) and Oil Storage

The contractor shall ensure the establishment of designated fuel storage and refuelling bay within the construction camp site. The refuelling bay needs to be on an impermeable surface,

enclosed with bund walls that can capture 110% of the fuel storage tanks' capacity. The bay also needs to be fitted with a hydrocarbon drainage system in the event of a leak or spill.

This area needs to be equipped with an emergency spill kit and all personnel needs to be trained in handling and clean-up an incident or spill.

No underground fuel or diesel storage is allowed – fuel will be transported to the site as and when required and stored in the temporary fuel storage tank.

The refuelling of vehicles is allowed within the designated refuelling bay area within construction camp compound. Where this is not possible, the Contractor shall notify the Engineer and get approval of the refuelling method to be used. The use of hand held funnels are strictly prohibited.

Any leaking equipment shall be repaired immediately or removed from the site. Refuelling shall be carried out by means of pumps with hoses that enter the fuel receptacle, or gravity fed hoses fed from elevated tanks. The use of hand held funnels are strictly prohibited.

4.3.4 Site Safety Measures

Fire extinguishers need to be located practically across the site, easily and readily accessible in the event of an accidental/uncontrolled fire. No open fires will be allowed on site.

4.4 Earthworks

All earthworks have to be done in such a manner that least impacts the environment. Prior to the proposed earthworks the ECO has to walk the site with the contractor and SE to establish which fauna and flora has to be marked and conserved. No earthworks machinery and/or equipment will be allowed outside of the demarcated construction area. Construction/earthwork activities will be closely monitored by the CER.

All equipment and earthworks vehicles need to be kept in good working condition in order to reduce the risk of accidental hydrocarbon spillages/leakages.

4.5 Biodiversity Management

Areas that are earmarked for the construction of structures i.e. construction site offices etc. needs to be cleared of bushes, trees and plants. However this will be done in consultation with the CER as to ensure biodiversity is maintained and vegetation is conserved prior to the commencement of construction works. No trees or vegetation will be damaged/removed outside the construction servitude area.

Under no circumstances are contractors allowed to use the cleared vegetation or trees as fire wood or for any other purposes – these off-cuts need to be disposed of at a suitable site.

Alien and/or invasive flora species may be removed by the contractor upon instruction from the CER. Complaints regarding the destruction of and/or damage to indigenous flora need to be reported to the ECO and recorded in the complaint log.

Woody vegetation removed during the earthworks need to be spread evenly across the veldt as to provide biomass for micro-organisms and habitats for small animals – this may also be stockpiled for the rehabilitation phase of the project.

No animals may be poached during the construction phase of the project – nor will fishing in the water bodies be permitted. The use of pesticides is strictly forbidden. No animals shall be killed unless an immediate threat to human health is perceived.

Allow for a suitable buffer in order to provide some protection of sensitive areas against peripheral impacts, wetland related habitat types in particular. Al areas that were ascribed a High Ecological Sensitivity should be buffered against potential impacts. Guidelines of the wetland specialist should be implemented in this regard;

The Applicant must appoint an Environmental Control Officer (ECO) prior to start of construction. Responsibilities should include, but not be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting.

The Contractor should compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Environmental monitoring should be conducted at least twice per year (Summer, Winter).

Care should be taken by the Contractor to limit construction, maintenance and inspection activities in areas of high slopes, drainage lines, etc. to dry periods in order to curb occurrence/ augmentation of erosion in areas of existing erosion, destabilizing of substrate. The Contractor shall implement strict erosion monitoring and management procedures in all areas where slopes are present.

Ensure off-site storage of hazardous materials or storage thereof in properly constructed facilities with the required safety measures in order to prevent accidental spillage, contamination or pollution.

The Contractor is required to develop prior to construction an emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas.

Construction sites/camps need a detailed ecological assessment prior to construction.

The Contractor shall limit damage to protected tree species in the Olea woodland as far as possible. Adapt layout plans to avoid any excessive damage to this habitat type.

All individuals/ stands of protected trees must be clearly and visibly marked prior to the start of construction or maintenance procedures.

Demarcate construction areas by semi-permanent means in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts.

No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required.

Marking of plants should be done by means of semi-permanent (removable) marker tape.

Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted.

Vehicular traffic shall not be allowed in permanently wet areas, no damage shall be caused to wet areas. Where necessary, alternative methods of construction shall be used to avoid damage to wet areas.

Prohibit construction of new access roads. Use should be made of existing roads, ensuring proper maintenance/ upgrade. Alternative methods of construction/ access to sensitive areas are recommended.

The Contractor shall select a suitable level area free of rock and large bushes as lay down area.

The Contractor shall select an area a suitable distance from any sensitive environmental feature as a construction camp.

Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible.

Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area.

Disturbance of vegetation must be limited to areas of construction.

The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO.

No animal may be hunted, trapped, snared or killed for any purpose whatsoever.

The Contractor shall conduct a search and rescue operation in all affected areas to remove animals from old termite mounds prior to the commencement of construction activities (vegetation clearing and ground levelling). Reptiles and small mammals that utilises these micro-habitat should be captured and released in suitable nearby areas.

Vehicular traffic should not be allowed after dark in areas which are not properly lit in order to limit accidental killing of nocturnal animals.

Dangerous animals should be handled by a competent person.

Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

Obtain necessary and required approval per application for damage/ removal/ cutting/ pruning of Protected tree species from Department of Forestry, as per National Forests Act (Act No. 84 of 1998) under Government Notice GN 1012 of 2004 and GN 767 of 2005 as well as NCDENC.

Cutting/ pruning/ damaging of any Protected tree species should not be allowed at any circumstances, unless a permit has been obtained for this purpose.

The Contractor shall conduct a detailed walkthrough of moderately suitable habitat for Lithops aucampiae subsp. aucampiae var. aucampiae. Implement a removal and relocation programme if required.

4.6 Water Management

4.6.1 Water for Human Consumption

Potable water will be available at readily accessible points on site – this includes the construction area.

4.6.2 Storm water Management

All storm water needs to be directed into the storm water system. Clean and dirty surface runoff needs to be separated and diverted away from site. Measures have to be implemented to minimize standing water in the construction servitude area. All spoil/stockpile areas have to be constructed in such a manner as to prevent erosion resulting from surface runoff. No contaminated storm water will be allowed to enter the natural surface drainage lines or wetland areas.

4.6.3 Wetland Management

Sedimentation will be limited during construction if the Contractor applies the following measures:

- Major vegetation clearing activities and earthworks should be undertaken during the dry season as far as practically possible.
- The footprint of vegetation clearing should be limited to the direct footprint of the proposed developments where practical. The construction servitude should be fenced off prior to the commencement of construction activities and all construction activities should be limited to this servitude.
- Access roads and construction roads should include regular low levels humps to slow down storm water flow and direct storm water off the road surfaces and into adjacent grassland at regular intervals to minimise erosive energy of storm water runoff.
- Storm water infrastructure should include sediment traps.

Water quality deterioration will be eradicated if the Contractor applies the following:

- All potentially polluting and hazardous substances used and stored on site should be stored in clearly demarcated areas.
- Storage areas for diesel, oil and other polluting substances must have adequate spillage containment measures to contain any spills within the direct area of the spill. Ideally, all

potentially polluting substances should be stored in bunded areas of sufficient capacity to contain the full volume plus 10% of the storage containers.

- All re-fuelling areas and workshops should make use of drip trays to capture fuel and oil spills during re-fuelling or during vehicle maintenance and repairs.
- Storm water should be diverted around the storage areas of polluting substances to prevent contamination of clean storm water.
- Sufficient quantities of spill clean-up materials (e.g. Drizit or Spillsorb) should always be available on site. Once used, absorbent material and contaminated soil should be disposed of at a registered hazardous waste disposal site.
- The following guidelines apply to the use of polluting substances on site, and specifically to the use of cement and concrete:
  - Carefully control all on-site operations that involve the use of cement and concrete.
  - Limit cement and concrete mixing to single sites where possible.
  - Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
  - Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

In order to reduce increased flows within a watercourse the Contractor shall not discharge any dirty or contaminated water into a watercourse.

4.7 Waste Management

Solid & General Waste Management

The site will be kept neat and tidy at all times. No littering by construction workers will be allowed, during the construction period. Fines shall be implemented for persons found littering – this fine system will be implemented by the CER. It is the responsibility of the contractor to provide litter collection facilities for safe disposal at a licensed waste disposal sites.

It is the responsibility of the contractor to implement a refuse control system which applies to all waste generated on site:

- Building rubble
- Solid general waste
- Cement bags and wrapping materials
- Surplus food, packaging and organic waste
- Hazardous waste/materials.

Solid waste shall only be stored in the designated general waste storage area in covered, tip proof waste skips for disposal. The burying and/or burning of refuse/waste is at no time permitted within the construction site. It is the responsibility of the contractor to ensure that there are enough refuse bins placed around site. These bins need to be closed, in order to protect the contents from the elements i.e. restrict leaching and emptied on regular basis. Temporary waste storage facilities need to be equipped with waste skips, to be emptied on a weekly basis. The waste skips need to be placed on an impermeable surface and enclosed.

The mixing of general waste and hazardous materials is not permitted – waste separation needs to occur before waste is placed in the waste skips.

The contractor is responsible for keeping the site neat and tidy – no refuse is to be found on site outside bins/skips allocated for these purposes. The contractor is responsible for the removal and disposal of any and all general solid waste generated during the construction phase of the project to the active workface of the licensed waste disposal site. Record of this has to be kept for the ECO Audit.

4.7.1 Hazardous Waste Management

The temporary storage area for spent hazardous materials needs to be enclosed by walls (bunded), under cover (roof) and located on an impermeable surface. All spent hazardous material needs to be disposed of at a licensed hazardous waste disposal facility. The contractor will also have to provide the ECO with the disposal certificates for these.

4.7.2 Effluent Management

All sewage/effluent water originating from the site camp office shall be disposed of in such a manner as not to adversely affect the surrounding water sources (streams, rivers, wetlands, etc.). No wastewater shall be allowed to enter the drainage system. Sanitary arrangements should be to the satisfaction of the CER, the local authorities and all applicable legal requirements. It is essential that sewage be managed appropriately by means of a modular sewer treatment works and that all required authorisations are obtained from the local authorities in terms of the disposal of the effluent thereof in the evaporation ponds. The contractor is responsible for recording the volumes of sewage effluent disposed of in the evaporation ponds on a weekly/monthly basis and ensure that it complies with the volumes as agreed upon by the Authorities.

4.7.3 Ablution Facilities

Washing and acts of excretion/urination is not permitted anywhere on site, except within the facilities provided. During the construction period it is the contractors' responsibility to supply and maintain chemical toilets. Sanitation facilities will be supplied by the contractor for the workers at a maximum ratio of 1:20. Sanitation facilities will be located within the contractors' camp and readily accessible to all employees.

The contractor will ensure that these facilities are maintained on a weekly basis to maintain a good hygiene status. Toilet paper will be provided by the contractor. The discharge of any other materials and or waste within the sanitation system will be prohibited. Toilets will be secured and provided with a closing mechanism.

These facilities will be placed at points no closer than 100 meters from environmentally sensitive areas, drainage lines, wetlands or water bodies.

4.8 Heritage Management

In order to mitigate the identified as well as any undocumented finds of Archaeological Sites specifically at sites **PGS06** –The contractor needs to ensure that the sites are documented through a surface collection and test excavation to determine the extent of the site. This will include mapping of the lithic distribution as well as analysis of the lithic assemblage. In terms of Cemeteries and in particular **AC02 - PGS09 and PGS13** it is recommended that the development layout be adjusted to accommodate the cemeteries and that the cemeteries be fenced with a 10 meter buffer.

It is further recommended that in the event that the cemeteries cannot be incorporated in to the development the graves be relocated after a full grave relocation process that includes comprehensive social consultation. The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
- Site notices indicating the intent of the relocation
- Newspaper Notice indicating the intent of the relocation
- A permit from the local authority;
- A permit from the Provincial Department of health;
- A permit from the South African Heritage Resources Agency if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- An exhumation process that will safeguard the legal implications towards the developer;
- The whole process must be done by a reputable company that are well versed in relocations;
- The process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Possible infant burials at **ACO013**, **PGS11-13** needs to be monitored during construction. However best practice would be to do test excavations to ascertain the presence of possible infant burials at each of these sites.

4.9 Soil & Erosion Management

In order to reduce the risk of erosion the contractor has to design and implement a storm water management system for the site – this system has to be signed off by the SE. The system has to be designed in such a manner that the clean and dirty surface runoff is separated and diverted of site.

Topsoil is regarded as the top 300mm of soil and needs to be stockpiled at a designated point – clearly indicated on the site layout plan. Removed topsoil needs to be handled as little as possible – preferably only twice – once upon removal and once during rehabilitation. Soil stockpiles are not allowed to be higher than 2.5 meters. Areas designated for stockpiling needs to be indicated on the site layout plan and managed accordingly.

Contaminants need to be stored away from stockpiles, and they need to be kept free from refuse, biological material and hydrocarbons. Soil stabilisation measures i.e. soil wetting or chemical stabilisation, needs to be implemented at all cleared areas and stockpile areas.

In the unlikely event of unearthing a heritage/cultural artefact during the construction phase of the project – it has to be reported to the CER and ECO immediately. The EM also has to ensure that the SAHRA is notified in order to undertake the required investigation.

4.10 Nuisance Control

4.10.1 Visual Impact Mitigation

The contractor will be responsible for reducing the aesthetical impact of the proposed project on the visual receptors. During the construction phase the contractor will put in place a visual screen along the R 356. The visual screen may consist of vegetation such as trees and shrubs;

The contractor has to allow, where screening has been implemented that the indigenous vegetation is maintained and blends in with the natural landscape to reduce the visual impact. The minimum amount of existing vegetation and topsoil should be removed from construction areas. Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the site design. Eradication of vegetation should be done in 'natural manner', avoiding harsh straight lines;

Dust suppression techniques should be in place at all times during the construction and operational phases;

Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the power block but which still illuminate the buildings/roads;

Avoid high pole top flood and security lighting in these areas;

4.10.2 Dust Control

Dust control measures need to be implemented during the construction period. The contractor has to ensure that all vehicles/machinery abide by the traffic regulations and that the speed limit

is enforced. In addition to this measure, the contractor has to implement a dust suppression programme i.e. watering or chemical stabilisation in order to manage the dust generated from aggregate/soil stockpiles and roads.

4.10.3 Noise Management:

Where possible, stationary noisy equipment (for example compressors, pumps, pneumatic breakers,) should be encapsulated in acoustic covers, screens or sheds.

Use of low-noise generation construction machinery. Noise control measures on construction machinery must, however, be agreed with the manufacturer.

Curtailing the uses of reverse-warning signals on site vehicles in certain areas and at certain times. Consideration of alternative safety measures may be necessary when taking such a measure.

All construction vehicles, plant and equipment are to be kept in good repair, for example, cover sheets should not vibrate or rattle; wheels, rollers and pulleys should not squeak.

With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and owners on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.

As construction workers operate in a very noisy environment, it must be ensured that their working conditions comply with the requirements of the Occupational Health and Safety Act (Act No 85 of 1993). Where necessary ear protection gear should be worn.

When construction works need to continue over a weekend or on a public holiday, all IAP's need to be informed in writing, well in advance. All engineering controls aimed at reducing the level of noise generated by the proposed activity needs to be implemented. When it is expected that the activity will generated noise levels over the 85db threshold, all employees exposed to the noise have to wear suitable hearing protection gear.

4.10.4 Lighting

Day-night switches have to be used at the construction site camp in order to minimise energy wastage. The Contractor shall furthermore ensure that lighting is kept to a minimum, and that light masts are positioned away to minimise light pollution and intrusion especially into adjacent private properties.

4.11 Pollution Risk Control Measures

It is also the responsibility of the contractor to minimise and where practicable avoid pollution contaminating the site and surrounding property and natural environments. Pollution risks may arise from factors such as the site's layout, drainage and the activities that will be undertaken

during the operational phase. The contractor has to compile a pollution risk control sheet wherein all the pollution sources/risks are identified and the ways in which he/she plans to manage and or mitigate these risks.

These mitigation measures can be procedural or structural in nature. **Structural control measures** would typically be of a physical nature and are designed to control the movement of possible contaminants around the site, such as designated batching areas, material storage and handling areas etc. Bund walls, storm water cannels and enclosed-sump systems can all be categorised under structural control measures.

Procedural control measures are verbal or written instructions on how to carry out certain operations such as Standard Operating Procedures (SOP's) for the handling of spills, the decanting of fuel/hazardous materials and refuse management.

4.12 Rehabilitation after Construction

In the instance that the temporary construction camp and facilities fall outside the ultimate footprint of the heliostat fiels and the land requires remediation it is the responsibility of the contractor to rehabilitate the construction site camp and the construction servitude once construction has ceased.

Rehabilitation must be scheduled to take place as soon as possible after construction has been completed with acceptable cover being achieved after 3-6 months. Only indigenous vegetation may be used for the rehabilitation plan.

4.12.1 Construction Camp Structures, Facilities & Fencing

Upon decommissioning all structures, facilities and fencing are to be removed from site. Cement / concrete slabs allowed for foundation structures are to be removed and the compacted soils to be ripped and rehabilitated through grassing.

4.12.2 Water Management

Storm water trenches utilised for the purpose of the site camp are to be levelled and grassed to prevent erosion. The construction servitude is to be grassed to prevent erosion.

4.12.3 Effluent/Sewage:

All prefabricated ablution facilities and temporary chemical latrines are to be removed from the site and any resultant waste disposed of at the municipal sewage treatment works.

4.12.4 Access Roads

All access roads used during the course of the project are to be rehabilitated to their previous states.

4.12.5 Soil

All soils that were compacted during construction phase of the project needs to be ripped, the topsoil to be re-spread and the entire area re-grassed.

All topsoil which has been removed or disturbed during the construction phase must be replaced, levelled and grassed to stabilise the construction area and prevent erosion and dust.

4.12.6 Visual Mitigation

The visual impact of the construction servitude and site camp will be mitigated by means of landscaping and grassing the area with grass indigenous to the area.

4.12.7 Dust Management

With regards to dust management the construction camp site and construction servitude is to be grassed with grass indigenous to the area.

5 Operational Phase EMP

The Operational Environmental Management Programme (OEMP) serves as the Contractor and SE's guideline to ensure that sound environmental management practices are implemented during the operational phase of the project. The OEMP will specify the control measures that need to be implemented and maintained by the contractor during the operation of the proposed plant.

5.1 General Operational Management Activities

All registers and procedures as developed for the construction phase need to still be maintained on site and accessible. Any and all complaints need to be logged in the complaints register and brought under the attention of the CER. Procedures for the remediation of accidental spills and incidents still apply and need to be implemented upon the occurrence of the incident.

All operational management procedures as described in the Site Documentation need to be implemented. These reports will be accessible on site at all times. The solar power facility is to be kept neat and tidy at all times – housekeeping should be in good standing order. All equipment and materials need to be stored according the storage procedure developed by the CER.

5.2 Dedicated Area Specifications

5.2.1 Workshop

When operating the workshop on site the same principles as during the construction phase would apply. No soil and land contamination would be tolerated and proper impermeable bunded areas with the required oil water separator mechanisms is required from the applicant. When servicing equipment, drip trays must be used to collect the waste oil and other lubricants. All waste material must be disposed of in accordance with national, regional and local laws, regulations and by-laws. The waste material must be stored and removed off site in terms of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste and disposed off at an approved waste disposal site. Where possible, appropriate material shall be re-used or recycled. Wash water must also be collected if the possibility exists that lubricants and solvents will be transported by the wash water.

5.2.2 Vehicle Service Area & Wash-Bay

This designated area will be assigned for the purpose of servicing and washing of operational vehicles – vehicles/equipment will only be serviced within this area. This area has to have an impermeable surface, and be enclosed. The area has to be equipped with a drainage system – whereby the spilled hydrocarbons are channelled into a sump, to be treated or gathered for disposal at a licensed hazardous waste disposal site. All vehicles / equipment need to be kept in good working order to ensure that there are no oil/fuel leakages. Drip trays will be used during vehicle servicing at all times. Emergency spill response kits need to be on site at all times – and all personnel needs to have a complete understanding of their function and how to use them.

5.2.3 Ablution Facilities

Washing and acts of excretion/urination is not permitted anywhere on site, except within the facilities provided. The contractor will ensure that these facilities are maintained on a weekly basis to maintain a good hygiene status. Toilet paper will be provided by the operator. The discharge of any other materials and or waste within the sanitation system will be prohibited. Toilets will be secured and provided with a closing mechanism. During operations staff will be utilizing the proper ablution and sanitary facilities. These must be linked to the sewer treatment system which comprises of a modular sewer treatment plant with sufficient capacity to process all the sewage generated on the plant.

5.2.4 Change Rooms

Changing rooms will be clearly marked for each sex. Changing Rooms will have adequate seating for the maximum employees present during working hours.

5.2.5 Waste Disposal Facility Operation and Development

An appropriately bunded area will be demarcated and designed to contain general waste in designated bins. This area will be included in the contractor's site layout plan to be approved by the SE. General waste must be sorted at source and removed weekly to a licensed waste disposal / landfill facility..

5.2.6 Site Access & Security

The site will be accessed via the existing gravel road. Effective access control must be ensured by having the site fenced to a minimum height of 1.8 metres, with gates of the same height at all entrances. The entrances will at all times be monitored by staff. The gravel road will be maintained by the operator to ensure it is in proper condition. The access gate to the facility must be manned at all operating hours. The gates must be locked when not in operation.

5.2.7 Fencing

The Applicant is responsible for the maintenance of the fence surrounding the proposed plant. The fence needs to be inspected on a regular, monthly basis and maintenance needs to be done when required. All repairs are to be done within the confines (boundary) of the site.

5.2.8 Biodiversity Management

5.2.8.1 Fauna & Flora Management

It is crucial that biodiversity is managed during the operational phase of the project. This allows for no indigenous fauna and flora to be removed, however invasive species need to be managed as per instruction by the SE. It is also recommended that the facility site be monitored for alien and invasive species at all times.

The damage of flora outside the site boundary should be avoided at all times – if damage does occur it needs to be reported to the CER for remediation. Under no circumstances are employees allowed to trap and / or kill animals.

No fires are allowed on site – under any circumstances and no one may cut vegetation (grass and shrubs) unless absolutely required. No clearing of vegetation or soil by grading machinery shall be undertaken;

The establishment and regrowth of alien vegetation must be controlled after the removal of grass;

All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);

Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Damage to re-vegetated areas should be repaired promptly;

Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act, No. 43 of 1983 and should be addressed on a continuous basis;

5.2.8.2 Avi-Fauna management

During operation it is required that the operator of the plant cover the evaporation ponds and any other attenuation ponds with waste water with a chicken-wire mesh structure to prevent any white-backed vultures, blue cranes, flamingos and other water birds entering or using the water at all. The mesh will need to be monitored for breaks and maintained monthly.

Any overhead power lines which are built within the site, and which are 132kV or lower, should use a “bird friendly” monopole structure, fitted with a bird perch, as per Eskom standard guidelines in order to prevent electrocution.

5.2.8.3 Water Management

Stormwater Management

The facility operator will be responsible for the maintenance of the storm water system put in place during the construction and operational phase. This is especially crucial for the workshop and evaporation pond areas. It is necessary that surface runoff be managed appropriately in order to simultaneously address erosion control measures. The stormwater and drainage system needs to be cleaned of debris on a bi-weekly basis.

Cut off Trenches

Storm water cut off trenches will be constructed on the upstream sides of the site will be constructed to control storm water from entering the site.

Cut off Berms

Berms will be constructed around the cells to ensure that the working front be kept as small as possible and to ensure the diversion of run-off away from the waste body.

Care must be taken to ensure that no water ponding takes place and that any water falling on this area, which will be deemed clean, can be released to the environment via the cut off berms on the outside of the site.

Evaporation Ponds

The evaporation pond will consist of a low lying area constructed in such a manner to contain all runoff from the site. Proper maintenance and inspection of the ponds are required monthly.

Water for Human Consumption

The Contractor will ensure Potable water will be available at readily accessible points on site Potable water systems must be inspected for leakages on monthly basis' to ensure no water is wasted

5.2.8.4 Soil Management

The various soil protective/management measures that were installed during the construction phase of this project have to be upheld and properly maintained.

5.2.9 Nuisance Management

The CER is to ensure that the following nuisance control measures are to be implemented and maintained throughout the lifespan of the operation.

5.2.9.1 Dust

Dust control measures need to be implemented during the operational phase. Surface roads must be maintained adequately for all weather conditions. Un-surfaced roads must be regularly graded and watered to control dust.

The contractor has to ensure that all vehicles/machinery abide by the traffic regulations and that the speed limit is enforced.

In addition to this measure, the contractor has to implement a dust suppression programme i.e. watering or chemical stabilisation in order to manage the dust generated from soil stockpiles reserved for cover material.

5.2.9.2 Emissions

All equipment and vehicles must be maintained in good working condition.

5.2.9.3 Visual Impact

As per the conditions of the CEMP the visual impact will be mitigated by means of vegetation. It is the responsibility off the operator to ensure that the vegetation around the site is well maintained to create some sort of visual buffer from the R356.

5.2.9.4 Noise Management:

Noise pollution emanating from the facility during operation will not generate excessive noise but where possible, very noisy activities should not take place at night (between the hours of 20h00 to 06h00). It must be ensured with the washing of the heliostats at night that noise levels from the high-pressure hose system (compressor) on the trucks are minimised.

5.2.9.5 Lighting

Adequate lighting will be installed around buildings. Lighting around buildings will be fitted white day- night switches to minimise electricity usage.

5.2.9.6 Fire on Site

No fires will be permitted on site under any circumstance. The burning of waste is not allowed and will not be tolerated.

5.2.10 Monitoring and Auditing

The License Holder must develop and implement a Monitoring and Measurement Plan that must include, but not be limited to:

- Tonnage received, reclaimed and or landfilled;
- Surface and groundwater quality monitoring;
- Compaction ratio monitoring;
- Biogas monitoring
- Air space monitoring; and
- Landfill stability monitoring.

Please note: Water quality monitoring must be undertaken in accordance with the frequency stipulated and parameters outlined within the Site Documentation.

6 Auditing

6.1 Internal Audits

Internal auditing must be conducted quarterly by the license holder. Official audit reports must be compiled by the relevant auditor and the findings of these audits must be available to the external auditor and the authorities. Non-conformances raised during audits must be addressed and closed-out to ensure further compliance.

6.2 External Audits

The license holder must appoint an independent external auditor to audit the site annually and this auditor must compile an audit report documenting the findings of the audit. Findings raised in audits must be addressed and corrective actions included for auditing in quarterly compliance audits. The external audit report must be submitted by the license holder to the CA on an annual basis.

The external auditor team must consist of the following persons:

– An Environmental Assessment Practitioner with ECO experience; and

– A Professional Registered Engineer.

The external audit report must:

– Specifically state whether the landfill site is in compliance with the Site Documentation, with specific reference to whether the conditions of the WML are adhered to;

– Include an interpretation of all available data and test results regarding the operation of the site and all its impacts on the environment;

– Specify target dates for the implementation of the recommendations by the license holder to achieve compliance;

– Contain recommendations regarding non-compliance or potential non-compliance and must specify target dates for the implementation of the recommendations by the license holder and whether corrective action taken for the previous audit non conformities was adequate; and

– Show monitoring results graphically and conduct trend analysis.

6.3 Monitoring Committee

A monitoring committee must be established in terms of Appendix 11 of the Minimum Requirements for Waste Disposal by Landfill. The Monitoring Committee shall meet at least once every four months and not later than 30 days after the external audit report is issued.

6.4 Reporting /Public Complaints

Naledi Local Municipality must compile a complaints register, recording all complaints and action taken for reporting to the Monitoring Committee and authorities when requested.

7 Rehabilitation and Closure

Progressive rehabilitation, as outlined within the Site Documentation, must be undertaken under the supervision of the SE.

A concept closure and rehabilitation report and rehabilitation plan is contained in Appendix A.

Appendix A

Draft Decommissioning Plan

DRAFT DECOMMISIONING PLAN

PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, POSTMASBURG, NORTHERN CAPE PROVINCE

DEA EIA REFERENCE: 12/12/20/2316

PREPARED FOR: SOLARRESERVE®

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JANUARY 2012

HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT

DECOMMISIONING PLAN

TABLE OF CONTENTS

8 BACKGROUND

8.1 Introduction

This document is part of the Draft Environmental Management Plan (EMP) for the proposed Humansrus Solar Thermal Energy Power Plant Environmental Impact Assessment (EIA) as required in terms of the National Environmental Management Act as well as the National Environmental Management: Waste Act.

This report is a concept report compiled by SolarReserve and will be finalised in detail by the appointed EPC contractor upon appointment for the construction of the project.

The company responsible for preparing this document is SolarReserve South Africa, and the individual responsible for it is Mr. Terence Govender (contact details contained on cover page).

8.2 Purpose

The solar thermal power generation plant will be decommissioned 20–50 years after its commissioning. During this process, the complete decommissioning of the solar thermal power generation plant – which will consist of approximately 10 300 to 17 500 heliostats each with a mirror surface of approximately 64 to 116m^2 and comprising mirror modules, structural support components, two motors for changing orientation, a local heliostat driver and a foundation – must be undertaken.

The design of the heliostat planned is as follows:

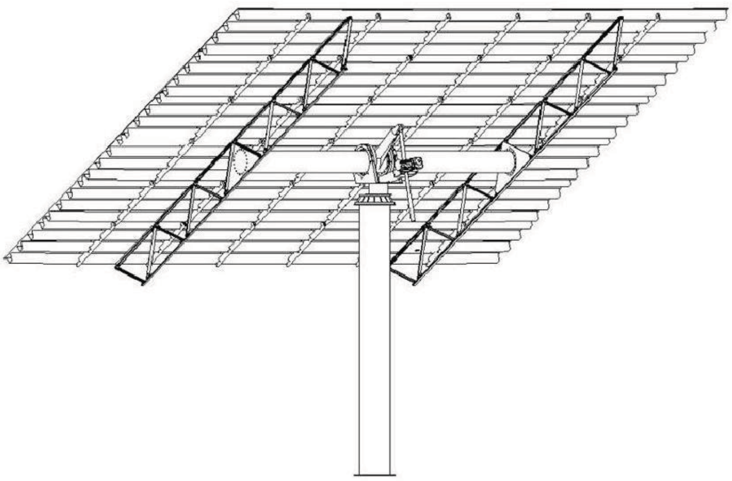

Figure 1: Heliostat Design

The solar concentration tower is one of the plant's main elements. This is a concrete tower that supports the central receiver, with the following dimensions:

– Height without the solar receiver: 165 m
– Height with the solar receiver: 200 m (*)
– Solar receiver and crane height: 37 m
– Side of square base section: 35 m
– Side of square section in the upper area: 26.4 m

The objectives of the decommissioning of the plant are therefore as follows:

– Decommission surface infrastructure that has not been converted to other uses so that all traces of this activity are decommissioned.
– Removal to a monitored disposal site – in accordance with their type – of the waste and unrecyclable material.
– Restore as far as possible the slopes in the affected areas of the site in order to recover naturalised reliefs and restore native vegetation or uses in the affected areas in a way that ensures that the environment is recovered.
– Carry out the final restoration of land after the activity has ended and been decommissioned.
– Achieve the complete recovery of the environment in which it is located, which should be accomplished within a maximum period of one year after the operation is finished.

In short, the purpose of this document is to define the work related to the decommissioning and subsequent management of the facilities as well as the work related to the restitution of the soil and revegetation after the solar thermal power generation plant has been decommissioned, thus achieving the recover of the area with regard to its current state. The definition of this work will comprise the following:

– Phases in the decommissioning process
– Demolition and decommissioning
– Destination of components and recycling of materials
– Soil surface recovery plan
– Classification and quantification of the surfaces affected
– Species to be used Size, age, density
– Origin and source of seeds or plants
– Sowing and planting periods
– Machinery to be used

- Cartography
- Budget
- Topsoil management

9 PHASES IN THE DECOMMISSIONING PROCESS

9.1 Introduction

The decommissioning of the solar thermal power generation plant will be done once the activity, which is expected to take place after a period of 20 to 50 years subsequent to its commissioning. Once the plant's activity has ended, and as provided for in the project's Environmental Impact Statement, removal and restoration must take place within one year.

The planning of each phase will be done by preparing a decommissioning project so as to ensure personal and environmental safety without loss of efficiency while carrying out the work.

Before the activity ends, a work plan for the demolition work will be prepared that will include the necessary specifications, including:

- **A plan for handling equipment,** pipes, electrical wiring and equipment and their parts, structural steel from the building and cladding, **for recycling or reuse.**
- **A plan for eliminating** those components not included in the above paragraph; these will be disposed of **in authorised disposal sites.**
- A restoration plan.

This division of work plans based on the destination of the materials will be taken into account in the description of the different phases described below.

9.2 Preparatory work for decommissioning

Just as when a solar thermal power generation plant is installed, the removal of the infrastructure associated with the project will involve the preparation of the area, given the amount of machinery and workers that will remain and work on the decommissioning. Since the decommissioning is expected to take place within less than a year after the cessation of activity, it is estimated that the access roads will be in good condition and be appropriate for the transit of machinery (heavy cranes, special trucks, etc.), so that only slight improvements or additions will be needed and these will be limited to certain sections of the service road.

Prior to the decommissioning works themselves, all waste materials and chemicals will be removed for reuse in other facilities or proper management through authorised waste management service providers. Thus, the salt storage tanks will be emptied and the products that can be sold as farming products will be solidified, since the main salt using during the process can be used as an agricultural fertiliser. Once the tanks and the product lines are emptied, the tanks will be washed using an internal system that avoids possible spills.

In addition, during this phase the elimination of all lubricants and chemical products stored in the plant will be carried out. These products may be sold or turned over to an authorised waste management service provider, as they are not the plant’s main components.

9.3 Decommissioning and demolition of surface infrastructure

This phase includes the demolition and elimination of the materials and equipment from all areas of the plant.

The components present in the plant which will be treated according to the plans described are as follows:

- Buildings: these are plant components that do not represent any hazard, with any building being covered by Plans A and B described in Section 1.
- Collection field: the decommissioning of heliostats, including the mirror modules, positioners, etc. is covered by Plan A. The electrical connections will be removed and sold for their copper content, which also will be reflected in Plan A.
- Salt storage tanks and pumps:
    - Tanks Reflected in Plan A, hereinafter (a)
    - Pumps (a)
    - Insulation (a)
    - Cladding Shown in Plans A and B, hereinafter (b)
- Heat generation equipment and buildings; the plan covering each infrastructure is indicated in brackets.
    - Exchangers (a)
    -
    - Salt conduits (a)
    -
    - Buildings (a and b)
- Solar receiver and tower:
    - Solar receiver (a)
    - Salt conduits (a)
    - Tower (b)
- Power island
    - Steam turbine generator (a)
    - Steam exchanges (a)
    - Feeders for boiler water, condensate pumps, etc. (a)
    - Fire protection system (a)
    - Tanks for storing the water for fighting fires (a)
    - Conduits (a)
    - Buildings and crane (a and b)

- Air coolers (a)
- Demineralisation plant (a)
- Control room equipment (a)
- Control room (a and b)

- Electrical system:
- Transformers (a)
- Wiring (a)

9.4 Removal of concrete elements

The main structures during this phase are the tower of the receiver and the foundations of the heliostats, buildings, etc.

In accordance with industry standards for the safe demolition of high-rise towers and massive concrete structures, explosives will be used to bring down the towers and conventional heavy machinery to reduce the size of the debris, thus facilitating its subsequent transport and recycling.

The removal of underground infrastructure up to 20 cm of concrete below ground level – the measurement used to calculate the decommissioning budget attached to this report – will be ensured with respect to the final levelling.

9.4.1 Decommissioning of underground infrastructure

Water pipes, gas pipes, electrical wiring, etc. – which will be removed from the ground – are included in this phase.

Excavation and land management and final levelling

After excavation and land management, a final levelling will be carried out to recover the original conditions of the affected area so that they are returned to the land's original function and slopes and create favourable conditions for the subsequent revegetation activities with native plants.

Also during this phase, the accesses (around the perimeter, etc.) built for the project's design life, as well as any residual materials from the evaporation ponds, will be removed. The wastes generated will be managed via Plan B (removal to an authorised disposal site).

10 DEMOLITION AND DECOMMISSIONING

10.1 Introduction

Using industry standards for the means and methods of demolition and the application of measures to reduce the risk to the safety of workers and the environment, minimising exposure time and keeping workers at a reasonable distance from the demolition work.

One of the most important facilities of the plant having a complicated demolition is the solar receiver tower, given its size. Currently, the demolition of similar structures – as in the case of industrial smokestacks – is done with a combination of machinery appropriate for this purpose, such as:

- Pulveriser or demolition jaw with rotation unit
- Tower crane or mobile crane
- Hydraulic generator or excavator to supply oil to the tools
- Remote control for the demolition tool

However, based on the decommissioning plan established by the project company, the use of explosives to demolish the tower is being considered

The following recommendations – among others – will be taken into consideration:

- Prior to demolition, a study of the land, the conditions of the various structural elements, etc. will be conducted.
- The demolition order will be implemented by first removing from the buildings any elements that might make debris removal more difficult.
- Load-bearing elements will be demolished, in general, in the opposite order in which they were built.
- The most appropriate demolition method will be chosen based on the type of project: by collapse, or combined demolition.

As specified in the standard, general conditions for executing the demolition of foundations and elements that are buried or underground are:

- - The order and manner of execution, and the means to be used in each case, will comply with the requirements set out in the Technical Documentation (and therefore, a demolition project will be prepared for the decommissioning in compliance with the regulations in effect at the time the activity stops).
- Before excavation begins, technical management will approve the layout done.
- Fixed reference points will be placed in places that cannot be affected by the excavation work, which will be referred to for all readings involving levels and horizontal and/or vertical displacements from the points on the land. The daily readings of displacement with reference to these points will be recorded in summary reports for monitoring by technical management.
- Surface water will be prevented from entering the excavation, and the solutions provided in the Technical Documentation will be adopted for draining deep water.

- Rock lenticles that protrude beyond the edges of the excavation will not be extracted or undermined without prior authorisation.
- If any unanticipated anomaly is found during excavation – such as a variation of the strata and/or their characteristics, groundwater watercourses, objects of archaeological value, etc., – work will be halted and this will be brought to the attention of technical management to take the proper decisions in compliance with the law.

11 DESTINATION OF COMPONENTS AND RECYCLING OF MATERIALS

11.1 Introduction

In this section, the elements to be removed during the decommissioning of the plant are listed, in two different groups based on their final use: reusable items and wastes themselves. A table indicating the EWC of the main wastes that will be obtained is included, and states whether the wastes are hazardous or nonhazardous.

11.2 Reusable elements

These will be components that can be used again, i.e., are not waste as such. It is advantageous to find a use for these so-called sub-products, due to the reduced costs involved with the consequent economic and environmental benefits.

The possible sub-products from the solar thermal power generation plant will be multiple in terms of type, quantity and volume. Thus, certain substances are considered to be "usable", such as salts, lubricants, etc. Other materials from the plant may be reusable in other facilities when it is decommissioned, depending on their condition.

11.3 3. Recyclable wastes

As indicated in previous sections, the wastes considered to be reusable or recyclable will be included in a facilities management plan to be completed by the EPC contractor; the main components that can be managed by avoiding disposal are discussed in the following paragraphs.

Use will be done in one of the two ways (recycling or reuse) of all of the collection field, so that heliostats, mirror modules, positioners, etc. and electrical connections – which will be dismantled and sold for their copper content – are covered by the management plan (Plan A).

The decommissioning of the salt storage tanks and auxiliary pumps – including tanks, pumps, insulation and part of the lining used – will also be managed by recycling or reusing.

Exchangers, salt conduits and part of the buildings associated with the heat generating equipment will also be managed in this way, as will the solar receiver and salt conduits, but not the tower itself.

Most of the elements of the power island will be recycled or reused, with the exception of certain elements in the building and control room (see Phase 2).

Lastly, transformers and electrical system wiring will also be managed as recyclable or reusable material.

The main usable wastes from the plant after decommissioning with their EWL code are therefore as follows:

- Steel
- Concrete
- Electrical Components
- Aggregates and Terrigenous
- Substances and Fluids

Other recyclable materials that can result from the decommissioning of the plant are:

- Metals (steel, aluminium, etc.): fittings, ladders, etc.
- Plastics: auxiliary tanks, etc.
- Electronic and electrical components: Control panels, electrical switchboards, light bulbs, fluorescent tubes, earthing grid system, security and fire-fighting systems, etc.

The management of the different materials described in this section will be done through authorised waste management service providers; these wastes may be removed by the service providers in the facilities or taken to a recycling centre or a construction and demolition waste treatment plant (in the case of this type of waste).

11.4 Non-recyclable wastes

The removal plan established by the project company when the activity ends will be applied to those wastes that are neither reusable nor recyclable. Through this plan, non-recyclable wastes will be properly decommissioned and managed. They will be turned over to an authorised waste management service provider and discarded in authorised disposal sites (inert disposal site or hazardous waste disposal site).

The main plant elements included in this management plan are certain components of the various buildings as well as the support tower for the solar receiver. However, when they are turned over to an authorised waste management service provider, the provider will carry out a second evaluation to determine whether the materials can be recycled.

12 SURFACE SOIL RECOVERY PLAN

12.1 ntroduction

Prior to beginning the restoration, or considering it to be the beginning, a series of activities aimed at recovering the soil surface after decommissioning will be carried out.

Taking into account that all underground foundations and infrastructure will have been removed down to the level planned below ground (20 cm) the recovery of the soil surface will be very important.

12.2 Treatment of altered surfaces

Decompacting will be done prior to adding topsoil, which will be done by mechanical means (subsoilers, rippers, etc.).

After using the topsoil removal initially, an analysis will be done of the availability of the volume of land needed for totally covering the soil surface affected by the decommissioning work and for the restoration of the areas where various infrastructure elements were located.

The existing profiles of the land affected will be improved and stabilised thereby leaving profiles not incompatible with the topography of the area, which is essentially flat.

The areas or land for extracting subsoil will be identified; they must have the appropriate environmental permits. The agrological characteristics should be similar to the affected soils (same texture, colour, permeability, etc.).

13 CLASSIFICATION AND QUANTIFICATION OF THE SURFACES AFFECTED

13.1 Classification and quantification of surfaces

In this section, the areas to be restored are classified according to their plant life as it existed prior to the execution of the works, slope, soil characteristics and orientation.

The study area is homogeneous in terms of features such as slope, orientation and soil characteristics, and therefore it is classified based on existing vegetation and the other factors are described.

The approximate areas utilising the figures indicated to be restored according to the layout of the project:

- Number of heliostats: 17,150
- Surface area of each heliostat (m^2): 62.4
- Mirror surface area (m^2): 1,082,640 m^2/ 108.25 ha
- Radius of heliostat field: 1,310 m
- Radius of entire plant: 1,350 m
- Total area of plant: including: 572.5 ha
    - Total solar field area 539 ha
    - Six metre wide perimeter road: 49,386 m^2
- Auxiliary facilities area: 53,620 m^2
- TOTAL SURFACE AREA: 580 ha

The baseline studies conducted for the EIA is a good reference to utilise in the rehabilitation of the area. The studies to be referenced includes the biodiversity, wetland and surface water studies.

14 SPECIES TO BE USED JUSTIFICATION

14.1 Species selected for sowing

Grassland species adapted to the environment have been chosen, which will the most suitable for holding the soil and for favouring its colonisation by the surrounding herbaceous and shrub plants. As for what seeds to use, a mixture of seeds of different grass species (95%) and shrubs (5%) is recommended, such as the species outlined in the flora study of the biodiversity impact assessment.

The choice and mixture of species must be determined by the EPC contractor in collaboration with a qualified botanist or landscape architect.

The restoration of tree and shrub vegetation will be done with plants from a plant nursery. The plants supplied will be healthy and sufficiently hardened off enough not to endanger their rooting and future development and should have a height and diameter in accordance with their age and species. Defects in the above-ground part that can exclude plants from commercial quality are: plants with poorly healed wounds, partially or totally dried up, malformed with an excessively curved stem, with stem lacking a healthy terminal bud, with clearly insufficient branching, evergreen leaves with the newest leaves severely damaged to the point of jeopardizing the survival of the plant and with the root collar damaged. In addition, the defects in the underground part that may exclude plants from commercial quality are: plants whose taproots are intensely curled or spiraled, with secondary roots absent or severely amputated, with retrogressive taproot root and with insufficient root density (insufficient live tips.) The plants will be supplied in containers and should be balanced between the above- and belowground parts. The container must be rigid enough to hold the shape of the root ball and protect the entire root mass during transport.

In general, and with respect to plant health, plants must not show any defects caused by disease, pests or physiological disorders that reduce its value or classification for use. They must be free of pests and diseases – or any signs or symptoms of these – which may significantly affect their quality and reduce the value of their use. The plants must not show signs of overheating, fermentation or humidity due to being stored in the plant nursery, nor should have any decay or injuries. The supply of plant must comply with current legislation on plant health, particularly in relation to harmful organisms and diseases that may significantly affect their quality.

Lastly, each batch of plant material intended for sale should be accompanied by a delivery order issued by the supplier, which must show such information as:

- Age in number of years.
- Full botanical name.
- Region of origin.
- Quantity.
- Diameter of root collar (mm) or plant height (cm).
- Manner of presentation.
- Container type and volume.
- Plant passport number.

It is also advisable for it to have this information: plant batch number, date of departure from the plant nursery and the last phytosanitary treatment.

15 PLANNING AND EQUIPMENT TO BE USED FOR REVEGETATION ACTIVITIES

15.1 Sowing and planting periods

The best sowing period is between August and October, after the first spring rains.

The best time for planting will be during the period of plant dormancy, which coincides with the cooler months – from late May to early September – avoiding the hottest days, heavy frosts or high or dry winds. In this case, the best time will be after the summer rainy season.

In addition, the provisions in the EMP must be taken into account; thus, the restoration must be completed within one year after the activity has finished.

15.2 Machinery to be used

Taking into account the following activities to be carried out:

- Decompacting
- Sowing of grassland and shrub species Planting of tree species
- Maintenance work
- The machinery needed will be as follows:
- For decompacting and sowing activities: farming tractor > 120 hp, with approximately 60 cm. subsoiler, stream type planter or fertiliser and a harrow for covering the seed.
- For planting and maintenance activities: farm tractor > 120 hp, with approximately 60-cm subsoiler and hand tools.

16 RESTORATION WORK

16.1 Introduction

Beginning with land that has been prepared and in line with the topography of the area that results from the execution of the decommissioning, the subsequent restoration plan is based on carrying out the following tasks:

– Sowing of grassland species.

– Planting of tree species

– Maintenance work

16.2 Decompacting

This activity will be aimed at preparing the areas that have suffered a significant transfer of soil in order to ensure natural regeneration. It is estimated that this activity will be needed in areas such as roads, heliostat foundations, etc., so it is estimated that it will be needed on at least 200 ha.

16.3 Spreading of topsoil

After the land has been prepared and the final topography based on that existing prior to the implementation of the project has been reached, next the areas will be prepared with the distribution and spreading of topsoil. This work will be done with the use of specialised machinery (frontloader, dumper, etc.).

It is expected that there will be a significant amount of topsoil moved during the construction work for installing the solar thermal power generation plant. This topsoil will be stored in stacked strips of less than 1.5 metres tall and, if the storage period exceeds 6 months, it will be fertilised and sown with legumes and used in subsequent restoration work. As stated in the EMP, the topsoil will be used in creating the plant screen and for planting herbaceous plants in the area affected by the project where facilities are not planned. If there is a surplus, it can be stored properly for use in restoration work after decommissioning.

The topsoil must be properly managed, which includes proof of origin in the event that exogenous soil is needed and it being transfer to areas undergoing restoration (disposal sites, quarries, etc.) if there is a surplus after completing the work reflected in this report.

16.4 Sowing of grassland species

Rolling the soil before planting is essential to bringing the land into contact with the seed and encouraging the flow of water around the seed. In practice, harrowing and rolling are two activities that are often alternated. It will be important to carry out these two operations with good judgment and adapt the implements according to the conditions of the soil, the crops and the climate in order to increase the growth potential of the proposed species.

Lastly, raking will be done with the intensity and in the areas Site Management deems appropriate. It will be verified that the surface finish is appropriate to each type of grassland, with clods broken up into small pieces and with an absence of undesirable elements such as stones, branches, etc.

The aim of this activity is for these areas to be quickly colonised in order ensure its integration into the landscape.

The sowing of grassland species adapted to the environment has been planned. These will the most suitable for holding the soil and for favouring its colonisation by the surrounding herbaceous and shrub plants.

16.5 Planting of tree species

Revegetation will be done with different native species, at densities to be determined by a qualified botanist or landscape architect. The surface to be revegetated with these species can vary depending on the characteristics of the area at the time of decommissioning, since continuity with the surrounding landscape will be sought.

16.6 Maintenance work

The maintenance and conservations operations must attain the following functional and aesthetic objectives:

- Maintain a vegetal cover, more or less continuous, capable of controlling erosion on embankments.

The following tasks will be done for maintenance:

- Support irrigation: It is estimated that at support irrigation will be needed at least twice, especially in the areas being revegetated through planting. The irrigation will take place – in the absence of rain – the first weeks after planting at the rate of 50 l/week and plant with a 10 m^3 lorry.
- Replacement of unhealthy plants: Unhealthy plants will be replaced the year after the completion of the revegetation work.

This work is not budgeted.

Appendix S

Public Meeting Exemption Approval

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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DEA Reference: 12/12/20/2316
Enquiries: Ms Masina Litsoane
Telephone: 012-395-1778 **Fax:** 012-320-7539 **E-mail:** MLitsoane@environment.gov.za

Ms Leanna Rautenbach
Environmental Scientist
WorleyParsons Resources & Energy
PO Box 36155
MENLO PARK
0102

Fax No: 012 460 1336

PER FACSIMILE / MAIL

Dear Ms Rautenbach

REQUEST FOR EXEMPTION FROM REQUIREMENTS OF A PUBLIC PARTICIPATION (PUBLIC MEETING) DURING THE DRAFT EIA PUBLIC REVIEW PHASE FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT ON THE FARM 469, THE HAY ROAD, NORTHEN CAPE PROVINCE

The motivation letter requesting exemption from holding a public meeting as part of the integrated EIA application for the above development received by the Department on 01 November 2011 refers.

The Department has evaluated the submitted request dated October 2011 and has no objection in WorleyParsons not hosting public meetings during the draft EIA public review. However, it must be noted that you are only exempted from holding public meetings and not exempted from conducting the remaining complete public participation process. Other aspects of the public participation process must be conducted by WorleyParsons in fulfilment of the requirements as stipulated in Regulation 54 of GN R.543 of 18 June 2010 (The EIA Regulations, 2010).

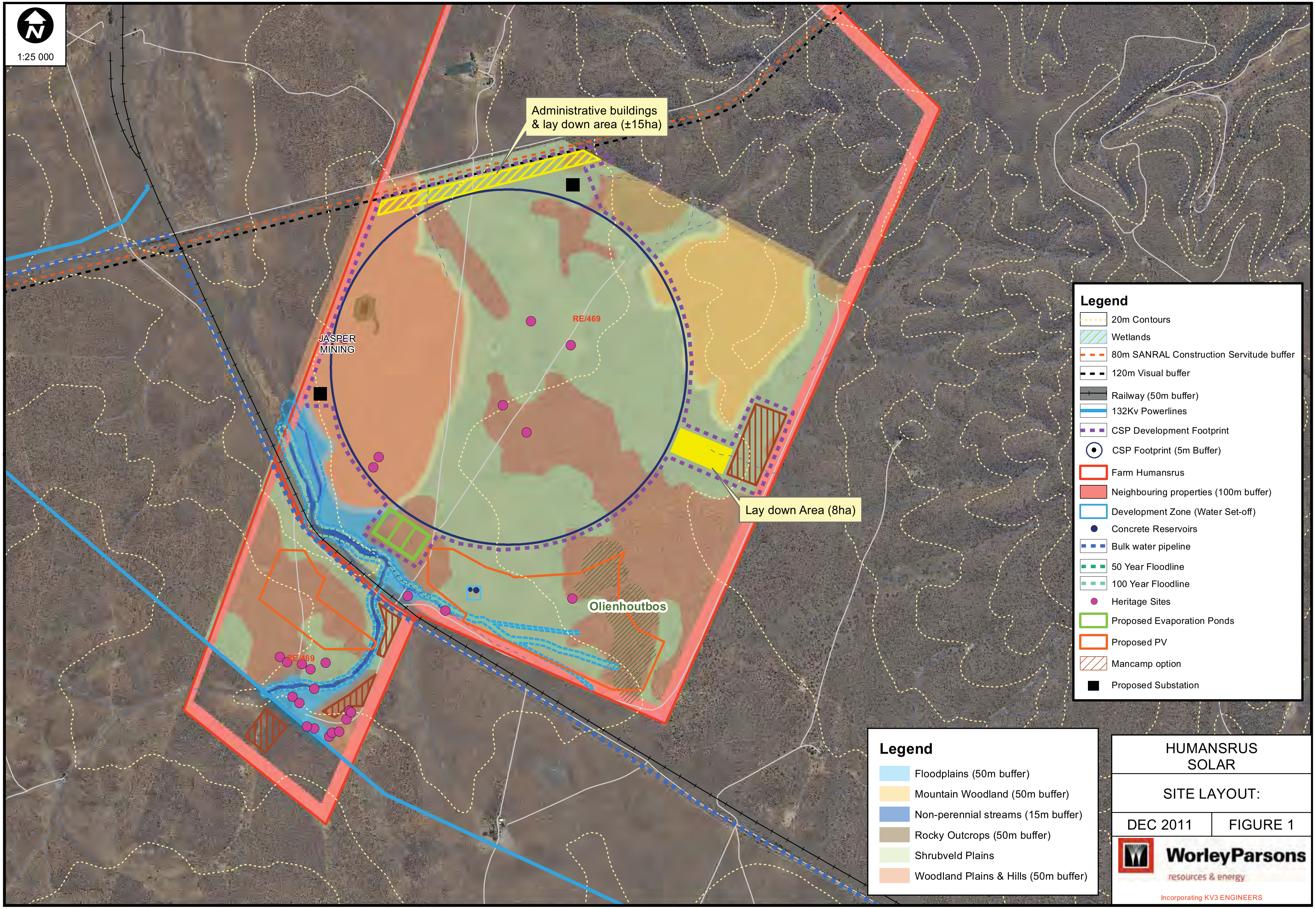
Yours sincerely

Fatima Rawjee

Mr Ishaam Abader
Deputy Director-General: Environmental Quality and Protection
Department of Environmental Affairs
Letter signed by: Ms Fatima Rawjee
Designation: Director: Environmental Impact Evaluation (Acting)
Date: 23/11/2011.

Appendix T

Site Layout Plan


1:25 000
Administrative buildings & lay down area (±15ha)
JASPER MINING
RE/469
Lay down Area (8ha)
Olienhoutbos
RE/469
Legend
20m Contours
Wetlands
80m SANRAL Construction Servitude buffer
120m Visual buffer
Railway (50m buffer)
132Kv Powerlines
CSP Development Footprint
CSP Footprint (5m Buffer)
Farm Humansrus
Neighbouring properties (100m buffer)
Development Zone (Water Set-off)
Concrete Reservoirs
Bulk water pipeline
50 Year Floodline
100 Year Floodline
Heritage Sites
Proposed Evaporation Ponds
Proposed PV
Mancamp option
Proposed Substation
Legend
Floodplains (50m buffer)
Mountain Woodland (50m buffer)
Non-perennial streams (15m buffer)
Rocky Outcrops (50m buffer)
Shrubveld Plains
Woodland Plains & Hills (50m buffer)
HUMANSRUS SOLAR
SITE LAYOUT:
DEC 2011
FIGURE 1
WorleyParsons
resources & energy
Incorporating KV3 ENGINEERS

Appendix U

Geotechnical Assessment

MOORE SPENCE JONES
CONSULTING GEOTECHNICAL, CIVIL & ENVIRONMENTAL ENGINEERS
CONSULTING GEOLOGISTS & SCIENTISTS

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PRELIMINARY GEOTECHNICAL REPORT

TO	: WorleyParsons	**FROM**	: Nino Welland
ATT	: Leanna Rautenbach	**DATE**	: 8 July 2011
E Mail	: Auto	**REFERENCE**	: 11-764.04
		NO. OF PAGES	: 1 of 4
COPY	: Solar Reserve RSA		
ATT	:		
E Mail	:		

PROPOSED CSP SOLAR PHOTOVOLTAIC PLANT AT HUMANSRUS, NORTHERN CAPE PROVINCE: GEOTECHNICAL INVESTIGATION: PRELIMINARY GEOTECHNICAL REPORT AND RECOMMENDATIONS

1. INTRODUCTION

Moore Spence Jones (Pty) Ltd (MSJ) was instructed by Mr Jacques Harris of Worley Parsons (on behalf of Solar Reserve) to complete the above-mentioned investigation. The scope of works and costs are based on the MSJ revised quotation dated 25 May 2011 and referenced 11-782.02. The scope of works complies with the request set out in an e-mail from Ms Leanna Rautenbach of Worley Parsons, dated 30 May 2011

The fieldwork was completed on 14th June 2011 and comprised the excavation of 20 test pits with soil profiling and limited sampling. A DFA-type report was presented to the client, referenced 11-764.02, dated 30 May 2011 and also a preliminary report referenced 11-764.03 and dated 30 June 2011. The intention of this report is to provide preliminary foundation and earthworks recommendations based on the visual and tactile assessment of site conditions, together with the laboratory test results. **The status of the investigation, and thus the results in this report, are still considered preliminary due to the limited number of test pits and laboratory test results (ie 1 test pit per 80 ha).**

2. INVESTIGATION METHOD AND RESULTS

2.1 Desk Study and Reconnaissance Survey

The published geological map of the area (2822 Postmasburg, scale 1:250 000, dated 1977) shows the site to be underlain by possibly lava, agglomerate, chert and jasper of the Ongeluk Formation, tillite jaspilite and dolomite of the Makganyene Formation and gently-dipping jaspilite and crocodilite of the Asbestos Hill Formation.

The soil cover is represented by quaternary Aeolian sand.

The available study area is approximately 1600 ha. In a square-shaped area located approximately 12 km north west of Lime Acres, in the Northern Cape Province. The northern and southern boundaries are represented by roads.

A number of small non-perennial streams traverse the site.

Topographically the site slopes gently in a south-westerly direction from 1550 masl to 1530 masl at a very flat grade of 1V:300H or less than 0.5%.

The Weinerts N- value for the site is approximately 20 and thus the site area occurs in an arid warm, dry region (TRH 4, 2.1). Residual soils are expected to be thin and gravely and mechanical disintegration is the only mode of weathering. Pedogenic soils are expected to be calcareous (calcrete).

The mean annual surface temperature is between 17.5 and 20.0 degrees C and the potential for evaporation is between 2200 and 2400 mm (modified after DWAF, 1986). Mean annual precipitation is 300 to 400 mm. The type of weathering of the underlying bedrock is expected to be very slight (Fookes et al, 1971).

The erodibility of the subsoils in the area is expected to be low with a corresponding Erodibility Index of between 16 and 20 (Verster and WRC, 1992).

Seismologically, the site is characterised by seismic intensity of V (MMS) with a 10% probability of being exceeded at least once in a 50 year period (Geological Survey, 1992). This translates to a predicted maximum horizontal ground acceleration of less than 50 cm/s2 or 0.025g (CGS, 2003). Under these conditions, the probability of liquefaction is considered unlikely (Welland, 2002).

The total lightning risk (estimated for 2006-2007), based on flashes per km2 and positive polarity lightning measurements, has been determined at severe (Gill, 2008).

2.2 Inspection Pits and Exposures

The main portion of the investigation comprised the excavation of 20 inspection pits using a Komatsu WB 93R TLB machine. The in situ soil profile was recorded and limited representative samples were collected for laboratory testing to determine the engineering properties.

The depth of the 20 inspection pits ranged from between 0.65 m and 3.2 m below existing ground level. The average refusal depth of the inspection pits is 1.75 m in stiff residual or weathered lava bedrock. Shallow refusal of the TLB (<1 m bgl) was encountered in only 3 of the inspection pits (15%) at between 0.65 m and 0.9 m (average 0.8 m) on slightly to unweathered hard rock lava.

No ground water was encountered in any of the inspection pits and throughout the site. However, during periods of prolonged rainfall, particularly during the summer season, increased groundwater seepage flow can be anticipated, particularly at the soil / rock interface. Perched groundwater flows at the soil / rock interface. The following general soil profile was recorded as follows across the site:

Table 1: Summary of Soil Profile (Mudrock in Northern Sector)

Depth (m-m)	Origin	EABC* (kPa)	Description
0.0-0.75	Hillwash	N/A	Moist, red brown, loose, silty fine sand.
0.75-1.75	Residual	100-200	Moist, yellow orange brown, firm to stiff, silty sandy clay with ferricrete nodules.
1.75+	Saprolite to weathered bedrock	250+	As above but medium dense, gravely sand to very soft rock lava.

*EABC = estimated allowable bearing capacity

The following Table 2 shows the summary of the geotechnical constraints on the site:

Table 2: Summary of Geotechnical Parameters and Constraints

Geotechnical Condition	Parameter	Constraint and recommendations
Potential expansiveness/activity	PI = 18% and clay <5%.	The upper lava residuum may be moderately expansive but tested as inert.
Collapsibility	Expect collapse in the upper hillwash layers, generally very loose sandy silt.	Low to medium collapse at low to medium loads in the upper transported sands.
Erodibility	CL-CH:SM to ML	Significant in hillwash layers
Compressibility	GM:SM with LL < 50%	Nil to low possibility of compressibility in all other layers.
Bearing capacity & subgrade	Competent weathered bedrock at 1.75 m depth average.	Weathered bedrock to provide 250 kPa or more.
Seepage	No seepage encountered in any of the inspection pits over the site during the investigation.	De-watering during construction will probably not be required. Subsoil drainage measures should only be required in deep cuts.
Construction materials	CL-CH and ML (generally A.4 to A&.6)	Most materials arising will not be suitable for construction purposes. Careful selection is advised in weathered lava and hillwash.
Excavatability	Anticipate soft excavation up to TLB refusal depths. Anticipate Intermediate to hard below these depths	Soft (SANS 1200) to 1.75 m average in transported, residual, and weathered rock. Only 15% of IP refused at <1m below surface. Expect intermediate to hard excavation below this level.

2.3 Laboratory Test Results

Table 1: Summary of Foundation Indicator Test Results (Residual Lava)

IP	Depth (m)	LL (%)	PI (%)	LS (%)	GM	CBR @ 93%*	TRH 14	PRA & USCS
13	0.8-1.9	47	18	9.0	2.22	25	G8	A.6 & OL

*Estimated from GM-PI relationship (after O Schnitter).

The above results show that the residuum is coarse-grained with a fairly high compacted CBR but high PI that excludes the soil for use as a construction material.

The layer does not seem to improve in quality with depth and does not show an indication of high compressibility (LL<50%).

3. CONCLUSIONS

- Topographically the ground has a very gentle slope in a south-westerly direction. Restricted and minor bulk excavations to create construction platforms will not be extensive.
- The majority of bulk and restricted excavations should be provisionally classed as ‘soft’ excavation according to SABS 1200D to an average depth of 1.75 m (but can be shallower than 1 m below surface in localised areas). Thereafter, heavy ripping due to estimated intermediate to hard excavation classification.
- Suitable foundation horizons occur at an average nominal depth of 1.75 m but can be shallower than 1 m below surface and generally the transported layers are **not** suitable for founding, even for lightly-loaded structures.

- Groundwater seepage should not be a problem during bulk earthworks and restricted foundation excavations.
- The use of materials for construction purposes is generally un-favourable and careful selection of suitable weathered rock and hillwash material is required.

4. PRELIMINARY RECOMMENDATIONS

- Suitable allowable bearing capacity in excess of 250 kPa for conventional pad foundations for the structures exists at an average depth of 1.75 m below existing ground levels on weathered lava bedrock.
- Hard excavation and possible blasting should be expected below an average depth of 1.75 m below existing ground level. This should be expected over the majority of the site.
- The results of this preliminary investigation are based on a limited number of test pits and laboratory testing and further more detailed intrusive investigations are required before more detailed planning and design can be completed. A summary of the development potential of the site is given below:

Zone	**Area (ha) & (%)**	**Test Pits**	**Characteristics**	**Constraints**	**Development Potential**
A (southeast)		Nil	Unknown	Environmentally sensitive plantations	Poor
B (northeast)		Nil	Shallow bedrock	Steep topography and excavatability	Poor
C (central)		Nil	Shallow rock	Jasper mine	Poor
D (remainder)		20	Residuum over shallow calcrete	Medium expansive residuum	Good

- Finally it is important to note that the information given in this preliminary report relates specifically to the positions of the inspection pits put down on site and also in conjunction with the proposed final formation level (FFL) and structural loads. It is possible that variations in the subsoil conditions may be encountered elsewhere on site during construction. These variations must be taken into consideration during on site supervision and construction. For this reason it is important that Moore Spence Jones be appointed to evaluate these variations and the effect on the development so that unnecessary expense and delays can be avoided.

Nino Welland, Pr Eng., Pr Sci Nat
Principal Engineer and Gauteng Regional Manager
MOORE SPENCE JONES (PTY) LTD

APPENDIX A
Inspection Pit Profiles

MOORE SPENCE JONES
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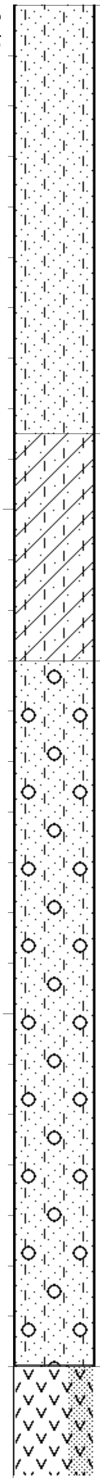
GEOTECHNICAL, CIVIL & ENVIRONMENTAL ENGINEERS

Humanrus

HOLE No: **IP1**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale
1:15



0.00	Moist, reddish orange brown, loose silty fine grained SAND. Transported.
0.85	Moist, yellowish orange brown, blotched greyish firm to stiff, silty sandy CLAY with scattered nodules. Residual Andesite?
1.30	Slightly moist, yellowish creamish brown, medium dense, silty coarse grained gravelly SAND with numerous nodules. Completely weathered Andesite.
2.70	Yellowish grey and stained creamish, stained yellowish and black, highly weathered, non ?, fractured, ferruginised, very soft Andesite.

NOTES

1) No groundwater seepage.

2) Final depth at 2.70m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP1**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
TEXT : ..\11-764\LOGS\11-764.DOC

MOORE SPENCE JONES

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GEOTECHNICAL, CIVIL & ENVIRONMENTAL ENGINEERS

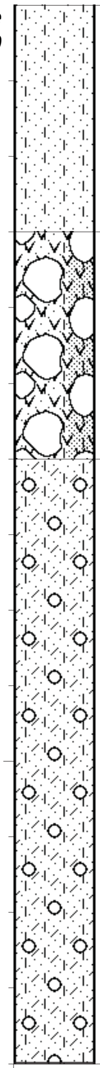
Humanrus

HOLE No: **IP2**

Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00	Moist, reddish orange brown, loose silty fine grained SAND. Transported.
0.30	As above with andesite boulders. Transported.
0.60	Moist, blotched yellowish greyish and reddish brown, medium dense to dense, silty gravelly clayey SAND. Residual Andesite with numerous sub-rounded and blocky, medium hard stained black Andesite.
1.40	

NOTES

1) No groundwater seepage.

2) Final depth at 1.40m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP2**

REVISION :
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DATE : 08/07/11 08:35
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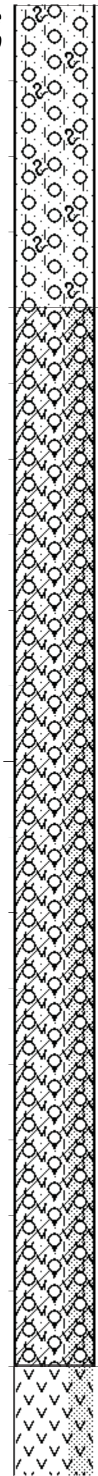
JOB NUMBER: 11-764

Scale 1:10



0.00

Moist, orange brown, very loose, silty medium grained SAND with scattered gravel and roots. Transported.

0.40

Moist, creamish greyish blotched yellowish brown, medium dense to dense, silty sandy GRAVEL of ferruginised sub-rounded ±20-30mm and 80mm andesite cobbles with blotched, silty gravelly sandy CLAY. Residual Andesite.

1.80

Andesite bedrock, fractured.

NOTES

1) No groundwater seepage.

2) Final depth 1.80m.

3) Refusal.

CONTRACTOR :	*INCLINATION :*	*ELEVATION :*
MACHINE :	*DIAM :*	*X-COORD :*
OPERATOR :	*DATE DRILLED :* 2011	*Y-COORD :*
PROFILED BY : PR	*DATE PROFILED :* 2011	*HOLE No:* **IP3**
REVISION :	*DATE : 08/07/11 08:35*	
SETUP FILE : MSJ2004.SET	*TEXT : ..\11-764\LOGS\11-764.DOC*	

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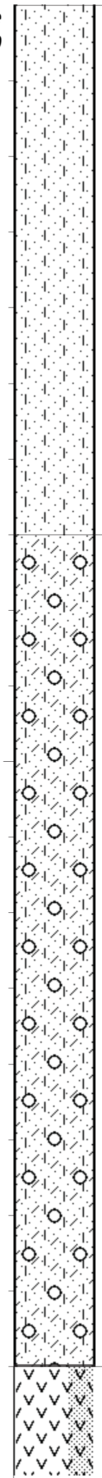
HOLE No: **IP4**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00

Moist, reddish orange brown, loose silty fine grained SAND. Transported.

0.70

Moist, blotched yellowish greyish and reddish brown, medium dense to dense, silty gravelly clayey SAND. Residual Andesite with numerous sub-rounded and blocky, medium hard stained black Andesite.

1.80

Andesite bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 1.80m.

3) Refusal.

CONTRACTOR :	*INCLINATION :*	*ELEVATION :*
MACHINE :	*DIAM :*	*X-COORD :*
OPERATOR :	*DATE DRILLED :* 2011	*Y-COORD :*
PROFILED BY : PR	*DATE PROFILED :* 2011	*HOLE No:* **IP4**
REVISION :	*DATE : 08/07/11 08:35*	
SETUP FILE : MSJ2004.SET	*TEXT : ..\11-764\LOGS\11-764.DOC*	

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HOLE No: **IP5**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10

0.00	Moist, reddish orange brown, loose silty fine grained SAND. Transported.
0.90	Moist, blotched yellowish greyish and reddish brown, medium dense to dense, silty gravelly clayey SAND. Residual Andesite with numerous sub-rounded and blocky, medium hard stained black Andesite.
2.00	Andesite bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 2.00m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP5**

REVISION :
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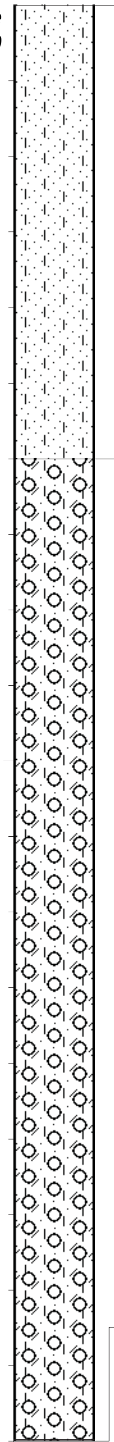
HOLE No: **IP6**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00

Moist, reddish orange brown, loose silty fine grained SAND. Transported.

0.60

Slightly moist, reddish orange brown, firm to stiff, silty sandy clayey GRAVEL of sub-rounded, numerous cobbles. Possibly reworked Andesite.

1.90

NOTES

1) No groundwater seepage.

2) Final depth 1.90m.

3) Difficult penetration.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP6**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
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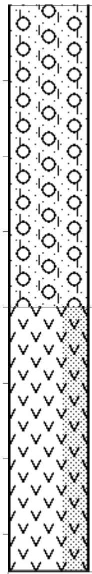
HOLE No: **IP7**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00

Slightly moist, orange yellowish brown, loose, silty fine grained SAND with scattered gravel. Transported.

0.40

Moist, yellowish, stained black and red, very dense, highly cemented, highly ferruginised, Andesite. Highly weathered, highly cemented, Andesite with fractured Andesite rock.

0.75

NOTES

1) No groundwater seepage.

2) Final depth at 0.75m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP7**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
TEXT : ..\11-764\LOGS\11-764.DOC

dot.PLOT 5003 J&W

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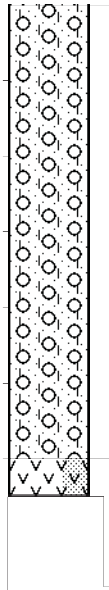
JOB NUMBER: 11-764

Scale 1:10



0.00

Slightly moist, orange yellowish brown, loose, silty fine grained SAND with scattered gravel. Transported.

0.60

Moist, yellowish, stained black and red, very dense, highly cemented, highly ferruginised, Andesite. Highly weathered, highly cemented, Andesite with fractured Andesite rock.

0.65

NOTES

1) No groundwater seepage.

2) Final depth 0.65m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP8**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
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HOLE No: **IP9**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10

0.00	Moist, reddish brown, loose, slightly clayey silty gravelly SAND with gravel of blocky, sub-rounded, slightly to moderately weathered Andesite. Transported.
0.55	Slightly moist, yellowish creamish brown, medium dense, silty coarse grained gravelly SAND with numerous nodules. Completely weathered Andesite.
1.80	Slightly moist, yellowish creamish brown, medium dense, silty coarse grained gravelly SAND with numerous nodules. Completely weathered Andesite.
2.00	

NOTES

1) No groundwater seepage.

2) Final depth 2.00m.

3) Refusal / difficult penetration.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP9**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
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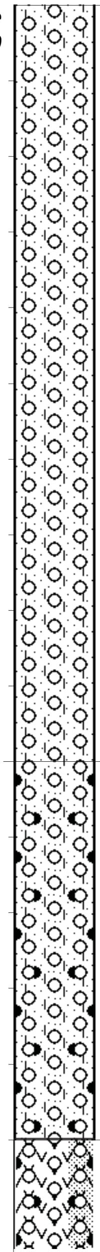
HOLE No: **IP10**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00

Slightly moist, orange brown, loose, silty fine grained SAND with scattered occasional gravel. Transported.

1.00

As above with silty sandy GRAVEL of medium cemented ferricrete gravel.

1.50

Highly cemented ferricrete with Andesite gravel.

NOTES

1) No groundwater seepage.

2) Final depth 1.50m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP10**

REVISION :
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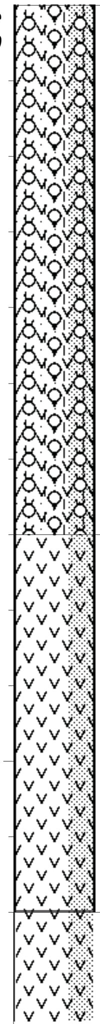
HOLE No: **IP11**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00	Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.
0.70	Stained orange, bluish grey, ironised, ferruginised, fractured, soft rock Andesite with rock inbetween fractures. Highly weathered Andesite.
1.20	Andesite bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 1.20m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP11**

REVISION :
SETUP FILE : MSJ2004.SET

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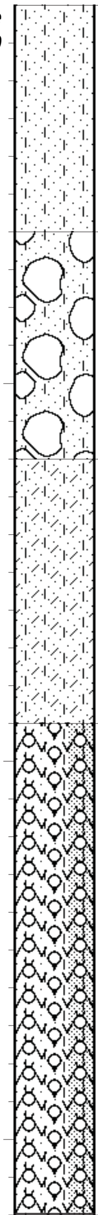
HOLE No: **IP12**

Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:20



0.00	Moist, reddish orange brown, loose silty fine grained SAND. Transported.
0.60	As above but with sub-rounded boulders / cobbles, pebbles. Transported.
1.20	Moist, yellowish creamish, firm / medium dense, silty clayey SAND. Residual Andesite.
1.90	Moist, yellowish creamish speckled black, silty sandy GRAVEL of blocky, friable soft Andesite. Completely to highly weathered Andesite.
3.20	

NOTES

1) No groundwater seepage.

2) Final depth 3.20m.

3) Difficult penetration.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP12**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
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HOLE No: **IP13**

JOB NUMBER: 11-764

Scale 1:10

0.00	Moist, orange brown, soft/loose, silty gravelly clayey SAND to sandy CLAY with gravel of sub-rounded, sub-angular Andesite. Transported.
0.80	Slightly moist, yellowish creamish, medium dense, silty SAND with numerous zones of sub-angular ferruginised fractured Andesite. Completely to highly weathered Andesite.
1.90	

S1

NOTES

1) No groundwater seepage.

2) Final depth 1.90m.

3) Refusal.

4) Samples taken :
S1 0.80--1.90m (IND)

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP13**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:35
TEXT : ..\11-764\LOGS\11-764.DOC

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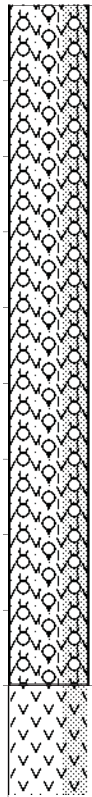
HOLE No: **IP14**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale
1:10



0.00

Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.

0.90

Andesite bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 0.90m.

3) Refusal.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP14**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

dot.PLOT 5003 J&W

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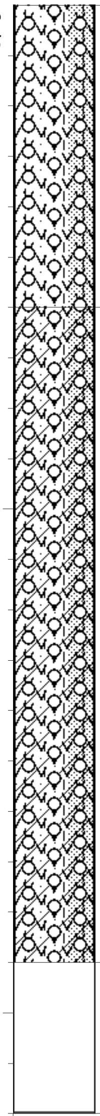
HOLE No: **IP15**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:15



0.00

Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.

0.60

Moist, creamish greyish blotched yellowish brown, medium dense to dense, silty sandy GRAVEL of ferruginised sub-rounded ±20-30mm and 80mm andesite cobbles with blotched, silty gravelly sandy CLAY. Residual Andesite.

1.90

Highly weathered Andesite.

2.20

NOTES

1) No groundwater seepage.

2) Final depth 2.20m.

3) Refusal on bedrock.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP15**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

dot.PLOT 5003 J&W

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HOLE No: **IP16**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10

0.00	Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.
0.80	Yellowish orange, silty SAND with bluish grey, unweathered Andesite. Highly weathered with zones of unweathered Andesite.
1.40	

NOTES

1) No groundwater seepage.

2) Final depth 1.40m.

3) Refusal on bedrock.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP16**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

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HOLE No: **IP17**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10

0.00	Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.
0.60	Moist, creamish greyish blotched yellowish brown, medium dense to dense, silty sandy GRAVEL of ferruginised sub-rounded ±20-30mm and 80mm andesite cobbles with blotched, silty gravelly sandy CLAY. Residual Andesite.
1.60	Highly weathered fractured Andesite bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 1.60m.

3) Refusal on bedrock.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP17**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

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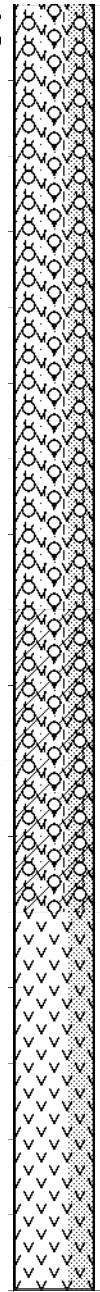
HOLE No: **IP18**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00	Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.
0.80	Moist, creamish greyish blotched yellowish brown, medium dense to dense, silty sandy GRAVEL of ferruginised sub-rounded ±20-30mm and 80mm andesite cobbles with blotched, silty gravelly sandy CLAY. Residual Andesite.
1.20	Highly weathered fractured Andesite bedrock.
1.70	

NOTES

1) No groundwater seepage.

2) Final depth 1.70m.

3) Refusal on bedrock.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP18**

REVISION :
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DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

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HOLE No: **IP19**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:15

0.00	Slightly moist, orange brown, loose, silty sandy GRAVEL of ferruginised andesite gravel. Hillwash.
0.60	Slightly moist, orange brown, medium dense, ferruginised, ferricrete gravel with andesite rock.
2.30	Slightly moist, yellowish orange, speckled bluish, loose to medium dense, silty SAND with scattered, sub-rounded gravel. Reworked Residual Andesite.
2.80	

NOTES

1) No groundwater seepage.

2) Final depth 2.80m.

3) Refusal on bedrock.

CONTRACTOR :
MACHINE :
OPERATOR :
PROFILED BY : PR

INCLINATION :
DIAM :
DATE DRILLED : 2011
DATE PROFILED : 2011

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP19**

REVISION :
SETUP FILE : MSJ2004.SET

DATE : 08/07/11 08:36
TEXT : ..\11-764\LOGS\11-764.DOC

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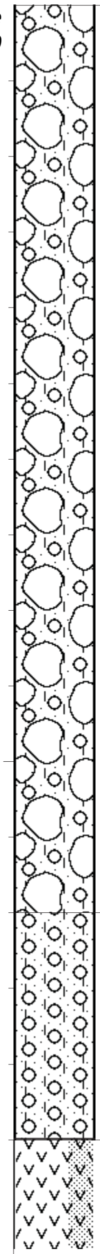
HOLE No: **IP20**
Sheet 1 of 1

JOB NUMBER: 11-764

Scale 1:10



0.00 Moist, reddish brown, loose, silty sandy GRAVEL with massive ferruginised boulders.

1.20 Slightly moist, yellowish orange, speckled bluish, loose to medium dense, silty SAND with scattered, sub-rounded gravel. Reworked Residual Andesite.

1.50 Highly weathered Andesite with slightly weathered zones. Bedrock.

NOTES

1) No groundwater seepage.

2) Final depth 1.50m.

3) Refusal on bedrock.

CONTRACTOR :	*INCLINATION :*	*ELEVATION :*
MACHINE :	*DIAM :*	*X-COORD :*
OPERATOR :	*DATE DRILLED :* 2011	*Y-COORD :*
PROFILED BY : PR	*DATE PROFILED :* 2011	*HOLE No:* **IP20**
REVISION :	*DATE : 08/07/11 08:36*	
SETUP FILE : MSJ2004.SET	*TEXT : ..\11-764\LOGS\11-764.DOC*	

APPENDIX B
Laboratory Test Results

GEOPRACTICA
SOILS & MATERIALS TESTING
P.O.BOX 227, MARAISBURG, 1700

TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: lab@geopractica.co.za

FOUNDATION INDICATOR

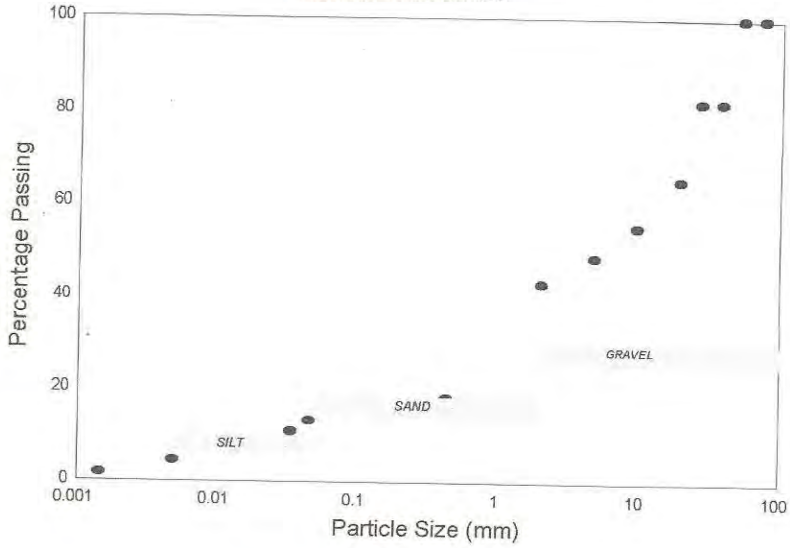
Client	MOORE SPENCE JONES		
Location	HUMANRUS - NORTHERN CAPE	IP 13 @ 0,8 - 1,9m	
Date	01 JULY 2011	Test No	1624
Job No	11162	Checked By	EB

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	82.02
26.50	82.02
19.00	65.12
9.50	55.05
4.75	48.44
2.00	42.97
0.425	18.12

GRADING ANALYSIS



HYDROMETER ANALYSIS

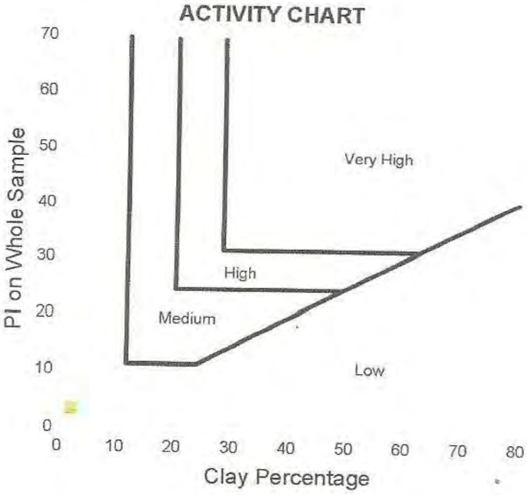
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0832	16.63
0.0609	15.27
0.0451	13.23
0.0335	10.86
0.0048	4.41
0.0015	1.70

ATTERBERG LIMITS & OTHER VALUES

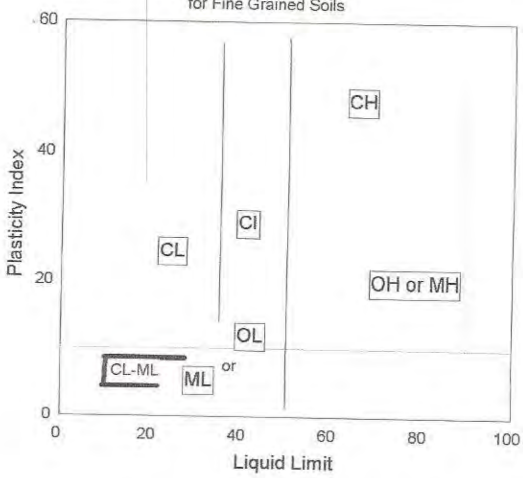
Liquid Limit	47
Plastic Limit	29
Plastic Index	18
Linear Shrinkage	9
Grading Modulus	2.22
Moisture Content	10.39
PI on Whole Sample	3
PRA Classification	A.2.7
Unified Classification	GC

ACTIVITY CHART



PLASTICITY CHART

for Fine Grained Soils



Digitally signed by M.Goslin
Date: 2011.07.08 07:46:36 Z
Reason: I have reviewed this document

Revision No 3 (06/04/2001)

APPENDIX C
Site Plan

SITE PLAN SHOWING APPROXIMATE POSITIONS OF : **IP 1- INSPECTION TEST PITS** **-SITE BOUNDARY** **A- ENVIRONMENTALLY SENSITIVE AREA (PLANTATION)** **B- ACCESS DIFFICULTY** **C- JASPER MINE**	**CLIENT : SOLAR RESERVE RSA(Pty)Ltd** **JOB TITLE :** GEOTECHNICAL INVESTIGATION FOR SOLAR PLANT,HUMANRUS MOORE SPENCE JONES CONSULTING GEOTECHNICAL, CIVIL & ENVIRONMENTAL ENGINEERS CONSULTING GEOLOGISTS & SCIENTISTS	**DATE :** 07/07/2011 **DRAWN :** P.R **CHECK :** NINO WELLAND **11-764** **FIG :** 1

Appendix V

Soils and Agricultural Assessment

REPORT

On contract research for

SSI ENVIRONMENTAL / WORLEYPARSONS RSA

and SolarReserve SA (Pty) Ltd

ARC • LNR

SOIL INFORMATION FOR THE PROPOSED HUMANSRUS SOLAR THERMAL ENERGY POWER PLANT, NEAR POSTMASBURG, NORTHERN CAPE

By

D.G. Paterson (Pr. Sci. Nat. 400463/04)

May 2011

Report No. GW/A/2011/42

ARC-Institute for Soil, Climate and Water,
Private Bag X79, Pretoria 0001, South Africa

Tel (012) 310 2500 Fax (012) 323 1157

DECLARATION

I hereby declare that I am qualified to compile this report as a registered Natural Scientist and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

D G Paterson
May 2011

CONTENTS Page

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SSI Environmental / WorleyParsons RSA to undertake a soil investigation on a site near Postmasburg, in the Northern Cape Province. The purpose of the investigation is to contribute to the Environmental Impact Assessment (EIA) process for a proposed concentrated solar power (CSP) facility on behalf of SolarReserve SA (Pty) Ltd.

The objectives of this study, which is a desk-top investigation that forms part of the scoping phase assessment, are:

- To obtain all existing soil information and to produce a soil map of the specified area as well as

- To assess broad agricultural potential.

2. SITE CHARACTERISTICS

2.1 Location

An area was investigated lying approximately 25 km to the east of the town of Postmasburg between 28^{o} 17′ and 28^{o} 20′ S and between 23^{o} 20′ and 23^{o} 24′ E.

The area lies immediately to the south of the R385 Posmasburg-Danielskuil tar road. The position of the site is shown on the map in Figure 1.

2.2 Terrain

The site is generally flat to gently sloping and lies at a height of approximately 1500 metres above sea level (although small areas of slightly steeper topography occur close to the north-eastern boundary). No permanent drainage ways occur in the study area, with only one small seasonal stream running through the south-western portion.

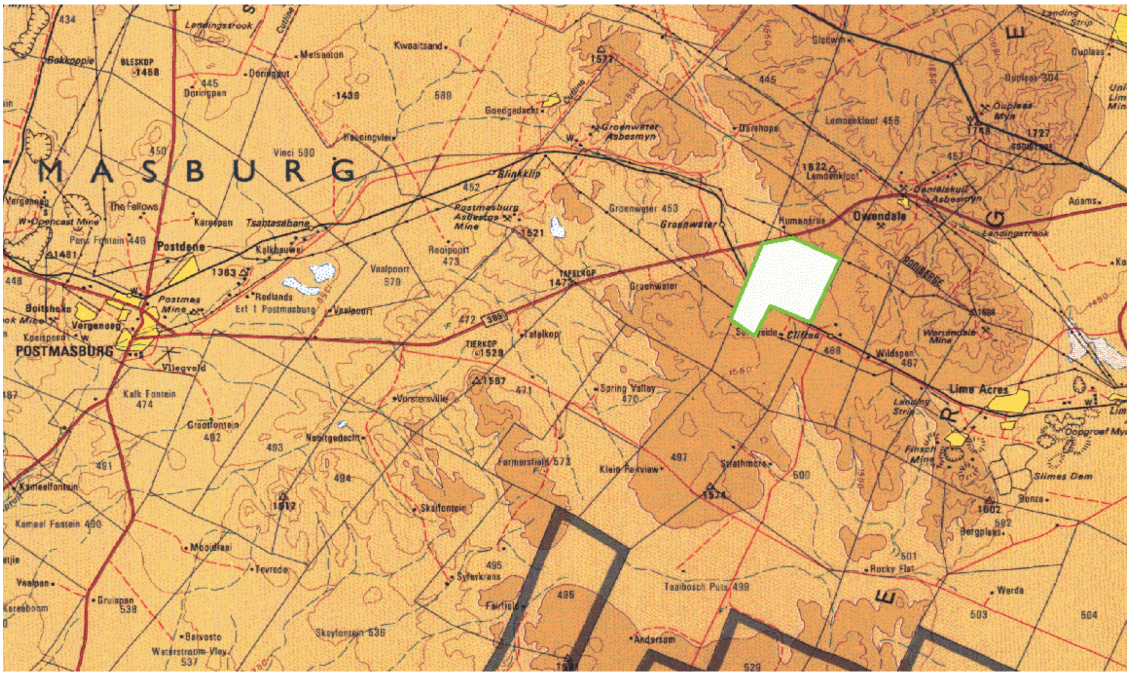


Figure 1 Locality map

2.3 Climate

The climate of the area can be regarded as typical of the northern Karoo interior, with a low, generally summer rainfall distribution, warm to hot summers and cold to very cold winters (Koch & Kotze, 1986). The main climatic indicators are given in Table 1 below.

Table 1 Climate Data

Month	Rainfall (mm)	Min. Temp (^oC)	Max. Temp (^oC)
Jan	62.6	17.1	33.2
Feb	71.9	16.5	31.5
Mar	84.3	14.5	29.0
Apr	45.3	9.3	26.0
May	19.1	4.7	22.8
Jun	7.8	1.0	19.3
Jul	3.1	0.6	19.8
Aug	7.2	3.0	22.4
Sep	7.5	7.1	26.3
Oct	20.0	11.2	28.9
Nov	29.1	13.7	30.7
Dec	50.1	15.6	32.0
Year	407.9 mm	18.2^oC (Average)	

Very warm temperatures (>42^oC) may be experienced in summer, while frost in winter (end of March to early September) is not uncommon, and may be severe on occasion.

2.4 Parent Material

The geology of the area comprises rocks of the Griqualand west Sequence (Geological Survey, 1977). In the west, lava of the Ongeluk formation occurs, while in the east, jaspelite, crocodilite and shale of the Danielskuil Formation is present. Much of the central area is covered by wind-blown Quaternary sand deposits.

3. METHODOLOGY

Existing information was obtained from the map sheet 2822 Postmasburg (Eloff *et al.*, 1986) from the national Land Type Survey, published at a 1:250 000 scale. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The area under investigation is covered by a total of three land types, as shown on the map in the Appendix, namely:

- Ae214, Ae215 (Red structureless soils, high base status)
- Ib237 (Rocky areas with shallow soil)

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur. The site was not visited during the course of this study, and so the detailed composition of the specific land types has not been ground-truthed.

A summary of the dominant soil characteristics of each land type is given in Table 2 below (the colours correspond to those used in the map in the Appendix).

The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in bold type.

4. SOILS

A summary of the dominant soil characteristics is given in Table 2 below.

It should be noted that the Agricultural Potential referred to in column 6 is *soil potential only* and does not take prevailing climatic conditions into account.

Table 2 Land types occurring (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Potential (%)
Ae214	Hutton 36	300-1200	31%	Red, sandy loam to sandy clay loam soils on hard rock	High:7.0 Mod: 41.3 Low: 51.7
	Hutton 33/36	100-300	30%	Red, loamy sand to sandy clay loam soils on hard rock	
Ae215	Hutton 33	450-1200	81%	Red, sandy soils on hard rock and calcrete	High:0.0 Mod: 92.5 Low: 7.5
	Hutton 30	450-1200	8%	Red, very sandy soils on hard rock and calcrete	
Ib237	Rock	-	61%		High:0.0 Mod: 14.0 Low: 86.0
	Hutton 30/33	50-300	25%	Red, sandy topsoils on rock	

5. AGRICULTURAL POTENTIAL

Much of the central part of the area (land type Ae215) comprises moderately deep to deep soils (300-1200+ mm deep) onto rock, while the remainder has more shallow soils (land type Ae214) or rock (land type Ib237). However, the low rainfall in the area (Table 1) means that the only means of cultivation would be by irrigation and the Google Earth image (Figure 2) of the area shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation.

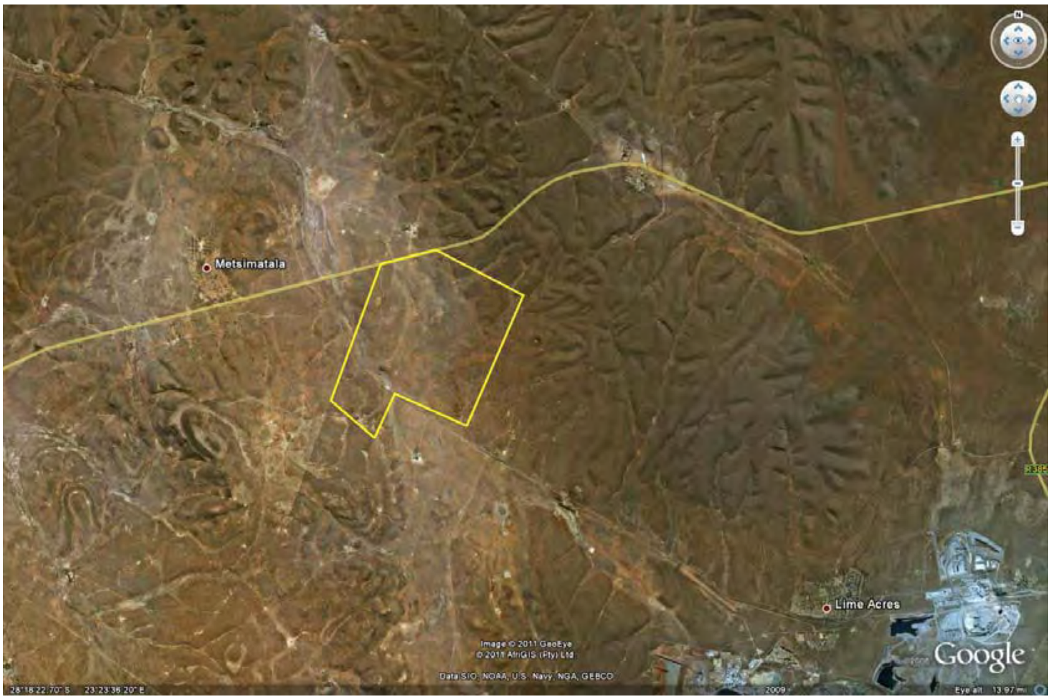


Figure 2 Google Earth image of study area

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 15-20 ha/large stock unit (ARC-ISCW, 2004).

6. IMPACTS

The project as envisaged will comprise infrastructure as follows:

1. Solar Field – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
2. Molten Salt Circuit which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers);
3. The Power Block; and
4. Auxiliary facilities and infrastructure which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

The major impact on the natural resources of the study area would be the loss of arable land due to the construction of the various types of infrastructure. However, this impact would in all probability be of limited significance (due to the low potential soils and the fact that construction of the infrastructure will not involve deep excavations or large-scale topsoil removal) and would be local in extent. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state, with little impact, especially given the low prevailing agricultural potential.

The impact can be summarized as follows:

Table 3 Impact significance

Nature of impact	Loss of agricultural land	Land that is no longer able to be utilized due to construction of infrastructure
Status of impact	Neutral (N)	No cost or benefit to receiving environment
Spatial Scale of impact	Low (1)	Confined to site boundary
Time Scale of impact	High (3)	Lifespan of project
Probability of impact	Probable (2)	Likely to materialise
Severity of impact	Average (2)	Mitigation & rehabilitation will be possible
Significance of impact	Medium (8)	
Mitigation factors	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs.	

It does not appear, from a soils aspect, that there are any especially sensitive areas ("fatal flaws") within the site that should be avoided.

In conclusion, due mainly to the low potential soils and prevailing climatic limitations for agriculture, it is extremely unlikely that any sort of detailed soil investigation will be necessary.

REFERENCES

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Koch, F.G.L. & Kotze, A.V., 1986 Climate data. In: Land types of the maps SE27/20 Witdraai, 2720 Noenieput, 2722 Kuruman, 2724 Christiana, 2820 Upington & 2822 Postmasburg. *Mem. Nat. Agric. Res. S. Afr.* No. 3. ARC-Institute for Soil, Climate and Water, Pretoria.

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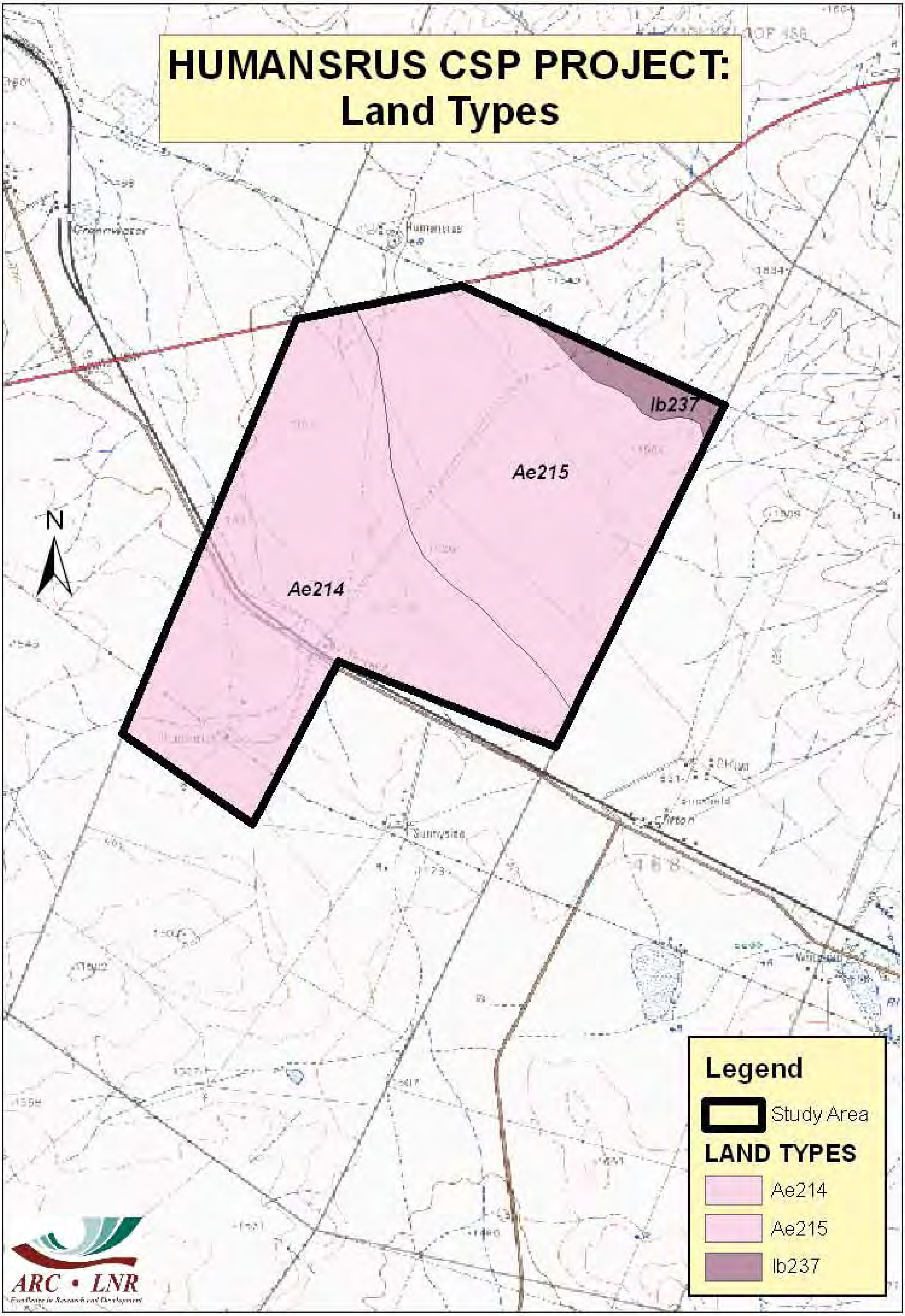
MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., 1977. Soil classification. A binomial system for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

APPENDIX

MAP OF LAND TYPES


HUMANSRUS CSP PROJECT:
Land Types
Ae214
Ae215
Ib237
N
Legend
Study Area
LAND TYPES
Ae214
Ae215
Ib237
ARC • LNR

Appendix W

Title Deed

HERTOG, MOULT, HORN, KRIEL & KIE,
PROKUREURS, NOTARISSE & AKTEBESORGERS,
N.B.S. GEBOU, JONESSTRAAT,
KIMBERLEY.

1988 -06- 13

AKTE VAN TRANSPORT

T 880 /19 88

ten gunste van

JOHANNA MAGDALENA ALBERTA SCHOLTZ

BC 003407 - 2008
GEKANSELLEER
CANCELLED

REGISTRATEUR/REGISTRAR

Landbank 1 6 OCT 2008

Opgestel deur my,

TRANSPORTBESORGER.
KRIEL N.H.
Van en Voorletters.

VERBIND MORTGAGED
VIR
FOR R 500 000-00

II

B 000659 / 2003
06 MAY 2003
REGISTRATEUR/REGISTRAR

101120

DIE IDENTITEITSNOMMER VAN DIE T/ncemator	THE IDENTITY NUMBER OF THE
IS VERANDER NA 310712 0058 086.	HAS BEEN CHANGED TO
06 MAY 2003	REGISTRATEUR/REGISTRAR

III

Transportakte

Hierby word bekendgemaak:

T 880 /19 88

DAT NOëL HENRY KRIEL
voor my, Registrateur van Aktes , KIMBERLEY,
verskyn het te KIMBERLEY
hy, die genoemde komparant synde behoorlik daartoe gemagtig deur 'n volmag aan hom verleen deur
die Eksekuteur in die
BOEDEL VAN WYLE FREDERICK ALLEN SCHOLTZ
(Nr. 7/88)
- BLANKE GROEP -

gedateer die 24ste dag van FEBRUARIE 1988 en geteken
te KIMBERLEY;

VIR ENDOSSEMENTE KYK BLADSY 6
FOR ENDORSEMENTS SEE PAGE

e

En genoemde Komparant het verklaar dat aangesien kragtens die gesamentlike Testament gedateer te Postmasburg op die 7de dag van November 1974 van wyle FREDERICK ALLEN SCHOLTZ wie op 20 Desember 1987 te Postmasburg oorlede is, en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ, egteliede met mekaar in gemeenskap van goedere getroud gewees, die langslewende eggenote geregtig is op een-helfte (½) van die hiernavermelde eiendom onderworpe aan die bepalings van die gemelde Testament, hierinlater uiteengesit, en ook kragtens die huwelik in gemeenskap van goedere geregtig is op die ander helfte (½) van gemelde eiendom,

en dat hy in sy voornoemde hoedanigheid hierby in volkome en vrye eiendom sedeer en transporteer namens die gesamentlike boedel, aan en ten gunste van

JOHANNA MAGDALENA ALBERTA SCHOLTZ
(Identiteitsnommer 310712 0058 00 3)
- Weduwee -
- BLANKE GROEP -

haar erfgename, eksekuteurs, administrateurs of regverkrygendes -

SEKERE Restant van Plaas Nr. 469

GELEë in die Afdeling Hay

GROOT as sulks TWEEDUISEND TWEEHONDERD DRIE EN DERTIG KOMMA NUL SES NUL DRIE (2233,0603) Hektaar

AANVANKLIK OORGEDRA kragtens Akte van Toekenning (GRIEKWALAND WES ERFPAGTE BOEKDEEL 18, FOLIO 25) met kaart wat daarop betrekking het en gehou kragtens Transportakte Nr. 783/1960 en Transportakte Nr. 1490/1973

A. SPESIAAL ONDERHEWIG aan die voorwaardes soos geskep in Akte van Toekenning (GRIEKWALAND-WES ERFPAGTE BOEKDEEL 18, FOLIO 25), wat lui as volg :

1. That all roads and thoroughfares now existing on the said land shall remain free and uninterrupted and that the Government reserves the right to make, or cause to be made on or across the said land for the public benefit such Roads, Railroads, Railway Stations, Paths, Aqueducts, Dams, Drains, Reservoirs, Watercourses or other Public works as may be required as also to conduct Telegraphs over the said land and to establish convenient Outspans for the use of Travellers.

2. That the Government reserves also the right, at all times to enter upon the said land, and to take, excavate, dig or quarry all stones, earth, gravel or other materials as shall or may be required for any such public works as in the preceding condition specified, without compensation to the proprietor, and that all Public Officers employed by Government as Surveyors, Engineers or the like, shall have the right to travel over and remain upon the said Land, with their Servants, Horses, Cattle and Equipages.

3. That the Government reserves the rights to all precious stones gold or silver found on or under the surface of the said land.

4. And lastly that the said land shall be subject to all such duties, rules and regulations as either now are or hereafter may be in force with regard to land granted on similar tenure.

B. 'n Gedeelte van binnegemelde eiendom groot 11,1847 Hektaar is onteien kragtens Artikel 130 Ordonnansie 15/1952 deur die Provinsiale Administratuer. Sien Onteieningskennisgewing Nr. R/017/539 gedateer 3 Oktober 1966 soos geëndosseer kragtens Artikel 31 van Wet 47 van 1937 op 13 Junie 1967 op Akte van Transport Nr. 783/1960.

C. ONDERWORPE aan 'n ewigdurende reg om elektrisiteit te gelei oor die binnegemelde eiendom ten gunste van die Elektrisiteits Voorsieningskommissie kragtens Notariële Akte van Serwituut Nr. 23 /1970S.

D. VERDER ONDERWORPE aan 'n permanente serwituut van waterleiding wat strek oor 'n strook grond ongeveer 165 meter lank en 10 meter breed ten gunste van die Republiek van Suid-Afrika, kragtens Notariële Sessie van Serwituut Nr. K 20/78 S.

E. VERDER ONDERWORPE aan die voorwaarde opgelê in die voormelde gesamentlike Testament, gedateer te Postmasburg op die 7 dag van November 1974 van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ insoverre dit die een-helfte (½) van die eiendom aanbetref, naamlik :

"4. Enige vroulike persoon wat kragtens hierdie ons Testament erf sal haar erfenis ontvang as haar vrye en uitsluitlike eiendom, vry van die skulde, beheer en maritale reg van, en uitgesluit van enige gemeenskap van goedere met, enige eggenoot met wie sy in die huwelik getree het of nog mag tree en haar kwitansie alleen sal 'n voldoende kwytskelding wees vir enige betaling aan haar."

B

Weshalwe die Komparant afstand doen van al die regte en titel wat die genoemde gesamentlike boedel van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ voorheen op genoemde eiendom gehad het en gevolglik ook erken dat die gesamentlike boedel van wyle FREDERICK ALLEN SCHOLTZ en nagelate eggenote JOHANNA MAGDALENA ALBERTA SCHOLTZ geheel en al van die besit daarvan onthef en nie meer daartoe geregtig is nie en dat, kragtesn hierdie akte, bogenoemde

JOHANNA MAGDALENA ALBERTA SCHOLTZ
(Identiteitsnommer 310712 0058 00 3)
- Weduwee -

haar Erfgename, Eksekuteurs, Administrateurs of Regverkrygendes tans en voortaan daartoe geregtig is, ooreenkomstig plaaslike gebruik, behoudens die regte van die Staat en ten slotte erken hy dat die eiendom gewaardeer is vir Boedelbelastingdoeleindes in die som van DRIEHONDERD DRIE EN VEERTIGDUISEND DRIEHONDERD RAND (R343 300,00);

Ten bewyse waarvan ek, genoemde Registrateur van Aktes tesame met die Komparant hierdie Akte onderteken en dit met die ampseël bekragtig het.

Aldus gedoen en verly op die kantoor van die Registrateur van Aktes te KIMBERLEY op 1988 -02- 20

In my teenwoordigheid,

q.q.

REGISTRATEUR VAN AKTES
KIMBERLEY.

Hereregte : Vrygestel
Belasting Uitklaring Sertifikaat uitgereik deur die Afdelingsraad van Hay.
NAGESIEN: 1. 2.

B

Deeds Office Property

windeed

PLAAS 469, 469, 0 (REMAINING EXTENT) (Kimberley)

GENERAL INFORMATION

Deeds Office	Kimberley
Date Requested	2011/10/05 12:22:15
Information Source	Deeds Office
Reference	

PROPERTY INFORMATION

Property Type	Farm
Farm Name	PLAAS 469
Farm Number	469
Portion	0 (REMAINING EXTENT)
Local Authority	NOT AVAILABLE
Registration Division	HAY RD
Province	NORTHERN CAPE
Diagram Deed	GWQ18/25
Extent	2229.4651H
Previous Description	
LPI Code	C03100000000046900000

OWNER INFORMATION

Owner 1 of 1

Person Type	Individual
Name	SCHOLTZ JOHANNA MAGDALENA ALBERTA
ID Number	3107120058003
Title Deed	T880/1988
Registration Date	1988/06/20
Purchase Price	
Purchase Date	-
Share	
Microfilm Reference	
Multiple Properties	False
Multiple Owners	False

ENDORSEMENTS (5)

#	Document	Description	Institution	Amount	Microfilm
1	B1988/2008	BOND	FIRSTRAND BANK LTD	R300000.00	
2	K20/1978S	CONTRACT SERVITUDES/MINERALS/LEASES/PC		Unknown	
3	K23/1970S	CONTRACT SERVITUDES/MINERALS/LEASES/PC		Unknown	
4	OD113/1993			Unknown	
5	ONTEIENINGS KENNISGEWIN G R/017/		539	Unknown	

HISTORIC DOCUMENTS (1)

#	Document	Description	Owner	Amount	Microfilm
1	B659/2003	BOND		Unknown	

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