



## TEMA LNG TERMINAL COMPANY LTD

# Environmental and Social Impact Assessment for the Proposed Tema LNG Terminal Ghana Project

**UPDATED ESIA REPORT**  
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Prepared by:

SAL Consult Limited, P. O. Box GP20200, Accra, Ghana

Prepared for:

Tema LNG Terminal Company Ltd, P. O. Box TS805 Teshie, Accra,  
Ghana



## KEY PROJECT TEAM FOR ESIA

No.	Name	Position	Qualification	Contribution to Report
1.	S.A. Larmie	Chief Consultant, Team Leader	MSc (Applied Science), VUB Brussels	- Quality Assurance - identification of impacts
2.	E. K. Acquah	Principal Consultant, <i>Environmental Policy Specialist</i>	MSc (Environmental Policy), University of Hull, UK	- Stakeholder Consultations - Analysis of impacts - Drafting sections of Report - Review of draft Report
3.	N.Y. Otu-Ansah	Senior Consultant, <i>Environmental Quality Specialist</i>	MPhil (Environmental Science), University of Ghana, Legon	- Consultations - Baseline Studies - Environmental Monitoring - Identification of impacts
4.	Ewuresi B. Opoku (Mrs)	Consultant, <i>Environmental Scientist</i>	MSc (Environmental Monitoring and Management), University of Nottingham, UK.	- Stakeholder Consultations - Socioeconomic and environmental baseline studies - Drafting sections of Report
5.	Dr. James Adomako	Associate Consultant, Terrestrial Ecologist	Ph.D. (Ecology), University of Ghana, Legon	- Terrestrial Flora and Fauna Study
6.	Prof. Francis K E Nunoo	Associate Consultant, Aquatic Biologist	Ph.D. (Fisheries Science), University of Ghana	- Aquatic Ecology Study of the Marine environment
7.	Adu-Nyarko Andorful	Associate Consultant Sociologist	M.Phil Adult Education, University of Ghana	-Community engagement and socio-economic study

**Email: [info@salconsultgh.com](mailto:info@salconsultgh.com)**

**UPDATED ESIA - TABLE SHOWING WHERE KEY UPDATES HAVE BEEN MADE. MARCH 2019**

<i>Key Chapters or sections</i>	<i>Subsections and pages where updates have been made</i>
EXECUTIVE SUMMARY	Page xiv, Paragraph 2 under <b>Purpose of the ESIA and Compliance with relevant laws and regulations</b>
	Page xvii, under <b>Provisional Environmental Management Plan</b> -Development of Specific Environmental/Social Management Plans added to bullet (see bullet 4) -Construction and operational phases impact management plan added to the bullets (see bullet 8) -Capacity building and Training added to the bullets (see bullet 11) -Community Development Program/Social Responsibility (see bullet 13)
1.0 INTRODUCTION	See page 3, paragraph 2.
	See page 3, paragraph 3 of Subsection 1.3
	See page 7, subsection 1.5.7.
2.0 POLICY, LEGISLATIVE AND ADMINISTRATIVE FRAMEWORK	Page 28, Subsection 2.6 (AfDB Operational Safeguards)
	Page 30, Subsection 2.7 (Gap analysis for the IFC PS and AfDB OS)
	Page 32, Subsection 2.8 (The Equator Principle)
5.0 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS	Subsection 5.4.4 pages 165/166
	Details of the PAPs are provided in Annex 5-4.
8.0 POTENTIAL IMPACT IDENTIFICATION AND ASSESSMENT	Page 215 (row no. 9 – Labour influx issues assessed)
9.0 IMPACT MITIGATION AND MANAGEMENT	Page 239, 2 <sup>nd</sup> row – mitigation measures for labour influx added.
10.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN	Page 260, subsection 10.2 (Programme to meet requirements) The following have been added to the bullets: <ul style="list-style-type: none"> <li>• Development of Specific Environmental and Social Management Plans</li> <li>• Construction and operational Phases Impact Mitigation Action Plan</li> <li>• Capacity Building and Training</li> <li>• Community Development/Social Responsibility</li> </ul>
	Page 264, Subsection 10.2.3 Development of Specific Environmental and Social Management Plans
	Pages 265/266 Subsection 10.2.7 Construction and operational phases impact mitigation action plan
	Page 292, Subsection 10.2.11 Capacity building and training
	Page 298, Subsection 10.2.15 Community Development/Social Responsibility
	Page 299, Table 10-5 updated

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## ACRONYMS

AfDB	African Development Bank
AOI	Area of Influence
ASME	American Society of Mechanical Engineers
BOG	Boil off Gas
CD	Chart Datum
CHEC	China Harbour Engineering Company Limited
CRA	Cathodic Resistant Alloys
DCS	Distributed Control System
EC	Energy Commission
EHS	Environmental Health and Safety
EHSS	Environmental Health Safety and Security
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPC	Engineering Procurement and Construction Contract
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
FROGGIE	Forest Reserves of Ghana Geographic Information Exhibitor
FSRU	Floating Storage Regasification Unit
FSU	Floating Storage Unit
GDSA	Gasfin Development SA
GMA	Ghana Maritime Authority
GNPC	Ghana National Petroleum Corporation
GoG	Government of Ghana
GPHA	Ghana Ports and Harbour Authority
GPMS	Ghana Petroleum Mooring Systems
GPS	Global Position System
GRC	Grievance Redress Committee
GRIDCo	Ghana Grid Company
IFC	International Finance Corporation
IFI	International Financial institutions
HAZID	Hazard Identification
IMO	International Maritime Organization

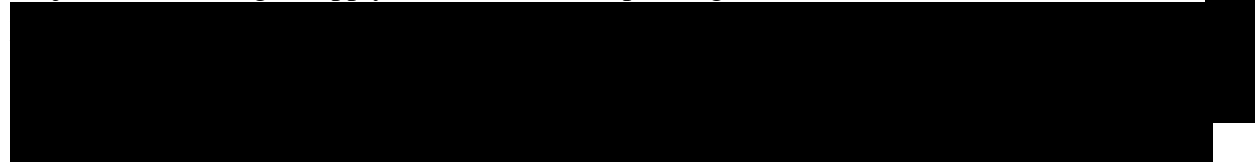


LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
MARPOL	Marine Pollution Regulations
NADMO	National Disaster Management Organization
NAAQ	National Ambient Air Quality Guidelines
NANLG	National Noise Level Guidelines
NPA	National Petroleum Authority
LSIR	Location Specific Individual Risk
PAA	Projected Affected Area
PERC	Powered Emergency Release Couplings
PPE	Personal Protective Equipment
PS	Performance Standards
RoW	Right of Way
QRA	Quantitative Risk Assessment
QHSE	Quality Assurance Health, Safety and Environment
STS	Ship to Ship
TMA	Tema Metropolitan Assembly
TDC	Tema Development Corporation
TOR	Tema Oil Refinery
TSHD	Trailer Suction Hopson Dredger
TLNG	Tema LNG Ghana Company
VALCO	Volta Aluminum Company
VOC	Volatile Organic Compounds
VRA	Volta River Authority
WAGP	West African Gas Pipeline Company
WRC	Water Resources Commission

## EXECUTIVE SUMMARY

### Project description and alternative considerations

Tema LNG Terminal Company Limited proposes to undertake the Tema LNG Terminal Ghana Project to meet the gas supply needs for thermal power generation in the Tema industrial area.



The Tema LNG Terminal Ghana project will be a floating liquefied natural gas import facility to receive, store and regasify LNG and to deliver natural gas to into the existing Tema gas network. It comprises the following:

- **Dredging:** To assure enough under keel clearance during the approach and berthing of the LNG Carrier, the channel and turning circle will be dredged to depths between -15 m CD or -16m mCD.
- **Breakwater construction:** Extension of the existing outer breakwater by about 800 m;
- **Mooring facilities:** To provide safe and permanent mooring of the Floating Liquefied Natural Gas (LNG) infrastructure, four mooring and breasting dolphins will be constructed in the protected waters behind the breakwater;
- **Floating infrastructure:** Installation and operation of a floating storage unit (FSU) and floating regasification unit (FRU) with a combined storage capacity of about 145,000 m<sup>3</sup> to 160,000 m<sup>3</sup>. The nominal gas send out capacity of the project will be 1.7 million tons per annum (MTPA) of Liquefied Natural Gas (LNG) about 230 MMSCFD (million standard cubic feet per day of natural gas);
- **Natural Gas Pipeline:** Construction and operation of a 8 km pipeline, submerged across the main port channel and connecting into the existing Volta River Authority header station, approximately 5km north-east of the Tema port, via an onshore pipeline along the existing oil and LPG pipeline right of ways as well as GRIDCo right of ways on the VALCO property.

The LNG supplier will deliver LNG in standard sized LNG carriers (“LNGCs”) to the FSU, which acts as the primary LNG storage. The LNG is then periodically transferred to the FRU, which has secondary LNG storage, from where it is regasified and delivered to Ghana National Petroleum Corporation (GNPC) at the tie-in point at the existing Volta River Authority (VRA) header station.

The proposed Tema LNG Terminal Ghana Project falls mainly within the Tema Metropolis in the Greater Accra Region. The floating infrastructure of the project will be sited just outside of the entrance of the Port of Tema to the southeast of the existing outer breakwater of the main port. The infrastructure will be protected by an extended breakwater, which connects close to the tip of the existing outer breakwater. The natural gas pipeline facility is largely within the Tema Metropolis but the existing VRA header station which will receive the gas for distribution is within the Kpone Katamanso District in the Greater Accra Region.

The estimated investment cost for the project is USD 300 million. Tema LNG Company is expected to handover the terminal to Ghana National Petroleum Corporation (GNPC) after 12 years of operating the facility as per the current contract arrangement.

For the development of the proposed Project, a number of options have been considered throughout the project design stages to present the most feasible alternatives that meet the project objectives. The alternatives under consideration include the following:

- Location for LNG Terminal;
- Site Selection Options within Tema Port;
- Layout Options within Tema Port;
- Tank Options (Type A tanks, Type B tanks, Type C tanks);
- Pipeline route options;
- Pipeline material;
- Pipeline construction options; and
- No action option.

### **Purpose of the ESIA and Compliance with relevant laws and regulations**

The purpose of the ESIA is to identify and address possible direct, indirect significant adverse environmental and social impacts to arise from the proposed project for acceptability and sustainability; and to satisfy both legal and institutional obligations specified under the Environmental Protection Agency Act 1994 (Act 490), Environmental Assessment Regulations 1999 (LI 1652). The project will also ensure compliance with all relevant national laws and regulations as well as the IFC Performance Standards. A final ESIA report was submitted to the EPA in August 2018 for an Environmental Permit.

The Safeguards team at the African Development Bank (AfDB), one of the project lenders, reviewed the August 2018 final ESIA report prior to the Environment & Social (E&S) Due Diligence visit to the Project site on 7-8 March 2019 and proposed a few changes intended to ensure that the ESIA reflects the AfDB's E&S safeguards and standards. Good international industry practice will be adopted for project implementation to ensure sustainability of the project.

### **ESIA Approach and Methodology**

The approach and methodology adopted for the study included:

- Field inspections and trekking;
- Review of available literature;
- Specialists studies for baseline information;
- Stakeholder Consultations;
- Data analysis and assessment of potential environmental and social risks and Impacts;
- Development of Impact Mitigation and Control Measures;
- Development of a provisional environmental management plan; and
- Reporting.

### **Overview of the Project Area of Influence/Baseline Information**

The LNG terminal facility is located within the Tema Port. The area of influence is the immediate surroundings of the Port of Tema and the pipeline route. Between 20-40 m Right-of-Way (RoW) pipeline will be required during the construction stage depending upon space. The operation phase

will require between 3.5m and 20 m RoW for accessibility purposes. The 3.5 m of the RoW will be permanently required and restricted in terms of use.

Eastward of the Tema port (project area) is located two coastal lagoons; the Chemu (about 1.8km from the proposed dredging site) and Gao (about 5.4km from the proposed dredging site) lagoons. The proposed natural gas pipeline route will cross the Chemu stream. The Chemu stream/lagoon is currently polluted because it receives wastewater from the Tema industrial area and the local communities also dump wastes into and near the drain.

The pipeline route goes along the Tema Oil Refinery (TOR) right of way (RoW) within the port boundaries and then uses the Volta aluminium Company (VALCO) Row to the Volta River Authority (VRA) Header Station. The key communities along the route include Abonkor, Manhean and Bankuman, all within 100m off the pipeline route. There are subsistence farms and piggery along the RoW that will be affected.

Ambient air quality and noise level measurements were carried out along the pipeline route in April 2018 as part of the EIA study. The sampling locations included the project area at the harbour (near the oil jetty), Abonkor and Bankuman communities near the onshore pipeline and at the Valco hospital. The dust level measurements for PM<sub>10</sub> along the pipeline route generally exceeded the EPA permissible limit of 70 µgm<sup>3</sup>, and all the sampling areas were non-compliant with WHO guideline level of 50 µgm<sup>-3</sup>. The results of the noise assessment indicate that the baseline noise data at Abonkor Community and Valco hospital were however above EPA guideline value of 65 dB(A) and 55 dB(A) respectively.

The vegetation along the pipeline route is mostly degraded due to the current land use. The pipeline route is a predominantly built-up area (industrial and human settlements) with very few small-sized subsistence farms, bare/fallow areas and isolated pockets of thin strip of degraded mangrove swamp along a section of the Chemu stream.

The results of the bathymetric survey carried out at the proposed marine offshore facility area show that the water depth ranges from approximately 8.4m to 17.9m below Chart Datum (CD), suggesting that some dredging will be required. Five distinct surficial facies were identified at the proposed marine offshore facility area during a marine geophysical survey carried and these included Reef Outcrop; Bioclastic Gravel; Fine to Medium Grained Sediment; Breakwater Armouring; and Anthropogenic Artefacts. The anthropogenic artefacts represent any man-made debris which have been discarded on the seafloor within the study area, and these included tyres, a linear pipe/chain/cable like artefact and a shipwreck.

Marine water and sediment quality were carried out in April 2018 at the port and the results compared with the Canadian Environmental Quality Guidelines (CEQGs) - Water Quality Guidelines for protection of aquatic life and Sediment Quality Guidelines. The result for the marine water quality show that all parameters measured (pH, Turbidity, BOD, COD, TSS, Oil, Total nitrogen, Total phosphorus and heavy metals) were within the associated guideline levels. The results for the sediment quality show that all the samples in the port area were above the CEQGs permissible levels for Mercury (0.13 mg/kg).

The port area is moderate to high in marine biodiversity, especially in fish resources. Marine reptiles and mammals occur in Ghana. Eight species of dolphins (*Stenella clymene*, *S. attenuata*, *Steno bredanensis*, *Tursiops truncatus*, *Grampus griseus*, *Lagenodelphis hosei*, *Globicephala macrorhynchus* and *Delphinus capensis*) have also been recorded with *S. clymene* as the most abundant species. These eight (8) species are not in the IUCN red list of threatened species. Three species of marine turtle have been recorded nesting on the Sakumo II lagoon (about 6 km west of the proposed offshore facility site). These are *Lepidochelys olivacea*, *Chelonia mydas* and *Dermochelys coriacea*, and are all endangered species according to the IUCN red list of threatened species.

### **Major Potential Impacts**

The indirect positive impact of the project will have far-reaching effects nationwide from the utilisation of natural gas produced from the Tema LNG Terminals Ghana Project. The direct potential positive impacts activities include:

- Employment opportunities/job creation
- Improved local economy through payment of various taxes and use of local resources during project implementation;
- Availability of natural gas for industrial use; and
- Improved institutional & national revenue

The potential adverse impacts and risks include:

#### Preparatory and Planning Phase

- Land/wayleave Acquisition
- Anxiety on the part of potentially affected persons/ institutions
- Occupational Health & Safety

#### Construction Phase

- Air quality deterioration
- Vibration and noise nuisance
- Loss of vegetation and impacts on flora and fauna
- Sanitation/waste generation issues
- Labour influx issues
- Occupational health & safety concerns and labour issues
- Public health & safety issues
- Road crossings and traffic impact
- Destruction of few subsistence farms/pigsty Loss of livelihood and access to land
- Marine water contamination/ impact on aquatic organisms and biodiversity
- Impact on Ecologically Sensitive Sites
- Surface water contamination/ impact on aquatic organisms
- Impact on cultural heritage
- General disturbance of port operations

#### Operation and Maintenance Phase

- Air quality deterioration
- Greenhouse Gas Emissions and Impact on Climate Change

- Contamination of Marine Environment/ impact on marine flora and fauna
- Introduction of Invasive Marine Pest Species
- Waste storage and disposal
- Occupational health and safety concerns and labour issues
- Public health & safety issues
- General disturbance of port operations

#### Post Construction Decommissioning Phase

The post-operational decommissioning phase impacts will be addressed in a separate section. The significant adverse impacts during the post-construction decommissioning phase will be similar to the construction phase impacts in general, in addition to loss of jobs.

### **Impact Mitigation and Management**

The mitigation and management measures for the identified significant adverse impacts are provided in the table labelled *Summary of potential impacts and mitigation measures* below. The application of the mitigation measures in general is expected to reduce major and moderate impacts to minor or negligible impacts that may not require further mitigation.

### **Provisional Environmental Management Plan**

A Provisional Environmental Management Plan (PEMP) is developed for the project in accordance with the Environmental Assessment Regulations of 1999, LI 1652 to assist the project to be carried out in an environmentally safe and sustainable manner. The provisional EMP addresses issues related to the following:

- Establishment of an Environment Health and Safety Management Structure;
- Adoption of Environmental Health and safety Policy and Operational Procedures;
- Adoption Environmental Health and Safety Management System;
- Development of Specific Environmental/Social Management Plans;
- Technical Co-operation;
- Staff Information and Awareness Creation;
- Public and community participation;
- Construction and operational phases impact management plan;
- Environmental and social monitoring programmes;
- Audits and Reviews;
- Capacity Building and Training;
- Grievance Redress Mechanism;
- Community Development/Social Responsibility;
- Environmental Reporting;
- Emergency Response Planning; and
- Environmental and social management budgeting.

A detailed EMP will be prepared and submitted to the EPA within 24 months of commencement of operations as required by law.

*Summary of potential impact and mitigation measures*

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>
Row Acquisition	All institutions within RoW	<ul style="list-style-type: none"> <li>• Ensure all stakeholders are engaged in the early stage of the project.</li> <li>• Project plans and designs must be discussed and agreed by RoW owners.</li> <li>• All permits and necessary documentation needed for acquiring RoW must be approved.</li> <li>• Prepare and implement a livelihood restoration plan which will also includes compensation for potentially affected structures and farms within RoW, and livelihood assistance programmes for loss of proven income and suspension of farming and piggery activities.</li> <li>• Ensure affected persons are well informed to remove crops and structures prior to the start of construction.</li> <li>• Tema LNG Terminal Company and the EPC contractor will liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs for use to prevent open defecation if necessary.</li> <li>• Disclose public information of the project.</li> </ul>
Anxiety on the part of potentially affected persons/institutions	Institutions /Potentially affected persons	<ul style="list-style-type: none"> <li>• Stakeholder interactions to educate all on proposed project activities, impacts and proposed mitigation measures.</li> <li>• Will develop and implement grievance mechanism as a part of a wider Stakeholder Engagement Plan enabling community concerns to be documented and resolved in a timely fashion.</li> <li>• Will ensure liaison with all stakeholders and nearby communities in the project area is maintained throughout project life.</li> <li>• The Tema Traditional Council will be consulted prior to the commencement of work to ensure that all the necessary customary rites are performed and a mechanism found/agreed with the stool to ensure peaceful coexistence.</li> </ul>
Occupational health and safety	Tema LNG Terminal Company Staff and consultants	<ul style="list-style-type: none"> <li>• The various contractors to be engaged will be required to comply with the GPHA Occupational Health and Safety Policy when working within the Port environment.</li> <li>• The consultants will be required provide first Aid Kits on site to treat minor ailments and cuts. However, major cases will be referred to the GPHA clinic for treatment or referral to the Tema General Hospital.</li> <li>• The owner as well as their various contractors will be required to provide the appropriate personal protective equipment such as safety boots and coats, hand gloves, earplugs and nose masks when carrying out their studies. Supervisors will be mandated to ensure the use of these protective devices and implement sanctions when necessary.</li> <li>• Ensure that well-trained workers will be engaged for the various construction roles.</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
<b>Construction Phase Impacts</b>		
Air Quality Deterioration	Workers/ Local communities and road users	<ul style="list-style-type: none"> <li>• Dust emissions from trucks, will be controlled and minimized by the use of designated routes in order to minimize impacts to residents, construction workers, port workers/users and institutions along the transport route.</li> <li>• The proposed road construction and road upgrade works will be done using mitigation and control techniques, such as standard dust suppression measures e.g. dampening of unpaved surfaces</li> <li>• Ensure vehicular speed limits of 30mph over any unpaved landscape to minimise dust generation. Material dumping will be regulated to reduce dust emissions.</li> <li>• Owners / operators of construction equipment and vehicles will implement the manufacturer recommended engine maintenance programmes to minimize the emission of fumes into the environment.</li> <li>• Contractor will monitor dust and remedial action will be taken whenever dust generating activities take place.</li> <li>• Dust-related grievances will be investigated and managed as part of the Grievance Mechanism.</li> </ul>
Vibration and noise nuisance	Workers/ Local communities and road users	<ul style="list-style-type: none"> <li>○ The contractor should employ standard noise abatement measures and engineering best practices to ensure that the impact of these issues is minimized and reduced to acceptable limits.</li> <li>• The contractor should ensure that earthworks and other construction activities will be phased out or controlled to reduce noise generation during construction.</li> <li>• All equipment and vessels shall be operated and maintained in accordance with appropriate industry and equipment standards including specifications for noise levels and manufacturer's specifications (including regular checks and maintenance).</li> <li>• Machines in intermittent use shall be shut down in the intervening periods between works or throttled down to a minimum.</li> </ul>
	Aquatic life/marine environment	<ul style="list-style-type: none"> <li>• Marine mammal/ sea turtle observation and regular monitoring will be conducted to observe any appearance of such animals along the coast/ shoreline or in the waters during dredging and major offshore construction activities. If sea turtles are observed especially during the evenings/night, the time will be noted and the Wild Life Division (which is in charge of protected species) in Accra will be alerted and their recommendations sought for implementation.</li> <li>• The contractor will include consideration of soft-starts for noise generating activity. E.g. During piling activities, soft start procedures will be adopted (i.e. commencing with reduced noise level to allow fishes to move away from the area before increasing the noise levels.</li> <li>• To reduce underwater noise levels associated with percussive piling, the following steps will be taken:</li> </ul>



Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>○ Quieter hydraulic hammers should be used instead of the noisier diesel hammers;</li> <li>○ Acoustic decoupling of noisy equipment on work barges should be undertaken. These techniques can include the use of a soft sling to retain the pile driving hammer, rubber-tired air compressor for bubble jacket/curtain, rubber pads on barge leaders and guides, and an air curtain around the pile barge.</li> </ul>
Loss of vegetation and impacts on flora and fauna	Terrestrial Flora, Fauna	<ul style="list-style-type: none"> <li>• Undertake pre-clearing survey and assessment of the flora to be impacted especially if construction will be carried out in the rainy season to help identify sensitive areas such as vegetation with active nesting.</li> <li>• The contractor will develop construction code of practice and ensure critical areas such as the remaining mangrove swamps along the Chemu stream/lagoon is avoided.</li> <li>• Allow an appropriate buffer distance between any construction activity and remnant native vegetation, where practicable.</li> <li>• Limit construction activities to only designated places and clearly mark out all vegetation, which will not be cleared, so that they are clearly visible as “no-go areas” to construction staff and vehicles.</li> <li>• Dismantle and remove all equipment and machinery after construction from site.</li> <li>• Rehabilitate trenches and disturbed areas as soon as possible.</li> </ul>
Sanitation/Waste Generation concerns	Soil, Chemu River, Valco and Bankuman Roads	<p><u>General Waste</u></p> <ul style="list-style-type: none"> <li>• The contractor must appoint a waste management coordinator. The coordinator shall prepare and implement a Waste Management Plan which specifies procedures and, incorporates the existing waste management plan for the Tema Port. This is to facilitate tracking of loads, and protocols for the maintenance of records of the quantities of wastes generated, recycled and disposed.</li> <li>• Waste remaining after implementation of the waste hierarchy measures will be collected by private waste management companies operating at the port for onward disposal.</li> <li>• The contractor should provide adequate waste bins at the temporary work camps to minimise littering of the port and also littering along the pipeline route. The collected refuse will then be transferred to the GPHA approved disposal site.</li> <li>• Good site practices shall be implemented to avoid waste generation and promote waste minimisation.</li> </ul> <p><u>Construction Waste</u></p> <ul style="list-style-type: none"> <li>• All scraps or other solid wastes will be disposed of at the approved disposal site of the TMA.</li> <li>• Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction.</li> <li>• Contaminated soil will be considered as waste material and disposed of accordingly at the Kpone Landfill Site.</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>Excavated material shall be used on site to the extent practical.</li> </ul> <u>Hazardous Waste</u> <ul style="list-style-type: none"> <li>All hazardous waste (e.g. oily waste) generated during construction/installation will be appropriately stored as per manufacturer's instructions. For onward recycling, treatment or disposal, EPA approved hazardous waste collectors will be engaged for collection and disposal of all hazardous waste.</li> </ul>
	Marine environment	<u>Dredged material</u> <ul style="list-style-type: none"> <li>The contractor will be required to develop a detailed dredge management plan to guide the dredging and disposal of dredged materials.</li> <li>The dredging works will generate about 560,000 m<sup>3</sup> of material. The Dredged spoil will be dumped offshore after acquiring the necessary approvals from GPHA and GMA.</li> <li>Construction workers will be instructed not to dispose or dump of any kind of waste into the marine waters and waste storage bins will be provided at conspicuous locations.</li> </ul> <u>Hazardous Waste</u> <ul style="list-style-type: none"> <li>The waste generated during construction/installation of the Project will be transported to land for re-use, recycling, treatment or disposal in alignment with the contractors' waste management plan.</li> </ul>
Labour influx issues	Local communities	<ul style="list-style-type: none"> <li>Tema LNG will implement a labour influx management plan to holistically address labour influx issues.</li> <li>Tema LNG will implement a stakeholder engagement plan that will include:               <ul style="list-style-type: none"> <li>informing stakeholders of increases in workforce and potential for influx.</li> <li>Engaging with local government/traditional authorities on issues, risks and opportunities regarding labour influx</li> <li>Engaging local communities to understand their concerns, raise awareness of risks and opportunities, and identify solutions to issues relating to labour influx</li> <li>Developing a feedback and grievance mechanism to collect any feedback or complaints related to labour influx associated with the project</li> </ul> </li> </ul>
Occupational Health and Safety Concerns and Labour Issues	Workers	<u>Adoption of Health and Safety Policies</u> <ul style="list-style-type: none"> <li>It is the policy of GPHA and for that matter the Port of Tema to establish and maintain high standards of occupational health, safety and environmental protection at work, to prevent personal injury or illness, property damage, fires, security losses and environmental pollution.</li> <li>The contractor will be required to prepare and implement health, safety and environmental protection at the workplace to guide the construction activities in compliance with the policy of GPHA. The</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<p>responsibility for implementing this policy lies directly and personally with the contractor through its workers. The policy objectives shall include the following:</p> <ul style="list-style-type: none"> <li>• Conduct activities in the Ports in accordance with relevant national and international laws and regulations on occupational health and safety. This includes Labour Act, 2003 (Act 651), the Factory, Offices and Shops Act, 1970 (Act 328), the Fire Service Act, 1997 (Act 537), Building Regulations, 2003 (LI 1724), MARPOL Convention 73/78, ILO Convention 152, 155 and 160; <ul style="list-style-type: none"> <li>○ establish regulatory and organizational framework for the efficient and effective management of occupational health, safety and environment issues;</li> <li>○ maintain safe plant, machinery and equipment;</li> <li>○ maintain safe and healthy work place for all Port workers and Port users</li> <li>○ maintain incident and injury-free working environments;</li> <li>○ prevent occupational related diseases/ illness among workers; and</li> <li>○ promote and maintain a clean, healthy and hygienic environment.</li> </ul> </li> </ul> <p><u>The Contractors OHSP</u></p> <ul style="list-style-type: none"> <li>• The contractor will be required to develop an Occupational Health and Safety Plan to international standards, including requirements for PPE, task risk assessment, mandatory training, audit and monitoring, incident reporting etc.</li> <li>• The Contractor will apply the hazard hierarchy when planning work to avoid/eliminate risks and reduce risk to as low as reasonably practical.</li> <li>• The contractors will educate workers on its health and safety policy. Workers will therefore be required to follow the health and safety policy of the Authority. The adoption of the health and safety policy at site will serve as a precautionary measure to prevent/ minimize the possibility of accidents and reduce health associated risks. The EPC contractor will ensure compliance with the Health and Safety Policies between the contractor and GPHA.</li> <li>• The contractors will train selected workers as first aid givers and provide adequate first aid kits at the construction areas to treat minor ailments and cuts. However, major cases will be referred to the GPHA clinic for treatment or referral to the Tema General Hospital.</li> </ul> <p><u>Use of Experienced Personnel</u></p> <ul style="list-style-type: none"> <li>• The contractors will ensure that well-trained workers will be engaged for the various construction roles. Only drivers with the requisite licenses will be allowed to handle vehicles and earth-moving equipment into the port. Initial training and testing in machine/ equipment handling and safe working procedures will</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<p>be given to all new drivers, operators and other field workers to help minimize the occurrence of accidents on site.</p> <ul style="list-style-type: none"> <li>The contractors will ensure that regular defensive driving training sessions are organized for the drivers to ensure their safety and the safety of the general public.</li> </ul> <p><u>Provision of Personal Protective Equipment (PPE)</u></p> <ul style="list-style-type: none"> <li>The contractor will ensure that workers are provided with the appropriate personal protective equipment such as safety boots and coats, hand gloves, earplugs and nose masks. Supervisors will be mandated to ensure the use of these protective devices and implement sanctions when necessary.</li> </ul> <p><u>Phasing out of Material Movements/ Scheduling Material Movements</u></p> <p>Movement of tanks, pipes and other construction materials to site or storage areas will be carried out in phases and properly regulated to control the number of cargo vehicles coming into the project site at any given time to reduce the risk of accidents. Tema LNG Terminal intends to carefully plan materials movement with GPHA activities to minimise these impacts. Materials and equipment will be transported to the sites during off peak periods.</p> <p><u>Use of Equipment</u></p> <p>All equipment's to be used will be in good condition and scheduled regular maintenance will be ensured to reduce/minimize of accidents.</p> <p><u>Worker Rights and Wellbeing</u></p> <p>The Contractor will develop and implement a Human Resource Policy and plan that adheres to the requirements of IFC PS2, including requirements for workers to have contracts, Workers Grievance Mechanism and develop retrenchment plans if there is a requirement for collective dismissals.</p>
Public Health and Safety and Security Impacts	Public/Communities	<p><u>Restriction of Access</u></p> <ul style="list-style-type: none"> <li>GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area.</li> <li>The security personnel will be trained to respect the human rights of the local people</li> <li>IFC PS4 will be used as the standard in relation to hiring, training and monitoring of security personnel</li> </ul> <p><u>Pipeline Design and Depth</u></p> <ul style="list-style-type: none"> <li>The pipeline is to be constructed from carbon steel and will be externally coated for corrosion protection to minimize damage.</li> <li>The pipeline will be laid to a minimum depth of 1m (yet to be confirmed by the final designs) to minimize the risk of exposure through soil erosion and there will be some restrictions to RoW usage.</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<p><u>Provision of temporary crossings over trenches</u></p> <ul style="list-style-type: none"> <li>The pipeline contractor will be required to provide temporary crossings over trenches at the Abonkor community section to enable pedestrians or residents to easily cross over open trenches crossing their footpaths.</li> </ul> <p><u>Public Health /Toilet facilities</u></p> <ul style="list-style-type: none"> <li>The contractor will provide mobile toilet facilities for workers during construction of the pipeline route.</li> <li>Currently TMA is promoting “toilet at half price” as part of the access to improve sanitation project under the GAMASWAP in the local communities around the project area in order to minimize open defecation.</li> <li>Tema LNG Terminal Company will liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs near the Valco fence wall for use to prevent open defecation.</li> </ul> <p><u>Use of warning signs</u></p> <ul style="list-style-type: none"> <li>Uncovered trenches or deep excavations will be protected using indicator linings or illustrative warning notices or wire mesh (whichever best suits the situation) to prevent fall hazards. All trenches and excavation will be covered as soon as possible.</li> <li>As much as possible the contractor will adopt progressive opening of trenches to reduce risks to as low as reasonably practicable</li> <li>Caution/warning signs should be placed at vantage points around the project site</li> </ul> <p><u>Scheduling of Work</u></p> <p>The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods.</p> <p><u>Announcement and Notification of Work</u></p> <p>The TMA and TDC will be informed at least seven days before start of work. All port users will also be informed of the schedule of work through their respective organisations. Tema LNG will make announcements and give notices for work schedule on affected roads through local FM stations as well as some nationwide stations, Assemblymen as well as Unit Committee leaders.</p> <p><u>Transport of Equipment and Materials</u></p> <p>Traffic impacts resulting from carting of equipment and materials (e.g. quarry materials) to the oil jetty site from local quarry sites will be limited to the Harbour roads and will be managed in line with the Traffic Management Plan to be prepared by the contractor for the movement of materials.</p> <p>The traffic management plan will be prepared in consultation with GPHA in order to minimise trucks congestion at the port as a result of the ongoing port expansion project.</p>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<p>Flagmen will be employed to man all major intersections to assist with passage of trucks conveying materials and equipment, on the route to the construction site and storage area.</p> <p>All the vehicles to be used for the project and especially in transporting equipment and materials will be serviced regularly and all the drivers to be engaged/ assigned would be required to hold the requisite driver's license as prescribed by the Drivers and Vehicles Licensing Authority (DVLA), and would be educated on public safety issues. Adequate traffic management measures will be instituted to caution the public and to create safety awareness.</p> <p>Some adequate measures and conditions to be instituted by the contractor in the transport of materials include the following:</p> <ul style="list-style-type: none"> <li>• All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and MTTD;</li> <li>• Haulage of materials including quarry products to the port area will be limited to off-peak hours;</li> <li>• Trucks transporting quarry products and other friable materials to the port will be covered;</li> <li>• All trucks conveying materials to the port will carry appropriate warning signals such as red flag and rotating amber lights;</li> <li>• Road worthy dump trucks will be used;</li> <li>• Very experienced drivers will be engaged;</li> <li>• Traffic wardens will monitor dump truck movements and ensure public and traffic safety; and</li> <li>• Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks.</li> <li>• Carry out regular inspections of haulage roads</li> </ul> <p>In the event truck failure along haulage routes, such trucks will be towed within 24 hours.</p>
Road crossing and traffic impact	VALCO vehicles, commercial and private vehicles	<ul style="list-style-type: none"> <li>• VALCO will be informed and will agree to the date and time of crossing the road</li> <li>• The contractor will be required to use appropriate methodology to cross the VALCO exclusive road to minimise or avoid delays in transport of people to and from the clinic.</li> <li>• The local communities will be informed on the schedule for the crossing of the untarred access road connecting Bankuman to the TOR area.</li> <li>• The contractor will be required to schedule its work such that crossing of the untarred access road is done when traffic is low to minimize inconvenience to motorists.</li> <li>• Where the untarred access road has to be blocked for work to proceed smoothly, adequate signs and notices will be strategically placed at diversion routes.</li> </ul>

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>
		<ul style="list-style-type: none"> <li>Any damaged sections of the roads will be reinstated by the contractor</li> </ul>
Destruction of crops/farm, pigsty, loss of livelihood and access to land	Affected subsistence farmers and pig owners	<ul style="list-style-type: none"> <li>Tema LNG will implement a livelihood improvement plan for potentially project affected persons that will take care of compensation, relocation, and livelihood assistance arrangements as required</li> <li>Appropriate compensation for affected standing crops and pigsty/pigpen at proven value will be paid.</li> <li>Monitoring will be undertaken to determine potential compensation/livelihood assistance measures required and verify they have been effective.</li> </ul>
Under water blasting effects	Marine life and ecology	<p>The first option is to avoid underwater blasting as much as possible and consider other alternatives such as hammering. However, the following mitigation measures will be adopted to minimize the effect of underwater blasting:</p> <ul style="list-style-type: none"> <li>The Inspectorate Division of the Minerals Commission will be consulted, and approve of the blasting design;</li> <li>Technical persons from the Ghana Navy/Coast Guard and the Inspectorate Division of the Minerals Commission will be around to supervise and observe the blasting operation;</li> <li>Blasting will be conducted during time when marine animals are least likely to be in the blasting area;</li> <li>In tidal areas, blasting will be conducted during the recommended tidal phase deemed appropriate for the area (i.e. slack or low-tide conditions);</li> <li>If multiple charges are required, time-delays will be used to reduce the overall detonation pressures to a series of smaller explosions;</li> <li>All shock-tubes and detonation cord or electric wires will be recovered and removed after each blast;</li> <li>All blasting events shall be weather dependent. Climatic conditions must be suitable for optimal viewing and minimal impact. Blasting will be prohibited under windy conditions, during periods of fog and heavy rain. The Meteorological Agency or the Port Meteorological Unit will be contacted to confirm conditions prior to initiation of the survey for each blast event;</li> <li>All blasting events will occur during daylight hours to ensure that optimal observation conditions occur; and</li> <li>If there are any problems encountered during blasting, the problems shall be evaluated by the technical persons from the Inspectorate Division of the Minerals Commission and the Navy as well as the explosive engineers. Solutions to the problems should be identified prior to the next blasting event.</li> <li>Marine mammal/ sea turtle observance and monitoring will be carried out during any underwater blasting to observe any appearance of such animals along the coast/ shoreline or in the waters</li> </ul>

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>
Marine water contamination/ impacts on aquatic organisms and biodiversity	Marine environment	<p><u>Dredging</u></p> <ul style="list-style-type: none"> <li>• A Dredge Management Plan will be developed in line with the requirements of IFC EHS Guidelines for Ports Harbours and Terminals to guide the project. The dredging management plan will include sampling and monitoring of sediment and will include measures to address exceedences.</li> <li>• Dredging will be done in small sized enclosed areas at a time, protected with silt curtains, blasting mats, fine meshed films and other BMPs, to shut out spread of fine sand/silt and re-suspension of any chemical contaminants in the marine bed.</li> <li>• The contractor shall ensure that the dredge cuts and lifts are designed such as to prevent undercutting of material at the cutterhead. The cutter head shall be selected in accordance with the material to be dredged and to minimise spillage and maximise the transport of dredged material to the suction mouth.</li> <li>• The contractor shall reduce the level of re-suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity to ensure that the cutter advancement rate is not greater than the ability of the suction pump to remove the material that has been cut; <ul style="list-style-type: none"> <li>• The contractor(s) will ensure that the works cause no visible foam,</li> <li>• oil, grease, litter or other objectionable matter to be present in the</li> <li>• water within and adjacent to the dredging s</li> </ul> </li> <li>• All boats shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.</li> <li>• All effluent from the project site should be contained in a digester for some days (up to 3 days) to help bring down temperature to that of receiving water as well as settle any solids before release into the environment.</li> <li>• Marine mammal/ sea turtle observance and monitoring will be carried out during dredging to observe any appearance of such animals along the coast/ shoreline or in the waters</li> </ul> <p><u>Trenching</u></p> <ul style="list-style-type: none"> <li>• Restricting trenching times, particularly during periods of high wave/wind activity</li> <li>• To reduce turbidity and spill, design and implement a trenching management plan which is informed by geotechnical and geophysical knowledge of the pipeline route</li> <li>• Install appropriate silt curtains around offshore works</li> </ul> <p><u>Oil spills</u></p>



Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<p>The contractors, prepare a spill prevention and control plan, incorporating measures outlined in the emergency response plan of GPHA, to minimize increased turbidity and surface pollution through oil spills. Monitoring and spill prevention drills will be required to ensure impacts are avoided to the maximum extent practical.</p> <p><u>Movement of ships</u></p> <ul style="list-style-type: none"> <li>• A dedicated navigation route will be used by ships/fishers to move in and out of the port.</li> </ul>
General Disturbance of Port Operations	Port users	<ul style="list-style-type: none"> <li>○ The contractor will elicit the assistance of the Harbour master, GMA as well as representative bodies of the port users to ensure that construction activities are scheduled so that port operations are not unduly interrupted.</li> <li>○ The harbor master will ensure all passing vessels are well informed of construction work, e.g. dredging, piling etc., and are cautious when moving in and out of the port facility.</li> </ul>
<b>Operations/Maintenance Phase</b>		
Contamination of Marine Environment	Marine environment	<p><u>Specific measures</u></p> <ul style="list-style-type: none"> <li>• The terminal operator shall ensure regular maintenance of the sewage treatment plant, manhole for runoff clarification and coalescence separator for the treatment of runoff in areas where fuels and light liquids are handled (e.g. fuel station, workshop).</li> <li>• The terminal operator will ensure that the waste reception facilities for the collection, storage, treatment and transfer of waste at the port are utilized by vessels arriving at the port. The Captains will be adequately informed of this.</li> <li>• Where necessary, filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) will be installed to prevent sediment and particulates from reaching the port water.</li> <li>• The terminal operator shall ensure regular inspection of storm water drains to remove settled materials to avoid blockage and ensure the proper discharge in the drainage systems</li> </ul> <p><u>General measures</u></p> <ul style="list-style-type: none"> <li>• The terminal operator will ensure that the likelihood of oil spills is reduced to the barest minimum through regular monitoring and audits of vessels being used.</li> <li>• The terminal operator will implement its oil spill contingency plan when required to promptly clean up oil spills and avoid contamination of the marine environment. Oil pollution control equipment on hand include Boom, Skimmer, Tug Boat, Dispersant units,</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>• GPHA has established of a Port community network, which brings together major stakeholders that impact on operations in the Port. This will be utilised to ensure pollution of the marine environment is quelled.</li> <li>• Punitive measures will be enforced for all persons observed to throw waste into the port waters.</li> <li>• The polluter pays principle is in place at the port and education of port users will be intensified to increase awareness. The principle implies that –Person(s), Institution and Companies that spill oil or pollute any part of the Port will be made responsible for the clearing of the pollutant and subsequently fined</li> </ul>
Air Pollution	Workers/ Port users	<ul style="list-style-type: none"> <li>• Terminal operator will incorporate the Air Quality Management Plan into standard operations. The plan will include the following: <ul style="list-style-type: none"> <li>○ dust from vehicular movement</li> <li>○ dust from cleaning activities</li> <li>○ exhaust emission from vehicles and machinery</li> <li>○ fumes from chemicals and welding</li> <li>○ VOCs from fuel storage and dispensing areas</li> <li>○ noise from operation of machinery</li> <li>○ monitoring</li> </ul> </li> <li>• Regular maintenance of machinery/equipment in accordance with manufacturer specifications to ensure minimum levels of emission from the terminal operations.</li> <li>• Maintaining stable tank pressure and vapour space by coordinating filling and withdrawal schedules (offshore)</li> </ul>
Waste Management	Workers/Port user	<p><u>Education campaigns</u></p> <ul style="list-style-type: none"> <li>• The terminal operator will ensure proper management and disposal of waste generated and will continue to educate workers on its waste management plan.</li> </ul> <p><u>Waste Collection and Disposal</u></p> <ul style="list-style-type: none"> <li>• The terminal operator will appoint a waste management coordinator. The coordinator shall prepare and implement a Waste Management Plan which specifies procedures and, incorporates the existing waste management plan for the Tema Port. This is to facilitate tracking of loads, and protocols for the maintenance of records of the quantities of wastes generated, recycled and disposed</li> <li>• Ensure different types of waste are segregated in different containers or skip to enhance recycling of material and proper disposal of waste.</li> <li>• Ensure chemical wastes are stored, handled and disposed of in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>All the collected wastes shall be transferred to the Port Waste Reception and Treatment Facilities</li> </ul>
Noise Nuisance	Port Users, terminal workers	<ul style="list-style-type: none"> <li>The terminal operators will ensure that silent equipment (low noise versions, which may cost a little extra) are used for the terminal operations. Additionally, silencers, mufflers and other appropriate engineering control devices shall be used on the noise generating equipment. Where possible, electrical instead of diesel or diesel-electric moving equipment will be used.</li> <li>Reduce noise levels through optimizing the terminal layout</li> <li>Regular site inspections will be carried out to audit the compliance with regard to noise control.</li> <li>Will provide appropriate PPEs for workers use.</li> </ul>
Occupational Health and Safety Concerns and Labour Issues	Terminal workers and subcontractors	<p><u>Training in equipment and chemical handling</u></p> <ul style="list-style-type: none"> <li>Risk assessments will be undertaken and avoidance / elimination of hazards prioritised to reduce the need for manual handling of chemicals.</li> <li>The terminal operator will also ensure that workers handling fuels, chemicals, machinery and equipment are well trained. Such workers will be provided with the necessary documentations including Material Safety Data Sheet (MSDS)) to serve as reference sources on the dangers and ways of handling these chemicals, fuels etc.</li> </ul> <p><u>Provision of appropriate PPEs</u></p> <ul style="list-style-type: none"> <li>The terminal operators will ensure that the Management of the various terminals provide workers with adequate personal protective equipment including overalls, earplugs, overalls and anticorrosive gloves etc. as their particular operations would require.</li> <li>Non-conductive hand tools rated for the voltage at which live electrical work is being performed at the substation will be provided.</li> <li>Caution/warning signs should be placed at vantage points around the site</li> </ul> <p><u>Preventive Measures</u></p> <ul style="list-style-type: none"> <li>The terminal operator will prepare comprehensive maintenance programme on commencement of operations to put in place measures to avert any serious breakdowns or failures. The required maintenance for the systems will include among others:</li> <li>Environmental incident/accident investigation;</li> <li>Routine equipment maintenance/inspection schedule;</li> <li>Annual equipment inspection and maintenance record;</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>○ Procedure for pre-arranged repair service;</li> <li>○ Procedure for preventive maintenance; and</li> <li>○ Regular calibration of equipment.</li> <li>○ The following safety precautions will be implemented to minimise danger of electrocution at the substation:</li> <li>○ As much as possible avoid working on live electrical parts except when de-energizing the equipment creates additional hazards or when the equipment must be energized to allow for testing that can only be performed live.</li> <li>○ Permit to work system will also be implemented for hot works, electrical works and work at height.</li> <li>○ Prior to initiation of hot works, it will be checked that there is no flammable material, gas or dry woodwork which could catch fire; and that surfaces which have been in contact with hydrocarbons or toxic substances are completely clean.</li> <li>○ Ensure that all staff working on live equipment or lines will be without conductive apparel (watches, bracelets, rings, key chains, necklaces, zippers, cloth with conductive thread, etc.)</li> <li>○ Provide barricades and signage for all live electrical equipment</li> </ul> <p><u>Emergency Provisions</u></p> <ul style="list-style-type: none"> <li>○ The terminal operators will implement its emergency response plan (to be developed from the framework plan provided in section 11). The plan which will incorporate the emergency response plan of GPHA will handle all emergency situations including fire, mechanical failures etc. that will arise from operations to minimize any hazards to humans and the environment. Management will ensure a triennial review of the plan.</li> </ul> <p><u>Housekeeping</u></p> <ul style="list-style-type: none"> <li>○ Good housekeeping practices will be an integral part of ports operations to maintain a well laid out working space and avert accidents resulting from slippage, fires from torn electrical wires, cobwebs etc.</li> </ul>
Public Health, Safety and security	Port Users, Local communities, General Public	<ul style="list-style-type: none"> <li>● The design of the facilities has incorporated adequate safety and security considerations as provided in Section 3 (project description), and the operations of the terminal will incorporate a scheduled inspection, monitoring and maintenance regime to avoid accidents.</li> <li>● Tema LNG Terminal Company will collaborate with GPHA security personnel to maintain security of the facilities within the Port environment to ensure that only authorised persons have access to the facilities.</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>• Tema LNG Terminal will engage private security firms and also involve key local community members in maintaining security of the facilities.</li> <li>• The security firm and the key community members will be hired and trained to comply with IFC PS4 requirements. The security people will also be trained to respect human rights of the local people to avoid conflicts and human right abuses.</li> <li>• Will define a protocol for community reporting of observed incidents (e.g. sight, smell or sound of pipeline leaks and procedures for community grievance redress mechanism.</li> <li>• Will identify emergency scenarios and develop emergency preparedness and response plans with allocation of responsibilities to local communities and authorities, (where appropriate)</li> <li>• Will continue safety awareness and education programs for impacted communities.</li> <li>• Will develop clear guidelines as to what level of public access and activity along the RoW is acceptable for maintaining pipeline safety and integrity, and ensure that this is enforced to help avoid encroachment and other potentially dangerous activities.</li> <li>• Will carry out community awareness /sensitization on the above guidelines to be developed regarding public access/use restrictions and safety. This will prevent encroachment of Right of Way over time with potential to compromise safety of pipeline and safety of people in the event of accident.</li> <li>• Will organise, in collaboration with the respective Tema Metropolitan Assemblies and the GPHA Port Health Department, awareness creation seminars and educational programmes for all workers and the general public on the behavioural changes required to prevent the spread of HIV/AIDS and other STDs.</li> </ul>
Accidental Events and impacts on nearby properties, marine/terrestrial ecology	Port Users, Valco, Gridco, GPHA, GPMS, WAPCo, Local communities	<ul style="list-style-type: none"> <li>• The design of the facilities has incorporated adequate safety and security considerations as provided in Section 3 (project description) to minimize potential accidents.</li> <li>• Tema LNG will develop and implement an emergency preparedness and response plan in collaboration with relevant stakeholders including GPHA, GPMS, Valco, Gridco, and WAPCo as appropriate.</li> </ul>
Introduction of Invasive Marine Pest Species	Marine water	<p><u>Ballast water</u></p> <ul style="list-style-type: none"> <li>• Ensure extensive dissemination of information on Ballast water management as prescribed in the International Convention for the Control and Management of Ships Ballast Water and Sediments.</li> </ul> <p><u>Biofouling</u></p> <p>Training and education of ships masters and crews regarding the risks associated with biofouling transference of marine pests and procedures of minimising risk such as:</p> <ul style="list-style-type: none"> <li>• Using anti-fouling systems appropriate to a ship hull and activity</li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>• Applying appropriate operational management practices to reduce the development of biofouling (e.g. maintaining seawater intake system cleaning)</li> <li>• Maintaining a biofouling management plan and record book to identify procedures prescriptive to each ship regarding biofouling management and to maintain records of procedures and measures being applied for each ship's biofouling management</li> <li>• Ensuring ship maintenance (e.g. of the anti-fouling system or other vessel components where biofouling accumulates) is completed on an appropriate life cycle to minimize growth of biofouling</li> <li>• Where in-water inspection of ships is required, consider whether targeted maintenance of areas where biofouling accumulates is appropriate. Risks associated with environmental harm from in water cleaning are acknowledged by the biofouling guidelines and a number of measures to reduce risk of harm are identified including completion of risk assessments, avoidance of cleaning where harm is likely</li> <li>• Ensure effective dissemination of information of relevance to biofouling management to ensure appropriate biofouling management systems are implemented by all vessels</li> </ul>
General Disturbance of Port Operations	Port users	<ul style="list-style-type: none"> <li>• The extension of the breakwater will correspondingly shift the turn further away from the harbour entrance, thus creating a greater distance between the LNG facility and the turn for moving vessels.</li> <li>• During STS transfer to FSU, passing vessels should as much as possible aim to maximize clearance of the LNGC. That would imply a safe clearance of at least 100-150 m from the traffic lane.</li> </ul>
Sustainability of the Tema LNG Terminal Project	GPHA/Ministry of Transport	<ul style="list-style-type: none"> <li>• The Management of Tema LNG Terminal will seek to operate profitably by implementing a system to collect appropriate user charges to cover the running and maintenance cost of its facilities.</li> <li>• The terminal will develop and implement an emergency response plan to handle all emergencies including fire, and oil spills that will arise from all its operations to minimize any hazards to humans and the environment. Management will ensure a triennial review of the plan.</li> <li>• A comprehensive maintenance programme will be put in place to avert any serious breakdowns or failures or accidents. The required maintenance for the systems will include among others: <ul style="list-style-type: none"> <li>○ Environmental incident/accident investigation;</li> <li>○ Carry out mock oil spill response drills</li> <li>○ Routine equipment maintenance/inspection schedule;</li> <li>○ Annual equipment inspection and maintenance record;</li> <li>○ Procedure for pre-arranged repair service;</li> <li>○ Procedure for preventive maintenance;</li> <li>○ Procedures for handling materials; and</li> </ul> </li> </ul>

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures
		<ul style="list-style-type: none"> <li>○ Regular calibration of equipment;</li> <li>• Coordinate with other agencies and organizations to provide technical assistance to inform activities and programs that can support the project</li> <li>• Ensure resource use efficiency influencing supply chain sustainability</li> <li>• Adopt a comprehensive monitoring plan to ensure effective implementation of mitigation and management measures.</li> </ul>
<b>Decommissioning Phase</b>		
<i>Post construction phase</i>		
Loss of jobs after preparatory and construction phases	Preparatory and construction phase workers	<p>All workers to be engaged by the EPC contractor will be informed that their engagement is temporary and ends after construction, and that their engagement is not a guarantee for reemployment during the operational phase.</p> <p>The contracts for all consultants to be involved during the preparatory and construction phase will clearly indicate the duration of their assignment.</p>
Occupational health and safety	(Similar to construction phase)	(apply mitigation measures for construction phase)
Public safety and traffic issues	(Similar to construction phase)	(apply mitigation measures for construction phase)
Marine water contamination	(Similar to construction phase)	(apply mitigation measures for construction phase)
Waste disposal	(Similar to construction phase)	(apply mitigation measures for construction phase)
Air pollution	(Similar to construction phase)	(apply mitigation measures for construction phase)
<i>Post operation phase</i>		
Loss of job	Operation and decommissioning phase workers	A retrenchment policy will be developed and included in the condition of service/service agreement for workers for them to know what they will be entitled to during retrenchment and closure of the affected company/ operator.
All other impacts	Bio-physical and social environment	(a detailed EIA will be carried out for approval and permitting by the operator before final decommissioning of both offshore and onshore facilities to confirm all impacts and appropriate mitigation measures to be implemented)

## Conclusion

The implementation of the project will provide competitively priced LNG from the global market to displace expensive liquid fuels currently constraining the electrical generation and industrial sectors. In addition to direct cost benefits, the project will also improve the diversity fuel supply sources, improve environmental performance (lowest emission fossil fuel) and improve security of supply for natural gas to Ghana

Generally, stakeholders are willing to participate in project implementation where necessary to help ensure that the project is implemented in an environmentally friendly and socially acceptable manner to the benefit of the country. The local communities however expect that appropriate measures will be put in place to address the potential risk especially explosion identified during the engagement.



## 1.0 INTRODUCTION

### 1.1 Background

Tema LNG Terminal Company Limited proposes to undertake the Tema LNG Terminal Ghana Project to meet the gas supply needs for thermal power generation in the Tema industrial area. The company is a registered limited liability company in Ghana with its headquarters in Accra.



The Tema LNG Terminal Ghana project will be a floating liquefied natural gas import facility to receive, store and regasify LNG and to deliver natural gas into the existing Tema gas network. It comprises the following:

- **Dredging:** To assure enough under keel clearance during the approach and berthing of the LNG Carrier, the channel and turning circle will be dredged to depths between -15 m CD or -16m mCD.
- **Breakwater construction:** Extension of the existing outer breakwater by about 800 m;
- **Mooring facilities:** To provide safe and permanent mooring of the Floating Liquefied Natural Gas (LNG) infrastructure, 4 (ea) mooring and breasting dolphins will be constructed in the protected waters behind the breakwater;
- **Floating infrastructure:** Installation and operation of the floating storage unit (FSU) and floating regasification unit (FRU) with a combined storage capacity of about 145,000 m<sup>3</sup> to 160,000 m<sup>3</sup>. The nominal gas send out capacity of the project will be 1.7 million tons per annum (MTPA) of Liquefied Natural Gas (LNG) about 230 MMSCFD (million standard cubic feet per day of natural gas);
- **Natural Gas Pipeline:** Construction and operation of an 8 km pipeline, submerged across the main port channel and connecting into the existing Volta River Authority header station, approximately 5km north-east of the Tema port, via an onshore pipeline along the existing oil and LPG (Liquefied Petroleum Gas) pipeline right of ways as well as GRIDCo (Ghana Grid Company Ltd) right of ways on the VALCO (Volta Aluminium Company Limited) property.

The LNG supplier will deliver LNG in standard sized LNG carriers (“LNGCs”) to the FSU, which acts as the primary LNG storage. The LNG is then periodically transferred to the FRU, which has secondary LNG storage, from where it is regasified and delivered to GNPC at the tie-in point at the existing Volta River Authority (VRA) header station. The project operation is indicated in the flowchart in **Figure 1-1**.

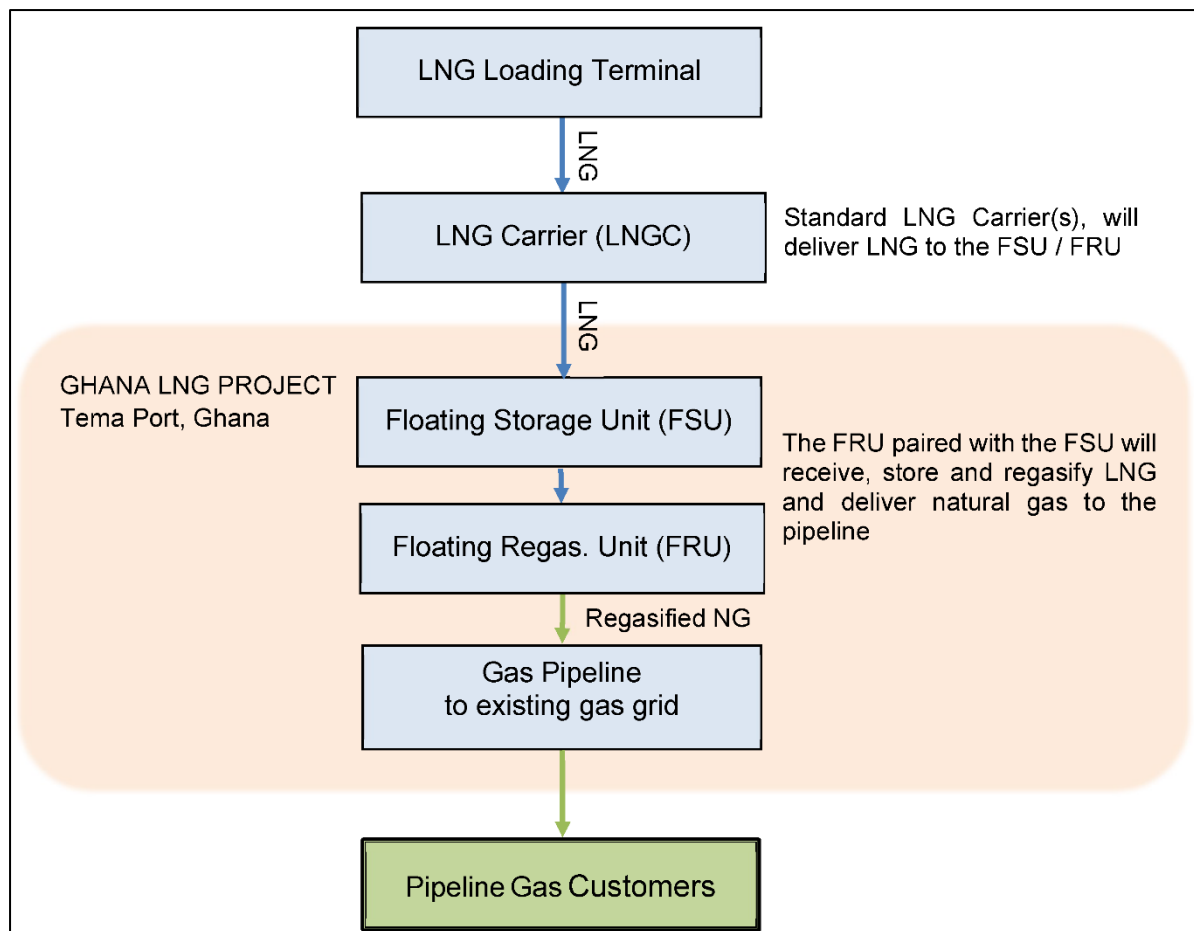


Figure 1-1: Project flow chart

The nominal gas send-out capacity of the project will be 1.7 MTPA (million tons per annum of LNG) or about 230 MMSCFD (million standard cubic feet per day of natural gas). The combined storage capacity of the FSU and FRU will be between 150,000 m<sup>3</sup> to 160,000 m<sup>3</sup>, approximately equivalent to two weeks of gas demand.

SAL Consult Limited, an environmental & water consulting firm based in Accra, Ghana was contracted [REDACTED] to prepare the Environmental and Social Impact Assessment (ESIA) Report to the Ghana Environmental Protection Agency (EPA) to facilitate the acquisition of an environmental permit from the Agency for project implementation.

In keeping with the Environmental Assessment Regulations 1999, LI 1652, Tema LNG Terminal Company Limited successfully registered the project with the Environmental Protection Agency (EPA) by completion of the prescribed EPA Registration Form EA2. The EPA, in a response letter referenced CE: 6425/01 of 18 January 2018 (see **Annex 1-1**) confirmed that the project falls in a category for which an Environmental Impact Assessment (EIA) is required, and thus requested the preparation of a Scoping Report as per the provisions of the Legislative Instrument (LI) 1652. The scoping report was duly submitted to the EPA, and the Agency's review comments (dated 26 March 2018 and referenced CE: 6425/01/07) is provided as **Annex 1-2**.

A draft Environmental Impact Statement (EIS) was submitted to the EPA on July 10, 2018, and the Agency's review comments on the draft EIS are provided in **Annex 1-3**. A final EIS, which

addressed the EPA review comments on the draft EIS (see **Annex 1-4** for relevant responses and sections in the final EIS documents where the EPA comments have been addressed), was submitted to the EPA in August 2018 for issuance of an environmental permit for project implementation.

The Safeguards team at the African Development Bank (AfDB), one of the project lenders, reviewed the August 2018 final ESIA report prior to the Environment & Social (E&S) Due Diligence visit to the Project site on 7-8 March 2019 and proposed a few changes intended to ensure that the ESIA reflects the AfDB's E&S safeguards and standards. This updated ESIA therefore complies with AfDB's Operational Safeguards.

In Ghana and for the EPA, an EIA also means an ESIA because the law defines 'environment' to encompass the biophysical as well as the social/human environment. The abbreviations EIA and ESIA used in this document refer to the same assessment.

## **1.2 Rationale for Proposed Project**

The current natural gas demand in Ghana is not being met by indigenous gas production nor sufficiently or reliably served by the West African Gas Pipeline. Hence, industrial customers and power plants are forced to use expensive liquid fuels. Adequate gas supply will facilitate the ongoing Electricity Grid Expansion Programme and provide an adequate reserve margin. Power is currently the single largest constraint on Ghana's ambition to achieve sustained high levels of Gross Domestic Product (GDP) growth to consolidate its middle-income status. Internationally, economic considerations and environmental credentials make natural gas the fossil fuel of choice for base load power generation. This also holds true for Ghana where natural gas, if reliably available and without requiring subsidized pricing would:

- a) be cheaper than the liquid fuel alternatives;
- b) bring the added advantages of improved operational efficiencies; and
- c) bring significant environmental benefits to the power generation sector in Ghana, since it is the lowest emission fossil fuel.

An LNG import facility that ties into the existing pipeline grid is the most feasible and reliable source of natural gas.

## **1.3 Aim/Purpose of the ESIA Study**

The purpose of the ESIA study is to identify and address possible direct, indirect and cumulative significant adverse environmental and social impacts to arise from the proposed project for acceptability and sustainability.

The study aims at satisfying both legal and institutional obligations specified under the Environmental Protection Agency Act 1994 (Act 490), and the Environmental Assessment Regulations 1999 (LI 1652).

This ESIA has also been developed as part of Tema LNG Terminal Company's commitment to address the requirements of the AfDB's Operational Safeguards and the IFC Performance Standards. The project is also being developed according to the Equator Principles, which apply

the IFC Performance Standards and the World Bank Group Environmental Health and Safety Guidelines and particularly to support the identification of project environmental and social impacts in comparison with potential benefits and the requirements for mitigation.

#### **1.4 Scope of Work for the ESIA Study**

The scope of work for the ESIA study is to among other things:

- Provide technical description of the proposed project and identify all activities of environmental/social concern;
- Establish the existing environmental and socio-economic baseline conditions of the project area of influence;
- Predict and examine all the significant environmental impacts on the surrounding communities and the general environment during implementation of the proposed project and advise on appropriate mitigation and abatement measures against potential adverse impacts;
- Provide a monitoring program for predicted impacts;
- Provide a Provisional Environmental Management Plan (PEMP);
- Document the socio-economic and cultural advantages and disadvantages associated with the proposed project for stakeholders and interested groups to make an informed decision on the level of environmental compromise and permitting.
- Provide framework to guide the development of an emergency response plan for the project;
- Provide guidelines to be followed in the event of decommissioning; and
- Carry out public consultations and include the outcome in the ESIA report with arrangements to address stakeholder concerns.

#### **1.5 Approach/Methodology for the ESIA Study**

The approach and methodology adopted for the study include:

- Field inspections and trekking;
- Review of available literature;
- Specialists studies for baseline information;
- Stakeholder Consultations; and
- Data analysis and reporting.

##### ***1.5.1 Field Inspections***

Reconnaissance surveys of the proposed project sites were carried out in January 2018 to confirm the project's area of influence as well as the environmental and social issues and conditions to be affected or are likely to develop from the implementation of the proposed project. This included the sites for the breakwater extension, 8 km RoW for proposed pipeline and the VRA Header station.

In addition to survey carried out by SAL Consult Limited, there was also a joint survey of the proposed pipeline route with the project proponent, project surveyors (AECOM), representative from VALCO, a representative from the Tema Development Corporation and SAL Consult Limited on 22 January 2018.

Further field studies were carried out between February and April 2018 to identify the potential project affected persons, as well as confirm the project's area of influence, key stakeholders, as well as environmental and social issues and conditions to be affected or are likely to develop from the implementation of the proposed project.

### 1.5.2 Review of Available Literature

The major documents reviewed include:

- Documents from the project implementers on scope of the project;
  - Attachments to application for provisional license from the Energy Commission of Ghana (version 02 January 2018)
  - Ghana LNG Project, GPHA Technical Overview, October 2017
  - Tema Port LNG Project: Gas Pipeline –Preliminary Routing Study, December 2017
- Ghana Gas Master Plan, Ministry of Petroleum, June 2016;
- Final Environmental and Social Impact Statement for the Port Infrastructure Development, Port of Tema, 2015;
- IFC Performance Standards and the Equator Principles;
- World Bank Group Environmental Health and Safety Guidelines;
  - IFC General EHS Guidelines (April 2007);
  - World Bank Group EHS Guidelines for Liquefied Natural Gas (LNG) Facilities (2017);
  - World Bank Group EHS Guidelines for Ports and Harbours (2017)
  - World Bank Group EHS Guidelines for Onshore /Offshore Oil & Gas Development (2015)
- AfDB Operational Safeguards;
- District Analytical Report, Tema Metropolitan Assembly, 2010 Population and Housing Census, October 2014; and
- District Analytical Report, Kpone Katamanso District Assembly, 2010 Population and Housing Census, October 2014.

### 1.5.3 Specialist Studies for Baseline Information

Specialist Studies conducted to provide additional information on the current environmental and socio-economic baseline to identify key issues and help assess potential impacts of the project. The scope of these specialist studies is presented in **Table 1-1** below.

**Table 1-1: Overview of Scope of Specialist Studies**

Resource	Description
Air Quality	<p>SAL collected baseline air quality information for 24 hours for all parameters except CO which was for 8 hours at the following sampling sites along the proposed pipeline route as well as the oil jetty at the Port of Tema. The selected sampling sites are as follows:</p> <ul style="list-style-type: none"> <li>• Bankuman community;</li> <li>• VALCO Clinic;</li> <li>• Abonkor community; and</li> <li>• Oil jetty at the Port of Tema.</li> </ul> <p>The parameters of interest were total suspended particles (TSP), PM<sub>10</sub> (Inhalable particles, diameter &lt;10 µm), Sulphur oxides (SO<sub>x</sub>), Nitrogen oxides (NO<sub>x</sub>), Carbon monoxide (CO) and Volatile</p>

Resource	Description
	<p>Organic Compounds (VOCs). Suspended particulate matter monitoring were measured with MiniVol™ TAS portable air samplers at a flow rate of 5L/Min. Gaseous emissions monitoring was measured with Accuro active pumps with graduated draeger/diffusion tubes.</p> <p>VOC monitoring was conducted with the AQM60 and series 500. The equipment uses photo-ionizing detectors (PID) as a smart technology to sense or measure the volatile organic compounds in the ambient Environment.</p>
Noise	<p>Baseline noise levels were measured simultaneously with air quality at the identified locations. The noise level parameters measured are as follows:</p> <ul style="list-style-type: none"> <li>• LAF<sub>eq</sub> (equivalent sound level, with A-weighted frequency response and Fast time constant)</li> <li>• LAF<sub>90</sub> (noise level exceeded for 90% of the measurement period, with A-weighted frequency response and Fast time constant)</li> <li>• LAF<sub>min</sub> (minimum sound level with A-weighted frequency response and Fast time constant)</li> <li>• LAF<sub>max</sub> (maximum sound level with A-weighted frequency response and Fast time constant)</li> </ul> <p>The equipment utilized is 3M (SoundPro) high precision integrated sound level meter (Type 2), mounted on a tripod stand at a height of about 1.5 meters above ground.</p>
Terrestrial Ecology and Land Use	<ul style="list-style-type: none"> <li>• conducted detailed desk and site surveys of the terrestrial habitats encompassing vegetation, birds, mammals, reptiles, and amphibians in the vicinity of the proposed disposal sites,</li> <li>• determined the habitat structure of the whole site,</li> <li>• evaluated the habitat in the context of its uniqueness within the local area, and</li> <li>• identified any species of particular ecological value.</li> <li>• determine the occurrence, distribution, relative abundance and diversity of terrestrial invertebrates (mainly insects) and vertebrates inhabiting the proposed sites</li> </ul>
Marine	<ul style="list-style-type: none"> <li>• Conducted studies to collect primary data (marine baseline survey). Marine life studied included phytoplankton, macrophytes, macro- invertebrates, and fishes, crustaceans and amphibians. Methods such as scooping, coring, stonewashing, and net sweeping nearshore was employed.</li> <li>• Reviewed secondary data sourced from existing studies in the Project Area. <ul style="list-style-type: none"> <li>○ Collected secondary data to generate aquatic flora and fauna data with more attention to diversity, community structure and populations.</li> <li>○ Marine water quality (pH, Temperature, TPH, Turbidity, COD, BOD, TSS, Total N, Total P, DO, Chlorophyll “A”, Oil/Grease, Lead, Cadmium, Chromium, Mercury, Arsenic, Total coliform, Faecal coliform)</li> <li>○ Seabed sediment quality</li> <li>○ Met ocean (wind, wave and climate) data.</li> </ul> </li> </ul>
Cultural and Heritage Survey	<ul style="list-style-type: none"> <li>• Conducted consultations with project affected communities to obtain information on possible existing heritage, cultural and archaeological significant sites and resources;</li> <li>• Field identification and recording on heritage forms, photographs and coordinates of the affected sites or resources;</li> <li>• Synthesizing and analysing collected field data in a report.</li> </ul>
Socio-Economic Baseline	<ul style="list-style-type: none"> <li>• <u>Desktop studies</u> reviewed available data from the National Population and Housing Census reports, District Medium Term Development Plan, existing EIA reports and other socio-economic research/reports for the Project Area.</li> <li>• Land ownership, land tenure and land use in the project area</li> <li>• <u>Key informant interviews and focus groups</u> with local leaders (government, traditional leaders), key workers (VALCO head office and clinic). These was inclusive of men, women, and youth, land users, and land owners.</li> <li>• Socio-economic analysis for socio-economic baseline.</li> <li>• land ownership, land tenure and land use have been defined in maps and described qualitative.</li> </ul>

#### ***1.5.4 Stakeholder Identification and Consultations***

The project proponents have been engaged to understand the project scope, design and implementation and to obtain relevant project documents.

Extensive consultations have been held with key stakeholders and interested groups as part of information gathering process on environmental and socio-economic issues by means of one-on-one interviews and stakeholder consultation meetings. These include relevant Government Institutions and regulatory bodies, the project beneficiaries and engineers, local political authorities and project affected persons/interest groups.

The stakeholder engagements also assisted in appreciating the role of the identified stakeholders in the successful implementation of the proposed project. Details of the stakeholder consultations are provided under **Chapter 6**.

#### ***1.5.5 Land Use Studies***

Methods employed included:

- Field observations of existing properties at the project area; and
- Use of the 1:50,000 topographical maps and satellite images of the project area to demarcate the project area of influence.

#### ***1.5.6 Socio-economic Studies***

The methodology used for the studies included:

- Observational studies;
- Interviews with traditional leaders and members of Abonkor, Manhean and Bankuman communities;
- Interviews with the Tema Metropolitan Assembly;
- Review of District Profiles for the Tema Metropolitan Assembly; and
- Review of district information from the 2010 Population and Housing Census.

#### ***1.5.7 Data Analysis and Reporting***

The data obtained from the desk and field studies were analysed and have been presented in this Environmental Impact Statement (EIS). This updated EIS is in line with the Ghana EPA format and AfDB/IFC requirements.

## 2.0 POLICY, LEGISLATIVE AND ADMINISTRATIVE FRAMEWORK

The ESIA process is developed in line with the national and international regulations and standards, including those of International Finance Institutions (IFI). The relevant national and sector policies and plans, national legal and institutional frameworks, international conventions, African Development Bank Operational Safeguards, IFC Performance Standards, and national environmental quality guidelines to guide the implementation of the Tema LNG Terminal Company Limited are described in this chapter.

### 2.1 National and Sector Policies and Plans

The national and sector policies and plans identified to be relevant to the proposed Tema LNG Terminal Ghana Project include the following:

- National Energy Policy, 2010;
- Health, Safety and Environmental Policy for the Energy Sector, 2016;
- Ghana Gas Master Plan, 2016;
- National Land Policy, 1999;
- Strategic National Energy Plan, 2006-2020;
- National Environmental Policy, 2012;
- National Climate Change Policy, 2013; and
- Ghana Shared Growth and Development Agenda (GSDAI), 2015.

The key compliance requirements for the policies listed above are summarised in **Table 2-1**.

**Table 2-1: Summary of National and Sector Policies and Plans**

<i><b>Policy Framework</b></i>	<i><b>Summary of core requirements</b></i>	<i><b>Relationship to proposed project</b></i>
National Energy Policy, 2010	<p>This National Energy Policy of February 2010 is intended to guide the development and management of Ghana's energy sector, especially the emerging oil and gas sector, following the discovery in commercial quantities of petroleum resources in 2007. It outlines the energy sector goals, challenges and actions. Within the context of energy sector vision, the goal of the energy sector is to make energy services universally accessible and readily available in an environmentally sustainable manner.</p> <p>In order to secure future fuel supplies, efforts will be made to increase and diversify the fuel mix in power generation. The following policy action will be pursued: <i>"Infrastructure for new fuel supply sources"</i>: Encourage public-private partnership financing of natural gas infrastructure".</p>	The proposed project is in line with the policy's objective to diversify the fuel mix in power generation.
Health, Safety and Environmental Policy for the Energy Sector, 2016	The policy describes the elements necessary to develop, implement and maintain a high level of safety in all energy sector activities. The policy develops relevant regulations and standards, which will ensure that operators take into account relevant information about hazards, environmental effects, safety and security threats to their operations. To achieve this outcome, regulators are to ensure that, energy sector activities are carried out in an efficient manner that strives for continuous improvement of HSSE performance	The proposed project is in line with the policy's objective to ensure that there is minimal harm to property, the environment and



<b><i>Policy Framework</i></b>	<b><i>Summary of core requirements</i></b>	<b><i>Relationship to proposed project</i></b>
		the national reputation while implanting the project.
Ghana Gas Master Plan, 2016	<p>The primary objective of the GMP is to develop a medium to long-term strategy for infrastructure development priorities that will contribute to the development of the country's natural gas resources and security of energy supply. The GMP and related pricing policy options offer guidance for the Government of Ghana (GoG) and other stakeholders within the energy sector by providing the following outputs:</p> <ul style="list-style-type: none"> <li>• Proposed gas allocation plans across domestic power and industrial sectors and exports (if feasible) on the basis of economic value added and the available supply</li> <li>• A medium to long-term infrastructure plan that will ensure security of supply and be in line with the proposed gas allocation plans</li> <li>• Recommendation on a suitable gas pricing policy which ensures upstream production as well as security of demand</li> <li>• Recommendation on a suitable institutional framework to be in line with international best practice and promote development of the sector</li> <li>• A review of the regulatory framework analysing the major points of deficiency for gas sector development.</li> </ul>	The proposed project is in accord with the objectives of the plan.
National Land Policy, 1999	<p>The National Land Policy provides for the protection of water bodies and the environment in the long-term national interest under any form of land usage be for human settlements, industry and commerce, agriculture, forestry and mining. Key aspects of Section 4.4 (Ensuring Sustainable Land Use) of the Policy relevant to the Project are provided below:</p> <ul style="list-style-type: none"> <li>(a) The use of any land in Ghana for sustainable development, the protection of water bodies and the environment and any other socioeconomic activity will be determined through national land use planning guidelines based on sustainable principles in the long term national interest.</li> <li>(b) Land categories outside Ghana's permanent forest and wildlife estates are available for such uses as agriculture, timber, mining and other extractive industries, and human settlement within the context of a national land use plan.</li> <li>(i) Unless approved by the appropriate public authority, no land use change of any kind will be countenanced.</li> <li>m. All land and water resources development activities must conform to the environmental laws in the country and where Environmental Impact Assessment report is required this must be provided. Environmental protection within the 'polluter pays' principle will be enforced.</li> </ul>	The RoW of the proposed project meets the land use planning requirements for the affected land.
Strategic National Energy Plan, 2006-2020	The SNEP reiterates the sector Ministry's vision to develop an 'Energy Economy' that would ensure sustainable production, supply and distribution of high quality energy services to all sectors of the economy in an environmentally friendly manner for Ghana's future while making significant contribution to the country's export earnings. In this regard, the following ten (10) broad objectives are highlighted by the policy:	The LNG Terminal Ghana Project fulfils the vision for high quality energy services to all sectors of the

<b><i>Policy Framework</i></b>	<b><i>Summary of core requirements</i></b>	<b><i>Relationship to proposed project</i></b>
	<ul style="list-style-type: none"> <li>• Stimulate economic development by ensuring that energy plays a catalytic role in Ghana's economic development;</li> <li>• Consolidate, improve and expand existing energy infrastructure;</li> <li>• Increase access to modern energy services for poverty reduction in off-grid areas;</li> <li>• Secure and increase future energy security by diversifying sources of energy supply;</li> <li>• Accelerate the development and utilization of renewable energy and energy efficiency technologies;</li> <li>• Enhance private sector participation in energy infrastructure development and service delivery;</li> <li>• Minimize environmental impacts of energy production, supply and utilization;</li> <li>• Strengthen institutional and human resource capacity and R&amp;D in energy development;</li> <li>• Improve governance of the Energy Sector; and</li> <li>• Sustain and promote commitment to energy integration as part of economic integration of West African states.</li> </ul>	economy in an environmentally friendly manner.
National Environmental Policy, 2012	<p>The Ghana National Environmental Policy was launched in November 2012 with the vision to manage the environment in a sustainable way to benefit Ghanaian society. The objective of this policy is to promote healthy lifestyles and reduce risk factors that arise from environmental, economic, social and behavioural causes thereby promoting healthy lifestyles in a healthy environment.</p> <p>The policy notes that proper management of Ghana's resources requires that efforts should be redirected into more environmentally sustainable programmes and practices. Such programmes should protect and preserve the resource base for use by present and future generations. Assessment of the potential environmental impacts of development projects and planning in advance to mitigate or eliminate these impacts will decrease environmental costs to the economy and make more cost-effective use of the country's resources.</p> <p>The ultimate aim of the National Environmental Policy of Ghana is to improve the surroundings, living conditions and the quality of life of the entire citizenry, both present and future.</p> <p>It seeks to promote sustainable development through ensuring a balance between economic development and natural resource conservation. The policy thus makes a high quality environment a key element supporting the country's economic and social development.</p> <p><u>Specifically, the policy seeks to:</u></p> <ul style="list-style-type: none"> <li>• Maintain ecosystem and ecological processes essential for the functioning of the biosphere;</li> <li>• Ensure sound management of natural resources and the environment;</li> <li>• Adequately protect humans, animals and plants, their biological communities and habitats against harmful impacts and destructive practices, and preserve biological diversity;</li> </ul>	The proposed project must promote sustainable development by including economic, social and environmental considerations.

<b>Policy Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
	<ul style="list-style-type: none"> <li>• Guide development in accordance with quality requirements to prevent, reduce, and as far as possible, eliminate pollution nuisances;</li> <li>• Integrate environmental considerations in sectoral structural and socio-economic planning at the national, regional, district and grassroots levels;</li> <li>• Seek common solutions to environmental problems in West Africa, Africa and the world at large.</li> </ul> <p><u>Principles of the National Environmental Policy</u></p> <p>In order not to deviate from the Policy in the National Environmental Action Plan, 1991, by the then Environmental Protection Council (EPC), this strategic plan take into consideration the following principles that are consistent with the above policy:</p> <ul style="list-style-type: none"> <li>• Optimum sustainable yield in the use of resources and ecosystems;</li> <li>• Use of most cost effective means to achieve environmental objectives;</li> <li>• Use of incentives in addition to regulatory measures;</li> <li>• Delegation of decision-making and action to the most appropriate level of government;</li> <li>• Polluter pays for the cost of preventing and eliminating pollution and nuisances caused by him/her;</li> <li>• Public participation in environmental decision-making;</li> <li>• International co-operation;</li> <li>• Citizens have the right to safe, healthy environment</li> <li>• All sectors of society are responsible for ensuring a sustainable environment, viz. government, business, industry and the citizenry.</li> </ul>	
National Climate Change Policy, 2013	The National Climate Change Policy provides strategic direction and coordinates issues of climate change in Ghana. The three objectives of the Policy are (1) effective adaptation, (2) social development and (3) mitigation. To address the adaptation issues in Ghana, five thematic areas have been prioritised. These are (1) energy and infrastructure, (2) natural resources management, (3) agriculture and food security, (4) disaster preparedness and response and (5) equitable social development.	LNG is the cleanest fossil fuel source for energy generation.
Ghana Shared Growth and Development Agenda (GSDAII), 2015	The transformation agenda under the GSGDA II is expected to be aided by the development of the oil and gas industry with effective linkage to the rest of the economy. Implementation of policies will focus on addressing the critical constraints and issues in five focus areas including Protection of the Environment. The overall objective to be achieved in this focus area is to ensure that the practices in the oil and gas industry are consistent with international standards on environmental sustainability. The strategies to be adopted will include: <ul style="list-style-type: none"> <li>• developing adequate capacity of environmental and regulatory agencies;</li> <li>• strengthening the exploration and production laws to minimize environmental cost to oil and gas exploration; and</li> <li>• Strengthening the emergency preparedness to managed disasters in the oil and gas industry.</li> </ul>	The proposed project seeks to reduce to the minimum the impact of the proposed project on the environment

## 2.2 National Legal Framework

The relevant environmental laws and regulations to guide Tema LNG Terminal Company Limited through the conceptualization stage of the project to implementation, monitoring and decommissioning are summarised in **Table 2-2**.

**Table 2-2: Summary of National and Sector Legal Frameworks**

<i>Legal Framework</i>	<i>Summary of core requirements</i>	<i>Relationship to proposed project</i>
<b>Sector Regulations</b>		
Energy Commission Act 1997, Act 541	The Energy Commission Act 1997 (Act 541) provide for its functions relating to the regulations, management, development and utilisation of energy resources, provide for the granting of licences for the transmission, wholesale supply, distribution and sale of electricity and natural gas, refining, storage bulk distribution marketing and sale of petroleum products and to provide for related matters.	Tema LNG Terminal Company has applied and obtained a provisional license and siting permit from the Commission and is in the process of applying for a construction permit
National Petroleum Authority (NPA) Act 2005, Act 691	The NPA Act 2005, Act 691 empowers the authority to regulate, oversee and monitor activities in the petroleum downstream community; To establish a unified petroleum price fund taking cognisance of the prescribed petroleum pricing formula; and to provide for related purposes.	The Tema LNG Terminal Company will obtain the relevant licence from NPA. The importation of petroleum products including LNG into the country is done under the Licence of NPA.
Natural Gas Pipeline Safety (Construction, Operation and Maintenance) Regulations, 2012, LI 2189	<p>The LI 2189 provides consistent, uniform standards and procedures for the safe construction, operation and maintenance of natural gas facilities throughout the country. The Regulations prescribe the minimum safety standard requirements for:</p> <ul style="list-style-type: none"> <li>the construction, operation and maintenance of pipeline facilities for the transportation of natural gas including transportation within the territorial waters and exclusive economic zone of the Republic;</li> <li>the selection and qualification of pipes and components of the pipeline;</li> <li>the design of pipelines;</li> <li>the welding of steel materials in pipelines;</li> <li>the joining of materials in pipelines other than by welding and outside the course of the manufacture of pipes or pipeline components;</li> <li>the installation of customer meters, service regulators, service lines, service line valves and service line connections to the mains;</li> <li>the protection of metallic pipelines from external, internal and atmospheric corrosion;</li> <li>testing of pipelines;</li> <li>uprating of pipelines;</li> </ul>	The proposed project will incorporate the standards and procedures in the project implementation.

<b>Legal Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
	<ul style="list-style-type: none"> <li>persons qualified to perform tasks on a pipeline facility;</li> <li>integrity management programmes on pipelines; and</li> <li>the abandonment or decommissioning of pipeline facilities.</li> </ul>	
<b>Environmental assessment</b>		
Environmental Protection Agency (EPA) Act 1994, Act 490	The EPA was established under the Environmental Protection Agency Act (Act 490 of 1994) as the leading public body responsible for the protection and improvement of the environment in Ghana. It is responsible for enforcing environmental policy and legislation, prescribing standards and guidelines, inspecting and regulating businesses and responding to emergency incidents. It is responsible for issuing environmental permits and pollution abatement notices for controlling waste discharges, emissions, deposits or others sources of pollutants and issuing directives, procedures or warnings for the purpose of controlling noise. The EPA has the authority to require an EIA and is responsible for ensuring compliance with EIA procedures.	The proposed project is being developed in accordance with Environmental Assessment (EA) procedures for approval by the EPA.
Environmental Assessment Regulations 1999, LI 1652	<p>The Environmental Assessment Regulations 1999 (LI 1652) enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to the commencement of the project. The regulations require that “No environmental permit shall be issued by the Agency for any of the undertakings mentioned in Schedule 2 to these Regulations unless there is submitted by the responsible person to the Agency, an environmental impact assessment in accordance with these Regulations in respect of the undertaking”.</p> <p><u>Application for environmental permit</u></p> <p>4. (1) A person required under regulation 1 or 2 to register an undertaking and obtain an environmental permit shall submit to the Agency an application in such form as the Agency shall determine.</p> <p>2. There shall be paid for the application such fee, as the Agency shall determine.</p>	The proposed project falls in Schedule 2 and therefore an EIA is mandatory, as per the regulations.
Fees and Charges (Amendment) Instrument 2015 (L.I. 2228)	The Fees and Charges (Amendment) Instrument 2015 (L.I. 2228) provides comprehensive rates, fees and charges collectable by Ministries, Department and Agencies (MDAs) for goods and services delivered to the public. The LI 2228, therefore, repeals the Environmental Assessment Regulations (Amendment) 2002 (LI 1703) which originally stipulated the fees and charges to be paid by proponents with respect to Environmental Permits and Certificates.	All stipulated fees and charges shall be Paid in order to obtain permit from the EPA.
<b>Environmental Protection</b>		
Ghana Investment Promotion Centre Act 1994, Act 478	The Ghana Investment Promotion Centre Act 1994 (Act 478) requires that every investor wishing to invest in the country must in its appraisal of proposed investment	Tema LNG Terminal Company acknowledges the proposed project has

<b><i>Legal Framework</i></b>	<b><i>Summary of core requirements</i></b>	<b><i>Relationship to proposed project</i></b>
	projects or enterprises, "...have regard to any effect the enterprise is likely to have on the environment and measures proposed for the prevention and control of any harmful effects to the environment...".	environmental impacts, and mitigation measures have been proposed in the ESIA to address the impacts.
Water Resources Commission Act 1996 (Act 522)	<p>The Water Resources Commission Act 1996 (Act 522) establishes and mandates the Water Resources Commission as the sole agent responsible for the regulation and management and the utilisation of water resources and for the co-ordination of any policy in relation to them.</p> <p>Section 13 prohibits the use of water (divert, dam, store, abstract or use water resources or construct or maintain any works for the use of water resources) without authority. Section 16 empowers the Commission to grant Water Rights (water use permits) to prospective users. The Act states under Section 24 that, except in accordance with the provisions of this Act or with the approval of the Environmental Protection Agency, any person who pollutes or fouls a water resource beyond the level that the EPA may prescribe, commits an offence and is liable on conviction to a fine or a term of imprisonment or both.</p>	In the event water abstraction will be necessary or diversion of river is necessary during crossing, a permit will be obtained from the WRC.
Water Use Regulation (WUR) 2001, LI 1692	<p>The Water Use Regulations, 2001 (LI 1692) list such activities for which water use permit is required and this includes domestic, commercial, municipal, industrial water use among others. The Regulations also prescribe the raw water charges and processing fees to be paid by prospective water users with respect to the water use permits. The Water Use Regulations 2001, LI 1692 prohibits the use of water resources without authority from the Water Resources Commission.</p> <p>The Act provides under section 16 for any person to apply to the Commission in writing for the grant of water right. The Regulations also prescribe the raw water charges and processing fees to be paid by prospective water users with respect to the water use permits. The Commission is also mandated to request for evidence that an environmental impact assessment or an environmental management plan has been approved by the EPA before issuance of the Water Use Permit.</p>	Any utilization of raw water resources for the proposed project will require a water use permit
Ghana Meteorological Agency Act 2004, Act 687	This ACT establishes the Ghana Meteorological Agency, which replaces the Meteorological Services Department. The Agency is to provide meteorological information, advice, and warnings for the benefit of agriculture, civil and military aviation among others to mitigate the effects of natural disasters such as floods, storms and droughts on socio-economic development and projects. The Agency is to provide the accurate data on climatic data which are relevant for establishing climate change trends.	Climate information will be obtained from the Agency to guide project implementation.



<b>Legal Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
Hazardous and Electronic Waste control and Management Act 2016 (Act 917) and Hazardous, Electronic and other waste (Classification), Control and Management Regulations 2016, LI2250	The hazardous and Electronic waste and control ACT 2016 (ACT 917) provides list of hazardous and other waste. It also provides control, management and disposal of electrical and electronic waste. Hazardous waste generally refers to waste with properties that makes it potentially dangerous or harmful to human health or the environment and they include liquids, solids or gases which cannot be treated or disposed of by common means. The Act will also ensure that harmful elements associated with hazardous and other waste products are captured and processed safely to preserve critical ecological components such as the soil, groundwater, flora and fauna	The ACT will guide the project on hazardous and electronic waste management and disposal during project implementation.
<b>Ports and Marine Environment</b>		
Ghana Maritime Authority Act, 2002	The Ghana Maritime Authority Act 2002 (Act 630) has been enacted establishing the Ghana Maritime Authority, which will advise Government on maritime matters and assist the Ministry of Transport (MOT) to formulate policies, monitor, regulate and coordinate activities and programmes of the various sub-sectors in the maritime industry.	The GMA will monitor, regulate and coordinate activities programmed for the project implementation at the Port.
Ghana Ports and Harbours Authority Law, 1986	The Ghana Ports and Harbours Authority Law 1986, PNDC Law 160 mandates the Ghana Ports and Harbours Authority (GPHA) to plan, build, develop, manage, maintain, operate, and control Ports in Ghana. The law enjoins the GPHA among other functions to: <ul style="list-style-type: none"> <li>• provide in a port facilities as appear to it to be necessary for the efficient and proper operation of the port;</li> <li>• maintain the port facilities and extend and enlarge any such facilities as it shall deem fit;</li> <li>• regulate the use of any port and of the port facilities; and</li> <li>• maintain and deepen as necessary the approaches to, and the navigable waters within and outside the limits of any port, and also maintain lighthouses and beacons and other navigational services and aids as appear to it to be necessary.</li> </ul>	The GPHA is providing in port facilities to enhance implementation the proposed project activities.
Ghana Shipping Act, 2003	The Ghana Shipping Act 2003 (Act 645) has been enacted to replace the erstwhile Merchant Shipping Act 1963, Act 183. These are all geared towards the overall restructuring of maritime administration in the country and implement the provisions enshrined in the Port Regulations 1964, LI 352.	The Ghana Shippers Authority is mandated to ensure registration, Building, Importation and Licensing of Ships and Proprietary Interest in Ships are in compliance with industry standards.
The Fisheries Act, 2002, Act 625	The section 93(1) of the Fisheries Act 2002, Act 625 states that any person or government department or other agency planning to conduct any activity other than fishing, which is likely to have a substantial impact on the fishery resources or other aquatic resources of Ghana, shall	The Fisheries Commission will need to be informed of the proposed development.

<b>Legal Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
	inform the Commission on the plans prior to the commencement of the planned activity with a view to the conservation and protection of the resources.	
Oil in Navigable Waters Act, 1964	The Oil in Navigable Waters Act, 1964 (Act 235) makes provision for preventing the pollution of the sea and of navigable waters by oil. Methods approved by international authorities (i.e. MARPOL 73/78) for containing or treating discharges would be strictly followed to prevent or minimise any oil pollution	The project will ensure that strict policies are formulated and its activities will not pollute navigable waters by oil.
The Beaches Obstructions Ordinance of 1897, Cap. 240	The Beaches Obstruction Ordinance of 1897, Cap. 240 section 5 indicates that where a person without lawful excuse, causes, whether by an act or omission, an obstruction or impediment to the navigation of a port, river or lagoon, or to the lawful use of a pier, jetty, landing place, whether reserved or not under section 2, wharf, quay, dock, mooring, or any other work in the port, river, or lagoon the District Chief Executive may cause the obstruction or impediment to be removed. Additionally, a person who causes the obstruction or impediment commits an offence and is liable on conviction before a magistrate to a fine not exceeding twenty-five penalty units, and to pay the expenses of the removal.	All activities will be in consultation and will have to be approved by GPHA Tema Port to ensure that the project implementation does not cause obstructions or impediments to existing Port activities.
<b>Labour and Safety in the Workplace</b>		
Factories, Offices and Shops Act 1970, Act 328	The Factories, Offices and Shops Act of 1970 (Act 328), as amended by the Factories Offices and Shops (Amendment) Law 1983 PNDCL 66, the Factories Offices and Shops (Amendment) Law 1991 PNDCL 275 s.1 (a), and the Ghana National Fire Service Act, 1997 (Act 537) requires all proponents to register every factory/workplace with the Chief Inspector of Factories Inspectorate Department. The Act requires all factories, offices and shops to among others to notify the Chief Inspector of accidents, dangerous occurrences and industrial diseases, post in a prominent position in every factory the prescribed abstract of the act and other notices and documentations, as well as outlines the regulations to safeguard the health and safety of workers. The Act compliments the provisions made in the Factories (Dock Safety) Regulations 1960, LI 86.	The project will be registered with the Factories Inspectorate Division and any accident reported as per Act 328, 1970.
The Labour Act 2003, Act 651	Section 118(1) of the Labour Act 2003 (Act 651) stipulates that it is the duty of an employer to ensure that every worker employed works under satisfactory, safe and healthy conditions. Act 651 contains a number of specific provisions relating to an employer's duty of care to its workers. These include providing and maintaining "at the workplace, plant and system of work that are safe and without risk to health" and taking "steps to prevent contamination of the workplaces by, and protect the workers from, toxic gases, noxious substances, vapours, dust, fumes, mists and other	Tema LNG Terminal Company is required to put in place measures to ensure safety and well-being of its workers in accordance with the act



<b>Legal Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
	substances or materials likely to cause risk to safety or health". A worker is required to report situations that he believes may pose "an imminent and serious danger to his or her life, safety or health".	
The Children's Act 1998, Act 560	The Act spells out the rights of the child, quasi-judicial/judicial child adjudication, parentage /custody/access/maintenance, fosterage/ adoption and employment of children issues. The Act defines a child as a person below the age of 18 years. The minimum age for admission of a child to employment is fifteen years and the minimum age for the engagement of a person in hazardous work is eighteen years. No person shall engage a child in exploitative labour, and labour is exploitative of a child, if it deprives the child of its health, education or development.	The project will comply with this Act to ensure no child labour is employed.
Workmen's Compensation Law 1987	It is to provide for the payment of compensation to workmen for personal injuries caused by accidents arising out and in the course of their employment. The tenets of the law places a large share of the burden of supporting workers injured at the workplace on the shoulders of the employers.	This will apply to this project and the safety of all workers will be the responsibility of the proponent
Ghana National Fire Service Act 1997	The Act re-establishes the National Fire Service to provide for the management of undesired fires and to make provision for related matters. The objective of the Service is to prevent and manage undesired fire. For the purpose of achieving its objective; the Service is to organize public fire education programmes to create and sustain awareness of the hazards of fire, heighten the role of the individual in the prevention of fire and provide technical advice for building plans in respect of machinery and structural layouts to facilitate escape from fire, rescue operations and fire management. The GNFS has a rural fire department responsible for the control and management of bushfires.	Fire certificate and permits will be obtained for the operation of the project.  GPHA will also provide relevant approvals including fire permits for construction work camps within the Port.
The Fire Precaution (Premises) Regulations 2003, LI 1724	The Fire Precaution (Premises) Regulations 2003 (LI 1724) requires all premises intended for use as workplaces to have Fire Certificates and confers enforcement powers on the Ghana National Fire Service (GNFS) to demand a fire certificate for premises that are put to use as a place of work.	Fire certificate and permits will be obtained for the operation of the project.  GPHA will also provide relevant approvals including fire permits for construction work camps within the Port.
<b>Development Planning</b>		
Local Governance Act 2016, Act 936.	This Act establishes and regulates the local government system and gives authority to the RCC and the District Assembly to exercise political and administrative power in the Regions and District, provide guidance, give direction to, and supervise all other administrative authorities in the regions and district respectively. The	The proposed project is situated within the Tema Metropolis and the Kpone Katamanso District, and the Assemblies shall be

<b>Legal Framework</b>	<b>Summary of core requirements</b>	<b>Relationship to proposed project</b>
	Assembly is mandated to initiate programmes for the development of basic infrastructure and provide municipal works and services as well as be responsible for the development, improvement and management of human settlements and the environment in the district.	fully engaged during the implementation of the project.
Land Use and Spatial Planning Authority (LUPSA) Act 2016, Act 925	<p>The LUPSA Act 2016, Act 925 seeks to ensure the orderly and progressive development of land, town and other areas whether urban or rural for conserving and developing resources and to preserve and improve amenities thereof, and for related matters. It is the new legislation in force regulating the general planning and development of human settlements.</p> <p>It seeks to promote sustainable human settlements developments based on principles of efficiency, orderliness, safety and healthy growth of communities.</p>	The project area is zoned as industrial
<b>Land Regulations</b>		
Lands Commission (LC) Act 2008, Act 767	<p>This act provides for the management of public lands and other lands and for related matters. The Commission manages public lands and any other lands vested in the President by the Constitution or by any other enactment or the lands vested in the Commission. The act advises the Government, local authorities and traditional authorities on the policy framework for the development of particular areas to ensure that the development of individual pieces of land is co-ordinated with the relevant development plan for the area concerned.</p> <p>The commission formulates and submits to Government recommendations on national policy with respect to land use and capability; advise on, and assist in the execution of, a comprehensive programme for the registration of title to land throughout the Republic in consultation with the Title Registration Advisory Board established under section 10 of the Land Title Registration Act, 1986;</p> <p>The Minister may, with the approval of the President, give general directions in writing to the Commission on matters of policy in respect of the management of public lands. The commission has the following divisions:</p> <ul style="list-style-type: none"> <li>• Survey and Mapping;</li> <li>• Land Registration;</li> <li>• Land Valuation;</li> <li>• Public and Vested Lands Management; and</li> <li>• Any other Division the Commission may determine.</li> </ul>	The proposed project requires land acquisition and registration and falls under the lands commission. The Project will be implemented in line with the objectives of the Commission for sustainable development of land.
The Survey Act 1962, Act 127	<p>The Survey Act 1962, Act 127 relates to geological, soil and land survey. The part I of the Survey Act, 1962 states that the Director of Geological Survey and every officer of the Geological Survey Department shall have the power of—</p> <p>(a) going to any part of the surface of any land or any underground passages or workings there under in order to make surveys, take samples, make borings and do and</p>	All plans on the proposed pipeline route will be certified by official surveyors.

<b><i>Legal Framework</i></b>	<b><i>Summary of core requirements</i></b>	<b><i>Relationship to proposed project</i></b>
	<p>cause to be done all things necessary for carrying out the geological survey of such land or for making any report thereon; or</p> <p>(b) calling for the production of, inspecting and taking copies or extracts from, any books, papers, plans and documents dealing with prospecting or the operation of mining on any land which is the subject of a mining concession.</p> <p>Part II of the Act deals with demarcation and survey of lands. Under the law, the sector minister may appoint official surveyors and the Chief Survey Officer (Director of Surveys) may license private surveyors. It is the official surveyor or licensed surveyor that shall certify plans for attachments to instruments of conveyance, leases, assignment, charge or transfer. Under the law it is an offence to damage, destroy or alter any boundary mark.</p> <p>The Act 127 with its amendments gave legal backing to the Director of Surveys to carry out cadastral and other surveys through official surveyors who work directly under him at the Survey Division of the Lands Commission. It also gave authority to the Director of Surveys to recommend from time to time experienced surveyors to the Minister responsible for Lands to be licensed to undertake surveys.</p>	
Office of the Administrator of Stool Lands Act 1994, Act 481	<p>The OASL Act 1994, Act 481 establishes the Office of the Administrator of Stool Lands as enshrined in Article 267 (2) of the 1992 Constitution and it is responsible for establishment of stool land account for each stool, collection of rents and the disbursement of such revenues. The Administrator is charged with the management of stool lands and in accordance with the provisions in the 1992 Constitution, 10% of the gross revenue goes to the Administrator of Stool Lands for administrative expenses whilst the remainder is disbursed as follows:</p> <ul style="list-style-type: none"> <li>• 25% to the stool through the traditional authority for the maintenance of the stool;</li> <li>• 20% to the traditional authority; and</li> <li>• 55% to the District Assembly, within the area of authority of which the stool lands are situated.</li> </ul>	The appropriate traditional and stool land owners will be consulted for land acquisition.

### 2.3 Institutional Framework

The EIA process followed for this project is consistent with the regulations in Ghana and involves consultations throughout the life cycle of the Project with a number of governmental authorities which are likely have an interest in the project. These include ministries, departments and agencies as well as regional and local agencies.

The proposed project falls directly under the jurisdiction of the Ministry of Energy. The objectives of the Ministries are attained through the actions of their respective departments and agencies. The key agencies whose mandates will be triggered by the proposed Tema LNG Terminal Ghana Project are summarised in **Table 2-3** in relation to their respective Ministries.

**Table 2-3: Key sector agencies**

No.	Sector Ministry	Key Agencies	Relationship with Project
1.	Ministry of Energy	Energy Commission	Technical midstream and downstream gas regulator
		Ghana National Petroleum Corporation (GNPC)	Main client for the natural gas from the Tema LNG project
		National Petroleum Authority	Regulate, oversee and monitor the petroleum downstream industry in Ghana
		Bulk Oil Storage and Transport (BOST)	Licensed by the Energy Commission in 2015 as the National Gas Transmission Utility (NGTU)
		Volta River Authority (VRA)	Operator of the tie-in point for proposed gas send out system
		Ghana Grid Company (GRIDCo)	Owner of portion of RoW to be utilised by the proposed project.
		Tema Oil Refinery (TOR)	Owner of portion of RoW to be utilised by the proposed project.
		Public Utilities Regulatory Commission (PURC)	National entity responsible for economic regulation for electricity, gas and water
2.	Ministry of Transport	Ghana Maritime Authority	Regulator for Maritime industry
		Ghana Ports and Harbours Authority (GPHA)	Mandate to plan, build, develop, manage, maintain, operate, and control Ports in Ghana
		Ghana Shippers Authority (GSA)	To effectively and efficiently manage Ghana's commercial shipping and to protect and promote the interests of shippers in relation to international trade and transport logistics.
		Department of Urban Roads (DUR)	Permission required for public road crossings
		Ghana Railway Authority (GRA)	Operator of Ghana's railway network
3.	Ministry of Works and Housing	Tema Development Corporation (TDC)	The public entity tasked with the planning and development of the entire city of Tema
4.	Ministry of Defence	Ghana Navy	Responsible for maritime security.
5.	Ministry of Interior	Ghana National Fire Service	National institution responsible for the prevention and management of undesired fire.
6.	Ministry of Employment and Labour Relations	Department of Factories Inspectorate	Regulations for health and safety of workers
		Labour Department	It exists to enforce labour laws and regulations in Ghana and provide, for the benefit of workers and employers, employment-related services such as job-matching, job counselling and mediation; and to generate reliable labour market information for employment policy and national development planning

No.	Sector Ministry	Key Agencies	Relationship with Project
7.	Ministry of Water Resources and Sanitation	Water Resources Commission	Sole agent responsible for the regulation, management and utilisation of surface water resources, including pipeline river crossings. It issues water rights to potential water users
8.	Ministry of Environment, Science, Technology and Innovation (MESTI)	Environmental Protection Agency (EPA)	Regulating the environment and ensuring the implementation of government policies on the environment. Issues permits for development projects.
		Land Use and Spatial Planning Authority	Regulator for land use and spatial planning
9.	Ministry of Planning	National Development Planning Commission (NDPC)	Advises the President on development planning policy and strategy
10.	Ministry of Fisheries and Aquaculture	Fisheries Commission	Regulator for the fishery industry. The Commission needs to be informed of all developments with a potential substantial impact on the fishery resources or other aquatic resources of Ghana, prior to the commencement of the planned activity.
11.	Ministry of Local Government	Tema Metropolitan Assembly/ Kpone Katamanso District Assembly	The planning authority, charged with the overall development of the district

## 2.4 International Conventions

Ghana is signatory to a number of international conventions that have been established by the United Nations or its specialized agencies to sustainably manage and/or protect the environment. The ones that should be considered for the Project are:

- United Nations (UN) Convention on Biological Diversity 1994;
- United Nations Framework Convention on Climate Change (UNFCCC);
- Stockholm Convention on Persistent Organic Pollutants;
- United Nations Convention on the Law of the Sea (UNCLOS);
- The International Code of Safety for Ships using Gases or other Low-Flashpoints Fuels (IGF Code);
- Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention) 1981;
- Convention on Civil Liability for Oil Pollution Damage (CLC);
- International Convention on the Prevention of Pollution from Ships (MARPOL), 1973/78 et al
- Convention on Limitation of Liability for Maritime Claims (LLMC), 1976;
- The International Ship and Port Facility Security (ISPS) Code; and
- ILO Conventions.
  - Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise, and Vibration (ILO No. 148) 1987;
  - ILO Convention 29 (1930) Forced Labour - Article 5
  - ILO Convention 105 (1957) Abolition of Forced Labour - Article 1

- ILO Convention 138 (1973) Minimum Age - Articles 1-3
- ILO Convention 87 (1948) Freedom of Association and Protection of Right to Organise - Articles 2- 11
- ILO Convention 98 (1949) Right to Organise and Collective Bargaining - Articles 1-4
- ILO Convention 100 (1951) Equal Remuneration - Articles 1-3
- ILO Convention 111 (1958) Discrimination (Employment and Occupation)
- ILO Convention 97 (1949) Migration for Employment - Articles 1-9
- ILO Convention 143 (1975) Migrant Workers (Supplementary Provisions) - Articles 1- 12; and
- ILO Convention 184 (2001) Safety and Health in Agriculture - Articles 7- 21

#### United Nations (UN) Convention on Biological Diversity 1994

The Convention on Biological Diversity (CBD) is an international legally binding treaty. The Convention has three main goals:

- conservation of biological diversity (or biodiversity);
- sustainable use of its components; and
- fair and equitable sharing of benefits arising from genetic resources

In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document regarding sustainable development.

#### United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC) provides the basis for global action to protect the climate system for present and future generations. 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 189 countries having ratified.

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

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.

### Stockholm Convention on Persistent Organic Pollutants

Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).

### Basel Convention on the control of transboundary movements of hazardous wastes and their disposal

This is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.

### United Nations Convention on the Law of the Sea (UNCLOS)

The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. Under this convention, Ghana claims rights within 12 nm of territorial water and a 200 nm Exclusive Economic Zone (EEZ). Clearance for Project vessels (e.g. dredging vessels, tug boats) travelling into the territorial waters (e.g. to and from the onshore base) must be obtained from the Ghana Maritime Authority (GMA) and notification should also be made to the Ghanaian Navy.

### Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention) 1981

The Convention for the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention). The Action Plan and the Abidjan Convention were adopted by the Governments in 1981; the Convention entered into force in 1984. The Abidjan Convention covers the marine environment, coastal zones and related inland waters falling within the jurisdiction of the States of the West and Central African Region, from Mauritania to Namibia inclusive, which have become Contracting Parties to the Convention.

The Abidjan Convention is a comprehensive umbrella agreement for the protection and management of the marine and coastal areas. It lists the sources of pollution which require control: - pollution from ships, dumping, land-based sources, exploration and exploitation of the sea-bed, and pollution from or through the atmosphere. It also identifies environmental management issues from which co-operative efforts are to be made: coastal erosion, specially protected areas, combating pollution in cases of emergency; and environmental impact assessment. There are also articles on scientific and technological co-operation and liability and compensation.

### Convention on Civil Liability for Oil Pollution Damage (CLC)

The key Conventions under liability and compensation are the International Convention on Civil Liability for Oil Pollution Damage (CLC), 1992 and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, (FUND) 1992. The CLC places liability for pollution damage in the event of oil spillage on the ship owner

and ensures that compensation is paid for the destruction of the shoreline ecosystem as well as to affected victims such as fishermen, beach resort hotels and recreational facilities, restaurants etc.

However, in situations where the compensation paid under the CLC is inadequate, countries can access additional funding from the FUND, provided they are contracting parties to it. Through the initiative of the Ghana Maritime Authority, Ghana has ratified the CLC and the FUND Conventions and has become a beneficiary country which can claim international compensation for oil pollution damage.

#### International Convention on the Prevention of Pollution from Ships (MARPOL), 1973/78 et al

With regard to the marine environment protection, the key conventions are the International Convention on the Prevention of Pollution from Ships (MARPOL), 1973/78 the International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), 1972 and its Protocol of 1996, the International Convention on Oil Pollution, Preparedness, Response and Cooperation (OPRC), 1990 as well as the provision dealing with the protection of the environment, contained in Part XII of the United Nations Convention on the Law of the Sea, 1982.

MARPOL is the main international treaty dealing with the prevention of pollution of the marine environment by ships from operational and accidental causes. The regulations covering the various sources of ship-generated pollution are contained in six technical annexes of the Convention. Ghana has ratified I and II which deals with prevention of pollution by oil and the control of pollution by noxious liquid substances in bulk.

These Annexes give contracting parties the mandate to inspect ships including tankers and other supply vessels to ensure that their operations are safe and will not pollute the marine environment.

The London Dumping Convention is intended to promote the effective control of all sources of marine pollution and regulate dumping into the sea of waste materials, whilst the OPRC provides a framework for cooperation among countries for responding and combating oil spillage. The OPRC Convention has been ratified by Ghana but MARPOL Annexes III - VI and the London Dumping Conventions are yet to be ratified.

#### Convention on Limitation of Liability for Maritime Claims (LLMC), 1976

The Convention provides the limit of liability for two types of claims – (i) claims for loss of life or personal injury, and (ii) property claims (such as damage to other ships, property or harbour works). The 1976 Convention, replaced the International Convention Relating to the Limitation of the Liability of Owners of Seagoing Ships, which was signed in Brussels in 1957, and came into force in 1968. This convention would be most applicable in the operational phase of the proposed project, when the ship traffic is expected to increase significantly.

#### The International Ship and Port Facility Security (ISPS) Code

The International Code for the Security of Ships and Port Facilities (ISPS Code) is the brain child of the Maritime Safety Committee and Maritime Security Working Group under the auspices of the International Maritime Organization (IMO). It was adopted at the Conference of contracting



Governments to the International Convention for the Safety of Life at Sea in 1974, and came into effect on the First of July 2004.

The most remarkable feature of this code, apart from the detailed and well grafted mode of security for ships and port facilities, is the adoption of a hierarchical and collaborative system of operation. This system which operates in a bilateral form involving the efforts of the Company Security Officer (CSO), the ship security officer and the port facility officer on the one hand, and the ship security officer and the port facility officer on the other. The Convention was made applicable to ships named in the Convention which engage in international voyage. The mode of achievement of the objectives of the code includes the gathering, assessment and exchange of information on security threats and measures.

### ILO Conventions

*Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise, and Vibration (ILO No. 148) 1977*

Article 9 of the 1977 Convention of ILO states that as far as possible, the working environment shall be kept free from any hazard due to air pollution, noise or vibration,

- (a) by technical measures applied to new plant or processes in design or installation, or added to existing plant or processes; or, where this is not possible,
- (b) by supplementary organisational measures.

*ILO Convention 29 (1930) Forced Labour - Article 5*

No concession to companies shall involve any form of forced or compulsory labour.

*ILO Convention 105 (1957) Abolition of Forced Labour - Article 1*

Not make use of any form of forced or compulsory labour

*ILO Convention 138 (1973) Minimum Age - Articles 1-3*

Abolition of child labour and definition of national minimum age for labour not less than 15-18 years (depending on occupation).

*ILO Convention 87 (1948) Freedom of Association and Protection of Right to Organise - Articles 2- 11*

Freedom to join organisations, federations and confederations of their own choosing; with freely chosen constitutions and rules; measures to protect the right to organise.

*ILO Convention 98 (1949) Right to Organise and Collective Bargaining - Articles 1-4*

Protection against anti-union acts and measures to dominate unions; established means for voluntary negotiation of terms and conditions of employment through collective agreements.

*ILO Convention 100 (1951) Equal Remuneration - Articles 1-3*

Equal remuneration for men and women for work of equal value.

*ILO Convention 111 (1958) Discrimination (Employment and Occupation)*

Equality of opportunity and treatment in respect to employment and occupation; no discrimination on the basis of race, colour, sex, religion, political opinion, national extraction or social origin.

*UN Declaration on the Rights of Indigenous Peoples (2007) - Articles 2, 8(2e), 9, 15(2), 16(1), 21(2), 22, 24(1), 29(1), 46(3)*

No discrimination based on origin or identity; free to express identity based on custom; special attention to and full protection of rights of indigenous women.

*ILO Convention 97 (1949) Migration for Employment - Articles 1-9*

Provision of information; no obstacles to travel; provision of health care; non-discrimination in employment, accommodation, social security and remuneration; no forced repatriation of legal migrant workers; repatriation of savings.

*ILO Convention 143 (1975) Migrant Workers (Supplementary Provisions) - Articles 1- 12*

Respect basic human rights; protection of illegal migrants from abusive employment; no trafficking in illegal migrants; fair treatment of migrant labour.

## 2.5 IFC Performance Standards

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing.

The Performance Standards may also be applied by other financial institutions electing to apply them to projects in emerging markets. Together, the eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC or other relevant financial institution. They are summarised in **Table 2-4**.

**Table 2-4: Summary of IFC Performance Standards**

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger	Remarks or recommendation for proposed project
PS1	<i>Assessment and Management of Environmental and Social Risks and Impacts</i>	Identify and evaluate environmental and social risks and impacts of the project and adopt measures anticipate, avoid and when avoidance is not possible, minimise and or compensate Project Affected People/Communities and Environmental Area of Influence. The achievement of the above, Clients should establish an effective ESMS, which ensures stakeholders/community participation and grievance redress mechanisms.	Triggered	The Tema LNG terminal project impacts on both biophysical environment, and socio-cultural and livelihood.
PS2	<i>Labour and Working Conditions of workers</i>	Management of projects should ensure workers safety promote the fair treatment, non-discriminatory and equal opportunity of workers and establish, maintain and improve the worker-management relationship, and comply with national employment and labour laws of host country.	Triggered	Worker's safety and congeniality of workers' condition is cardinal in the successful project implementation.

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger	Remarks or recommendation for proposed project
PS3	<b>Resource Efficiency and Pollution Prevention</b>	Avoid or minimise adverse impacts on human health and the environment through avoidance or minimisation of pollution including release of greenhouse gases from project and promote sustainable use of resources such as energy and water. Clients are also expected to ensure the use of efficient pollution abatement machinery to reduce pollution.	Triggered	The implementation of the Tema LNG Terminal project will involve the use of high quantities of resources such as fuel, electricity, water etc. and the release of resultant wastes into the environment.
PS4	<b>Community Health, Safety and Security</b>	To evaluate the risks and impacts to the health and safety of the Affected Communities during the project lifecycle and establish preventive and control measures consistent with Best International Practices and commensurate with their nature and magnitude of impacts.	Triggered	The construction and operation of the proposed pipeline will have impact on the nearby communities of Abonkor, Bankuman and Manhean
PS5	<b>Land Acquisition and Involuntary Resettlement</b>	As much as possible project siting and activities should not displace people. However, where avoidance is not possible, displacement should be minimised by alternative project design considerations. No force eviction should be undertaken by client. Land acquisition should be done in a manner as to minimise adverse social and economic impacts through the provision of compensation packages and to ensure a humane resettlement procedure, disclosure of information, consultation and participatory of PAPs. It should be the client's duty to ensure the physical and economic wellbeing of displaced people are not worst of than their pre displaced lives.	Triggered	The proposed pipelines RoW will be largely limited to existing RoWs. A few properties (farms and temporary structures encroaching these RoWs may be affected by the construction works.
PS6	<b>Biodiversity Conservation and Sustainable Management of Living Natural Resources</b>	All clients should identify both direct and indirect project related impacts that could potentially threaten biodiversity and ecosystem services. The following indicators should be used as a guide: habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution.	Triggered	Marine studies show that the project area is moderate to high in marine biodiversity. Dredging works and pipeline river/marshland crossing will have a temporary impact on local biodiversity.
PS7	<b>Indigenous People</b>	The client will identify, through an environmental and social risks and impacts assessment process, all communities of Indigenous Peoples within the project area of influence who may be affected by the project, as well as the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage), and environmental impacts on them. Adverse impacts	Not triggered	There are no indigenous people on the project site or within the project communities of influence

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger	Remarks or recommendation for proposed project
		on Affected Communities of Indigenous Peoples should be avoided where possible. Indigenous People are defined as a social group with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population.		
PS8	<i>Preservation of Cultural Heritage</i>	Client must protect cultural heritage from the adverse impacts of project activities and support its preservation. Clients should also promote the equitable sharing of benefits from the use of cultural heritage.	Triggered	A community cemetery has been identified close to the proposed pipeline route. This will be avoided as much as possible.

## 2.6 African Development Bank Operational Safeguards

The Bank has adopted five Operational Safeguards (OS) as summarised in **Table 2-5:**

- OS1 sets out the Bank's overarching requirements for borrowers or clients to identify, assess, and manage the potential environmental and social risks and impacts of a project, including climate change issues.
- OSs 2-5 support the implementation of OS1 and set out specific requirements relating to different environmental and social issues, including gender and vulnerability issues, that are triggered if the assessment process reveals that the project may present certain risks.

**Table 2-5: Summary of AfDB Safeguard Policies**

No	AfDB Safeguard Policy	Summary of core requirements	Potential for Trigger	Remarks or recommendation for proposed project
1.	Operational safeguard 1 – Environmental and social assessment	Borrowers or clients are responsible for conducting the environmental and social assessment (Strategic Environmental and Social Assessment, or SESA, or Environmental and Social Impact Assessment, or ESIA) and for developing, as an integral part of project documentation, an appropriate plan for managing possible impacts. It categorises proposed projects into categories 1, 2, 3, and 4 based on the extent of adverse impacts anticipated from the project.	Triggered	The ESIA satisfies the requirements for the OS1 as a category 2 project, has appropriate plans for managing possible impacts. The original ESIA prepared in August 2018 was submitted to the EPA and a permit received from the Agency.
2.	Operational safeguard 2 – Involuntary	It relates to Bank-financed projects that cause the involuntary resettlement of people. It seeks to ensure that when people	Triggered	The proposed pipelines RoW are within existing GRIDCo high tension RoWs. A few

	resettlement: land acquisition, population displacement and compensation	must be displaced, they are treated fairly, equitably, and in a socially and culturally sensitive manner; that they receive compensation and resettlement assistance so that their standards of living, income-earning capacity, production levels and overall means of livelihoods are improved; and that they share in the benefits of the project that involves their resettlement.		properties (vegetable farms and pigsties) encroaching these RoWs may be affected by the construction works. No land acquisition is required for this project. No physical displacement will occur.
3.	Operational safeguard 3 – Biodiversity, renewable resources and ecosystem services	This Operational Safeguard (OS) outlines the requirements for borrowers or clients to (i) identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats, and (ii) observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services	Triggered	Marine studies show that the project area is moderate to high in marine biodiversity. Dredging works and pipeline river/marshland crossing will have a temporary impact on local biodiversity.
4.	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency	This OS outlines the main pollution prevention and control requirements for borrowers or clients to achieve high quality environmental performance, and efficient and sustainable use of natural resources, over the life of a project. It draws on and aligns Bank operations with existing international conventions and standards related to pollution, hazardous materials and waste, and related issues	Triggered	The implementation of the Tema LNG Terminal project will involve the use of high quantities of resources such as fuel, electricity, water etc. and the release of resultant wastes into the environment.
5.	Operational safeguard 5 – Labour conditions, health and safety	This OS outlines the main requirements for borrowers or clients to protect the rights of workers and provide for their basic needs. When the borrower or client intends to employ a workforce for a project, it develops and implements a human resources policy and procedures appropriate to the nature and size of the project, with the scale of the workforce in alignment with this OS and with applicable national laws. The OS requires the protection of the workforce through the institution of appropriate health and safety measures taking into account risks inherent in the particular sector and specific classes of hazards in the borrower's work and does not support the use of child labour and forced labour	Triggered	Worker's safety and congeniality of workers' condition is cardinal in the successful project implementation.

## 2.7 Gap Analysis for the IFC PS and AfDB OS

The IFC has eight (8no.) performance standards to guides the environmental and social assessment requirements for its investment projects as compared to the five (5no.) operational safeguards of the AfDB required for its investment projects. However, AfDB OS 1 is used to address the other three IFC PS (i.e. PS 4- community health, safety and security; PS 7- Indigenous People; and PS 8-Preservation of Cultural Heritage). Table 2-6 provides some gap analysis for the IFC PS and the AfDB OS.

Both the IFC and AfDB have some form of guidance to support their safeguards systems. The guidance addresses the procedural steps in the environmental and social assessment process and on how to apply the specific safeguards. For example, the IFC has prepared a set of guidance notes corresponding to their Performance Standards – focused on explaining the requirements and good practice in assessing and managing the issues.

In addition, the IFC uses the World Bank Group Environmental, Health and Safety (EHS) Guidelines (IFC 2007), which is an internationally recognised source of comprehensive guidance (both general and industry specific) on the pollution control and health and safety standards that should be met by industrial projects, referred to as Good International Industry Practice.

The African Development Bank's Integrated Safeguards System includes a compendium of safeguards related guidance, including a set of detailed “keysheets” on a wide range of sub-sectors, not restricted to industrial projects, including transport, energy, agriculture, water supply and sanitation and social infrastructure. These are designed to assist in screening and scoping of the environmental and social risks typically associated with the sector and to provide information on suggested mitigation and management options. The AfDB also recognises and applies the World Bank Group EHS Guidelines under OS 4 - pollution prevention and control, hazardous material and resource efficiency.

**Table 2-6: Gap analysis - the IFC PS and AfDB OS**

No.	AfDB Operational Safeguards	IFC Performance Standards	Key differences and similarities
1	Operational safeguard 1 – Environmental and social assessment	PS 1 - Assessment and Management of Environmental and Social Risks and Impacts	Both the OS 1 and the PS 1 act as a <i>de facto</i> procedural “umbrella” policy and is used in part to identify others that may be applicable to a project.  The environmental and social issues addressed by IFC PS 1 and AfDB OS 1 are substantially the same except for some portions of Operational Safeguard (OS) 5 (Labor Conditions, Health and Safety) which are outside the scope of the IFC PS
2	Operational safeguard 2 – Involuntary resettlement: land acquisition, population displacement and compensation	PS 5 -Land and Involuntary Resettlement	Whiles the IFC PS is to ensure that the physical and economic wellbeing of displaced people are not worse off than their pre displaced lives, the AfDB ensures that the overall means of livelihoods of displaced persons are improved; and that they share in the benefits of the project that involves their resettlement.

3	Operational safeguard 3 – Biodiversity, renewable resources and ecosystem services	PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources	Both safeguards seek to protect and conserve biodiversity and classifies habitats into natural habitats, modified habitats and critical habitats. While PS 6 seeks to maintain the benefits from ecosystem services, OS 3 expects clients to observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services
4	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency	PS 3 - Resource Efficiency and Pollution Prevention	Both safeguards require compliance with internationally accepted environmental standards, particularly the World Bank Group Environmental Health and Safety (EHS) Guidelines. With regards to Green House Gas (GHG) emissions, under PS 3, for projects that are expected to produce more than 25,000 tonnes of CO <sub>2</sub> -equivalent annually, the client is required to quantify the GHG emissions annually, while under OS 4, the Bank will report ex-ante on GHG emissions estimated to be produced by the Bank's investments on a project-by-project basis and will report on GHG emissions (gross and net) in project documentation. The Bank will also report reductions in emissions achieved as a result of the Bank's investments.
5	Operational safeguard 5 – Labour conditions, health and safety	PS 2 - Labour and Working Conditions of workers	<p>The two safeguards generally address occupational health and safety issues. The structure of AfDB's labour safeguard is similar to those of IFC but with some differences. The first objective of AfDB's OS 5 is to "protect workers' rights", in contrast to objective of IFC's PS 2: "To promote the fair treatment, non-discrimination and equal opportunity of workers".</p> <p>With regards to subcontracted workers, the AfDB policy instructs that "the borrower or client incorporates these requirements [of OS 5] in contractual agreements with its contractors, subcontractors and intermediaries".</p> <p>This appears to be firmer than the stipulation of IFC's PS 2 that "the client will use commercially reasonable efforts to incorporate these requirements [of PS 2] in contractual agreements with such third-party employers."</p>

## 2.8 The Equator Principles

The Equator Principles are a voluntary set of guidelines developed by leading financial institutions for managing environmental and social issues in project finance lending. The guidelines are based on the environmental and social standards of the IFC (i.e. IFC Performance Standards). These principles are intended to serve as a common baseline and framework for the implementation of participating institutions, individual, internal environmental and social procedures and standards for project financing activities across all industry sectors globally.

The Equator Principles aim is to ensure that prior to agreeing to provide financing, (a) a project has been subject to an appropriate level of environmental and social assessment in accordance with the requirements of the IFC Performance Standards and World Bank Group EHS Guidelines, and (b) that the project will implement appropriate measures for the management of environmental, social and health issues during construction, operation and decommissioning phases. Compliance with the EPs is expected to generally encompass the requirements of GIIF. The principles are summarized in **Table 2-7** with comments on the respective projects.

**Table 2-7: Summary of Equator Principles in relation to the Project**

No	Equator Principle	Summary Description	Potential for Trigger	Remarks/Comments
1.	<u>Principle 1:</u> Review and Categorization	As part of the Equator Principles Financial Institutions (EPFI) internal environmental and social review and due diligence, projects will be categorized into (A-C) depending on the severity of impacts, with Project in Category A being ranked as high-risk projects and Category C being ranked as low risk projects.	Triggered.	The Ghana EPA screened the project and requested for an ESIA to be prepared because of its high risk (similar as Category B projects).
2.	<u>Principle 2:</u> Environmental and Social Assessment	Environmental and Social Impact Risk of proposed projects should be conducted. The ESIA should identify impacts and risk, and propose measures to minimise, mitigate and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed project. CO <sub>2</sub> emissions exceeding 100,000 tonnes, should require alternative analysis for less Green House Gases (GHG).	Triggered	An ESIA was completed in August 2018 and a permit issued for the implementation of the project.
3.	<u>Principle 3:</u> Applicable Environmental and Social Standards	ESIA process should in the first and foremost comply with relevant host country laws, regulations and permits with respect to environmental and social issues. IFC Performance Standards on Environmental and Social Sustainability and World Bank Environmental and Safety Guidelines should apply to projects in Non-Designated countries whilst host country laws, regulations and permits pertaining to environmental and social issues should apply to Designated countries.	Triggered	The operation of the offshore Terminal facility and onshore pipelines comply with Ghana laws, regulations and permits and IFC Performance Standards and AfDB operational safeguards



No	Equator Principle	Summary Description	Potential for Trigger	Remarks/Comments
4.	<u>Principle 4:</u> Environmental and Social Management System and Equator Principles Action Plan	Environmental and Social Management System (ESMS) should be developed and maintained by the client for Category A and B Projects. Secondly, an Environmental and Social Management Plan (ESMP) should be prepared by the client to address issues raised in the ESIA for the same Project Categories.	Triggered	An appropriate ESMS is being developed for the project, which includes specific management plans
5.	<u>Principle 5:</u> Consultations and Disclosure	The client should demonstrate an effective Stakeholder Engagement with affected communities and other stakeholders in a structured and culturally acceptable manner. Risks and impact of the Project phase development, Preference language of affected communities, Decision-making processes, needs of disadvantaged and vulnerable groups, should form the core issues for discussions.	Triggered	A stakeholder engagement plan was prepared as part of the ESIA, and extensive stakeholder engagement carried out. Project affected persons and vulnerable groups were identified during the ESIA
6.	<u>Principle 6:</u> Grievance Mechanism	The borrower will establish a grievance mechanism as part of the management system for all category A and some category B projects.	Triggered.	A grievance redress mechanism was developed as part of the ESIA.
7	<u>Principle 7:</u> Independent Review	Environmental Assessment for project within Categories A and B, including EMP, ESMS and Evidence of Stakeholders Engagement shall be subjected to an independent review by a consultant not directly associated with the client as part of EPFI due diligence procedure to assess the Equator Principles compliance.  Independent Review shall be mandatory on high risk Projects including the following: <ul style="list-style-type: none"> <li>• adverse impact on indigenous peoples,</li> <li>• critical habitat impacts,</li> <li>• significant cultural heritage impacts and</li> <li>• large-scale resettlement</li> </ul>	Triggered.	-
8	<u>Principle 8:</u> Covenants	The client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects.  In addition, for Category A and B Projects, the client will covenant the financial documentation: a) to comply with the ESMPs and Equator Principles Action Plan (where applicable) during the construction and operation of the Project in all material respects;	Triggered.	Tema LNG will implement the ESMS and specific ESMPs

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## 2.9 National Environmental Quality Guidelines (NEQGs)

In addition to national and sector policies and plans described above, the environmental guidelines and standards relevant to the Project are presented below.

- **Environmental Impact Assessment Guidelines for the Energy Sector (2010), Volume 1** has been prepared to ensure the sustainable use of energy resources and also contribute towards sound environmental management in the energy sector. Volume 2 of the Guidelines provides systematic procedures on EIS/EMP preparations for the energy sector as well as guidelines on common potential impacts and mitigation measures;
- **Environmental Impact Assessment Guidelines for the General Construction and Services Sector (2011)**, have been prepared to ensure the sustainable development of the general construction and services sector and also contribute towards sound environmental management in the general construction and services sector;
- **Environmental Assessment in Ghana, A Guide (1996)** produced by the EPA provides detailed guidance on the procedures to be adhered to when undertaking an EIA;
- **Environmental Quality Guidelines for Ambient Air (EPA)** provides advice on maximum permissible levels of a variety of air pollutants;
- **Environmental Quality Guidelines for Ambient Noise (EPA)** provides advice on the maximum permissible noise levels; and
- **Ghana's EPA Guidelines for Discharges into Natural Water Bodies** provide maximum permissible concentrations for a number of parameters.
- **Target Water Quality Ranges (TWQR) of the Ghana Raw Water Quality Criteria and Guidelines (Volume 4(B): Agricultural Water Use (Irrigation))** this provides the national Ghana Raw Water Quality Criteria and Guidelines levels as administered by the water Resources Commission.

## 2.10 Relevant Legal Approvals – Permit/Licenses/Certificates

The relevant approvals required for the implementation of the Project are summarized in **Table 2-8**. The list is indicative and will be updated as the project design progresses.

**Table 2-8: Key regulatory approvals**

Regulatory body	Permits/licenses and certificates	Applicable	Project Phase	Remarks /Status
Environmental Protection Agency	Environmental Permit	Yes	Prior to Construction Phase	After acceptance of final EIS by the EPA.
	Environmental Certificate	Yes	Within 24 months of commencement of Operations	After preparation of first EMP. Renewable every three years
Energy Commission	Acquisition of provisional licence	Yes	During the planning and design stage	-
	Acquisition of siting clearance (siting permit)	Yes	Prior to commencement of construction works	Requires Environmental Permit

Regulatory body	Permits/licenses and certificates	Applicable	Project Phase	Remarks /Status
	Acquisition of construction work permit (authorization to construct)	Yes	Prior to commencement of construction works	After obtaining Environmental Permit
	Acquisition of operational licence	Yes	Prior to commencement of operation	- After obtaining Environmental Permit
Ghana Maritime Authority	Marine Safety Permit	Yes	Planning phase	For all vessels including dredgers
	Permit to operate in Ghanaian waters	Yes	Planning phase	For all vessels including dredgers
Ghana Ports and Harbours Authority	Permit for sand borrow and offshore disposal of dredge material	Yes	Construction phase/ prior to dredging	After submission of Dredging Management Plan or Dredged Materials Disposal Plan
Fisheries Commission	Approval and confirmation of minimal impact on fisheries	Yes	Construction phase/ prior to dredging	After submission of project description
Ghana National Fire Service	Fire Permit/ Certificate	Yes	Construction of office buildings/ facilities	Renewable on annual basis
Tema Development Corporation	Development and building approvals (for office buildings/ facilities)	Yes	Prior to construction of facilities	-
Factories Inspectorate Department	Certificate of Registration	Yes	Construction and Operation phase.	Renewable on annual basis

### 3.0 DESCRIPTION OF THE PROPOSED PROJECT

#### 3.1 Location of the Proposed Tema LNG Terminal Ghana Project

The proposed Tema LNG Terminal Ghana Project falls mainly within the Tema Metropolis in the Greater Accra Region (see **Figures 3-1 to 3-3**). The floating infrastructure of the project will be sited just outside of the entrance of the Port of Tema to the southeast of the existing outer breakwater of the main port (see **Figure 3-2**). The infrastructure will be protected by an extended breakwater of approximately 800m in length, which connects close to the tip of the existing outer breakwater.

The site proposed is in a semi-protected location and provides excellent conditions to place the proposed floating infrastructure. The direct access to open and sufficiently deep-water will ensure safe berthing of approaching LNG carriers without influencing neighbouring industrial operations. DNV-GL has carried out a shipping and safety distance analysis that confirms that the location of the project will not interfere with the existing port activities. In addition, a quantitative risk assessment (QRA) has been carried out by Bureau Veritas to confirm the suitability of the site in relation to public safety.

The proposed 8 km pipeline, submerged across the main port channel and extend onshore along the existing oil and LPG pipeline right of ways, owned by the Tema Oil Refinery, as well as GRIDCo right of ways on the VALCO property in the Tema Metropolitan Area. The pipeline will connect to the existing Volta River Authority header station located in the Kpone Katamanso Municipal Area as shown in **Figure 3-3**.



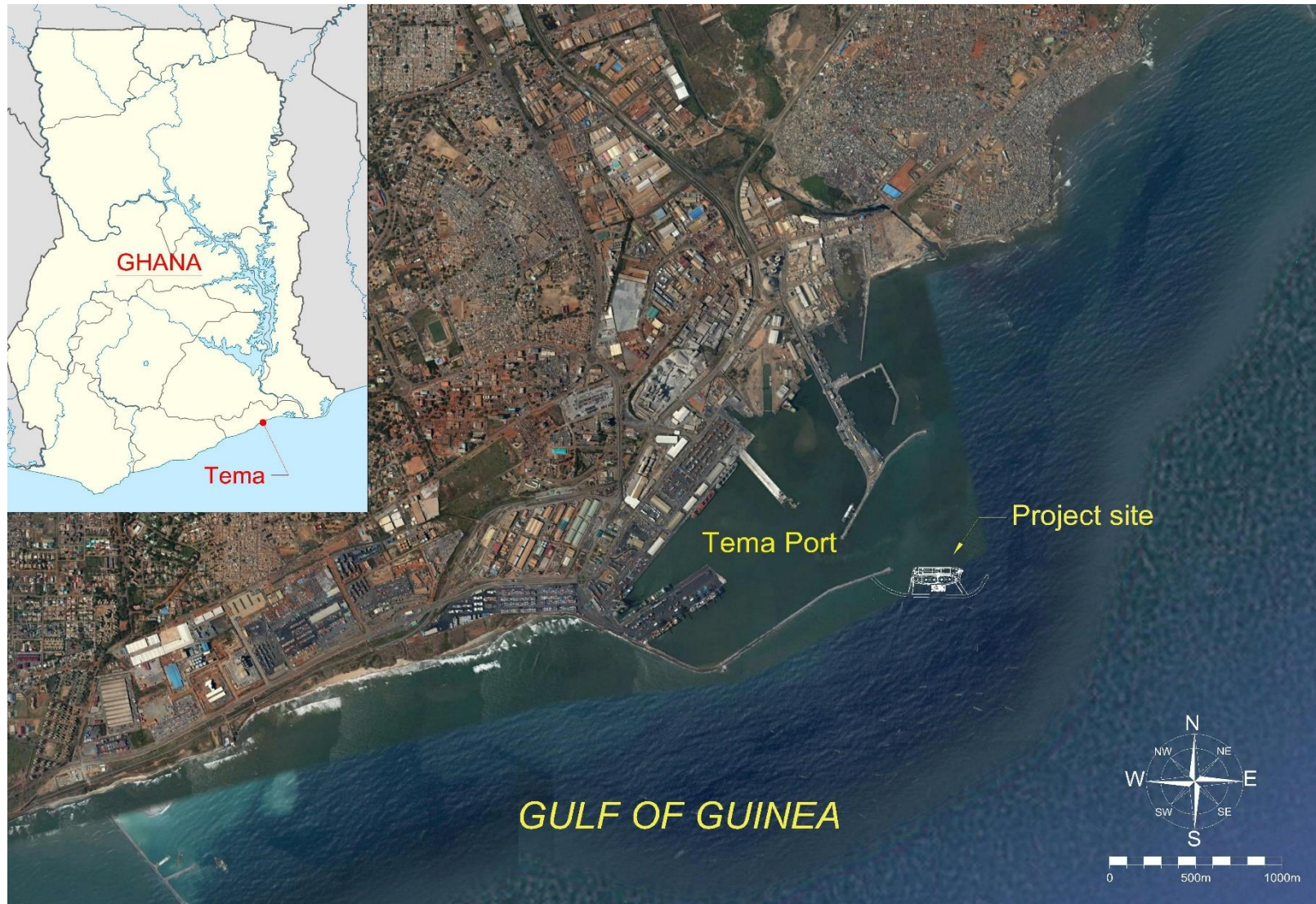


Figure 3-1: Overview of Project Area



Figure 3-2: Location of project marine infrastructure



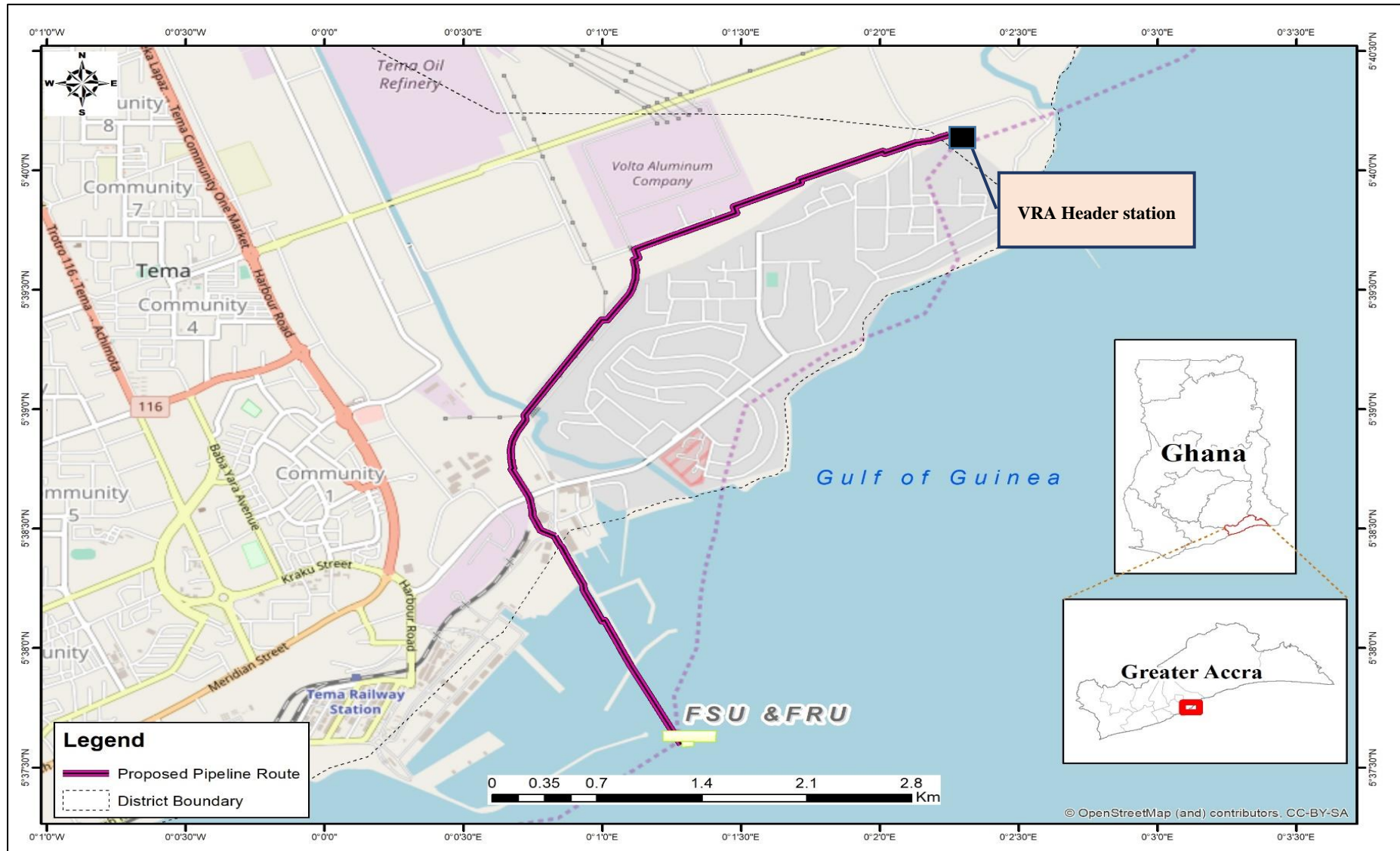


Figure 3-3: Location of proposed project sites



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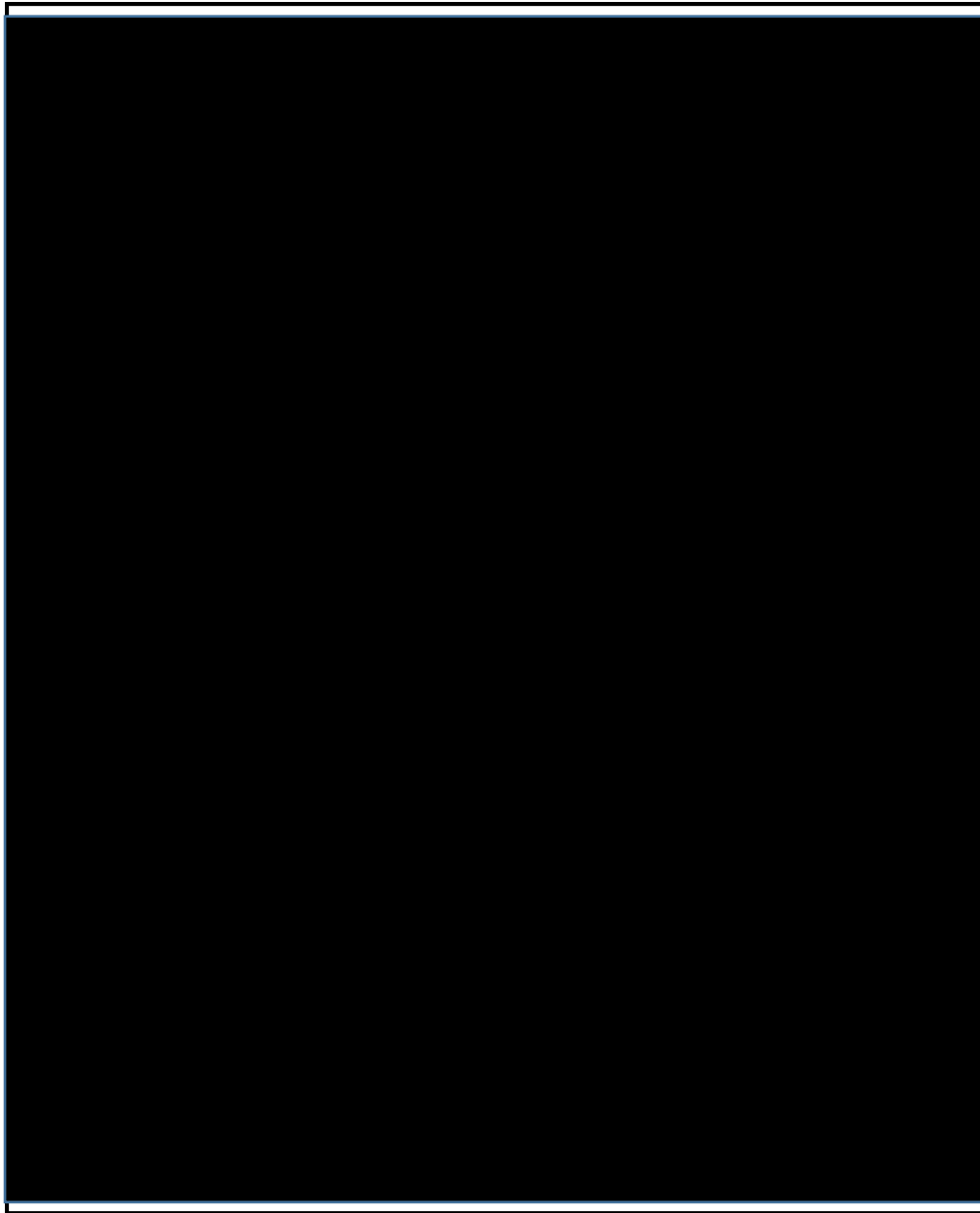
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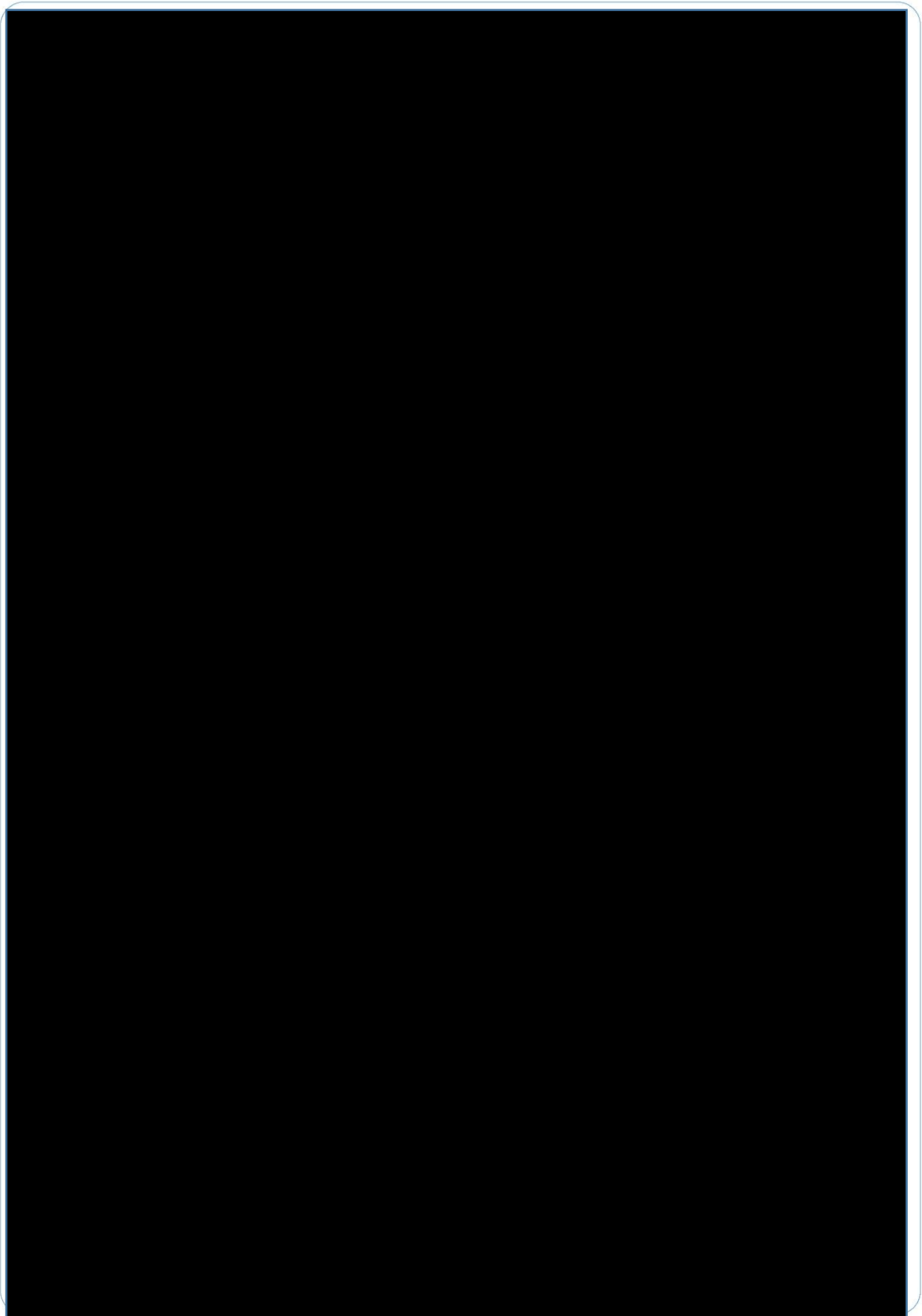
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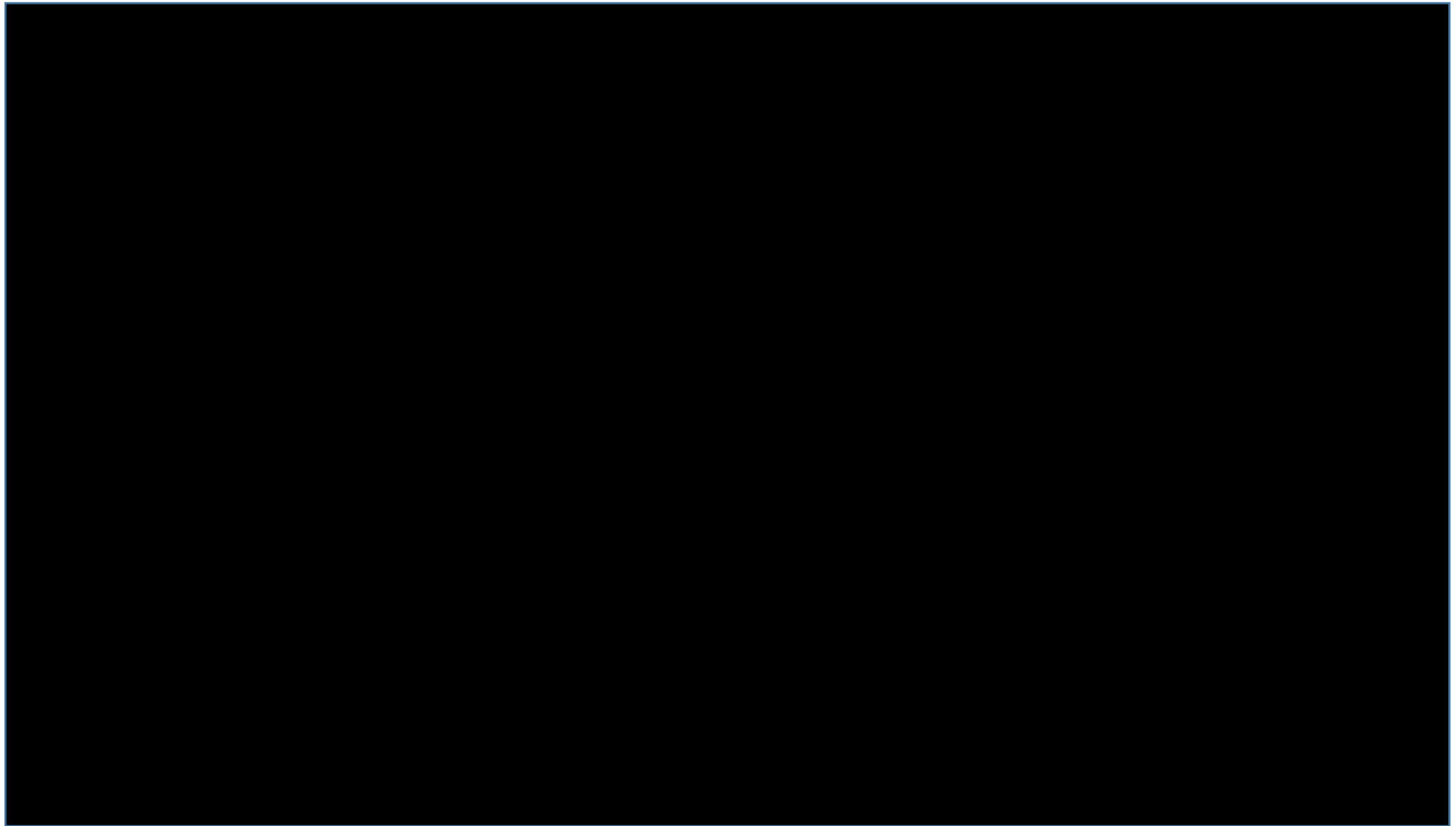
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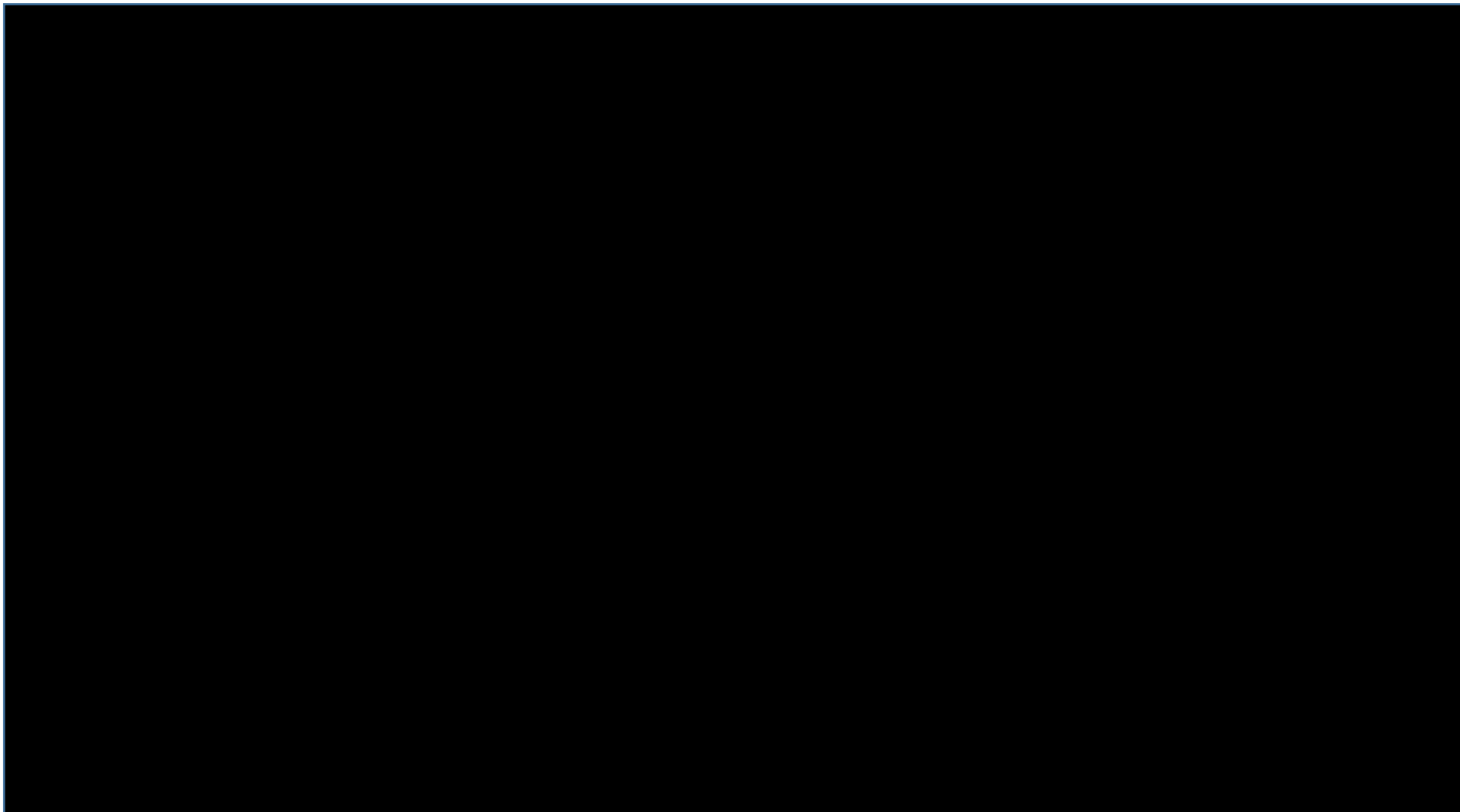
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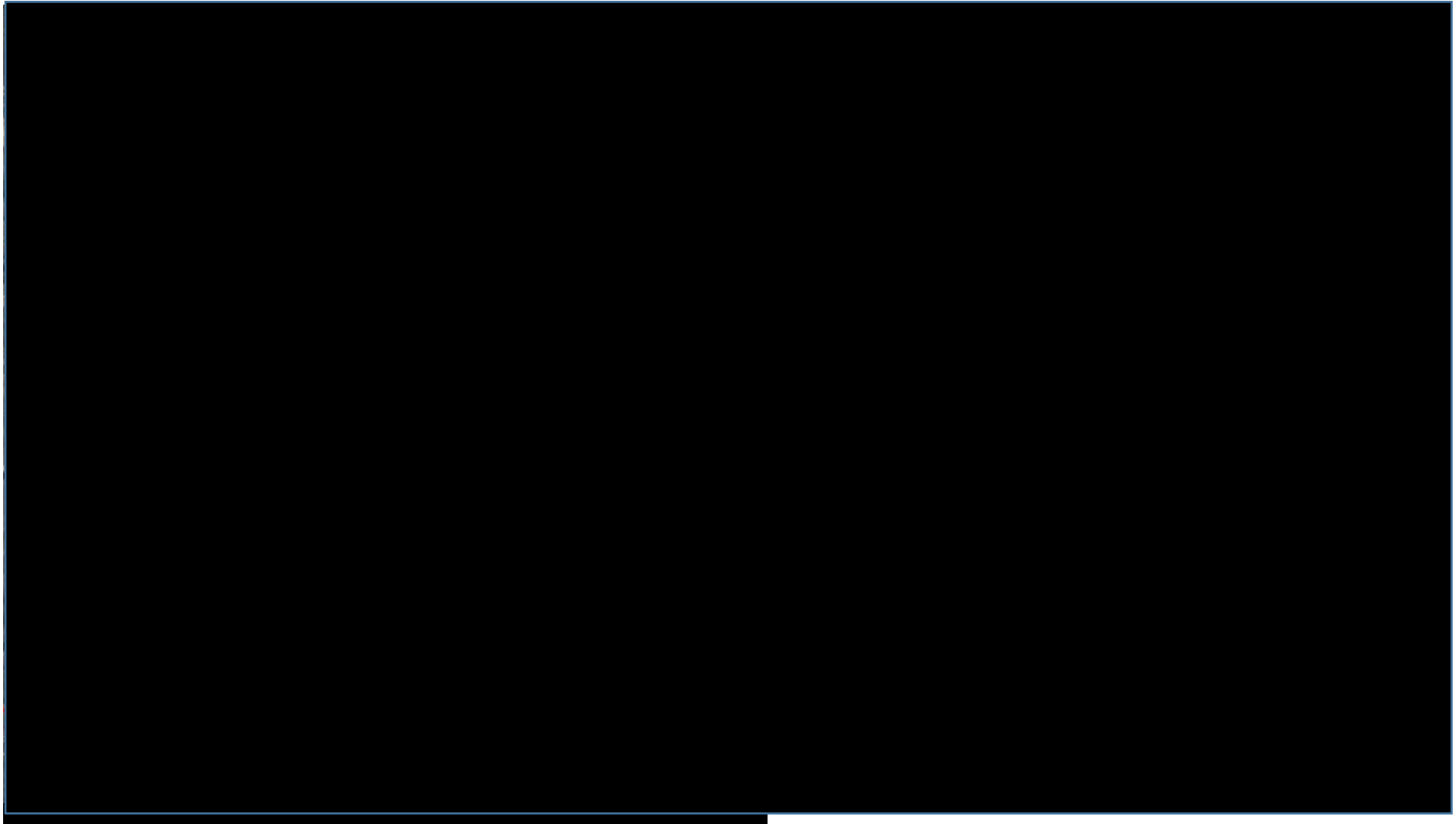




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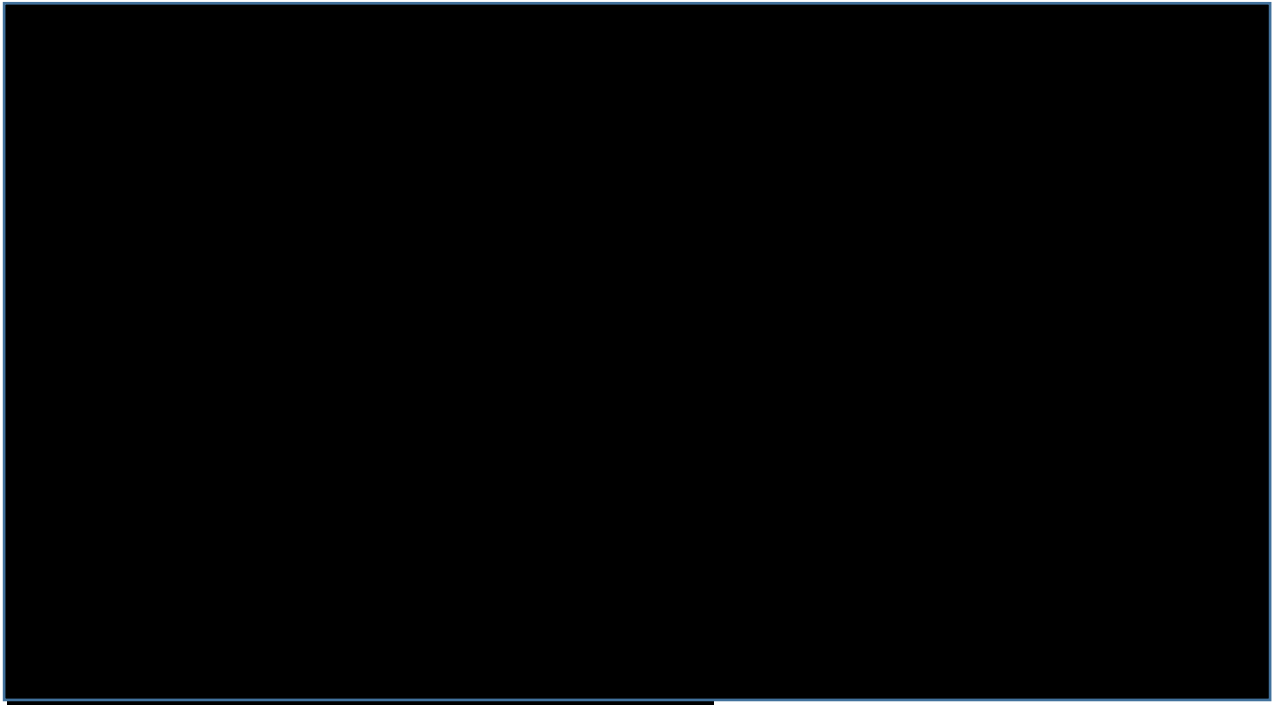
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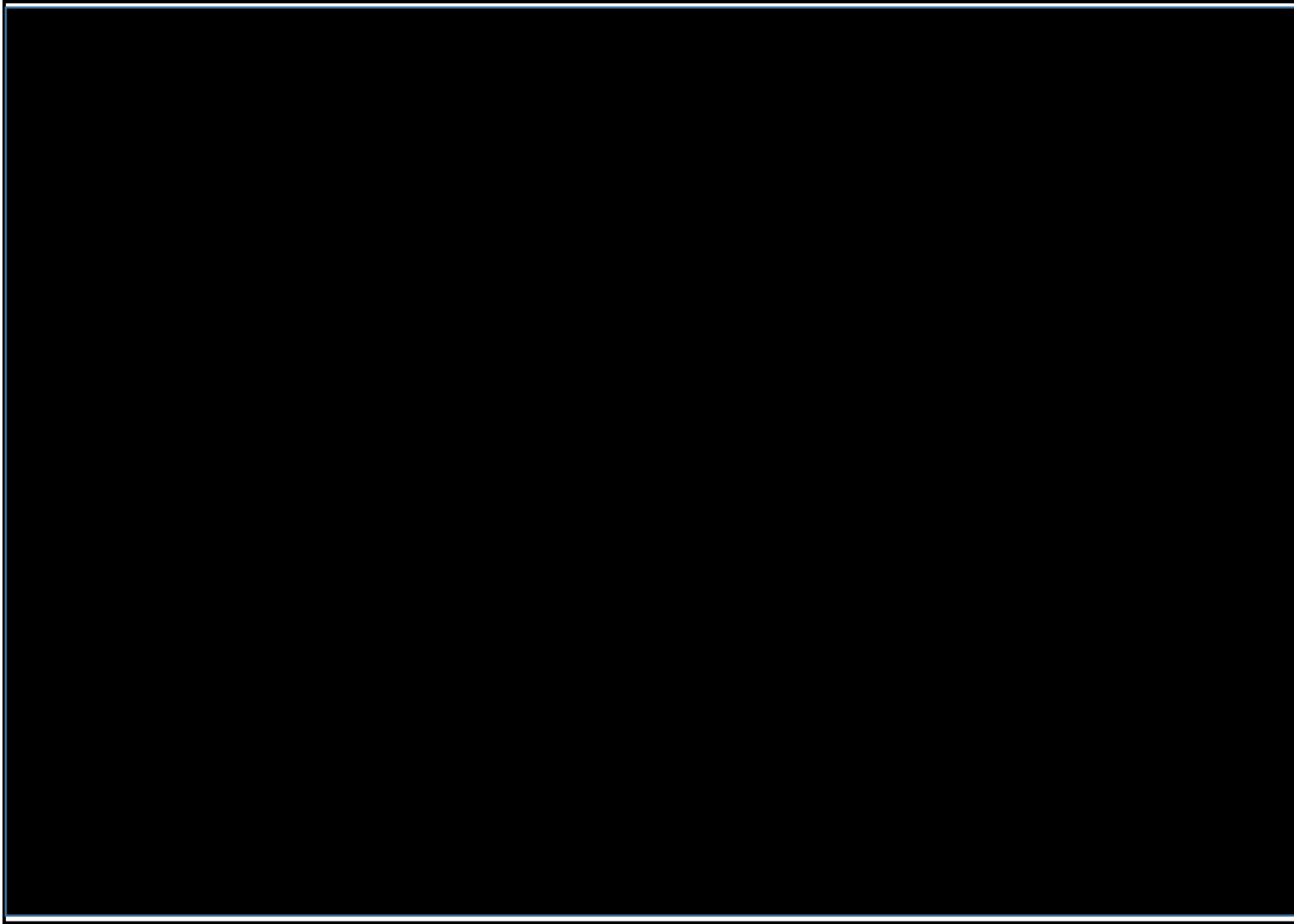
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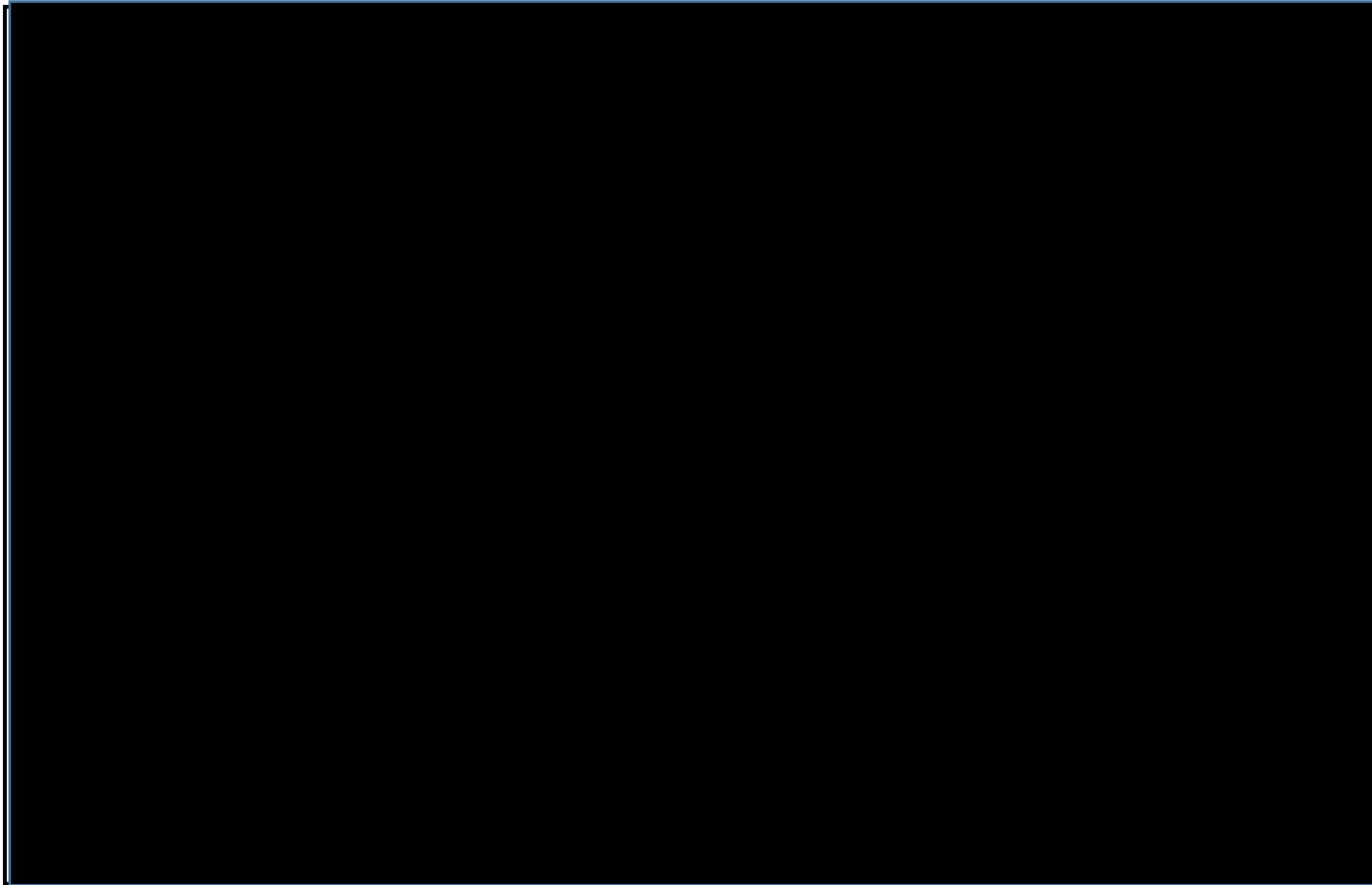
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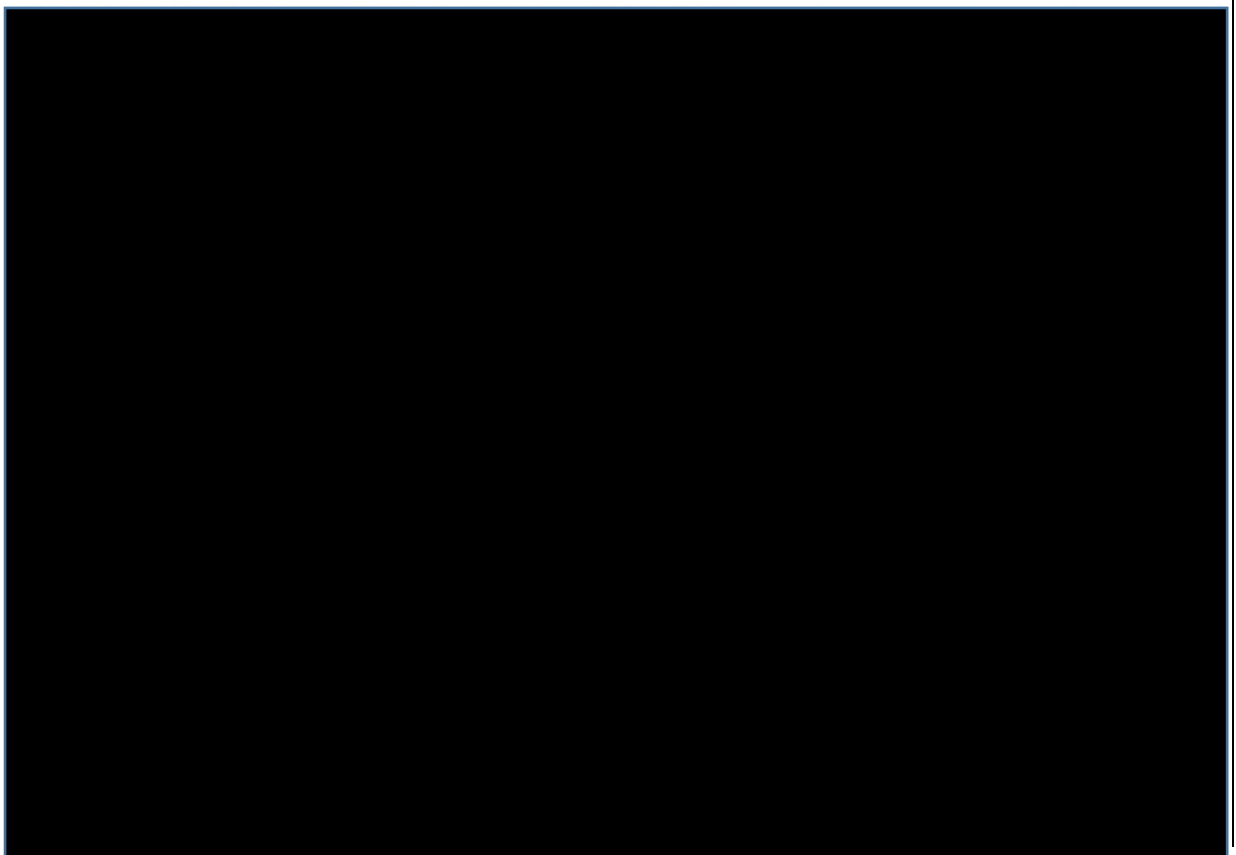


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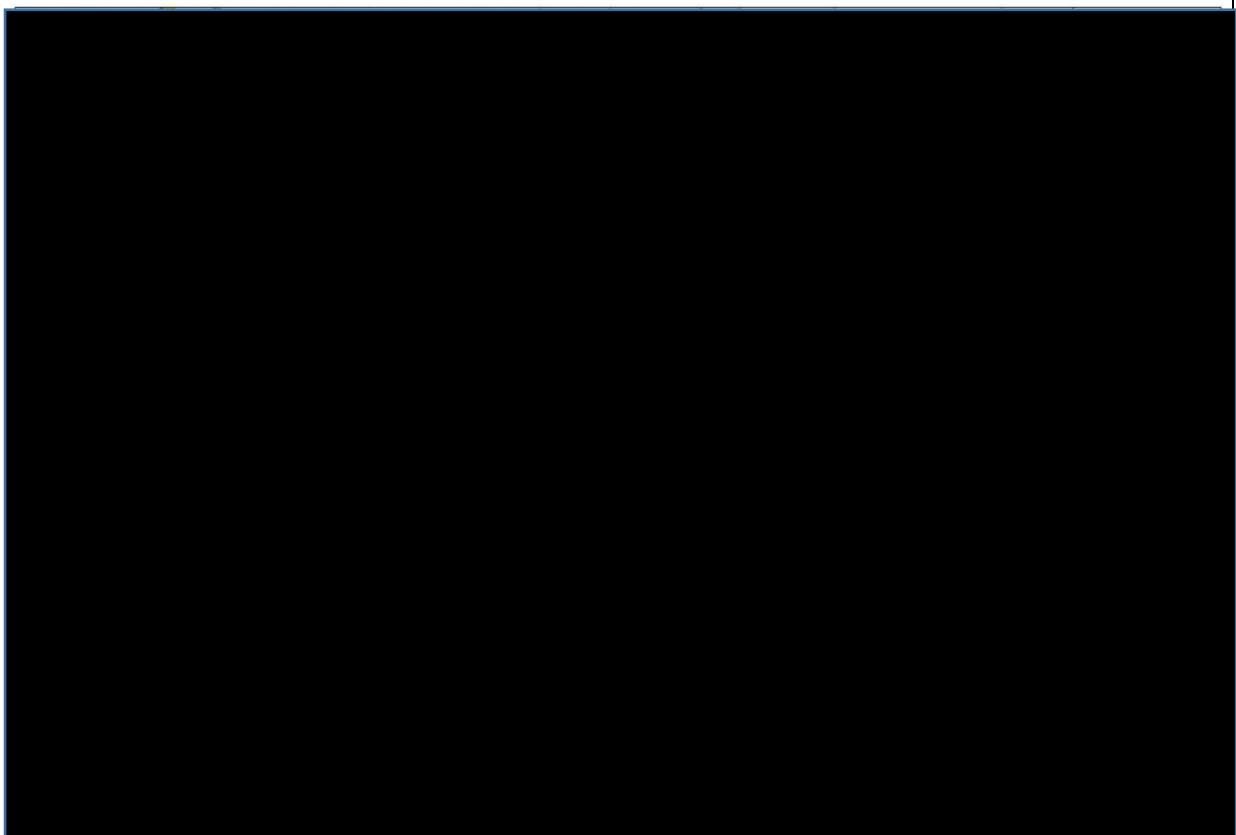
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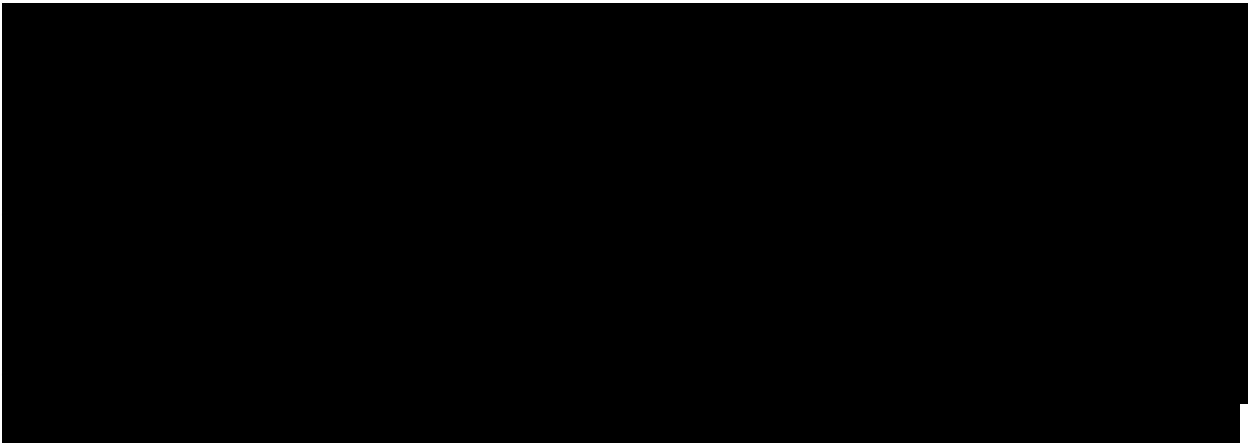
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## 5.0 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

This chapter provides a description of the environmental and socio-economic baseline within the project sites and areas where the direct and indirect impacts of the project are likely to occur. These cover the sites for work camp facilities, the pipeline corridor and the local communities near the pipeline as well as the marine and socio-economic environment at a wider scale.

This chapter summarises information available from secondary sources and previous reports (e.g. The Final EIS for Tema Port Infrastructure Development, July 2015, Revised EIS for the Proposed Development of Tema Port Access Roads, November 2017 and feasibility study reports for the Tema Port Expansion Project).

### 5.1 Project Area of Influence

According to the IFC Performance Standard 1, the area of influence encompasses, as appropriate:

- The area likely to be affected by: (i) the project (e.g. project sites, immediate airshed and water shed or transport corridors) and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable (e.g. railways, roads, transmission lines, pipelines, warehouses, logistics terminals).
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted (e.g. incremental contribution of gaseous emissions to an airshed, reduction of water flows in a watershed due to multiple withdrawals, increases in sediment loads to a water shed, interference with migratory routes or wildlife movement, or more traffic congestion and accidents due to increase in vehicular traffic on community roadways).

The ESIA study addresses the Project Area of Influence (AoI) which encompasses all areas directly and indirectly affected by the Project components such as the FSU, FRU, the mooring system, the offshore and onshore gas pipelines, VRA header station as well as sites for related and associated facilities and their corridors. This ESIA refers to the:

- Project Affected Area (PAA): the area where sea or land is required for construction of any component of the Project and the actual Project footprint; and
- Project AoI: is the PAA and the surrounding vicinity where the Project can affect receptors even if there is no direct Project activity taking place.

**Figure 5-1** shows the project facility sites and key features likely to be impacted. The project area of influence for the offshore facilities including subsea pipeline during construction is the immediate area to be dredged, the proposed offshore disposal site for dredged materials about 15 km from the dredging site (specific site yet to be determined and approved), potential receptors of sediment transport/fish from dredging activities such as the main Tema harbour, nearby Fishing



harbour (about 1km) and landing beach (about 1.5 km) and the Chemu lagoon (about 1.8 km), and in the worst case, the Gao lagoon (5.4 km).

The construction of the 800m breakwater will require supply of quarry materials from the Shai hills located about 35km to the Tema Port. The supply of quarry products may influence public safety and traffic conditions along the transportation route, i.e. Afienya –Tema Harbour road section of the Tema Akosombo road.

During operation, the project area of influence for the offshore facility is influenced by the extent to which explosion or accidental fire events will impact on nearby properties. The preliminary risk assessment study on public for the offshore facilities for the occurrence of jet fire, pool fire, and flash fire give a total distance of 460 m from the facility. The distance for extent of explosion coverage is yet to be determined.

For the onshore pipeline facility, the project area of influence during the construction phase is the 20 – 40 m proposed pipeline RoW required due to equipment/machinery and material space. Dust and exhaust fumes during construction of the pipelines from construction activities and equipment may be carried by wind to nearby receptors such as residential facilities of nearby local communities about 100m away and the Valco clinic about 100m from the pipeline route. The Chemu stream, which will be crossed will also be influenced by transport of exposed or eroded soil/sediments.

During the operation phase, the project area of influence includes the 3.5m to 20 m RoW requirement and the area of impact in the event of an explosion, which is likely to extent to beyond 100m (i.e. not yet confirmed). During operation, 3.5 m RoW will be permanently required and land use on this 3.5 m RoW will be restricted. The 20 m RoW to enable access to the pipeline, which is most cases the Valco dedicated road can provide such access to the pipeline within the Valco property.

The indirect positive impact of the project will have far-reaching effects nationwide from the utilisation of natural gas produced from the Tema LNG Terminals Ghana Project.

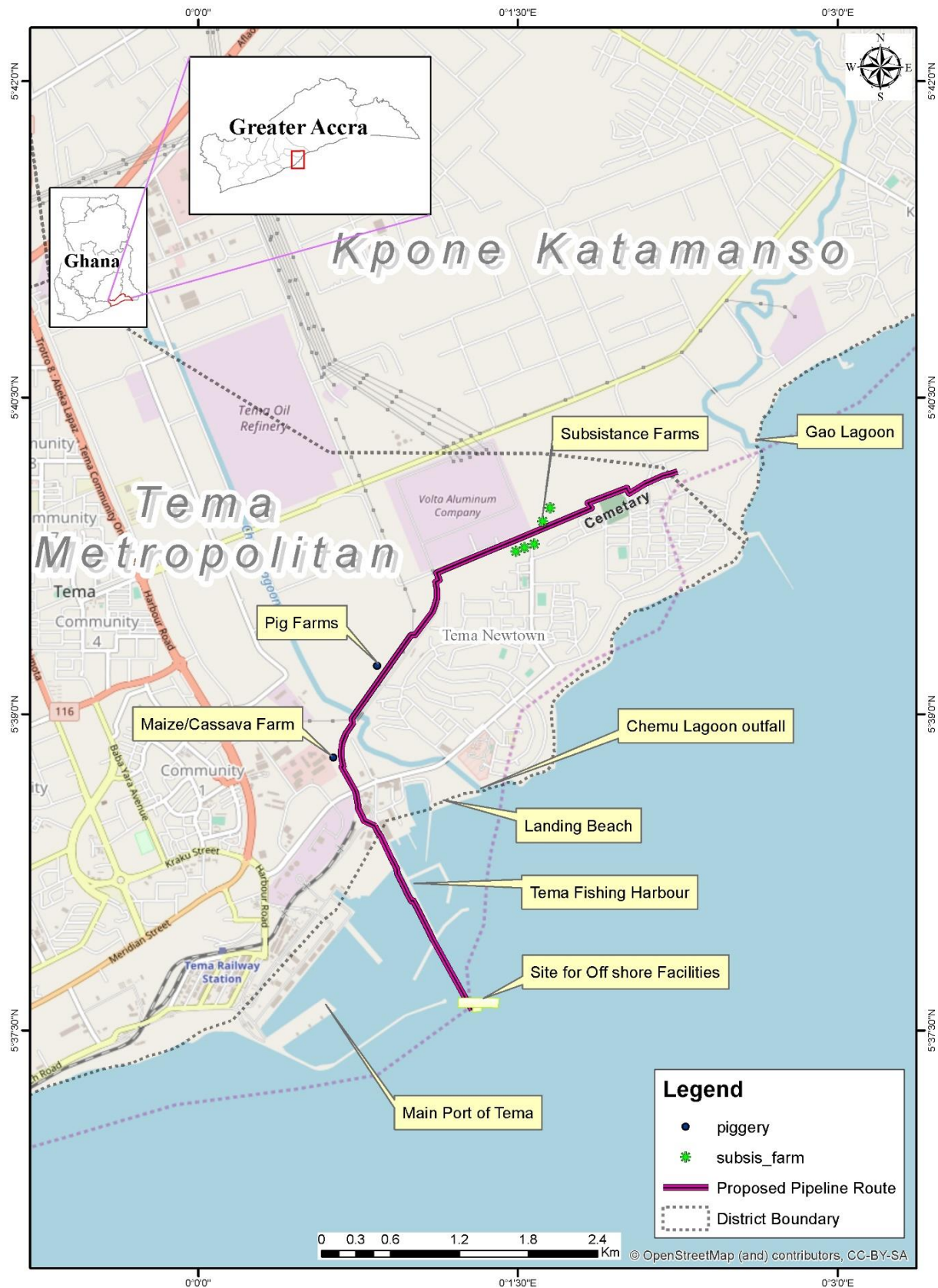


Figure 5-1: Project sites and key environmental/social features likely to be impacted

## 5.2 Physical Environment

### 5.2.1 Geology & Geotechnical Investigations

The Tema Harbour area is underlain by the Dahomeyan System of rocks consisting of heterogeneous assemblage of sericitic, biotitic or chloritic quartz schist. In some areas, many small amphibolite dikes occur in the rocks. Primary porosity as well as fracturing of the massive paragneiss is very low. The groundwater potential is poor. Generally, groundwater protection is of less concern in the Dahomeyan formation.

The harbour area lies in the Accra plains and falls under the Dahomeyan Precambrian formation. The decomposed weathered rocks are predominantly sandy clay. The lithological composition of the Dahomeyan System indicates that it represents a metamorphosed sedimentary or volcano-sedimentary sequence. The project area forms part of the middle Precambrian Dahomeyan rock system consisting of basic and acidic gneisses and schist with occasional bands of quartzite, which are hard, foliated and folded.

#### 5.2.1.1 Earlier Geotechnical Surveys

Various geotechnical investigations have been carried out within the Tema Port area between 1992 and 2013, as shown in **Figure 5-2**, locations of boreholes in the Tema Harbour area. The most relevant survey near the proposed project area is the 1992 investigations and this is summarised below.

Messrs Alluvial Mining and Shaft Shifting Company Limited conducted underwater investigation of the harbour basin on behalf of GPHA in 1992 under the supervision of Messrs Boskalis International BV. The geotechnical survey involved drilling of 17 boreholes to an average depth of 4m, using a pilkton Traveller P.N.4 hydraulic rotary rig with a triplex pump, to obtain a reliable impression of the soil and rock conditions. The findings from the investigation are presented below. The harbour basin has a general hard ground consisting of mainly metamorphic rock (light/dark banded gneisses), subdivided into rock types A1, A2, A3 and A4.

#### *Rock Type A1*

This rock type consists of micaceous gneiss which occurs in the inner part of the port basin and is predominant around the berthing areas (BH 1 to 7) and around the fishing harbour entrance (BH17). This rock type is moderate to strong foliated medium grained gneiss, having distinct micaceous bands of approximately 1mm. The opaque quartz bands (1-20mm) give the rock a platy appearance. The platy character of the mica causes fault development which weathers in to chlorite. Large elongated, lens shaped quartz fragments are also common in the mica rich bands. The mica content varies from 10% to 40% with high amounts recorded in BH 2.5, and 6. The rock has quartz-filled veins occurring parallel to the foliation. A sub-vertical and steep dipping (70 degrees) fracture is also common, with iron and clay materialization fractured surfaces.



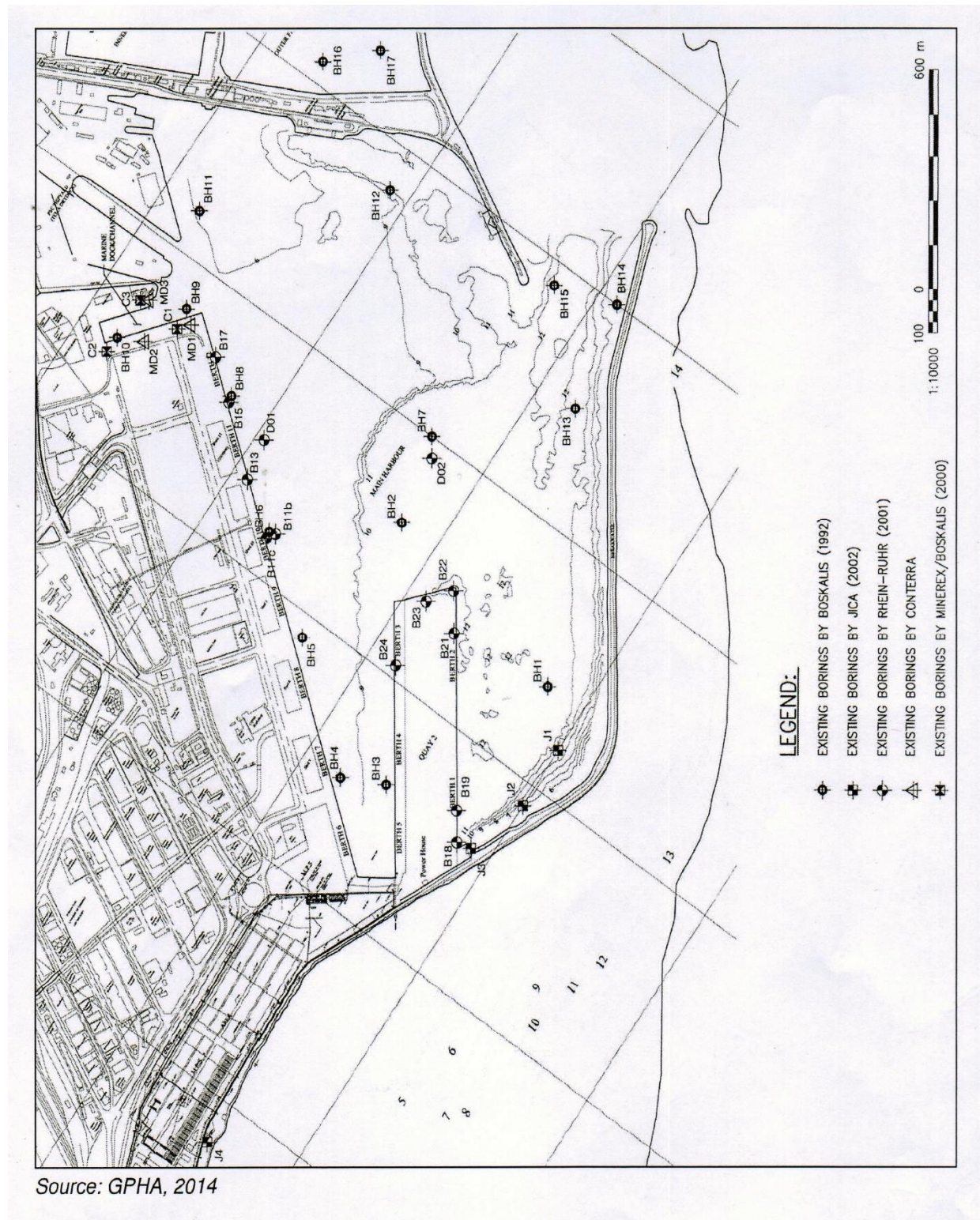


Figure 5-2: Locations of boreholes in the Tema Harbour Area

### *Rock Type A2*

This includes the Leucocratic granitic gneiss that forms the predominant rock at the port entrance. These are predominant around the main Harbour entrance (BH 12 and 15) and at the Fishing Harbour entrance (BH 16). These are medium to coarse grained granite with elongated lens shaped crystal, forming a weak foliation. It has a characteristic opaque purple quartz (30%) and pinkish, green weathering feldspar with few dark minerals. BH 15 has the lowest mica content with no elongated crystals and insignificant foliation. The mica content is however highest in BH16. The rock samples from BH 16 were very hard and compact with the highest mica content. These rocks have fractures developed at 60 degrees sub-vertical and along foliation. The fractured surfaces also have a covering of iron oxide and clay minerals.

### *Rock Type A3*

These are felsic-quartz gneiss which form the predominant rock underlying the eastern part of the port, (BH 8, 9, 10, and 11) and at the entrance (BH 13 and 14). They have fine grained gneisses with light quartz bands (50%) with lenses alternated by dark felsic minerals. They also contain biotites and amphiboles. Rock samples from BH 14 have almandine granite garnet which makes them hard and dense, showing no fracture. In the westerly direction, this rock type seems to grade in to rock type A1 with relatively more quartz and mica.

### *Rock Type A4*

These include the bioclastic limestone found exclusively near the port entrance (BH 13 and 15). These have a high porosity due to dissolution of shell fragments. They have high amounts of lithic clasts with sub-rounded, poorly sorted irregular shaped fragments ranging between 1-50mm of rock type A. They have a layer of dark grey silt as surface soil.

## **5.2.1.2 Proposed Offshore Site Geotechnical Investigations**

As part of the field investigations for the project design, [REDACTED] engaged Project Management International (PMI) to undertake an offshore geotechnical investigation at a pre-determined block for the proposed LNG facility. The survey area encompassed the approaches and entrance channel to the Tema Port. Drilling of the marine boreholes commenced on 26<sup>th</sup> December 2017 and was completed on 26<sup>th</sup> January, 2018. The location of the survey area, with Google Earth backdrop and proposed design overlay, is illustrated in **Figure 5-3**. The Geotechnical Site Investigations (GSI) included a total of 22 boreholes ranging in depth from 3.00 to 26.00 m below seabed. A summary of the borehole drill depth and coordinates is provided in **Table 5-1**.

**Table 5-1: Summary of the geotechnical borehole drill depth and coordinates**

Location	BH no.	Drill depth (m below seabed)	Coordinates and Elevation		
			Eastern	Northern	Elevation (m cD)
Area for marine structures	BH-D1	25.00	169981.95	622748.88	-14.78
	BH-D2	25.70	170071.15	622755.43	-15.22
	BH-D3	25.00	169985.33	622701.96	-15.49
	BH-D4	25.50	170079.08	622707.91	-15.70
	BH-D5	25.70	169838.97	622692.58	-14.75
	BH-D6	25.05	169883.80	622694.84	-14.88

Location	BH no.	Drill depth (m below seabed)	Coordinates and Elevation		
			Eastern	Northern	Elevation (m cD)
	BH-D7	25.00	170142.73	622714.09	-15.83
	BH-D8	8.60	170208.05	622731.70	-15.83
	BH-D8A	7.80	170209.58	622729.47	-15.83
	BH-D8B	26.00	170223.89	622746.25	-15.85
Breakwater area	BH-D9	15.00	169709.98	622687.74	-14.32
	BH-D10	6.60	169951.19	622641.15	-15.20
	BH-D11	13.80	170194.60	622661.27	-16.35
	BH-D12	5.30	170305.03	622762.99	-15.83
Subsea pipeline route	BH-D13	10.00	169796.44	622974.39	-13.06
Along dredge channel	BH-S1	4.00	169949.96	622926.24	-13.50
	BH-S2	3.50	170202.98	623068.75	-14.18
	BH-S3	4.00	169837.59	623089.09	-12.30
	BH-S4	3.00	170354.30	623005.54	-15.23
	BH-S5	3.85	170031.18	623178.98	-12.90
	BH-S6	4.50	170306.26	623268.03	-13.58
	BH-S7	5.50	169735.94	623288.90	-11.10
	BH-S8	5.00	170078.34	623299.97	-12.22
	BH-S9	3.00	170612.66	623159.44	-14.96

### SPT Testing

Within the soil deposits SPT tests were taken at intervals of typically 1.5m but in some locations where sample recovery was difficult, SPT's were done at 1m intervals. In soft clay horizons Shelby Tube samples were taken. The SPT results for the D-series and the S-series of boreholes show typically firm conditions within the upper 1.0m to 1.5m and thereafter it becomes very stiff.

### Ground condition overview

Along the line of the proposed breakwater, heading from west to east the ground conditions typically comprised of the following:

- BH D9, D5, D6, D10, (&D13 situated north of the area) – moderately weathered Gneiss at 4.4m depth becoming around 10m depth at locations D5 and D6 (7.8m at D13) then rising again D10 to 3.5m. These are overlain by either completely weathered Gneiss or residual soil (recovered as silty sand and some gravel of quartz). The surface marine deposits are typically thin (~0.3m).
- BH D1, D3, D4 – Moderately weathered and highly weathered Gneiss at around 2.5m deepening to 5m at D1. These are overlain by marine deposits of sands and clays although at D1 a 1.2m thick residual layer occurs between the marine and Gneiss horizons.
- BH D7 – this hole is similar to the first group in which highly weathered Gneiss occurs at 5.3m depth however unlike the adjacent BH D4, this hole has a greater depth of residual soil with marine deposits being 1.7m deep.
- BH D11, D8, D12 – Highly weathered Gneiss is encountered between 0.7m and 4m depth. It is shallowest at D12 (furthest east), deepest at D8B and intermediate depth (~2m) at D11. The marine deposits are typically 0.7m deep and depending on the depth of the highly weathered Gneiss, the mid layer is variable thickness of completely weathered Gneiss.





**Figure 5-3: Location of Geotechnical and Marine Survey Area**

Shallow boreholes for dredging purposes along and on the side of the existing entry channel encountered the following typical conditions:

- BH S1, S2, S4, S5, S9: 2.5-3m of Marine deposits of sand, sandy clays and sandy silts overlying completely weathered Gneiss or residual soils.
- BH S3, S7: a thin cemented sand layer or coral 0.1-0.2m thick overlying marine deposits of sand to 1.5-1.9m over residual soil or completely weathered Gneiss which at BH S7 becomes moderately weathered at 3.4m depth.
- BH S6: 1.7m of marine deposits of sandy silty clay over highly weathered Gneiss to 2.4m then slightly weathered Gneiss.
- BH S08: This hole encountered a thin (0.45m) layer of sand (marine deposit) over moderately strong calcite cemented sand to 2.4m deep overlying slightly weathered Gneiss.

### 5.2.2 Coastal Stability

The coastline is mainly covered by sand, partially with exposed rock. Revetment made of gneiss block can be found along coastline. According to "Environmental and Engineering Geology for Urban Planning in the Accra- Tema Area" by R. Muff and J. Quaye (see **Figure 5-4**), the shore stability is medium to high at the site, but the shore stability is low near Sakumo II and Chemu lagoon outfalls.

### 5.2.3 Seismicity

The design specifications for seismic parameters in Ghana are determined by the seismic zoning map (**Figure 5-5**), which shows the two main seismogenic zones of Ghana as the Axim-Elmina (A) and Accra-Ho (B) regions. The Accra-Tema corridor of the Accra-Ho seismic region is the most active and most susceptible earthquake area in Ghana. Therefore, as a precautionary measure it will be prudent to factor seismic concerns into the designs.

The Accra-Ho region earthquakes come mainly from reactivated faults in the Romanche fracture zone with some influence from the St. Paul's fracture zone system. Seismotectonic movements along the St Paul's transform and fracture zones have quieted significantly in the last century; but movement is taking place even in the present day along the Romanche transform-fracture zone system, causing on- going seismicity of southern Ghana (Kutu, 2013).

Significant earthquake activity has been reported in the coastal region of the country, that is, along the Gulf of Guinea, where earthquakes up to magnitude 5.5 to 6.5 according to the Richter scale have been historically recorded (in 1906 and 1939) and occur on repetitive periods of between 50 and 140 years.

Available records indicate that Seismic activity in southern Ghana is believed to be caused by movement along two active fault systems; the Akwapim Fault along the Akwapim mountain range which trends approximately NE-SW and is located about 20km west of Accra and the Coastal Boundary Fault which lies some 3 km offshore and runs almost parallel to the coastline in the vicinity of Accra. Tema lies between these two fault zones.



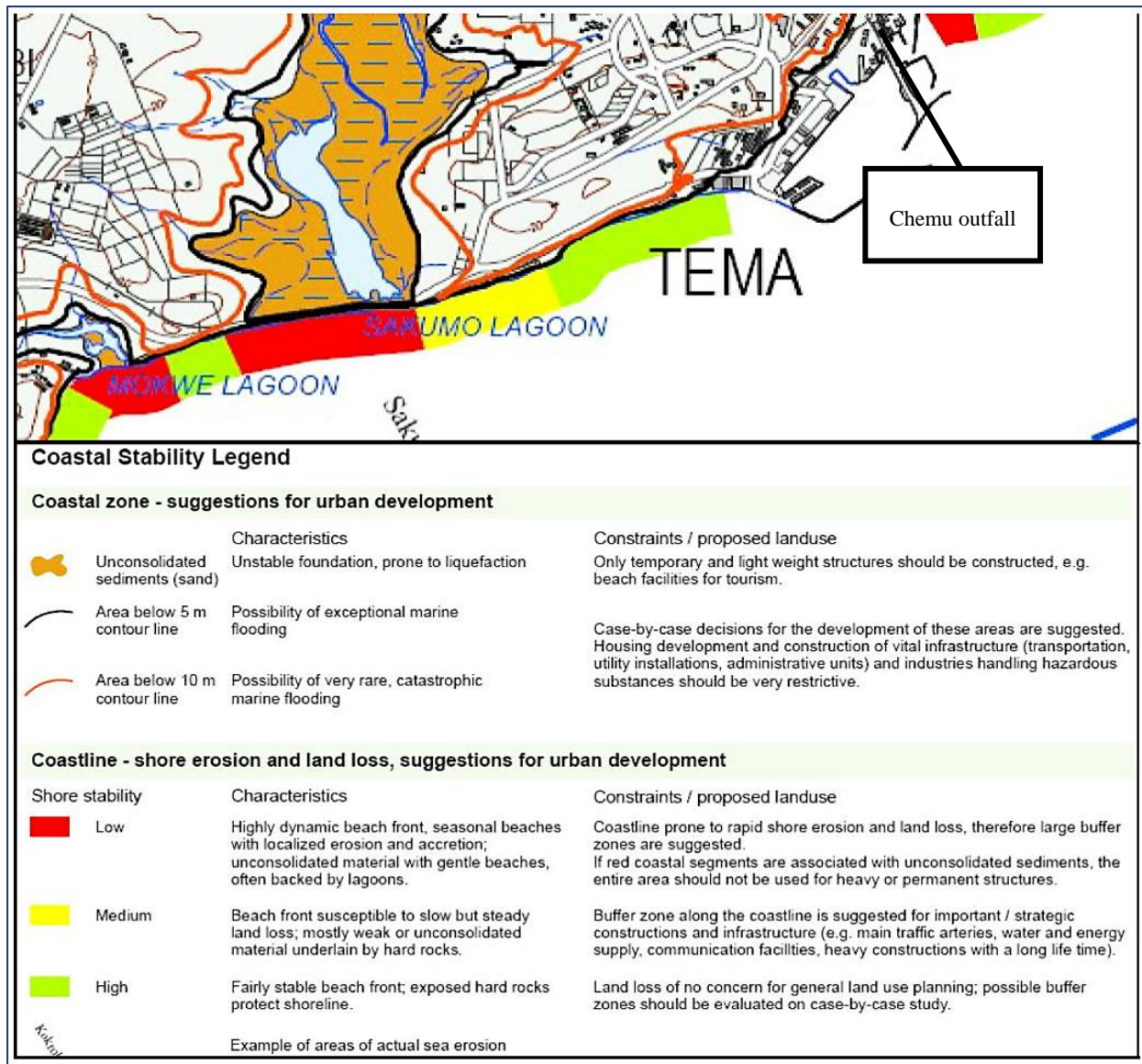


Figure 5-4: Coastal stability map of the project area (Source: R. Muff and J. Ouaye, 2006)

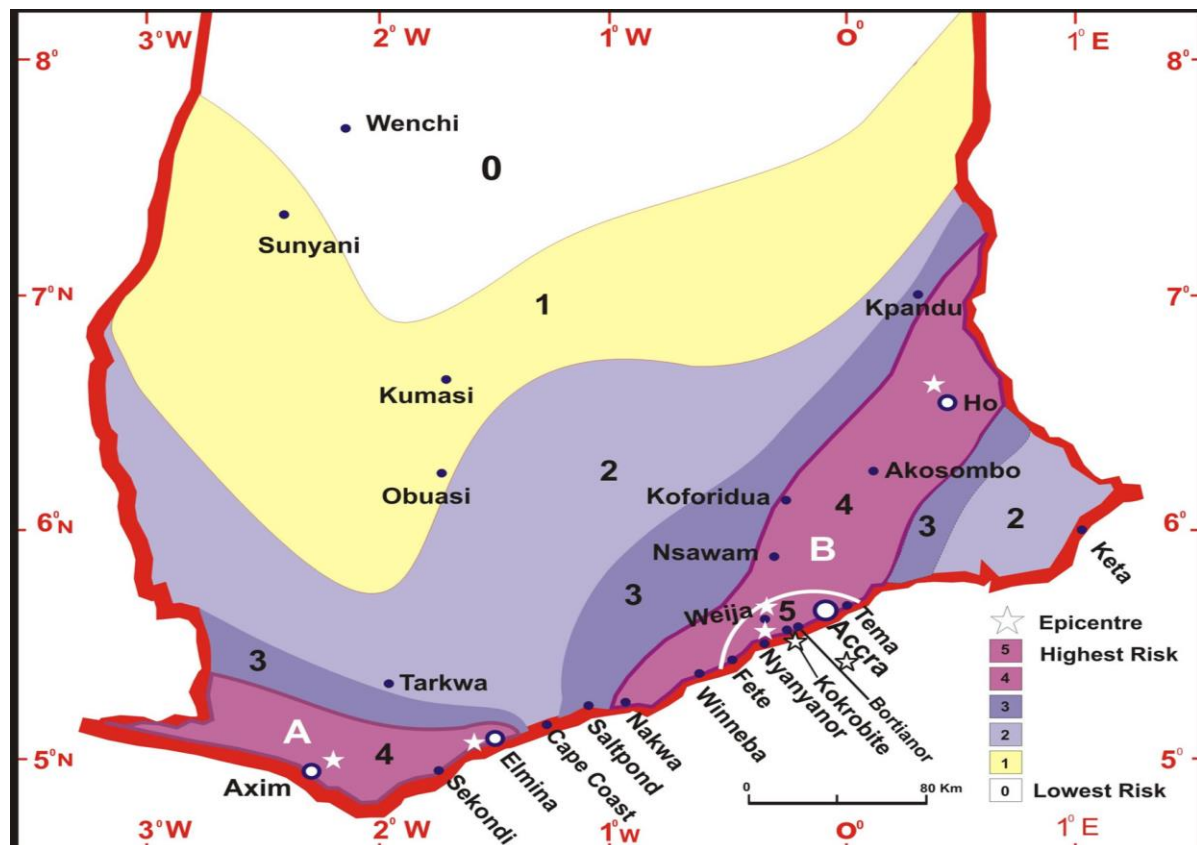


Figure 5-5: Seismic zoning map of Southern Ghana (Source: Kutu, 2013)

It was reported after the Accra Earthquake of June 1939, which measured 6.5 on the open-ended Richter scale, that portions of the Tema area was located in the Isoseismic V intensity zone. In recent, times seismic events on minor scales between 2 and 4 on the Richter scale, have been measured three or four times a year; and it is likely that the coastal fault is renewed with each event.

Building foundations, water and sewage pipes, oil pipelines and power cables might therefore be affected in the event of a major earthquake of the magnitude of that of 1939. The seismic factor should be taken into consideration in the development of quay extension structures.

#### 5.2.4 Marine Survey and Bathymetry

As part of the field investigations for the project design, Project Management International (PMI) was engaged by [REDACTED] to undertake a geophysical investigation of a pre-determined block for the proposed LNG facility. The survey area encompassed the approaches and entrance channel to the Tema Port. Survey operations took place from 03 – 06 December 2017.

The objective of the survey is to determine the characteristics of the seabed and sub bottom for future construction of a piled jetty structure, breakwater and dredging purposes. The following scope of works was performed:

- Marine survey over a nearshore area of approximately 200 ha, consisting of:
  - Bathymetric survey (with single beam echo sounder);
  - Side scan sonar;
  - Sub bottom profiling (with pinger); and
  - Marine magnetometer.

The location of the survey area has been shown in **Figure 5-3**. The bathymetric survey results show that the water depth ranges from approximately 8.4m to 17.9m below Chart Datum (CD), suggesting that some dredging will be required. **Figure 5-6** shows a single beam bathymetric map of the survey area relative to the Chart Datum. Chart Datum is the plane to which all tidal heights are referred, so by adding the tidal height to the charted depth, the true depth of water is determined.

The bathymetry deepens perpendicular to the coastline at slopes of  $0.2 - 0.6^\circ$ . Slopes in the order of  $3^\circ$  can be found adjacent to the entrance channel abutting up against the breakwaters. There are a few relative bathymetric highs which present with an approximately shore parallel orientation. The data shows a seafloor gently sloping in a seaward direction truncated by shore parallel ridges of lithological (rock) outcrops.

Five distinct surficial facies were identified from the side scan sonar dataset, namely:

- I. Reef Outcrop: This facies is the most dominant in the survey area covering 51.34%, showing a shoreline parallel orientation and dipping in a seaward direction.
- II. Bioclastic Gravel: Is the fourth most dominant, accounting for 0.87% of the total area. The facies occur predominantly along the seaward margin on the two breakwaters in the survey area and along the down current margin of reef outcrops.
- III. Fine to Medium Grained Sediment: This facies appear to have a shore parallel orientation, occupying relative depressions within the basal surface, is the second most abundant, accounting for 45.78% of the survey block.
- IV. Breakwater Armouring: There are two breakwaters in the survey area, forming the present entrance to the Tema Port. The breakwater armouring facies is where the armouring, which has been placed along the flanks of the breakwaters has been imaged by the side scan sonar. It accounts for 1.94% of the seafloor area.
- V. Anthropogenic Artefacts: Represents any man-made debris which has been discarded on the seafloor within the study area, and these included numerous tyres, a linear pipe/chain/cable like artefact and a shipwreck. The wreckage appears very intact with small scale debris around it and resting squarely on the seafloor in an upright orientation.



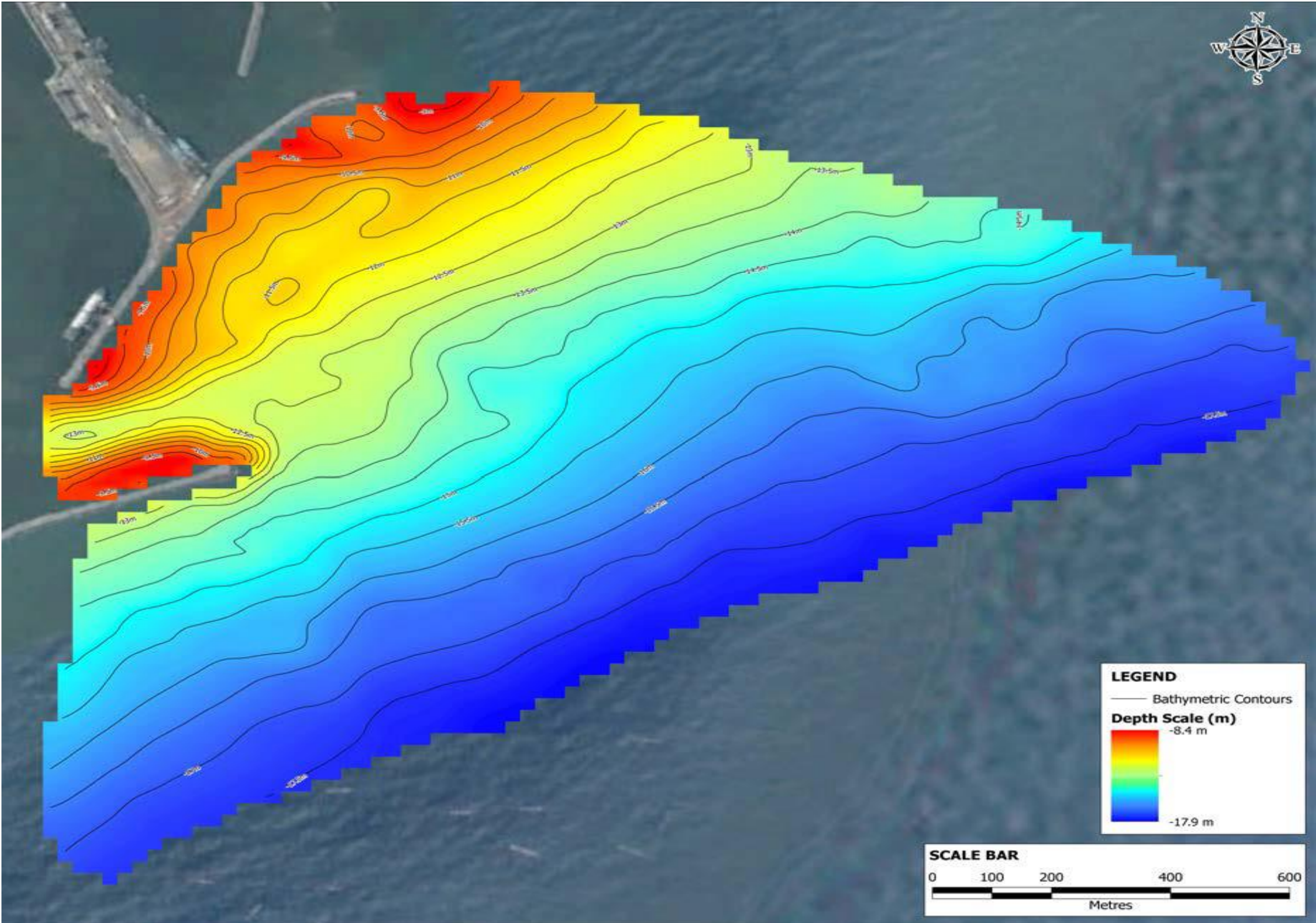


Figure 5-6: Singlbeam bathymetric chart of the survey area relative to Chart Datum

From the sub-bottom profiling data there are relative sediment depocentres between the reef outcrops following a similar orientation to these outcrops. The thickness of unconsolidated material within these relative depocentres is between 0m – 2.5m. The magnetic data shows a concentration of magnetic bodies around the western breakwater which could be the result of ferrous objects or the occurrence of magnetic blocks of gneiss which is used as the breakwater armouring. Within the rest of the area no buried pipelines or large buried objects were charted. There are however numerous small ferrous objects on the seafloor, most probably related to discarded tyres or fishing debris.

### 5.2.5 Marine Water Quality

#### 5.2.5.1 Water Quality Monitoring within the Tema Port

The marine water quality sampling survey was conducted in April 2018 as part of the ESIA. Baseline marine water quality sampling was undertaken at five (5no.) sampling sites within the port basin area as shown in **Figure 5-7**. Each Sample was taken at different locations and depths as shown in **Table 5-2**.

**Table 5-2: Location and Depths of marine water quality sampling points**

Sample	Coordinates	Location	Depth
TM1A	5°38'2.22"N, 0° 0'49.58"E	Within the Harbour	1.5 m
TM1B			8.2 m (9.7 m)*
TM2A	5°37'36.31"N, 0° 0'27.94"E	Within the Harbour	1.5 m
TM2B			9.8 m (11.3m)*
TM3A	5°36'49.17"N, 0° 0'8.14"E	Outside the Harbor	1.5 m
TM3B			6.4 m (7.9 m)*
TM4A	5°37'42.75"N, 0° 0'55.31"E	Entrance to the Harbour	1.5 m
TM4B			11.0 m (12.5m)*
TM5A	5°38'16.61"N, 0° 1'3.18"E	Entrance to the Dock	1.5 m
TM5B			5.4 m (6.9 m)*

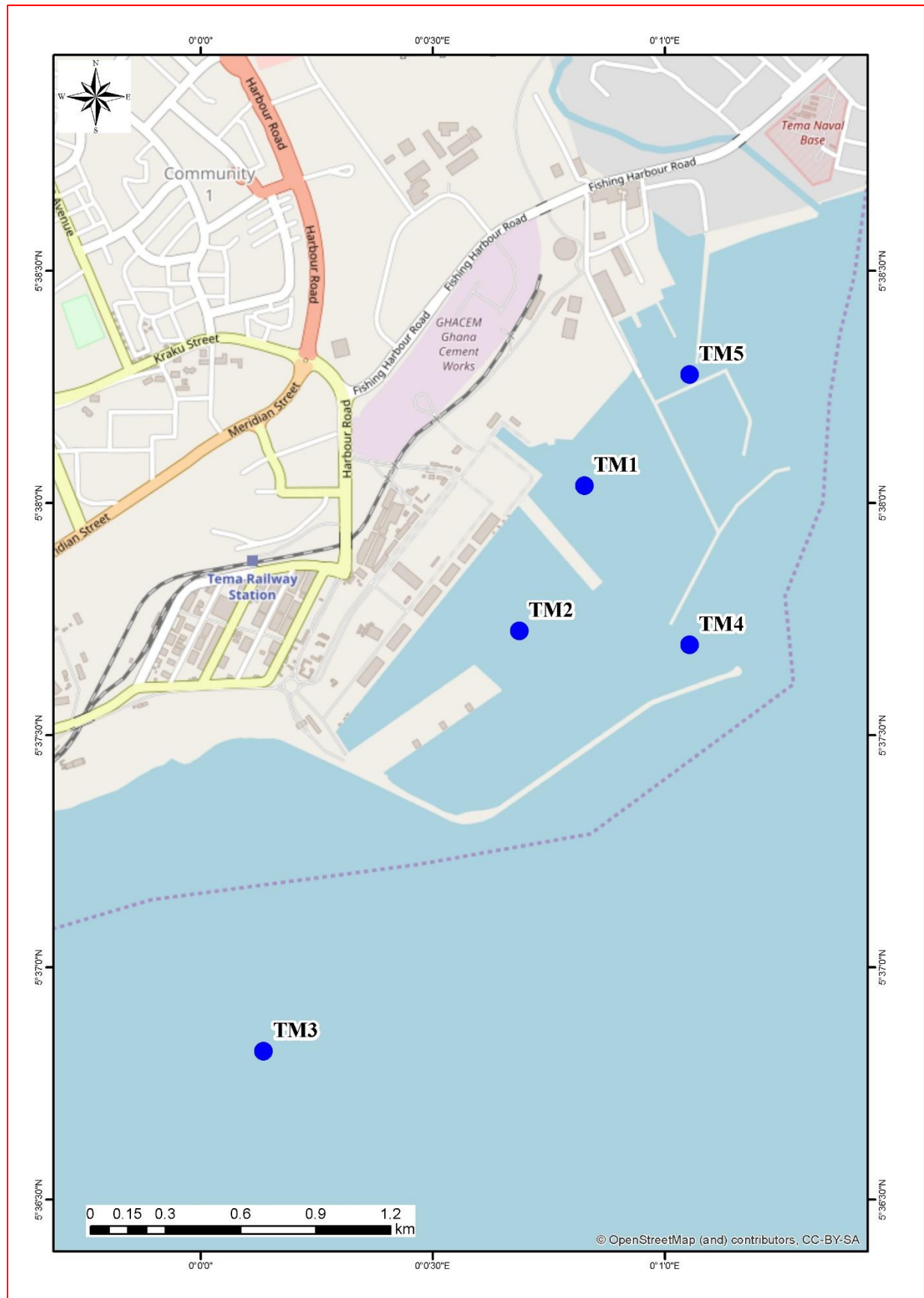
NB: \* = depth of bottom of water

#### Analysis of Results

The results have been compared with Canadian Environmental Quality Guidelines (Water Quality Guidelines for protection of aquatic life) and IFC guidelines for marine water quality. The results are provided in **Table 5-3**. All parameters measured were within the associated guideline levels for all samples. This is expected as pollutants (e.g., organic matter/BOD, nutrients, pesticides, bacteria, viruses, heavy metals) that move offshore are naturally diluted and at some point in time are absorbed/assimilated by the natural carrying capacity of the open-ocean waters.

#### Discharge from proposed project

Effluent/wastewater discharge from the proposed project will be sent to treatment companies onshore as indicated previously in Table 3-6. There will be no wastewater discharge to the marine environment. No major impact on marine water quality is expected.



**Figure 5-7: Sampling sites for Marine water quality and sediment sampling**

Table 5-3: Results for marine water quality analysis

Sample	pH	Turbidity	BOD	COD	TSS	OIL	T.N	T.P	Pb	Cr	Cd	Hg	As	Chlorophyll A
Units	pH unit	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l
TM-1A	7.84	1.00	6.20	44.0	1.00	1.00	0.11	0.286	<0.005	0.010	<0.002	<0.001	<0.001	2.03
TM-1B	7.89	3.00	8.40	49.0	6.00	<1.00	0.304	0.328	0.006	0.010	0.002	<0.001	<0.001	<0.001
TM-2A	7.90	1.60	8.80	63.0	5.00	<1.00	0.133	0.268	<0.005	0.010	<0.002	<0.001	<0.001	0.780
TM-2B	7.93	4.00	10.3	70.0	9.00	<1.00	0.142	0.286	0.008	0.010	<0.002	<0.001	<0.001	<0.001
TM-3A	8.02	2.00	6.90	58.0	1.00	3.00	0.085	0.347	<0.005	0.010	<0.002	<0.001	<0.001	0.740
TM-3B	8.04	5.00	12.8	90.0	6.00	<1.00	0.538	0.247	0.005	0.010	<0.002	<0.001	<0.001	<0.001
TM-4A	7.96	3.00	6.30	47.0	4.00	2.00	0.056	0.280	<0.005	<0.010	<0.002	<0.001	<0.001	0.184
TM-4B	7.97	5.00	18.4	121	10.0	<1.00	0.546	0.300	0.006	<0.010	0.003	<0.001	<0.001	<0.001
TM-5A	7.95	7.00	8.50	65	8	<1.00	0.126	0.300	<0.005	<0.010	<0.002	<0.001	<0.001	1.91
TM -5B	7.89	38.0	23.8	145	25	<1.00	0.718	0.310	<0.005	<0.010	<0.002	<0.001	<0.001	<0.001
<b>CEQGs</b>	<b>7.0 – 8.7</b>	-	-	--	-	-	<b>N.D</b>	<b>N.D</b>	<b>N.D</b>	<b>N.D</b>	<b>0.12</b>	<b>0.016</b>	<b>12.5</b>	<b>N.D</b>
<b>IFC Guidelines</b>	<b>6-9</b>	-	-	-	<b>50</b>	<b>10</b>	-	-	<b>0.5</b>	-	-	-	-	-

N.D = No Data



### 5.2.5.2 Earlier Studies on Marine Water Quality

Kombat et al, 2013 studied the quality of seawater in Tema over a three-month period. Monthly samples were collected.

#### Physico-chemical Parameters of Seawater in Tema

**Table 5-4** shows the temperature range from  $28.5 \pm 0.2$  to  $30.7 \pm 0.3^\circ\text{C}$  were recorded in Tema. pH values recorded in Tema ranged from  $7.4 \pm 0.5$  to  $8.4 \pm 0.3$ . Dissolved oxygen (DO) values recorded for Tema varied from  $4.9 \pm 0.3$  to  $5.5 \pm 0.2$  mg/L. Conductivity values ranged from  $53.8 \pm 0.2$  to  $54.9 \pm 0.4$   $\mu\text{S}/\text{cm}$  recorded in Tema. Total suspended solids recorded ranged from  $9.0 \pm 1.5$  to  $16.3 \pm 2.4$  mg/L in Tema, while total dissolved solids ranged from  $0.03 \pm 0.34$  to  $0.03 \pm 0.01$  ppm in Tema. Finally, salinity of seawater recorded in Tema during the study period varied from  $35.4 \pm 0.2$  to  $35.6 \pm 0.4$  ppt.

**Table 5-4: Results of physicochemical analysis of seawater**

SITE/ MONTH	Temp ( $^\circ\text{C}$ )	pH	DO (mg/L)	Cond ( $\mu\text{S}/\text{cm}$ )	TSS (mg/L)	TDS (ppm)	Salinity (ppt)
March	$28.5 \pm 0.2$	$8.4 \pm 0.3$	$5.2 \pm 0.1$	$53.8 \pm 0.2$	$16.3 \pm 2.4$	$0.03 \pm 0.01$	$35.6 \pm 0.4$
April	$30.7 \pm 0.3$	$7.5 \pm 0.4$	$5.5 \pm 0.2$	$54.9 \pm 0.4$	$14.3 \pm 1.5$	$0.03 \pm 0.01$	$35.4 \pm 0.2$
May	$30.4 \pm 0.1$	$7.4 \pm 0.5$	$4.9 \pm 0.3$	$54.0 \pm 0.1$	$9.0 \pm 1.5$	$0.03 \pm 0.34$	$35.5 \pm 0.1$
Mean $\pm$ sd	$29.9 \pm 0.7$	$7.8 \pm 0.3$	$5.2 \pm 0.2$	$54.3 \pm 0.3$	$13.2 \pm 2.2$	$0.03 \pm 0.00$	$35.5 \pm 0.1$

Source: Kombat et al, 2013 (Temp: Temperature; DO: Dissolved Oxygen; Cond: Conductivity; TSS: Total Suspended Solids; TDS: Total Dissolved Solids)

#### Microbiological Quality of water obtained from Tema

**Table 5-5** below shows the results of colony counts of bacteria in water samples obtained from the sea at Tema for the three-month sampling period. From the results, Tema recorded a THC ranging from  $9.4 \times 10^2$  to  $3.1 \times 10^3$  cfu/100 ml. In Tema TCC ranged between  $7.4 \times 10^2$  and  $7.9 \times 10^2$  cfu/100 ml. Tema was between  $2.4 \times 10^1$  and  $2.4 \times 10^2$  cfu/100 ml. The ECC in Tema ranged from  $3.4 \times 10^1$  to  $1.2 \times 10^2$  cfu/100 ml. Faecal coliform counts of the seawater were below the WHO guideline of  $\leq 1000$  cfu/100 ml of water.

**Table 5-5: Results of microbial quality analysis**

Site/Month	Total Heterotrophic Count (THC)	Total Coliform Count (TCC)	Faecal Coliform Count (FCC)	E. coli Count (ECC)
March	$9.4 \times 10^2$	$7.4 \times 10^2$	$2.4 \times 10^1$	$101.34 \times 10^1$
April	$1.5 \times 10^3$	$7.9 \times 10^2$	$1.3 \times 10^1$	$5.9 \times 10^1$
May	$1.3 \times 10^3$	$7.4 \times 10^2$	$2.4 \times 10^2$	$1.2 \times 10^2$
Mean	$1.8 \times 10^3$	$8.8 \times 10^2$	$9.1 \times 10^1$	$9.1 \times 10^1$

Source: Kombat et al, 2013.

### 5.2.5.3 Chemu Stream Water Quality

The Chemu stream was sampled in October 2017 as part of the ESIA study for the Bankuman Decentralized Sewer Project (Draft ESIA report Bankuman Decentralized Sewer Project, February, 2018). The sampling locations are shown in **Figure 5-8** and these have been compared with the Target Water Quality Ranges (TWQR) of the Ghana Raw Water Quality Criteria and Guidelines (Volume 4(B): Protection of Aquatic Ecosystems and Agriculture Water Use) and



Canadian Environmental Water Quality Guidelines for the protection of aquatic life as shown in Table 5-6.



Figure 5-8: Water Quality Sampling Points for the Chemu and Gao streams (Source: Draft ESIA Bankuman Decentralized Sewer System February, 2018)

Table 5-6: Results for water Quality analysis for Chemu Stream

Parameter (mg/L)	Gao Upstream	Gao Downstream	Chemu Upstream	Chemu Downstream	Ghana TWQR for protection of aquaculture	Ghana TWQR for agriculture water use	CEQGs
pH	8.09	8.36	7.52	7.86	-	6.5 – 8.5	6.5 - 9
Conductivity	1623	34,900	956	2100	-		-
Turbidity	24	25	75	194	-		-
Colour	20	5	37	50	-		-
Total Suspended Solids (TSS)	2	21	33	151	-	<50	-
Total Dissolved Solids (TDS)	6450	12,500	520	1090		<40	-
Alkalinity	213	170	214	292			-
Nitrate	0.039	0.039	0.049	0.038			13
Total phosphorus	0.544	0.369	0.459	1.68	-		-
Chloride	9,330	17,469	248	530	-	<100	
Fluoride	0.896	0.809	1.37	0.406	-	<2	120

Sulphide	<0.005	<0.005	<0.005	<0.005	-		
Total Iron	1.25	1.85	0.679	1.04	-	<5	
Zinc	0.285	0.654	0.207	0.147	2	<1	30
Lead	<0.005	<0.005	<0.005	<0.005	1.2	<0.2	
Biochemical Oxygen Demand (BOD)	75	92	78.9	241	-		-
Chemical Oxygen demand (COD)	155	210	173	624	-		-
Oil & grease	5	4	12.5	28	-		-
Total Coliform(cfu /100ml)	800	750	800	940	-		-
Faecal Coliform(cfu /100ml)	125	107	142	150	-	<1	-

(Source: Draft ESIA for Bankuman Sewer Project, February 2018).

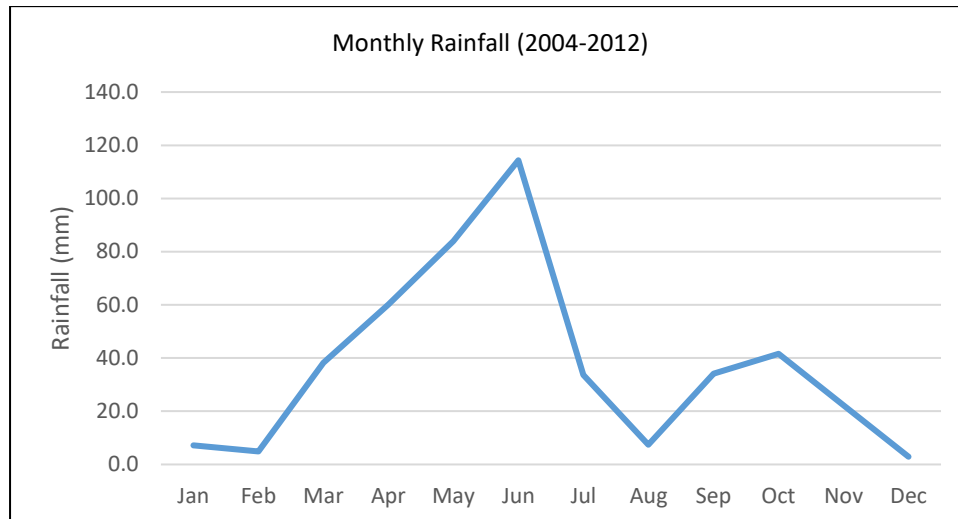
The results compared with Ghana target water quality results for aquaculture protection shows that lead and Zinc were within guideline levels for both Chemu upstream and downstream samples. However, in comparison with Ghana TWQR for Agriculture (irrigation) TDS, chloride, Fecal Coliform (Chemu upstream) and TSS (Chemu Downstream) were above guideline levels. The high levels of BOD, oil/grease and alkalinity could be attributed to discharges of industrial effluents (e.g. from VALCO, TOR) into the drain and waste dumping and open defecation activities of nearby settlements (e.g. Abonkor, Zinginshore, Manhean etc.) which drain into the stream resulting in the pollution. The results compared with the Canadian Environmental Quality Guidelines however show that all parameters were below the permissible guidelines for all parameters.

### 5.2.6 Climate

Tema is characterised by a dry equatorial climate. Tema is influenced by three air masses namely, the South-West Monsoon, the North-East Trade Winds (Tropical Continental Air Mass) and the Equatorial Easterly. The warm but moist South-West Monsoon which originates from the Atlantic Ocean and the warm, dry and dusty Tropical Continental Air Mass (Harmattan) from the Sahara Desert approach the tropics from opposite sides of the Equator and flow towards each other into a low-pressure belt known as the Inter Tropical Convergence Zone (ITCZ). Climatic data from 2004 to 2012 for Tema, as reported in the EIA for the Kpone Thermal Power Plant (2012) is presented in this section.

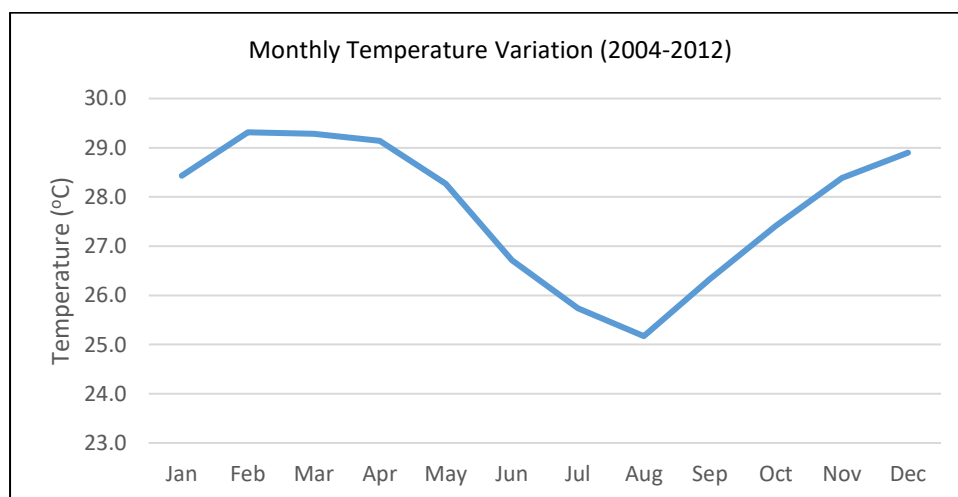
Tema lies in the driest part of southern Ghana, experiencing average annual rainfall of about 713 mm. The slow and irregular north-south oscillations of the ITCZ gives rise to the regime of wet and dry seasons. This region generally moderate amount of rainfall during the wet (rainy) season when the area comes under the influence of the South-West Monsoons. The wet season is

characterized by two main rainfall regimes, i.e. from March to July with a peak in June (i.e. mean of 114 mm for the period), and September to November with a second peak in October (i.e. mean of 41.6 mm for the period) as shown in **Figure 5-9**. In the dry season, the region comes under the influence of the North-East Trade winds or the Harmattan.



**Figure 5-9: Monthly variation in mean rainfall quantities (source: VRA, KTPP/EIA 2012)**

Maximum and minimum daytime temperature variation is illustrated in **Figure 5-10**. There are two peak temperature periods from February to April and November and December. The highest mean monthly daytime temperature of about 31.1 °C occurs between February and April and the lowest of about 21.7°C in August.



**Figure 5-10: Variation in daytime temperatures (source: VRA, KTPP/EIA 2012)**

Generally, the region is hottest at the early part of the year i.e. from January to April as well as towards the end of the year i.e. November to December. The coldest period is from July to September. The average mean daily duration of bright sunshine is 5.8 hours.

Generally, the driest periods are between January and February, while June to August is the most humid. **Figure 5-11** illustrates the variation in relative humidity.

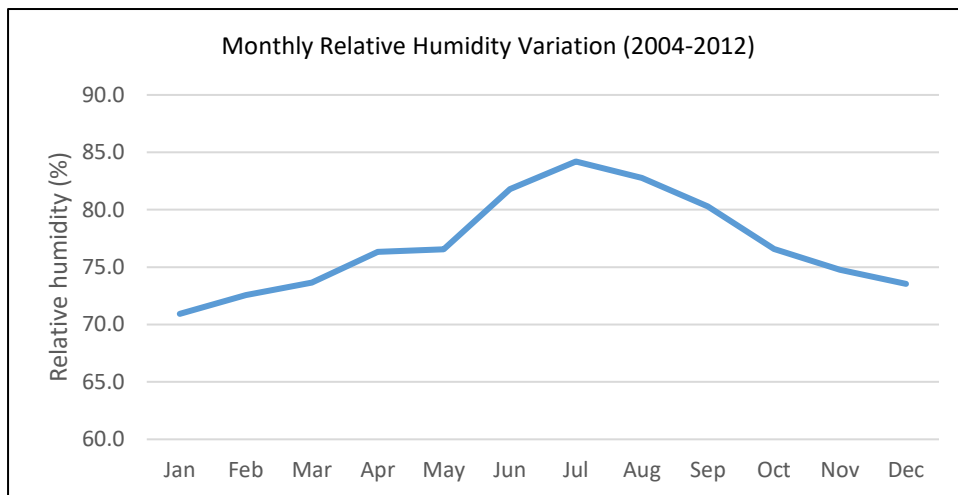


Figure 5-11: Monthly variation in mean relative humidity (source: VRA, KTPP /EIA 2012)

### **Measurements within the Tema Port**

Project Management International (PMI) is carrying out Metocean measurements within the project area [REDACTED], since January 2018. A weather station with a water sensor was installed onshore in January 2018 as shown in **Figure 5-12**.

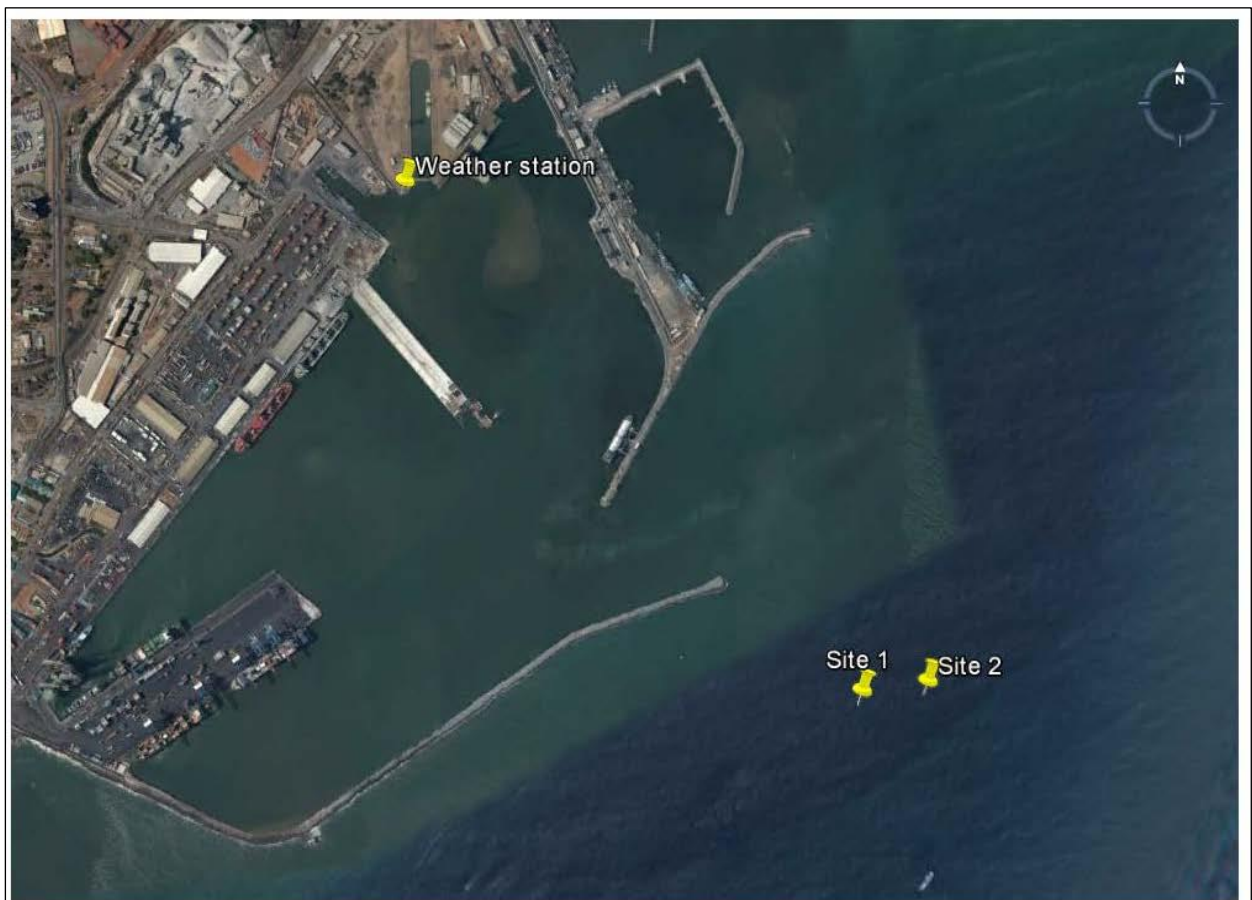


Figure 5-12: Location of weather station

The monitoring results from January to April, 2018 confirm the weather conditions to be typical of an equatorial region, with warm temperatures persisting throughout the measurement period. Temperatures mostly remained above 25°C up to 33°C and were recorded during daylight hours. Humidity ranged between 53% and 93% with a mean value of 78%. Atmospheric pressure ranged between 1004mBar and 1014mBar with the lowest values observed in late April 2018. 80% of mean wind speeds were observed between 2m.s-1 and 4m.s-1, with gust speeds of up to 22m.s-1 recorded on 20 February 2018. During the period, maximum wind speeds exceeded 10m.s-1 for over an hour, with mean speeds of up to 10m.s-1 observed during this period. This wind event appears to be a squall and is accompanied by a temperature drop of almost 4°C and a rapid increase in turbidity. Wind directions at the measurement location were variable between the South to West sectors.

Rainfall of 107mm was observed over the measurement period, with over half this rainfall occurring during a single event on 10 April 2018. This appears to be part of a passing squall, with gust speeds during this event showing a rapid increase up to 18m.s-1.

### **5.2.7 Hydrology and Drainage**

The streams in the Metropolis are seasonal in nature; they do not flow throughout the year. A number of streams however flow through depressions into the sea during the rainy season. Notable among them are the Gynakorgyor (flow into the Gao Lagoon between Manhean and Kpone). Water from the industrial area and the Eastern part of the township converge into a major drain ending up in the Chemu Lagoon located between the harbour area and Tema Manhean. These have contributed to the biological death of the Chemu lagoon. Chemicals washed from the industries pollute and destroy the aquatic life of lagoon (*Internet source: www.mofa.gov.gh*).

### **5.2.8 Topography**

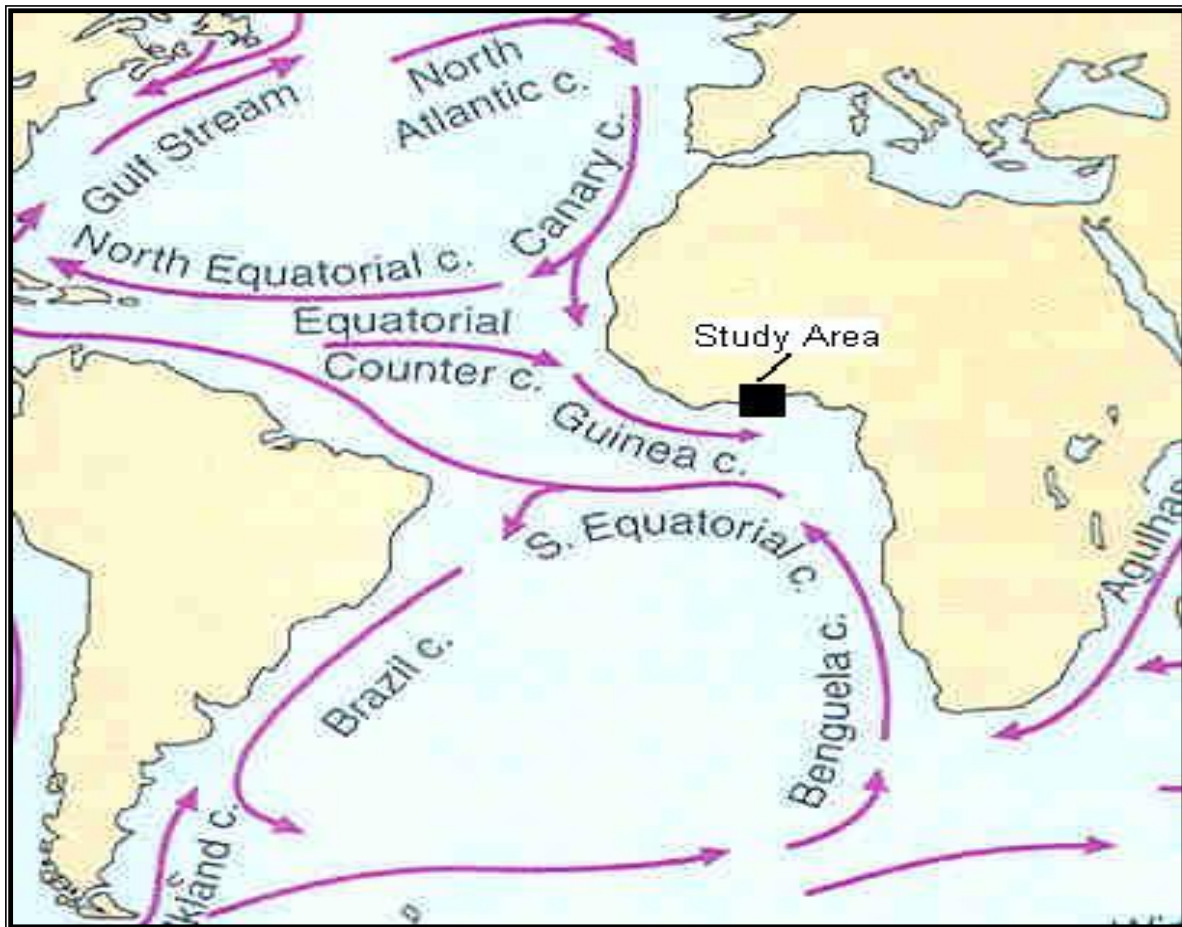
The topography of the Port is generally flat with gentle slope towards seaward of the Gulf of Guinea. Generally, from land to sea, geomorphic types of the site are coastal terrace, sea plain of intertidal zone and neritic zone in proper order. The elevation of onshore portion of the Port ranges between +3 m and + 12 mCD. The Tema port railway, which is oriented east-westwards, pass near the pipeline route within the port. The elevation of the railway varies between about +5.5 m and +8 mCD. Chart Datum is the plane below which all depths are published on a navigational chart. It is also the plane to which all tidal heights are referred, so by adding the tidal height to the charted depth, the true depth of water is determined. By international agreement, Chart Datum is defined as a level so low that the tide will not frequently fall below it. Chart Datum is shown on charts as the zero metre contour.

The Marine conditions of the Tema Port are directly influenced by the Atlantic Ocean and the South Westerly Monsoon wind. The principal oceanic factors that influence the coastline of the project area include tides, currents and waves. Information on waves and currents in the Accra-Tema area are scarce since there are no quantitative measurements of these covering a sufficiently long period.



### Currents

The hydrography of the area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans (see **Figure 5-13**).



**Figure 5-13: Major current systems influencing the Gulf of Guinea**

The major current influencing the area is the Guinea Current flowing from west to east. This current runs opposite to the south westerly equatorial current between Africa and South America. Neither of these currents impact navigation to and from the Port of Tema. The Guinea Current reaches a maximum between May and July during the strongest South-West Monsoon Winds when it peaks at 1 to 2 knots, mean speed is 1.2 knots. For the rest and greater part of the year, the current is weaker. Near the coast, the strength of the current is attenuated by locally generated currents and winds, as well as friction at the sea bed. The current is less persistent near-shore than farther offshore. Geostrophic effects induce the tendency of Guinea Current to drift away from the coast especially during its maximum strength.

It is however subject to periodical and usually short-term reversals. The reversal of the Guinea current is probably due to the effects of the varying strengths of the Equatorial Current and the waters of Benguela origin. The general dynamics of the ocean currents in the Gulf of Guinea depends on the large-scale oceanic climatic seasonal exchanges which occur in the oceans and the morphology of the shelf and the orientation of the coast.

The coastal surface currents are predominantly wind-driven and are confined to a layer of 10–40 m thickness. Littoral drift, which is the main driving forces in coastal circulation in this area is generated by breaking waves. These littoral drifts, generally flowing in an eastward direction, flows at rates less than 1 m/s, but are responsible for transporting large volumes of littoral sediments. The direction of tidal current around the coast of Ghana is mostly North or North-East. The velocity of the tidal current is generally less than 0.1 m/s. the maximum velocity of tidal current observed in a day of strong winds is about 0.5 m/s. The wave induced longshore currents are generally in the west to east direction which is an indication of the direction the waves impinge the shoreline. The longshore currents may average bout 1m/s and vary between 0.5 and 1.5 m/s. The magnitude increases during rough sea conditions.

### Wind Speed and Direction

The offshore wind and wave data for the project site has been obtained from the Oceanweather database for the area. The hindcast data is from the most recent WANE3 model and provides the wind and wave conditions in hourly intervals from January 1979 to December 2014 (36 years). The wind rose and scatter plot of wind speed and direction from 1979 to 2014 is shown in **Figure 5-14**. These show that wind conditions are very benign and directional with wind speeds not exceeding 12 m/s (approximately 24 knots).

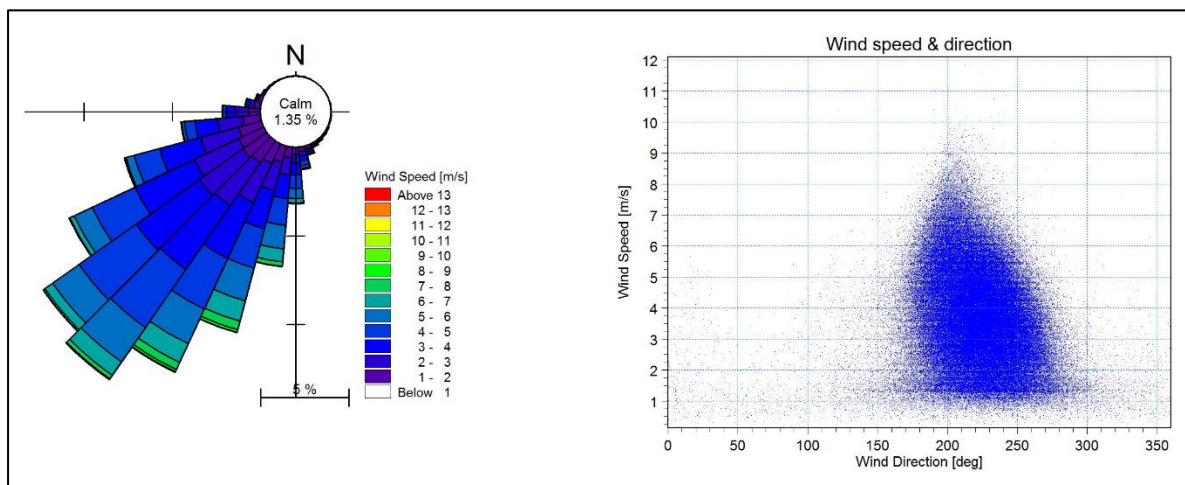


Figure 5-14: Wind rose and scatter plot for wind speed and direction

### Tide Level

The tide in Ghana is semidiurnal pattern which has generally two high and low tide levels each day. Average tidal heights of 1.6 m at MHMS and 1.3 m at MLWS and 0.7 m at MLWN are recorded twice daily. Tema has no tide gauge at present and any expansions to the port will need to seriously consider creating a tide gauge house for installing one.

### Waves

Waves reaching the shores of Ghana consist of swells originating from the oceanic area around the Antarctica Continent and seas generated by locally occurring winds. The data from 1979 to 2014 (see **Table 5-7**) indicates that over 98% of the wave heights are less than or equal to 2 m.

**Table 5-7: Frequency of occurrence for wave height and direction**

Significant Wave Height (m)	Direction							Total
	120	135	150	165	180	195	210	
0.5	0	0	0	0	11	0	0	11
0.7	0	0	25	504	3849	99	0	4477
1	0	30	39	2992	52123	2965	0	58149
1.2	0	11	19	7145	98621	7676	0	113472
1.5	0	0	0	6131	66639	6679	12	79461
1.7	0	0	0	4184	33119	2967	4	40274
2	0	0	0	1893	11376	921	0	14190
2.2	0	0	0	729	3382	236	0	4347
2.5	0	0	0	179	743	54	0	976
2.7	0	0	0	51	138	12	0	201
3	0	0	0	17	0	1	0	18
3.2	0	0	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>41</b>	<b>83</b>	<b>23825</b>	<b>270001</b>	<b>21610</b>	<b>16</b>	<b>315576</b>

Extreme offshore wave heights for 100-year return periods are about 3.5 m. The significant height of the waves generally lies between 0.9 m and 1.4 m and rarely attains 2.5 m or more. The most common amplitude of waves in the region is 1.25 m but annual significant swells could reach 3.3 m in some instances. Swells attaining heights of 4.8-6 m, however, occur with a 10-20-year periodicity. The peak wave period for the swells generally falls in the range of 7 to 14s. The swell wave direction is almost always south or south-west as shown in **Figure 5-15** and **Figure 5-16**, which are also based on the data from 1979 to 2014. The wave roses for the offshore wave conditions for the total sea and the separate components of sea and swell identified are shown in **Figure 5-15**. The wave roses for the wave conditions greater than 1 m are also shown in **Figure 5-16**.



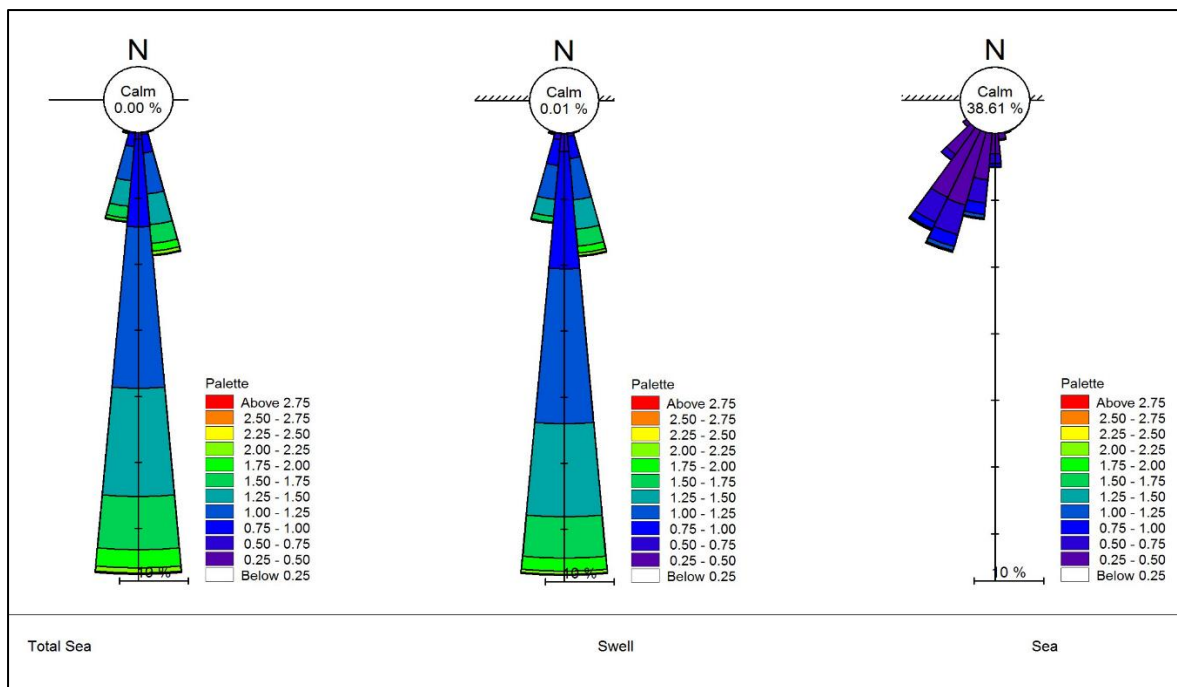


Figure 5-15: Wave roses showing the magnitude and direction of the different wave components

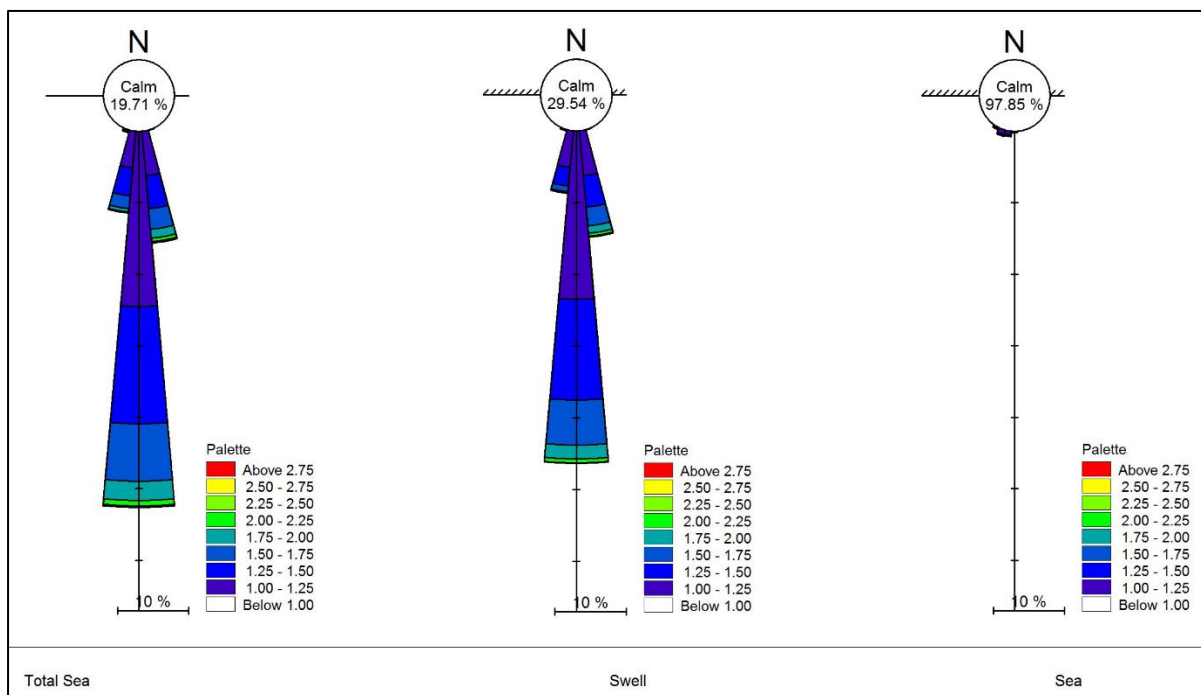


Figure 5-16: Wave roses showing the magnitude and direction of the different wave components > 1m

These two figures show that the wave climate is very uniform in direction with almost all wave energy approaching from within 20° of south (160° to 200°). Additionally, the wave conditions are less than 1 m for approximately 20% of the year on average over the 36 years.

Other observations on the wave climate include a long swell of distant origin and with wavelengths varying between 160 and 220 m. This swell has a primary period of 12 seconds and a relatively

regular averaged height between 1.0 and 2.0 m. The swells generally travel from southwest to northeast.

The wave heights and directionality as well as the wind and current conditions are favourable for arranging the mooring layout. The conditions are all within the environmental parameters set in the generic mooring study carried out by Moffatt and Nichol. The only exception is the long period swell which will potentially require the breakwater extension which is currently being assessed.

### **5.2.9 Sediment Transport**

The sediments along the coastline are redistributed primarily by the eastward longshore current, in the form of littoral drifts and, less importantly, tidal currents. The sediment grain size investigations along the proposed route of the WAGP carried out by ESL identified that, with a few exceptions, most fine-grained stations occurred at depths exceeding 37m. Sandy and/or hard cobble/ancient coral bottoms were found throughout the entire depth of the investigated proposed pipeline route. All of the stations sampled for the pipeline route have either sandy sediments or hard/cobble bottoms, which reflect the relatively high energy regimes in the area.

The near shore sediment of Tema could be described as being sandy and the offshore as sandy-mud. Pockets of muddy sediments occur in water depths between 30 – 40 m. Erosion of the shore line is quite prominent in areas where the onshore land consist of unconsolidated material. There is significant erosion to the east and west of the Port of Tema. Notable areas are Tema New Town (Manhean) and the west of the Port between Tema and Nungua. Near the Sakumo II outfall, armoured rocks have been used to construct revetments to check the erosion.

Results of the rough estimates of sediment transport carried out by Sellhorn/HPC as part of the feasibility studies for the Tema Port Expansion Project show that directly after the construction of the breakwater, the breakwater is expected to have an accretion of sediment west of it in the direct vicinity of the coast. The annual accretion rate was calculated as 1.5 million to 2.5 million m<sup>3</sup>. This accretion will continue until enough material settled west of the breakwater and sediments are passing by the harbour again. The by-passing of sediments will benefit from the deflection of the near shore currents with eastward directions caused by the breakwater.

No sediment transport modelling studies has been undertaken at the Tema Port to date. Site specific met-ocean data (e.g. waves, currents, turbidity, sediment particle distribution etc.) is currently ongoing since January 2018. A sediment transport study will only be undertaken once the full set of met-ocean data has been acquired from the deployed equipment. Samples are being taken to inform the turbidity levels to assist with the dredging assessment, and the backscatter (behind the deployed units) is also being recorded for input into the sediment transport model.

### **5.2.10 Marine Sediment Quality**

Shipping activities, rapid industrial developments and urbanisations associated with ports and harbours make them potential sites of marine pollution. Pollution in port environments may come from several sources such as vessel oil spills, disposal of industrial effluence from nearby industries, use of anti-fouling paints, discharge of ballast water, and sewage from human

settlements. Sediments provide records of metal pollution in aquatic environment and can also serve as a source of metals to the overlying water during re-suspension [Bryan et al (1992), Savvides, et al (1996)]. Sediment contamination will have implications for management of the dredged materials.

#### 5.2.10.1 Earlier Studies on the General Sediment Quality within the Port Basin

Heavy metals in surface sediments at the Port of Tema was carried out by Nyarko, et al (2014). Sediments were collected from nine stations at the Tema Port, from November 2010 to January 2011 (dry season) and from March to April 2011 (wet season).

Samples were taken from within the main port basin (stations MH1, MH2, MH3, MH4 and PE), from the station OS (open sea, which is near the proposed dredging area), from the station IFH (inner fishing harbour), OFH (outer fishing harbour) and station CB (canoe basin) as shown in **Figure 5-17**. The sampling distribution provides general information on the sediment quality within the Port Basin. There may be localised areas within the proposed dredging footprint that differ to these sampled areas, and prior to dredging, the planned detailed sampling to be carried out to inform the preparation of the dredging management plan to be approved by GMA, will fully characterise the area to be dredged.

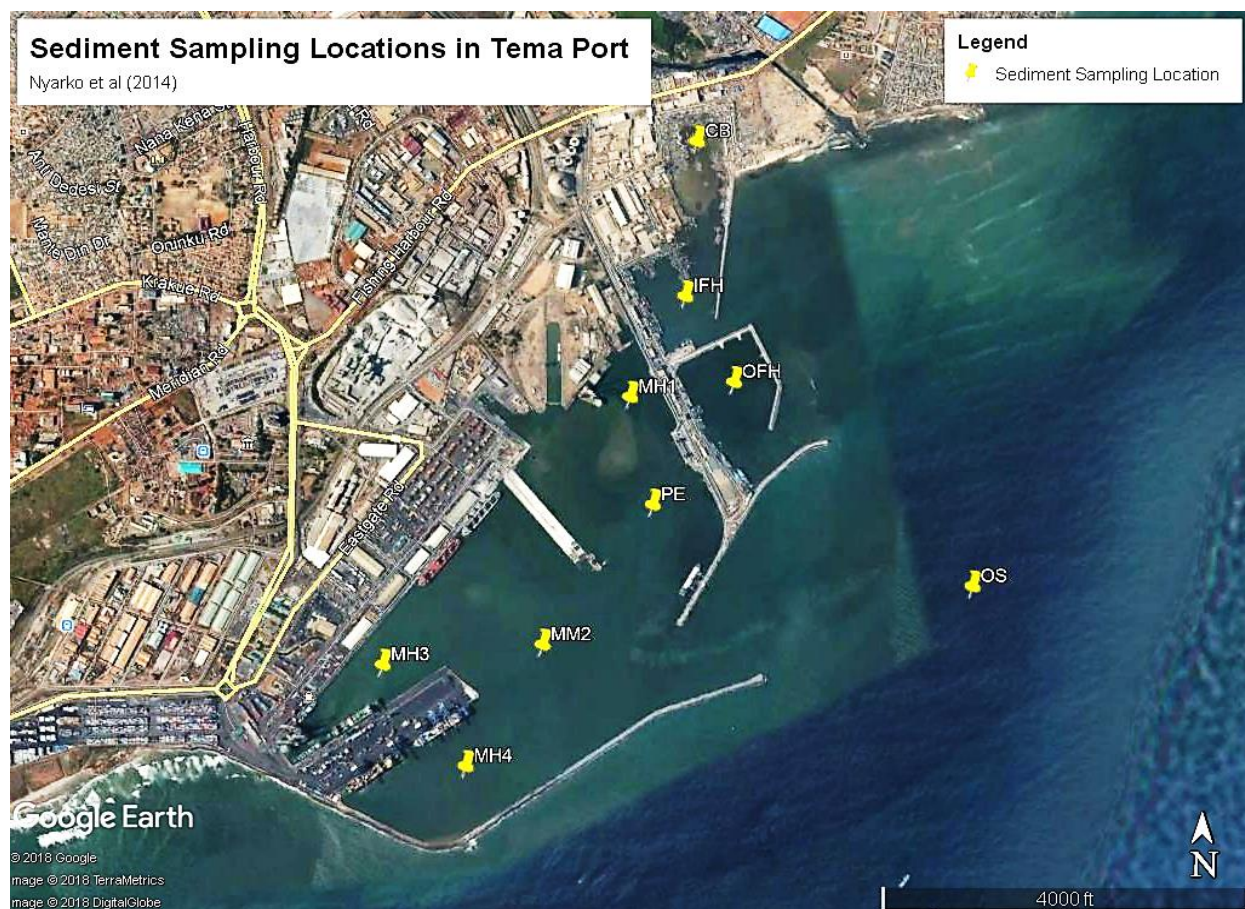


Figure 5-17: Sediment sampling locations for earlier studies

Analysis of samples was done using INAA (instrumental neutron activation analysis) for Mn, V, Cu, As and Cd, and AAS (atomic absorption spectrophotometry) for Fe, Cr, Zn, Ni and Co. Contamination effects in sediment were assessed using NOAA's SQuiRTs (screening quick reference tables) by Buchman. The results of the analysis compared to the sediment quality guidelines (Sediment quality Screening values prepared by NOAA) in **Table 5-8**. Level of contamination are assessed using estimated enrichment factors for analysed metals at Tema Port as presented in **Table 5-9**.

**Table 5-8: Comparison of metal concentrations (mg/kg) in the Tema Port to sediment quality guidelines**

Period	Location	Site	Fe	Mn	Cu	Zn	Cd	Ni	As	V
Dry season	Port Basin	MH1	4,618.1	252.1	23.1	40.5	12.2	48.1	3.1	132.1
		MH2	4,663.6	72.3	10.5	17.3	8.3	17.3	3.2	26.1
		MH3	5,758.2	21	23.5	25.6	15	26.2	3	126.2
		MH4	4,422.1	22.7	3.1	6.3	10.2	18.3	3.1	354.7
		PE	5,061.7	29.2	7.7	5.3	38.4	28.1	ND	87.8
	Open sea	OS	3,724	30	10.1	5.7	90.5	30.3	ND	100.2
	Fishing Harbour	OFH	6,778.1	24.3	37	39.5	4.5	14	3.1	59.2
		IFH	3,113.8	7.3	25.1	11.4	ND	22.3	ND	ND
	Canoe Basin	CB	1,923.5	ND	ND	ND	7	3.3	ND	ND
Wet season	Port Basin	MH1	7,033.3	48.2	50.1	39.3	13.7	68.9	3.2	154.1
		MH2	6,553.5	36.2	40.2	39.1	13.1	56.9	1.2	31.2
		MH3	5,550.3	40.5	33.5	35.7	ND	52.6	1.4	148.1
		MH4	5,891.3	34.4	15.5	20.4	8	74.6	1.1	416.1
		PE	5,283.1	34.5	11.8	16.1	11.3	57.4	1.4	125.1
	Open sea	OS	4,255.4	31	4.2	6.9	15.9	62.2	1.3	118.5
	Fishing Harbour	OFH	7,096.5	38.5	83.4	85.3	ND	35.2	2.2	69.5
		IFH	6,332.4	23.4	85.4	115.2	ND	ND	ND	ND
	Canoe Basin	CB	2,570.2	4.4	ND	3.6	ND	ND	ND	ND
Sediment quality Screening values		TEL			18.7	124	0.68	15.9	7.2	
		PEL			108.2	271	4.21	42.8	41.6	
		AET		260N	390MO	410I	3.0N	110EL	35B	57N

Source: Nyarko, et al (2014)

Screening values are taken from the SQIRT (screening quick reference table) prepared by NOAA. AET levels: I–infaunal community impacts; MO–microtox bioassay; B–bivalves; N–Neanthes bioassays; EL–echinoderm larvae; A–amphipods; ND–not detected.

**Table 5-9: Estimated Enrichment factors for analysed metals at Tema Port**

Period	Location	Sites	Fe	Mn	Cu	Zn	Cd	Ni	As	V	Pollution Load Index, PLI
Dry season	Port Basin	MH1	1	3	6	5	1244	10	6	11	0.293
		MH2	1	1	3	2	840	4	6	2	0.001
		MH3	1	0	5	2	1230	4	4	8	0.012
		MH4	1	0	1	1	1086	4	6	31	0
		PE	1	0	2	1	3576	5	-	7	0.001
	Open sea	OS	1	0	3	1	11467	8	-	10	0.004
	Fishing Harbour	OFH	1	0	6	3	312	2	4	3	0.003
		IFH	1	0	9	2	-	7	-	-	0
	Canoe Basin	CB	1	-	-	-	1719	2	-	-	0.056
Wet season	Port Basin	MH1	1	1	13	5	1397	15	6	13	0.366
		MH2	1	0	10	4	1323	12	2	3	0.012
		MH3	1	0	7	3	-	9	2	10	0.001
		MH4	1	0	4	2	859	17	2	36	0.02
		PE	1	0	3	2	1057	11	2	9	0.006
	Open sea	OS	1	0	1	1	2011	16	3	12	0.001
	Fishing Harbour	OFH	1	0	14	7	-	5	3	4	0.003
		IFH	1	0	32	20	-	-	-	-	0.009
	Canoe Basin	CB	1	0	-	1	-	-	-	-	0

Source: Nyarko, et al (2014)

The following conclusions were drawn from the analysis of the results:

#### *Comparison to Sediment Quality Guidelines*

1. The levels of analysed metals in sediments at the Tema Port showed no significant difference in concentration with respect to seasonality. However, seasonality influenced the accumulation patterns of metals at stations MH1, MH2 and MH3 inside the port basin.
2. Levels of V and Cd were very high in the Ports sediments beyond sediment quality guidelines with potential toxic effect on biological organisms in the sediments and the food chain at large. These metals (V and Cd) were extremely enriched above pre-industrial geochemical background levels, and their source may be as a result of oil pollution from vessels and other sources in the vicinity of the port.

#### *Metal concentrations and accumulation patterns*

3. Some stations were closely related than others, whereas some were highly dissimilar to others. This could be attributed to the sources and accumulation behaviour of the various metals analysed and the variability in the soil properties.
4. The study concludes that stations at the Fishing Harbour and the canoe beach, which recorded non-detectable levels to very low metal concentrations, are unpolluted with metals.
5. Heavy metal contamination in the Tema Port stems from activities both within and outside of the port. Within the port, activities such as loading and off-loading of the goods containing these metal pollutants are accidentally dropped or find their way into the port environment when exposed. The port also has an active dry dock which may be contributing significant metal pollutants into the port environment. This is in line with studies by Adamo et al. and Caplat et al.
6. Other sources of metal pollution from within the port may include daily waste generated, oils from vessels and other equipment and atmospheric deposition.

#### *Metal contamination outside the port basin*

7. Metal contamination from outside of the port is mainly of urban origin (sanitation discharge outlets and storm discharges) and industrial activities in the environs of the port. It is, however, suspected that the high levels of V and Cd recorded could come from sources such as oil pollution within and outside the harbour environment.
8. Sediments were extremely enriched with some individual metals such as V and Cd (toxic to marine organisms and human health), however, the estimated overall pollution load index for samples outside the Port Basin (OS) was low, periodic monitoring is required for effective management of pollution in the Tema Port.

#### *Textural classes of sediment*

9. The textural classes of sediment at the Tema Port are generally fine grains but parts of the main port basin and open fishing harbour are silt clay loam and other parts of the main port basin and open sea are clay loam whilst the outer fishing harbour and canoe basin are loamy sand.



### Polycyclic Aromatic Hydrocarbons

A study of the concentration of polycyclic aromatic hydrocarbons in the port sediments was carried out by Gorleku et al., 2014. The study identified twenty polycyclic aromatic hydrocarbons including the sixteen priority ones (USEPA, 2003c) in the sea water and sediments collected from ten different locations in the harbour. The identified polycyclic aromatic hydrocarbons are benzo(a)anthracene B(a)A, benzo(a)pyrene B(a)P, benzo(b)fluoranthene, B(b)F, benzo(k)fluoranthene B(k)F, chrysene (CHY), dibenz(a,h)anthracene (DaHa) and indeno(1,2,3-cd)pyrene (IP) which are known human carcinogens. The others are non-carcinogenic PAHs namely: naphthalene (NAP), acenaphthylene (ACY), acenaphthene (ACE), fluorene (FL), phenanthrene (PHE), anthracene(AN), fluoranthene(FLU), pyrene(PY) and benzo(g,h,i) perylene which make up the 16 priority PAH pollutants. The rest are cyclopenta(c,d)pyrene (CyP), benzo(j)fluoranthene B(j)F, benzo(e)pyrene B(e)P and anthanthrene (ANT).

The results have been compared with NOAA's SQuiRTs (screening quick reference tables). Results obtained from the study showed total mean concentrations of the PAH for sediments ranged from 28.6 to 190.3 µg/g w.wt. The means were however lower than the standard Threshold Effects level (TEL) and the Probable Effects level (PEL) as shown in **Table 5-10**. The results show that concentrations of PAHs at the canoe landing site (MC) are significantly different and higher than levels in the inner fishing harbour, IFE and IFD. This may be as a result of anthropogenic activities and the industrial waste from the Chemu lagoon canal discharge point at the landing site.

The results obtained could be influenced by marine hydrodynamics relatively confined in the harbour as the tidal exchange is restricted. Therefore, the oceanic currents and sedimentation rates facilitate particulate dispersion differently especially in the different basins at the port (Gorleku et al., 2014).

**Table 5-10: Results for PAH sampling in sediments at the Tema Port (Gorleku et al., 2014)**

<b>Sampling Sites</b>	<b>Sediments</b>
Canoe landing Site (MC)	190.3±4.5
Outer Fishing Entrance (OFE)	56.2±1.7
Outer Fishing Dock (OFD)	83.5±1.6
Inner Fishing entrance (IFE )	161.2±3.5
Inner Fishing Dock (IFD )	144.7±5.7
Main Harbour Dry Dock (MDD)	28.6±0.5
Main Harbour Oil berth (MHV)	34.9±1.5
Main Harbour Entrance (MHE)	102.2±2.2
Main Harbour Middle (MHO)	116.4±5.1
Main Harbour Berths (MB )	63.7±2.4
NOAA for Total PAHs in sediment (TEL)	1684.06
NOAA for Total PAHs in sediment (PEL)	16770.4

### 5.2.10.2 Sediment Quality Monitoring within the Tema Port

The sediment quality sampling survey was undertaken in April 2018 as part of the ESIA. Sediment quality sampling was at four (4no.) sampling sites within the port basin area that are likely to be directly impacted. The proposed dredging footprint may differ to these sampled areas, and that prior to dredging detailed sampling will be carried out by the EPC Contractor to fully characterise the area to be dredged and the results will be presented in a Dredge Management Plan to be approved by GMA and GPHA prior to commencement of the dredging works.

The samples were then taken to the laboratory for further analysis. The results are provided in **Table 5-11** and compared with the Canadian Environmental Quality Guidelines (CEQGs) for sediments and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZGFMWQ). Ghana does not currently have standards for measuring sediment quality/contaminant levels. **Figure 5-7**, earlier shown under the water quality monitoring section shows the location of the sampling points. Further sampling at the proposed dredging site will be required to GMA and GPHA for approval of the proposed disposal site.

**Table 5-11: Sediment Quality Sampling Results**

Parameters/mg/kg	TM-1	TM-2	TM-3	TM-4	CEQGs	ANZGFMWQ
Iron (Fe )	31,230	28,458	24,845	17,893	-	-
Manganese (Mn)	641	782	836	506	-	-
Zinc	78.0	59.6	73.7	86.2	124	200
Nickel(Ni)	19.1	23.9	17.5	32.8	-	21
Cadmium(Cd)	1.33	1.04	0.832	0.598	0.7	1.5
Lead(Pb)	12.9	8.41	5.19	9.82	30.2	50
Copper(Cu)	18.3	12.8	21.5	26.2	18.7	65
Arsenic (As)	2.93	3.16	1.18	1.63	7.24	20
Mercury(Hg)	1.85	2.69	1.34	1.47	0.13	0.15

#### Analysis of results

The results show that for Zinc, Lead and Arsenic, samples TM-1 to TM-4 were compliant with the sediment quality guideline levels prescribed by CEQGs and ANZGFMWQ. However, all the samples were above the permissible levels for Mercury (Hg), while TM1 and TM2 were above the CEQGs permissible levels for Cadmium. TM1 and TM2 are within the Port and urban discharges from vessels could account for the high values experienced.

### 5.2.11 Ambient Air Quality

#### Monitoring of Dust, NO<sub>x</sub> ,SO<sub>x</sub>

Baseline air quality monitoring was undertaken in April 2018 at four (4no.) sampling sites along the proposed pipeline route as well as the oil jetty at the Port of Tema as part of the ESIA study as shown in **Figure 5-18**. The selected sampling sites are as follows:

- Bankuman community;
- Abonkor community;
- VALCO Clinic; and
- Oil jetty at the Port of Tema.

The main objective of the air quality assessment was to provide a basis for determining the impacts on human health and the environment as a result of the operation of the Tema LNG Terminal Project. The parameters of interest were total suspended particles (TSP), PM<sub>10</sub> (Inhalable particles, diameter <10 µm), Sulphur oxides (SO<sub>x</sub>), Nitrogen oxides (NO<sub>x</sub>). The air quality analysis report is attached as **Annex 5-1**.

#### Sampling Equipment and Methodology Employed

Particulate matter was sampled using MiniVol samplers set to a flow rate of 5 L/min. Samplers were placed at a minimum height of 5 meters above ground level to prevent the collection of ground level dust temporarily made airborne by gusting winds. Pumped air was siphoned through a quartz filter paper, mounted in the sampling unit and sampling undertaken for 24 hours at each sampling location. The quartz filter paper was stabilized for a minimum of 24 hours before and after sampling in a desiccator. The fresh quartz filter paper was weighed before sampling. After the 24-hour sampling period, post-sampling filters were weighed and the difference in weight (W<sub>2</sub>-W<sub>1</sub>) was used to calculate the concentration of the particulate matter in µg/m<sup>3</sup> using the formula below:

$$(PM_{10}/TSP)\mu g/m^3 = \frac{\text{Net dust weight} * 10^6}{\text{Flow rate (L/Min)} * \text{Sampling time (Min)}}$$

Sulphur dioxide and Nitrogen dioxide were sampled using the detector tube method. The detector tubes (dragger tubes) contain chemical agents that change color in the presence of the pollutant gas of interest. The dragger tubes were opened at both ends and hanged for a period of 24 hours, to allow the diffusion of ambient air through the chemical resins in the tube (passive method). After the sampling period the length of the colored zone was read in parts per million (ppm) and the concentration of the gas calculated in µg/m<sup>3</sup> using the relation below.

$$\mu g/m^3 = \frac{\text{Concentration of gas (ppmh)} * \text{molecular weight of gas}}{22.4}$$

#### Monitoring Gaseous Pollutant (CO)

Carbon monoxide was sampled for 8 hours using the detector tube method. The detector tubes (dragger tubes) contain chemical agents that change color in the presence of the pollutant gas of interest. The dragger tubes were opened at both ends and hanged for a period of 8 hours to allow the diffusion of ambient air through the chemical resins in the tube (passive method). After the sampling period the length of the colored zone was read in parts per million (ppm) and the concentration of the gas calculated in mg/m<sup>3</sup> using a relation below.

#### Result of Air Quality Assessment

The results of the air quality assessment have been compared with EPA and WHO guideline levels. The IFC require host country standards to be used. The results have been presented in **Table 5-12** and discussed below.



**Table 5-12: Results of Air Quality Assessment**

No	Sampling Site	TSP $\mu\text{gm}^{-3}$	PM <sub>10</sub> $\mu\text{gm}^{-3}$	NO <sub>2</sub> $\mu\text{gm}^{-3}$	SO <sub>2</sub> $\mu\text{gm}^{-3}$	CO $\mu\text{gm}^{-3}$
1	Point 1 (Abonkor Community )	194.6	115.0	30.6	46.8	5.8
2	Point 2 (Bankuman Community)	138.0	102.5	28.9	43.4	3.1
3	Point 3 (Harbour Oil jetty)	166.7	76.4	34.0	51.0	4.6
4	Point 4 (Valco Hospital)	120.2	68.9	38.3	40.9	2.9
<b>EPA National Ambient Air Quality Guidelines (NAAQG) for industrial Areas over 24 hours except CO guideline value which is for 8hours.</b>		<b>230</b>	<b>70</b>	<b>150</b>	<b>150</b>	<b>10</b>
<b>WHO Guideline levels over 24 hours except NO<sub>2</sub> guideline value which is for 1 hour</b>		-	<b>50</b>	<b>200</b>	<b>20</b>	-

The following observations can be made from the results in **Table 5-12:**

- The TSP level ranges from 120.2 to 194.6  $\mu\text{gm}^{-3}$  and are within the EPA's maximum permissible guideline of 230  $\mu\text{gm}^{-3}$
- The PM<sub>10</sub> level ranges from 68.9 to 115.0  $\mu\text{gm}^{-3}$ . With the exception of the Valco Hospital all other sampling areas were non-compliant with EPA permissible guideline value of 70  $\mu\text{gm}^{-3}$ . All the sampling areas were non-compliant with WHO guideline levels. The baseline condition was poor during the monitoring. The increased levels experienced could be as a result of the untarred roads within the area contributing to dust generation.
- Concentrations of the gases (NO<sub>2</sub> and SO<sub>2</sub>) recorded for the monitoring period were below the EPA guideline value of 150  $\mu\text{g}/\text{m}^3$  for both gases.
- Concentrations of the SO<sub>2</sub> gas recorded were above the WHO guideline level of 20  $\mu\text{gm}^{-3}$  for the 24-hour monitoring period.
- Concentrations of CO ranges from 2.9 to 5.8, and were below the EPA guideline value of 10  $\mu\text{g}/\text{m}^3$ .
- The predominant wind direction is from South-West (SW).

The monitoring results are for a single 24- or 8-hour period and may not represent long term averages. However, the results are indicative of the air quality status along the pipeline route, and the air shed could be described as degraded or of poor quality with regard to particulate matter. The air quality monitoring will be continued during the construction and operation phases of the project as provided in the monitoring plan in Section 10.2.6.2 to address seasonal variations.



**Figure 5-18: Sampling points for air and noise monitoring**

### Monitoring of VOCs

Volatile Organic Compounds (VOCs) were monitored as part of the ESIA in May 2018 at the four air quality monitoring sites. The monitoring lasted for 24 hours at each location. The AQM60 and series 500 have been configured to measure a wide range of air pollutants such as ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), Sulphur dioxide (SO<sub>2</sub>) among others. The Equipment uses photo-ionizing detectors (PID) as a smart technology to sense or measure the volatile organic compounds in the ambient Environment. The results for the VOCs monitoring is provided in **Table 5-13**.

**Table 5-13: Volatile Organic Compounds Results**

No	Sampling Site	ppb
1	Point 1 (Abonkor Community )	<10.0
2	Point 2 (WAPCo)	10.0
3	Point 3 (Harbour Oil jetty)	30.0
4	Point 4 (Valco Hospital)	10.0
Ghana EPA/WHO/IFC guidelines for VOCs		

### **5.2.12 Ambient Noise Levels along the Pipeline Route**

Baseline noise levels were measured simultaneously with air quality at the identified locations in April 2018. A decibel (dB) is the unit for the measurement of noise. The noise monitoring report is attached as **Annex 5-1**.

### Methodology

Noise measurements/recordings were taken with a High Precision 3M Sound Level Meter, Model Type 1. The sound level meter has an inbuilt calibrator, and was calibrated before measurement/recordings were taken. The noise meter was calibrated at 114 dB (A) prior to the measurement. To obtain representative noise levels, measurements were recorded at a rate of 3dB at ten-minute (10) intervals for 24 hours. The noise level parameters measured are as follows:

- LAF<sub>eq</sub> (equivalent sound level, with A-weighted frequency response and Fast time constant)
- LAF<sub>90</sub> (noise level exceeded for 90% of the measurement period, with A-weighted frequency response and Fast time constant)
- LAF<sub>10</sub> (noise level exceeded for 10% of the measurement period, with A-weighted frequency response and Fast time constant)
- LAF<sub>min</sub> (minimum sound level with A-weighted frequency response and Fast time constant)
- LAF<sub>max</sub> (maximum sound level with A-weighted frequency response and Fast time constant)

The data was compared to the EPA's National Ambient Noise Level Guidelines (NANLG) is presented in **Table 5-14**.

**Table 5-14: EPA National Ambient Noise Level Guidelines**

Zone	Description of Area of Noise Reception	Permissible Noise Level in dB(A)	
		Day (0600 – 2200)	Night (2200 – 0600)
A	Residential areas with negligible or infrequent transportation	55	48
B1	Educational (school) and health (hospital clinic) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship such as churches and mosques	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

Source: Environmental Protection Agency, 1999

### Results of Noise Assessment

The results of the noise level assessment are summarized in the **Table 5-15**.

**Table 5-15: Results of noise level assessment**

No	Sampling Site	Zone	NANLG	IFC Guideline Levels	Leq	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	L <sub>max</sub>
1	Point 1 (Abonkor Community)	C1	65	55	66.0	68.2	65.0	54.1	78.0
2	Point 2 (Bankuman community near WAPCo)	C1	65	70	63.1	65.5	60.9	50.1	73.9
3	Point 3 (Oil Jetty Harbour area )	B2	70	70	60.3	64.1	58.9	51.2	71.3
4	Point 4 (Valco Hospital)	B1	55	55	59.7	62.0	57.8	49.8	63.0

The results of the assessment indicate that the baseline noise data at Point 2 (Bankuman community near WAPCo) and Point 3 (Oil Jetty Harbour Area) were compliant with EPA and IFC Guideline levels provided in the table. Point 1 (Abonkor Community) and Point 4 (Valco Hospital) were however above EPA and IFC guidelines during the monitoring period. The equipment utilized is 3M (SoundPro) high precision integrated sound level meter (Type 2), mounted on a tripod stand at a height of about 1.5 meters above ground.

The monitoring results are for a single 24-hour period and may not represent long term averages. However, the results are indicative of the noise quality along the pipeline route. The sensitive receptor, Valco clinic is located about 80m from the pipeline route, which relatively experience noise level above the EPA and IFC guideline values. The high noise level is largely from

vehicular/pedestrian movement on the Bankuman road leading to TOR/Kpone and activities at the clinic in general.

### **5.3 Biological Environment**

#### **5.3.1 Marine Ecology**

##### **5.3.1.1 Overview of the Coastline and Marine Environment**

The Ghanaian coastal zone may be divided into three geomorphologic zones; the west, central and east coasts (Ly, 1980):

- The West Coast covers 95 km of stable shoreline and extends from Ghana's border with Côte d'Ivoire to the estuary of the Ankobra River. The gently sloping beaches comprise mainly fine sand and are backed by coastal lagoons.
- The Central Coast shoreline is 321 km long and extends from the estuary of Ankobra River near Axim, to Prampram located to the east of Accra. Most of this embayed coast comprises rocky shores and headlands, together with littoral sand barriers enclosing coastal lagoons.
- The East Coast is made up of 149 km of shoreline extending from Prampram eastwards to Aflao, on the border with Togo. It is characterized by sandy beaches and about midway is the deltaic estuary of the Volta River. The Volta is the largest river in Ghana with a regulated flow of about 900 cumecs due to damming upstream.

Knowledge of the marine biota is comparatively better for larger organisms such as fish and molluscs, and for those organisms inhabiting more accessible habitats such as the marine intertidal and shallow subtidal areas where fishing occurs. Information is available on the biodiversity of commercially exploited species in the region. Non-target species (such as hermit crabs, jelly fishes and star fishes) belonging to other groups have also been recorded from catches of commercial fishermen.

Ghana has a marine coastline of nearly 343.8 miles and a total continental shelf area of about 24,000 square approximately that supports a marine fishing industry. The Exclusive Economic Zone (EEZ) in Ghana waters is 200 nautical miles. The marine sub-sector in Ghana is the most important source of local fish production with the annual average domestic catch being 300,000 MT. The marine fisheries sub-sector delivers over 70 percent of the total fish supply in Ghana (Nunoo et al 2006).

Marine fisheries in Ghana are affected by a seasonal upwelling (December/January – February and July – September) that occurs in its coastal waters. During the upwelling periods biological activity increases in the sea that result in increased production of natural food sources and abundance of most marine fishes. Fish become more available for exploitation during these upwelling periods. Therefore, large quantities of fish are caught during the major season (July-September) while very little fish are captured during the low or minor season, (December-January/February). Fish stocks have been declining due to overfishing (i.e. from 322,800 MT in 2005 to 300,000MT in 2011). According to GoG sources, fish stocks have been declining due to overfishing (i.e. from 322,800 MT in 2005 to 300,000MT in 2011).

Both the pelagic (migratory fish that feed above ocean bottom) and the demersal (sea bottom-feeding fish) fishery resources are exploited in Ghana. The most common fish captured in Ghana are the small pelagics such as mackerel, horse mackerel, chub mackerel, sardines, sardinella and anchovies. These small pelagic species account for about 70 percent of the total marine fish capture in Ghana. The biomass of the small pelagic resources fluctuate significantly. According to industry and GOG sources the quantities of captured sardinella, chub mackerel and anchovy fluctuate and have reached a point of near collapse. In addition, most shrimp vessels have shifted to tuna fishing due to consistently low levels of shrimp catch. The shrimp industry had subsequently collapsed over the past ten years. The large pelagic type is mainly tuna.

There are three types of tuna species of commercial importance and value including the skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*). These tunas undertake long-range migrations in the Atlantic Ocean and across national boundaries. Tuna is the only fisheries resource that can withstand considerable expansion in Ghana. Ghana is a member of the International Commission for the Conservation of Atlantic Tuna (ICCAT) which is made up of 48 members. The ICCAT operates a quota system for its members to avoid overfishing in the Atlantic Ocean. According to GOG sources, the potential annual tuna fish resource and sustainable catch in Ghana EEZ average yield is 70,000 MT. This area has been given a further boost by the construction of a tuna-landing bay at the main sea port (Tema) in Ghana by the Japanese Government. According to MOFA sources, biomass survey estimates show that the potential yield of the total demersal biomass on Ghana's continental shelf is 36,000 MT-55,000 MT per year. The demersal species captured in Ghana include cassava fish, red snapper, sea bream, burrito, cuttlefish, red mullet, and croaker.

Billfish species, exploited in much lower numbers, are found in shelf waters and open ocean, often above the thermocline, although they are known to frequently make short dives to depths of up to 800 m., such as the Atlantic blue marlin (*Makaira nigricans*). The main billfish species are Atlantic blue marlin, Atlantic sailfish (*Istiophorus albicans*) and swordfish (*Xiphias gladius*). Billfish species like Atlantic blue marlin and sailfish spawn in West African shelf waters throughout the year (Nakamura, 1985). The main species of sharks caught in Ghanaian waters include blue shark (*Prionace glauca*) and hammerhead shark (*Sphyrna* spp.) (MoFA, 2004).

Demersal fish are widespread on the continental shelf along the entire length of the Ghanaian coastline with a tropical assemblage of species representing several families (Koranteng 2001):

- **Triggerfish** (e.g., grey triggerfish – *Balistes capricus*);
- **Grunts** (Haemulidae) (e.g., bigeye grunt *Brachydeuterus auritus* and to a lesser degree sompat grunt *Pomadasys jubelini* and bastard grunt (*Pomadasys incisus*);
- **Croakers or Drums** (Sciaenidae – e.g., red Pandora – *Pellagus bellottii*, cassava croaker – *Pseudolithus senegalensis*);
- **Seabreams** (Sparidae) or Porgies (e.g., bluespotted seabream – *Pagrus caeruleostictus*, Angola dentex – *Dentex angolensis*, Congo dentex – *D. congoensis*, canary dentex – *D. canariensis* and pink dentex – *D. gibbosus*);
- **Goatfishes** (Mullidae – e.g., West African goatfish/red mullet – *Pseudupeneus prayensis*);
- **Snappers** (Lutjanidae: golden African snapper – *Lutjanus fulgens*, Gorean snapper – *Lutjanus goreensis*);
- **Groupers** (Serranidae: e.g., white grouper – *Epinephelus aeneus*);



- **Threadfins** (Polynemidae: e.g., lesser African threadfin – *Galeoides decadactylus*); and
- **Emperors** (Lethrinidae: e.g., Atlantic emperor – *Lethrinus atlanticus*).

#### Wetlands and Water Birds

Wildlife protected areas, including wetlands (Ramsar sites) are spread throughout the ecological zones of Ghana. There are five coastal Ramsar sites in Ghana namely Keta, Songhor, Sakumo, Densu delta, and Muni-Pomadze which are protected because of the uniqueness of habitat and diversity of species, especially water birds. The birds are dominated by shorebirds that are waders and coastal birds including terns. At least 15 species of seabirds including the Common tern *Sterna hirundo* occur in internationally important populations in Ghana (Ntiamo-Baidu, 1991). The abundance and diversity of coastal birds follow a seasonal pattern driven by weather conditions. Some birds migrate from temperate regions to tropical areas and vice versa. Ghana is on the boundary of two flyways of waterbirds, the East Atlantic Flyway and the Mediterranean Flyway (Piersma and Ntiamo-Baidu, 1995).

#### Marine Mammals /Sea turtles

Marine reptiles and mammals occur in Ghana; their distribution and occurrence along the coast is recorded. Studies on sea turtles in Ghana have revealed that five species of sea turtles (*Dermochelys coriacea*, *Erectmochelys imbricata*, *Chelonia mydas*, *Caretta* and *Lepidochelys olivacea*) occur on Ghanaian shores and coastal waters. Sea turtles are noted to nest in high numbers in beaches around Ada (95km from the Port), Prampram (31km from the Port), and Winneba (93 km from the Port).

Three species of marine turtle have been recorded nesting on the Sakumo II lagoon (about 6 km west of the proposed offshore facility site). These are *Lepidochelys olivacea*, *Chelonia mydas* and *Dermochelys coriacea*, and are all endangered species according to the IUCN red list of threatened species. Eight species of dolphins (*Stenella clymene*, *S. attenuata*, *Steno bredanensis*, *Tursiops truncatus*, *Grampus griseus*, *Lagenodelphis hosei*, *Globicephala macrorhynchus* and *Delphinus capensis*) have also been recorded with *S. clymene* as the most abundant species. These eight (8) species are not in the IUCN red list of threatened species.

The fish landing beaches in the Western region of Ghana record moderate numbers of dolphin landings caught with drift gill nets (Ofori-Danson, 2003). The diversity of whales is poorly known although several whales, some with calves, have been sighted or washed ashore in Ghana in recent years.

#### **5.3.1.2 Aquatic Flora and Fauna Study within the Tema Port Area**

Aquatic flora and fauna study was undertaken as part of the ESIA in April 2018. The marine ecological study aims to assess the overall biological integrity of the marine ecosystem in the project area (Port of Tema including the fishing harbour) covering the aquatic flora and fauna community structure and populations. The marine ecology study report is attached as **Annex 5-2**.

Such information, although one spot, provide a rapid assessment of the status and ecological health of the aquatic ecosystem to help inform further monitoring or remedial actions towards sound management of project activities. The report is presented with a view towards managing

environmental concerns associated with development activities to ensure national ecosystem conservation and preservation objectives are well addressed.

### Methodology

The study involved both desk and field assessments. All relevant and available literature was consulted as part of the desktop survey to help provide background environmental information as well as inform analysis of findings of study. Field observation, sampling and data collection and interviews of residents of Tema New town community and other workers in the port area was followed by laboratory data analysis.

The Tema port study site was divided into three stations as shown in **Figure 5-19**. Due to the vast nature of station 1, the inner port/inside the port, two sampling sites were used to form a single composite sample.

Station 1: Inside the Port (N 050 37 56.4; E 0000 00 59.4; and N 050 37 51.7; E 0000 00 41.4)

Station 2: Outside Port (N 050 37 20.9; E 0000 00 49.3; and N 050 37 10.2; E 0000 00 16.1)

Station 3: Intertidal area at Tema New town beach (N 050 38 18.1; E 0000 01 03.1).

Two replicates of fauna and flora sampling was done at Stations 1 and 2 offshore while two replicates of benthic sampling was done at the intertidal area on land at the Tema New town beach. Both at Station 3 and at the port, fishers were interviewed about the likely impacts of the project on their livelihoods.

### Water Quality Sampling

The water quality sampling was carried out for stations 1 and 2. Due to the vast nature of the inner Port (station 1), two samples were taken at different locations (see **Figure 5-19**) to form a composite sample for the analysis. Two separate samples (replicate 1 and replicate 2) from both station 1 and station 2 were analysed for physico-chemical parameters such as temperature, pH, conductivity, turbidity, dissolved oxygen, salinity, total dissolved solids and depth of taking the measurements were taken using the HORIBA multiparameter probe. An echo-sounder was used to determine the depth of the water.

### Fish Sampling

Fish Sampling was done by 6 semi-industrial fishermen during the day by using of trawl gear with the outer mesh or wing having a mesh size of 25 mm and the bag or cod-end having a mesh size of 10 mm. Each trawling event lasted twenty (20) minutes. The harvested fish was placed on ice in an iced chest and transported to the laboratory of the Department of Marine and Fisheries Sciences, University of Ghana for analysis.



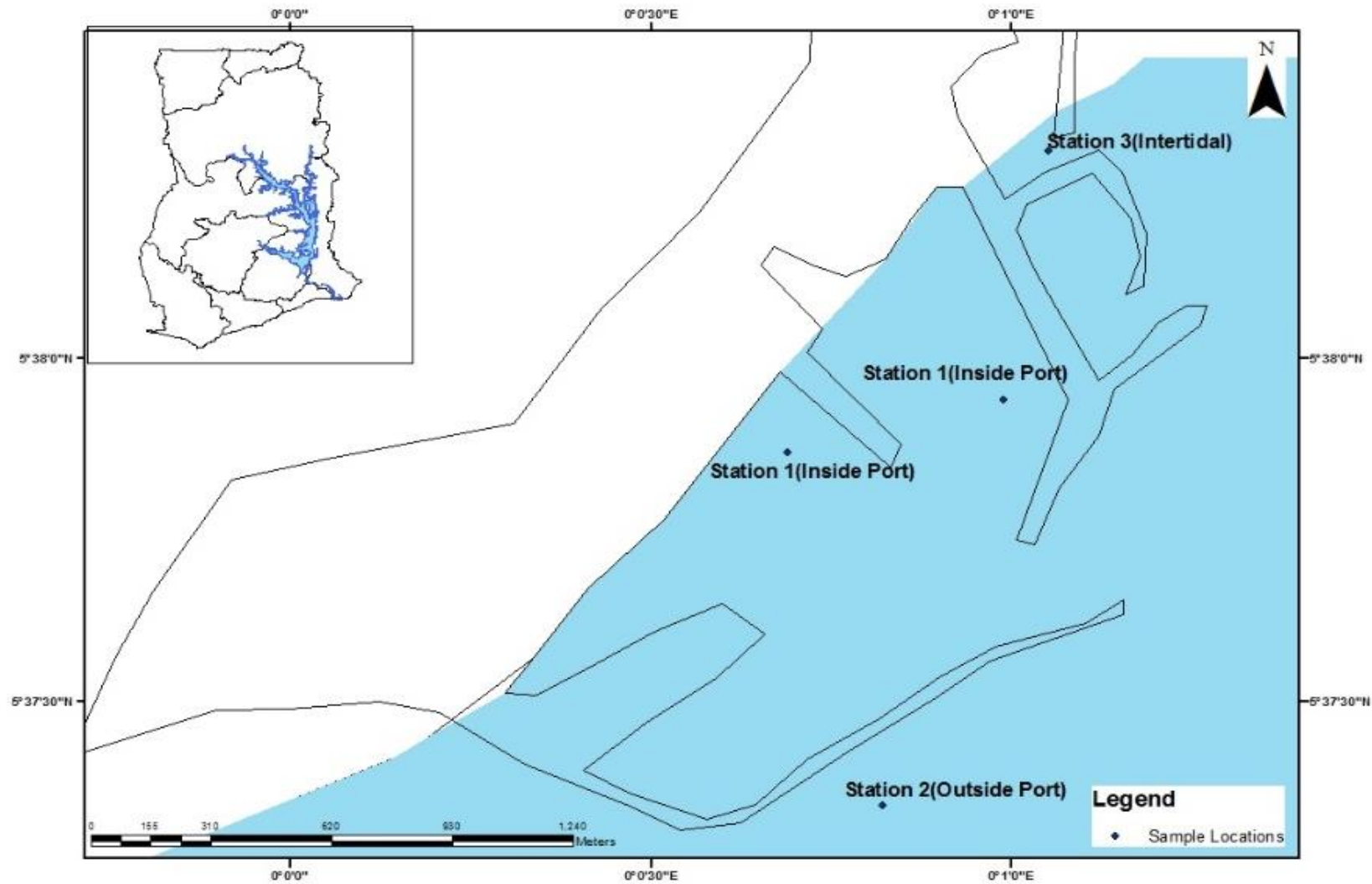


Figure 5-19: Map showing location of Aquatic study stations

### Laboratory Analysis

Fish samples obtained were sorted and species identified based on their physical features (morphological features). The identification of these sampled fishes was done by the use of fish identification keys by Carpenter *et al* 2016.

The diversity of fish catch was determined using diversity indices calculated as below:

$$\text{Shannon-wiener's diversity index (H')} = \frac{n \log n - \sum f_i \log f_i}{N}$$

Where n= total number of species recorded/sample size

Fi= sum of ith individuals

$$\text{Pielou's evenness index (J')} = \frac{H'}{\ln S}$$

Where H'= Shannon-wiener's diversity index

S= number of species recorded

$$\text{Margalef's species richness} = \frac{S-1}{\ln N}$$

Where S=number of species recorded

N= Sample size

### Macro Invertebrate Sampling

Sea sediment and intertidal samples were each taken at respective in-port and offshore locations using an Ekman grab and transferred into a cleaned 500 micron mesh size sieve box (Plate 1a) and sieved thoroughly leaving behind only samples above the 500 micron size. They were then transferred into sterile plastic containers and preserved with 4% buffered formalin and rose Bengal dye for further laboratory analysis.

For this study, benthic macrofaunal was defined as those organisms retained in the 500 micron mesh size. Organisms retained on the sieve were gently concentrated using water backwashing to move the sample material to a corner of the sieve. Because the collection sieve had the tendency to clog with use, and therefore show a reduced sampling efficiency, it was cleaned after the collection of each sample and emptied when more than one-quarter full (Emmett, 1980). The Ekman sampler was assumed to be 100 percent efficient during this study.

In the laboratory, the calcium chloride flotation method of Welch (Samman, 2002) was used to separate the benthos from the heavier inorganic debris (sand and stones). The benthic macrofaunal were transferred into clean glass petri-dishes and examined under a dissecting microscope and identified with the aid of identification key from Day (1967a and b); Yankson and Kendall (2001).

### Phytoplankton and Zooplankton Sampling

Phytoplankton and zooplankton samples were collected at the respective Station 1 (In-port) and Station 2 (Outer Port) offshore locations using plankton nets of 20 µm and 200 µm for phytoplankton and zooplankton respectively (Plate 2), on-board a motorized vessel. Plankton nets

were pre-washed prior to use in the various sampling stations. At each location, the nets were deployed to the surface and towed using the step-Oblique method for 15 minutes. The samples collected were back-washed and transferred into labelled containers and preserved with 4% buffered formalin and Lugol's solution for zooplankton and phytoplankton analyses. In the laboratory, samples were analysed for the abundance, composition and diversity of both phytoplankton and zooplankton.



**Plate 5-1: Phytoplankton sampler (LHS) and Benthos sampler (RHS)**

## Results and Discussion

### Water quality

The water conditions at the port were generally normal for survival of fauna and flora. Both temperature and salinity increased with depth at both stations (**Tables 5-16 and 5-17**). Overall salinity was high than at both stations than expected 35 ppt. Dissolved oxygen at Station 1 increased with depth while some stratification with depth was found at Station 2. Generally, there was less of DO within port than outside the port. This was expected given the high amount of organic matter concentrated within the port.

**Table 5-16: Water Quality Parameters at Station 1 (In Port)**

Parameter	Replicate 1			Replicate 2		
Temperature (°C)	27.77	27.94	27.93	27.98	27.93	27.92
pH	8.70	8.59	8.65	8.56	8.43	9.07
Conductivity (mS/cm)	52.6	54.2	53.9	53.6	54.7	54.8
Turbidity (NTU)	20.9	21.5	21.7	20.9	22.2	20.8
Dissolved Oxygen (mg/L)	5.31	5.95	5.90	5.49	5.73	6.29
Total Dissolved Solids (g/L)	31.6	32.5	32.3	32.2	32.7	32.9
Salinity(ppt)	34.7	35.8	35.7	35.4	36.1	36.4
Depth (m)	0.45	4.40	6.90	0.30	2.35	5.25

**Table 5-17: Water Quality Parameters at Station 2 (Out of Port)**

Parameter	Replicate 1			Replicate 2		
Temperature (°C)	27.84	27.73	27.80	28.27	28.11	28.05
pH	8.62	8.27	10.14	8.57	7.47	7.64
Conductivity (mS/cm)	54.5	54.6	55.0	53.1	54.2	54.7
Turbidity (NTU)	27.1	27.2	29.7	19.6	19.9	19.5
Dissolved Oxygen (mg/L)	6.27	6.63	6.01	6.08	6.14	6.39
Total Dissolved Solids (g/L)	32.7	32.8	33.0	31.8	32.5	32.8
Salinity(ppt)	36.1	36.2	36.5	35.0	35.9	36.2
Depth (m)	0.55	3.70	7.1	0.50	3.80	9

### Fish abundance

The fin-fish and shell-fish at both stations were similar and species rich; with 27 at Station 1 and 26 at Station 2 (see **Annex 5-2**). The species are made up of both typical marine and estuarine species. There is evidence of a higher species richness, evenness and diversity in Station 1 compared to Station 2 as provided in **Annex 5-2**, which is not surprising given the higher availability of food items in the port (trawl caught bags of rice and maize at various stages of decomposition in the water) compared with outside the port. Fin-fish was dominated in number by fish from the family Carangidae such as *Chloroscombrus chrysurus* and *Selene dorsalis*. Another important fish at both stations was *Drepane africana* from the family Drepanidae. The shell-fish was dominated by the lagoon swimming crab *Callinectes amnicola*; a few individuals of hermit crab was found in the catch. There were two main bycatch species, sea urchin and jellyfish. Additionally, Station 1 had an enormous amount of litter in the catch. The fishes in the catch from both stations had average sized fishes with only a few small sized and big sized individuals.

### Benthos

The benthic community had a paucity of species (**Table 5-18**). It was dominated by dead bivalve shells at the outer port and intertidal areas. Isopods and amphipods were expected to dominate the benthos from the intertidal area (deGraft-Johnson, 2010). The inner port had polychaete species in low abundance. The inner port was an organically rich environment so expected the indicated polychaetes in higher abundance. One individual of *Atylus* sp. (an amphipod) was found in a benthic sample from the inner port station.

**Table 5-18: Benthic Community Species**

Location	Organisms
Station 3: Upper Shore	Dead bivalve shells (20 /m <sup>2</sup> )
Station 3: Lower Shore	Dead bivalve shells (8 m <sup>2</sup> )
Station 2	Dead bivalve shells (5 m <sup>2</sup> )
Station 1	Polychaete: <u><i>Caulleriella capensis</i> - 2*</u> <u><i>Glycera convoluta</i>- 1*</u> Amphipod <u><i>Atylus</i> sp.- 1*</u>

\*Number of individuals found per sample

### Plankton

The zooplankton was dominated by calanoid and cyclopoid copepods; as well as chaetognaths. In all the zooplankton identified were from 11 different genera and occurred in low abundance as shown in **Table 5-19**. The phytoplankton is dominated expectedly by dinoflagellates and diatoms.

**Table 5-19: Zooplankton and Phytoplankton Species Identified**

Zooplankton taxa	Station 2	Station 1 (composite sample from the two station 1s)	Total
<b>Calanoida</b>			
Copepod adults	13	11	<b>24</b>
Copepoda naupli	12	-	<b>12</b>
<i>Temora stylifera</i>	12	11	<b>23</b>
<i>Centropages chierchiae</i>	15	-	<b>15</b>
<i>Nanocalanus minor</i>	12	-	<b>12</b>
<b>Cyclopoida</b>			
<i>Farranula gracilis</i>	11	-	<b>11</b>
<i>Corycaeus speciosus</i>	-	10	<b>10</b>
<b>Chaetognath</b>			
<i>Sagitta friderici</i>	1	-	<b>1</b>
<b>Others</b>			
<i>Oikopleura longicauda</i>	13	-	<b>13</b>
Decapod zoea	10	-	<b>10</b>
Cirripedia naupli	-	11	<b>11</b>
<i>Penilia avirostris</i>	12	-	<b>12</b>
Phytoplankton Taxa	Station 2	Station 1 (composite sample from the two station 1s)	Total
<b>Dinoflagellate</b>			
<i>Peridinium sp.</i>	33	15	<b>48</b>
<i>Prorocentrum sp.</i>	19	43	<b>62</b>
<i>Gonyaulax sp.</i>	12	-	<b>12</b>
<i>Ceratium tripos</i>	5	-	<b>5</b>
<i>Ceratium furca</i>	5	-	<b>5</b>
<b>Diatom</b>			
<i>Navicula sp.</i>	-	43	<b>43</b>
<i>Coscinodiscus sp.</i>	22	51	<b>73</b>
<i>Rhizosolenia sp.</i>	12	16	<b>28</b>

### Macroalgae

Only few strands of brown algae *Sargassum* was recorded. Various species of green algae, brown algae and red algae are present in Ghana waters. However, since 1993 annual blooms of the filamentous green alga *Enteromorpha flexuosa* have been reported in the western coast of Ghana, a phenomenon of major concern to fishermen and other users of the coast.

### 5.3.2 *Terrestrial Ecology*

The terrestrial flora and fauna survey of the pipeline route was undertaken in February 2018 as part of the ESIA. The terrestrial ecology study report is attached as **Annex 5-3**. The pipeline route is a predominantly built-up area (industrial and human settlements) with very few small-sized subsistence farms, bare/fallow areas and isolated pockets of thicket vegetation and a thin strip of degraded mangrove swamp along a section of the Chemu stream. In the rainy season, similar conditions may prevail along the proposed pipeline route except that vegetation of the fallow areas and pockets of thicket vegetation become bushy. In the rainy season, Gridco tends to control overgrown vegetation within the power-line corridor; VALCO also controls vegetation growth at the fallow areas within its property; and the Chemu stream tends to flood creating more swampy conditions around the flood plains; subsistence farming occur mostly near the VALCO drain that joins the Chemu stream. In view of the degraded nature of the pipeline route, the single season of baseline data is adequate for identifying and characterising impacts in the ESIA.

#### Methodology for Flora Survey

A literature review was conducted to obtain already existing information on the project area. This was followed by a detailed field survey. A reconnaissance walk was conducted in the study area and its external boundaries to obtain an overview of the extent, topography and complexity of the vegetation. Twelve 20 m x 20 m quadrat samples were studied in the proposed project site based on the variations detected in the vegetation along the pipeline route. Details of the sample locations and vegetation types encountered are presented in **Annex 5-3**. All vascular plants encountered in each sweep were identified and recorded. Sample point positions in the study site were recorded with the aid of Global Position System (GPS).

Specimens of species that could not readily be identified in the field were identified in the Ghana Herbarium. Nomenclature follows Flora of West Tropical Africa (Hutchinson & Dalziel, 1972). The ecological guild (which gives an indication of the ecological integrity of the habitat) and Star Rating for each species (national conservation status) were determined using the Forest Reserves of Ghana Geographic Information Exhibitor (FROGGIE) software. The global conservation status of each species was verified in the IUCN Red list (2017). The Star categories are as follows:

Black Star species:	Species rare internationally and at least uncommon in Ghana; urgent attention to conservation of populations needed
Gold Star species:	Fairly rare internationally and/or locally
Blue star species:	Widespread internationally but rare in Ghana or vice-versa
Scarlet star species:	Common, but under serious pressure from heavy exploitation
Red Star species:	Common, but under pressure from exploitation
Pink Star species:	Common and moderately exploited. Also, non-abundant species of high potential value
Green Star species:	No particular conservation concern, common in Ghana

#### Fauna

A literature review was conducted to obtain already existing information on the project area, followed by a detailed field survey. The detailed survey on the fauna of the area involved three main methods viz., direct/opportunistic observation, identification of animal spoor, and interviews.

Direct/opportunistic observation involved recording any animal sightings while driving or walking along the main access roads or animal trails to the areas bordering the proposed project site. Transect walks to spot animal *spoors* (any sign left by a living animal, such as feeding sites, regular pathways, tracks, footprints, faecal pellets, nests, etc.) were also undertaken. Some individuals in villages around the project site were interviewed for information about the fauna of the area. The interviews focused mainly on the identification of the various animals that commonly occurred in the area, and some indication of their abundance (animals are listed as Abundant, Common or Rare). Species of national and global conservation concern were identified.

#### General Vegetation of the project area

Generally, the Coastal Scrub and Grassland vegetation is a dense thicket of shrubs and small trees, up to 5 m; tall trees reaching between 15-20 m in height occur as isolated individuals. Some of the characteristic tall tree species of this vegetation type are *Albizia zygia*, *Antiaris toxicaria* and *Bombax buonopozense*. The small trees, shrubs and lianes include *Baphia nitida*, *Dialium guineense*, *Pouteria alnifolia*, *Lecaniodiscus cupanioides*, *Mallotus oppositifolius*, *Hoslundia opposita*, *Syncepalum dulcificum*, *Clausena anisata*, *Oncoba spinosa*, *Waltheria indica*, *Elaeophorbia drupifera*, *Mezoneuron benthamianum*, *paullina pinnata*, *Uvaria chamae* and *Grewia carpinifolia*. The common grasses of the grassland include *Heteropogon contortus*, *Andropogon* spp., *Ctenium* spp., *Vetiveria* spp., *Sporobolus* spp., *Dactyloctenium aegyptium*, *Panicum maximum* and *Digitaria horizontalis*.

#### Vegetation of the Pipeline Route

The various strands of vegetation are shown in **Plates 5-2 to 5-6**. The IUCN Threat Categories of the plant species of the project site are shown in **Table 5-20**. Eight of the species (*Avicennia germinans*, *Aeschynomene indica*, *Hygrophila auriculata*, *Paspalum vaginatum*, *Typha domingensis*, *Dichrostachys cinerea*, *Fuirena umbellata* and *Eleusine indica*) are of Least Concern (LC), with decreasing population trends (10.4%) and one (*Mangifera indica*, 1.3%) is Data Deficient (DD). However, majority of the species have not been yet assessed (NA) by the IUCN (88.3%). Thus, no species of global conservation concern was recorded during the survey.





Plate 5-2: Proposed route behind VALCO smelter with ruderal vegetation



Plate 5-3: Mangrove swamp forest (*Avicennia germinans*) on the margin of the Chemu lagoon, behind VALCO north wall.





**Plate 5-4: The Chemu Lagoon near local communities used as a refuse dump site**



**Plate 5-5: GRIDCO pylon right of way with grasses and forbs**



Plate 5-6: Thicket and waste dump along GRIDCO pylon right of way to VRA Header

Table 5-20: IUCN Threat Categories of Species of the Project Site

IUCN	No.	%
DD	1	1.3
LC	8	10.4
NA	68	88.3
<b>Total</b>	<b>77</b>	<b>100</b>

The proposed pipeline route passes through human settlements, industrial areas and farmlands (farms and farm re-growths). The mangrove swamp vegetation along the Chemu Lagoon has been converted into a waste dump site and therefore its primary ecological functions have been substantially modified, the lagoon could be described as essentially dead. The original Scrub vegetation has been converted largely to industrial concerns and human settlements and agriculture. Isolated pockets of thicket clumps occur in areas which are not suitable for farming.

#### Fauna of the Project site

The fauna of the project site is presented in **Annex 5-3**, and some of the fauna which were known to occur in the project area are of both national and global (IUCN, CITES) conservation significance (**Annex 5-3**). Reptiles observed and or confirmed via interviews during the survey include *Agama agama* (Agama/Rainbow lizard), *Chamaeleo gracilis* (Chameleon), *Varanus niloticus* (Nile monitor), *Naja melanoleuca* (Black-and-white Cobra), *Bitis gabonica* (Gaboon Adder/Viper). Birds include Herons, Egrets, Bitterns, common/hooded vulture, Pied crow. Mammals include African Fruit Bat, Senegal Galago/Bush baby (*Cricetomys gambianus*), *Thryonomys swinderianus* (cane rat).

The project site is currently deficient in fauna largely due to the degradation of the original habitat due to the human and industrial activities.

### Habitat Classification

The project qualifies for classification as Modified habitat in accordance with IFC Performance Standard 6 which states *inter alia*: *Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.*

## **5.4 Social Environment**

The Tema LNG Project is largely within the Tema Metropolis of the Greater Accra Region. General socio-economic information of the metropolis is obtained through information from the 2014 to 2017 Medium Term Development Plans (MTDP) and the Ghana Statistical Service report on the metropolis from the 2010 population and housing census. Information obtained from community engagement and field observations were also used together with the review of the Kpone Thermal EIA report of 2012.

### **5.4.1 Socio-economic Overview of the Project District**

#### **5.4.1.1 Demographic Characteristics**

The population of Tema Metropolis, according to the 2010 Population and Housing Census, is 292,773 representing 7.3 percent of the region's total population. Males constitute 47.8 percent and females represent 52.2 percent. The population in general live in urban localities. The population of the Metropolis under 15 years 34.5 percent depicting a broad base population pyramid which tapers off with a small number of elderly persons 60 years and above (6.0%). The total age dependency ratio for the Metropolis is 50.0, the dependency ratio the males is higher (51.3) than that of the dependency ratio females (48.7).

#### **5.4.1.2 Land Use and Visual Issues**

Land uses within Tema are diverse and include industrial, residential, agriculture, commercial, fishing and recreational facilities. Around the port, land uses include a wide range of industrial and commercial companies, producing or handling among others petroleum products, cement, food items, iron and steel, aluminium products and textiles. Most of the country's chief export, cocoa beans, is shipped from Tema. Manufacturing industries include aluminium, steel, oil refinery, soap, and fish processing, chocolate, textiles, cement, and chemicals factories.

The eastern side of the harbour is the fishing harbour, landing beach for artisanal fishers, the Chemu lagoon. Towards the Gao lagoon is characterized with developments including a berm crossing constructed by the West African Gas Pipeline project. This area is also traversed by a number of small pipelines carrying refined and crude oil to the refinery at Tema. Other pipelines in the area are intended for cooling water for power plants. In addition, there is an old sewer outfall pipe, which discharges wastes from the Tema Municipality into the ocean.

The pipeline route RoW within the Port is utilised by existing fuel/oil companies such as Tema Oil Refinery, Tema Lube Oil Company, Tema Fuel Company, and Cirrus Oil. The railway line runs almost parallel along the pipeline route within the port about 30- 50m from the existing fuel pipelines. The pipeline route crosses the Tema Fishing Harbour road which has existing ducts provided for use by pipelines. Outside the port boundaries, the proposed pipeline veers along the Valco fence wall. There is cassava/maize farm along the fence wall. The pipeline runs through generally fallow areas towards the Chemu stream. It crosses the Chemu stream at the Abonkor community section where there are temporary structures used for pig farming. The pipeline runs along the Gridco power line towards the Valco smelting junction where it crosses the Valco dedicated road and continue to run along the power line. Prior to reaching the Valco drain, the pipeline crosses the Valco road again in order to avoid the Manhean cemetery and moves along the power line route through the Valco property towards the Valco clinic. There are few subsistence farms on both sides of the dedicated road.

Prior to reaching the Valco clinic, the pipeline crosses the Valco road to move along the power line and then crosses the Bankuman untarred road to Kpone /industrial area to the VRA header station, which is directly opposite the regulating and metering (R&M) station of the West Africa Gas Pipeline Company (WAGPCo). The land use within the project corridor is provided in **Table 5-21**.

**Table 5-21: Land Use around the proposed pipeline route**

AREA	DISTANCE	LAND USE/ FEATURES
From GPHA Boundary to VALCO wall	0.71m (710 m)	<ul style="list-style-type: none"> <li>Road Crossing (GPHA Entry into restricted area). Ducts provided for pipelines</li> <li>Railway line and platform (50 m from RoW)</li> <li>GWCL valve (within RoW)</li> <li>Vegetation (herbs and Shrubs)</li> <li>Cassava/maize farm near VALCO wall (within RoW)</li> <li>Open defecation along the VALCO wall</li> </ul>
From VALCO Wall to Abonkor Community ( Along VALCO exclusive road )	1.67 km (1,673.9m)	<ul style="list-style-type: none"> <li>VALCO Fence (50m from RoW)</li> <li>Footpaths cutting through the fence (cut across RoW)</li> <li>Vegetation, Open field</li> <li>Chemu Lagoon</li> <li>Mangrove area along the lagoon area</li> <li>Open defecation along route</li> </ul>
From Abonkor Township to Manhean Township , utility corridor	1.28km (1.281m)	<ul style="list-style-type: none"> <li>GRIDCO high tension lines (along Valco RoW/ utility corridor)</li> <li>Piggery (within RoW, around broken fence of Valco)</li> <li>Vegetation</li> <li>Vegetable farms (under high tension lines after VALCO overhead Bridge to smelter)</li> <li>VALCO dedicated road (to be crossed)</li> <li>VALCO Offices (400 m from RoW)</li> <li>Open defecation along entire area</li> <li>Waste Dump Opposite broken fence entering the community</li> </ul>

From Manhean to Bankuman	0.67 km (669.5 m)	<ul style="list-style-type: none"> <li>• Vegetation (along RoW)</li> <li>• Cemetery</li> <li>• Settlements and shops (about 100m from RoW)</li> <li>• VALCO Hospital</li> <li>• VALCO exclusive road (RoW will cut across road)</li> <li>• Open defecation within the area.</li> </ul>
From VALCO Hospital to VRA Header station	0.36 km (356m)	<ul style="list-style-type: none"> <li>• Untarred road connecting Bankuman to TEMA Industrial Area and Kpone (30 m from Hospital) – RoW will cross road</li> <li>• Settlements (70m from RoW)</li> <li>• Rubbish Dump Site ( Along RoW)</li> </ul>

### Visual Issues

The most sensitive receptor along the Pipeline route outside the Port boundary is the VALCO clinic and the Manhean cemetery is the culturally sensitive site that has been identified. The VALCO dedicated road is used mainly by VALCO staff and therefore no public traffic issues are associated with it. With regards to the offshore facilities, the potential viewpoint includes vessels calling at the Port, the main harbour, the fishing Harbour and the Oil Jetty area.

#### **5.4.1.3 Land Management**

The Tema Metropolis comprises of two district planning areas – the Tema “Acquisition Area” which is administered by Tema Development Corporation (TDC) and the “Non-Acquisition Area” which, though owned by the various traditional authorities, is managed by the Town and Country Planning Department of the Tema Metropolitan Assembly (TMA). The Land Use Plan of this area was prepared in 1960 based on the concept of self-sufficiency per community and the neighbourhood concept of town planning.

Before the establishment of TMA (by Act 462), the Tema Development Co-operation (TDC), established by L.I 1468 ensured the appropriate development of the Acquisition Area. Currently this area also falls under the jurisdiction of TMA. This situation has resulted in the overlapping of planning functions which continues to breed a lot of conflict on issues between the two planning authorities. For instance, most residents report that development permits acquired from TDC are normally annulled by TMA and vice-versa. Most of the land within the immediate vicinity of Tema port is owned by the Ghana Ports and Harbour Authority.

#### **5.4.1.4 Economy**

About 72.0 percent of the populations aged 15 years and older are economically active while 28.0 per cent are economically not active. Of the economically active population, 90.4 percent are employed while 9.6 percent are unemployed. For those who are economically not active, a larger percentage of them are students (50.2%) and 20.2 percent perform household duties. Again, about 53.5 percent of the unemployed are seeking work for the first and available for work.

Of the employed population, about 31.5 percent are engaged as service and sales workers, 20.2 percent in craft and related trade and 10.4 percent in Elementary occupations. About 22.5 percent are engaged as managers, professionals, and technicians.

The Tema Harbour is the hallmark of economic activities in the Metropolis. It provides the appropriate facilities to handle efficiently the expected growth in trade and industry in the country. The Metropolitan Area serves as the industrial hub of Ghana with over 500 industries that produce chemicals, clothing, consumer electronics, electrical equipment, furniture, machinery, refined petroleum products, steel and tools. The country's biggest port and harbour facilities are located in Tema. These contribute substantially to the revenue of the state but not much to Tema Metropolitan Assembly. In order to reverse this trend, the Assembly is collaborating with businesses in the shipping industry to mobilize enough revenue from the Port.

Compared to the national average, a much larger proportion of houses in the Metropolis have facilities such as an inside tap, electricity for lighting and water closets. Fishing is one of the major economic ventures in the Tema Metropolitan Assembly (TMA). Artisanal, semi-industrial and industrial fishing activities are very prominent in the TMA. The number of canoes increased from 472 in 1995 to 500 in 2007. The breakdown of the canoes is as follows:

- Purse seines (199)
- Beach Seine (6)
- Set Nets (34)
- Hook & Line (326)
- Drift Gill Net (35)

Out of 230 semi-industrial vessels operating nationally, 150 operate from the Port of Tema. In addition, there are 60 industrial trawlers, 6 shrimpers and 40 tuna vessels base in the port of Tema. The Port of Tema provides ideal landing and marketing facilities for the industry. It is estimated that there are 15,250 active fishermen in the TMA as follows:

- Artisanal fishermen (5,000)
- Semi-Industrial fishermen (4,500)
- Industrial Trawler (3,000)
- Shrimpers (250)
- Tuna (2500)

Fisheries in the TMA directly supports some industries. There are 3 tuna canneries based in Tema which processed 55,000 metric tons of tuna in 2007. The 3 canneries employ over 3000 people. Export earnings from canned tuna in 2007 was US\$99 million. Fish and feed mills based in Tema, depend on the fish waste from the canneries as raw materials. There are 70 cold stores and ice making plants operating from TMA for storage of and preservation of fish both at sea and on land. The Tema Boatyard depends on repair of semi-industrial fishing craft for their survival while the Tema Dry-dock offers repair services to the industrial trawlers, shrimpers and tuna vessels.

More than half of the economically active population is employed in the services sector. Employment in agriculture and related activities in the Municipality is not as widespread as in other parts of the country because of the concentration of industry in the Municipality. In recent years agriculture activity may be described as coming under threat. In those communities that may be described as peri-urban, a major concern is the loss of agriculture land to new developers. Women are concentrated in the wholesale and retail trade sectors. The majority of workers are self-employed and this is especially the case for women of whom about 76% are self-employed.

Unemployment rate in the Metropolis was estimated at 11.7% in 2003. This is higher than the national unemployment rate of 5.5%. During periods of unemployment the most frequently used support mechanism was support from household members.

#### **5.4.1.5 Marine Water Uses**

The main water uses at the marine environment are shipping vessels related to the Port and fishing vessels ranging from canoes to steel hulled dragnet fishing boats. Single point moorings (SPM) for petroleum products loading and offloading are installed east of the harbour. Conflicts between large and small vessels may occur especially when the smaller fishing canoes drift near the port entrance. Fishing generally is banned within the port area up to 12 nautical miles (22.2km), which extends beyond the proposed dredging area.

#### **5.4.1.6 Underwater Noise**

Currently, underwater noise in the project area is due to movement of vessels calling at the Port, ongoing piling and other marine construction works (construction of new breakwater, jetties, berths etc.) associated with the ongoing Tema Port Expansion Project.

#### **5.4.1.7 Tema Fishing Harbour**

The Fishing Harbour comprises the Inner Fishing Harbour, the Outer Fishing Harbour and the Canoe Basin. The Inner Fishing Harbour was commissioned alongside the main harbour in 1962 to provide landing facilities for semi-industrial and industrial fishing vessels and to promote the development of the Ghanaian fishing industry. The Outer Fishing Harbour was added in 1965 to provide deeper draft for larger vessels of the national fishing fleet. More recently, a tuna wharf was commissioned in 1995 to accommodate larger tuna fishing vessels to encourage landing of tuna in Ghana. The Inner Fishing Harbour is equipped with the following facilities:

- Mooring facility of total quay length of 467metres (caters for 8 vessels of 54metres length overall);
- Finger Jetty approximately 60metres long;
- Lay-by jetty of 155 metres;
- Net-mending/Lay by wharf of 100 metres;
- Protective water area of approx. 10.0 hectares;
- Depth ranges between 3.5- 4.0 metres (Chart Datum); and
- Entrance is 63 metres wide.

The Outer Fishing Harbour is equipped with the following Facilities:

- Total Quay length of 486 metres;
- Capacity to accommodate Tuna vessels and Deep Sea Fish carriers;
- Depth ranges of 5.0 – 7.0 metres (Chart Datum);
- Lay-by mooring wharf opposite the main quay;
- Protective water area of approx. 12.5 hectares; and
- Entrance is 122 metres wide.

#### **5.4.1.8 Tema Port Operations**

Seaport operations play a major role in the overall socio-development development of Ghana. The Port of Tema Is the largest port in Ghana, stretching over a 3.9 million square metres of land area. The port receives an average of over 1650 vessel calls per year. These comprise container vessels, general cargo vessels, tankers, Ro-Ro and cruise vessels amongst many others. 85% of Ghana's trade is done through the ports with shipping routes and vessel calls to and from all continents through both direct and transshipment services. Infrastructure at the Port of Tema include quays, berths fuel bunkers, storage facilities

##### Berths

Tema Port handles cargo at fourteen berths within the port zone. Berths 1 through 5 at Quay 2, Berths 6 through 12 at Quay 1, and the Oil Berth and the Valco Berth at the South Breakwater. The two quays have a total paved quay apron of 2,196 m<sup>2</sup>. Berths 1 and 2 on quay 2 is a dedicated Container Terminal fitted with three 45 tons Ship- to- Shore Gantry Cranes and four 40 tons Rubber Tyred Gantry Cranes. Productivity per gantry crane is approximately 19 moves per hour. Berths 3-11 are multi-purpose berths and berth 12 is a clinker berth.

Although most container vessels are handled by MPS at the container terminal at berths 1 and 2, more than 10% of all containers are handled at the conventional berths. All containers at conventional berths are handled with ship's gear. Containers coming from the vessel are stacked with reach stackers at the quay, and simultaneously they are picked up by port trucks to be carried to the (GPHA) container yard, and vice versa for exports. Operations are inefficient because of lack of space, the use of ship's gear, and shortage of terminal equipment.

##### Fuel Bunkering

Re-fuelling of all marine craft is by the Ghana Bunkering Services at the Fishing Harbour. Heavy bunkers are available from the oil berth located on the south end of the main eastern breakwater. The Oil berth accommodates tankers up to 244m in length and 9.7m in draft.

##### Storage facilities

The Tema Port has a total of 53,270m<sup>2</sup> covered and 92,200 m<sup>2</sup> of open storage. A total of 19,000 m<sup>2</sup> storage area for transit cargo is available at Berths 1,2,3,4,5,7,9, and 11. There is storage capacity for cocoa in 4 sheds for a capacity of 60,000 tonnes. The open storage area is used almost entirely for containers and roro/vehicles, leaving hardly any space for conventional cargoes. Conventional cargo can be found everywhere between storage sheds, and alongside or on roads.

##### Security

The mode of operations at the Port makes it a high security zone. Security within the Tema Port is maintained by the GPHA security department, which is headed by a security manager. The implementation of the International Ship and Port Facility Security Code (ISPS) came into effect on the 1<sup>st</sup> July 2004, a global maritime security standard introduced by the international Maritime Organisation (IMO) for member nations. The Port maintains a 24 hour watch on VHF Channels 14 and 16, which can reach vessels within a radius of 140 km and during Harmattan conditions, vessels can, hear the signal 400 km from port. A 24-hour security is in place with security cameras



placed at vantage points. The Port operates four tugs fitted with pumps and monitors for firefighting. Towage is compulsory within the harbour.

### Transshipment

Transshipment is another important growing component of the core activities of the Port. There has been significant advance in the performance of transshipment since 2005. The tonnage of goods rose from 71,083 in 2004 to 327,648 tonnes in 2006. Key players in the transshipment business are Hull-Blyth, Maersk Line, ISAG, MOL and Messina Lines. The increase in transshipment volumes is attributable to the provision of a dedicated container terminal and the use of the ship-to-shore gantry cranes as well as good port management practices including cargo security. There is immense potential for growth in transit trade through Ghana to the landlocked countries in the sub-region. The total volume of transit cargo traffic stood at 887,325 tonnes in 2006. A 100,000 dwt dry dock and slipway facility is available at the Port and operated by PSC Tema Shipyard Ltd.

#### ***5.4.1.9 Transportation and Road Network***

The total length of roads within the Metropolitan area is 1,237 km (including Kpone-Katamanso which has been carved out since 2012), made up of 38 km asphaltic concrete, 301 km surface dressed and 898 km gravel and earth roads. Many of these roads have no drains, bicycle or pedestrian facilities and those that exist are generally in deplorable conditions. This situation causes a lot of difficulties for travellers when commuting from one place to the other and impact negatively on travel time, rate of accidents and productivity within the Metropolis.

The main mode of transporting goods and services in the Metropolis is by road. Currently, the rail system in the Metropolis is functioning and would help to relieve the pressure on road transport especially, if expanded from the Metropolis to other major cities. This has become imperative since goods like cocoa that serves as raw materials for some of the food production companies are transported not by rail but by road from the hinterlands. This situation sometimes results in congestion on the major roads in the Metropolis.

Due to the location of the harbour, a lot of shipping companies operates in the Metropolis that facilitates the export and imports of goods from other countries. There are private and commercial transport systems operating in the Metropolis, including, a web of taxi services which are available 24-hours. Heavy-duty trucks and Lorries come from all over the country carting goods to and from the harbour and the industries in Tema.

Basically, there are four types of commercial transport systems in the Metropolis; these are bus, commercial vehicles (trotro), shared and hired taxi services. All transport activities both within and intercity, originates and terminates at the various vehicle terminals and station at Community One which is also the central business district (CBD) of the Metropolis. Addressing transportation related problems in the CBD can therefore go a long way to improve activities in the transportation sector.

Currently, the Metro Mass Transit Services is in operation. Its services have impacted positively in the Metropolis since they started operation in late 2004. These buses commute from Tema to

areas like Accra, Ashaiman, Teshie-Nungua, Manhean and other areas. This transport service is the cheapest in the Metropolis, hence it is greatly patronized by many people in the Metropolis.

The N2 highway links the Tema to Shai Hills, the proposed location for quarry materials. N2 between Tema roundabout and Afiencya roundabout passes through the outskirts of the urban area of Tema and Ashaiman, is always congested and the pavement has deteriorated in some sections. The section from Afiencya to Asikuma Junction is a 2-lane road and there are several townships along N2 where speed limit of 50 km/hour is enforced.

#### **5.4.1.10 Cultural Heritage and Archaeology**

Located around the Gao lagoon at the eastern portions is a sacred grove comprised of undisturbed neem trees and baobab tree, which serves as a shrine for the people of the area. Rites are performed at this shrine during festive periods and other important occasions to seek for the blessings of the gods and deities, and to usher in a new year. A similar tree near the Meridian Hotel is also regarded as a deity by the traditional people of Tema. The Chemu lagoon and Sakumo II lagoon are also worshipped as deities with annual rites.

The Gao lagoon, Sakumo lagoon and Meridian hotel are located outside the project's area of influence. The Chemu stream/lagoon is within the project area of influence.

### **5.4.2 The Main Communities along the Pipeline Route**

This section describes key communities around the project area. Interviews were conducted in April-May 2018 to compile the socio-economic information of the communities. Apart from the primary data collected from communities and key informants, secondary data was also sourced from the Tema Metropolitan Assembly. The key communities include Abonkor, Manhean and Bankuman, all within 100m off the pipeline route. **Figure 5-20** shows the location of the communities near the pipeline route.

#### **5.4.2.1 Population**

The population of the main communities along the pipeline route is provided in the table below.

**Table 5-22: Population of main communities along pipeline route**

<b>Communities along Pipeline Route</b>	<b>2010</b>			<b>2018</b>		
	<i>Male</i>	<i>Female</i>	<i>Total</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
Manhean	7,061	7,369	14,430	8,525	8,519	17,043
Bankuman	703	677	1,380	849	783	1,631
Abonkor	8,839	9,756	18,595	10,671	11,278	21,949

(Source: Ghana Statistical Service, 05/07/2018)



Figure 5-20: Communities along pipeline route (Abonkor, Manhean, and Bankuman)

#### ***5.4.2.2 Socio-cultural Overview of the Local Communities***

Tema Newtown, also known as Tema Manhean came into being when the original inhabitants of Tema were moved from their land stretching from the Sakumo Lagoon to the now Tema Harbour, to their present location. This location is about 3 kilometers east of the present city of Tema. Manhean is a derivative of the two-word Ga language phrase “man-hee”. “Man” means town, while “hee”, is new; thus, new town. This forced resettlement began in 1952 and eventually took seven (7) years to complete. The construction of the city of Tema however began in 1954.

The land, measuring approximately 166 square kilometers, most of which belonged to the people of Tema, with small portions belonging to Nungua and Kpone, was acquired in 1952 under the Compulsory Acquisition of Land Ordinance. It was needed for the creation of a city that would deliver all the functions of a proposed modern seaport such as administration, commercial business, industry, and above all, housing for all people engaged in all capacities. The proposed projects of the Tema Harbour and the City of Tema were two of the five main components of the Volta River Project envisioned by Dr. Kwame Nkrumah, the first president of Ghana, for the rapid industrialization of the country.

The argument for the creation of Tema Manhean, as against their incorporation into the new city of Tema was for the preservation of their culture and identity as original inhabitants. It was in this regard that the decision was made to create a new settlement patterned along their traditional housing and community architectural designs, arrangements, and layout. The nucleus of Tema Manhean was a built area where housing compounds were provided. Each compound comprised a number of houses with an open area in the middle. Facilities such as sanitary blocks were provided a few compounds apart for shared use.

Other community facilities such as two (2) primary schools, a middle school, a Police Post and a small market had been established by 1961. By the 1960 census, the population of Tema Manhean was 9,665. Tema Manhean today stands at a voter registered population of about 170,000 as of December 2016 and spans from its western limits of the Tema fishing harbour to its north-eastern outskirt of Bankuman which borders Kpone, near the VALCO Hospital.

#### ***Socio-Cultural, Geographic, and Economic Information***

In the mid-1960s, the town experienced an influx of residents who came to work in the Industrial Area and the harbour due to proximity, non-availability of housing in Tema, and a lower cost of living compared with Tema. This economic migration has ever since continued. Tema Manhean has naturally developed a number of suburbs over the period of its growth. Some of these are Abonkor, Manhean, Zinginshore and Bankuman. The central area, which is the original built settlement of Tema Manhean is known as Manhean. This is not to be confused with the name Tema Manhean, (Tema Newtown) which refers to the totality of the expanded township, as we know it today.

Presently, the population is made up of the Ga peoples of Tema (original inhabitants), a mix of peoples of Northern Ghana, Ga-Dangbe, Ewe, and Akan group ethnicities. Although there are no designated suburbs or geographical areas for any people groups, Manhean naturally has the largest

concentration of original inhabitants while the suburbs tend to be more populated by economic migrants.

Two traditional festivals are observed, namely the Kplejoo and Homowo Festivals. The Kplejoo is peculiar to the Tema people and is celebrated at about Easter time around March or April each year. The Homowo, which is a festival common to all Ga communities is celebrated at different times by different communities. This is because it is linked to the harvesting of new maize. For the people of Tema Manhean, Homowo is usually celebrated near the end of the third quarter of the year when the fishing season peaks.

On the geographical front, Tema Newtown being on the coast has not been spared sea erosion; it has however been on a lower scale than other coastal towns such as Ada to the east, and Sekondi further west. The Chemu Lagoon, which takes its source from the Shai Hills and exits into the sea at Tema Manhean, has become toxic and no longer of any meaningful economic importance.

The apparent concentration of resources for the city of Tema to the neglect of Tema Manhean by successive governments and industry is a major source of grievance to the inhabitants of the town. The town's population has far outstripped its social amenities such as public sanitary blocks, especially toilets; and public healthcare facilities. Roads are in poor condition and there is a pressing need to find a sustainable solution to waste disposal. Above these the inhabitants bemoan their lost identity and livelihood as a primarily farming people, famous for the farming of all species of the gourd plant and vegetables. The erroneous identity of being primarily fisher folk is as a result of the acquisition of their vast farmlands, and subsequent confinement to the relatively small strip of land on the coast. The result is seasonal farming, and artisanal fishing which does not sustain them economically all year round. Some social and religious groups have introduced women groups to micro economic business ventures such as soap making and beadwork for income generation and financial empowerment.

Economic activities prevalent are fishing and fish mongering, seasonal farming, artisanal activities related to the construction industry, petty trading and some civil and public service work. With the collapse of many industries in the Industrial Area, which was a major source of employment, unemployment is estimated at 70% in the least. The resultant poverty over the time period presently has rendered sections of the community vulnerable and at risk, especially children. Many children are out of school because of parents' inability to pay school fees and other ancillary fees. The youth is the next at-risk group due to the high tendency of falling into social vices.

Compassion International, one of a few NGOs involved with Tema Newtown, has been working with the Assemblies of God and Methodist Churches in poverty reduction activities. This mostly entails the payment of school fees for some very needy children and a few income-generating activities. The government's Livelihood Empowerment against Poverty (LEAP) program under the Growth and Poverty Reduction Strategy II (GPRS II) was introduced at Manhean and Abonkor on a very limited scale in the fourth quarter of 2016.

TMA is currently promoting "toilet at half price" as part of the access to improve sanitation project under the ongoing Greater Accra Metropolitan Area Sanitation and Water Project (GAMASWAP) in the local communities around the project area in order to minimize open defecation. The

objective of the GAMASWAP is to increase access to improved sanitation/toilet facilities and water supply in the low-income communities of GAMA. Under the same GAMASWAP, the Bankuman Community is to benefit from a decentralised sewer system, where houses will be connected into the Tema Sewer line. The Manhean Community Primary and Manhean Methodist Basic School, which were without toilet facilities in March 2017 were to benefit from the institutional sanitation component of the GAMASWAP with the provision of toilet facilities. Some other schools in Manhean with poor toilet facilities were also selected to benefit from improved toilet facilities under the project and these include Manhean TMA Primary and 1&2 JHS, and Manhean SDA Basic School.

Another bright spot of development in the local community in recent times is a 386-unit housing development project commissioned in March 2018 for Officers of the Ghana Navy at Bankuman. Tema Newtown is also home to the country's Eastern Naval Command, the Tema Naval Base, which hosts the Chemu Point, one of the eight lighthouses in Ghana.

### **5.4.3 Vulnerable Groups**

Vulnerable groups are those at risk of becoming worse off due to the proposed project. The local communities near the proposed pipeline route and the artisanal fishing community near the fishing harbour are low income groups/ communities with poor sanitation and drainage conditions in the communities.

Vulnerable groups may include low-income residents of communities (Abonkor, Manhean and Bankuman) adjacent to the pipeline route; the owners of pigs and subsistence farmers with crops on the pipeline route; artisanal fishers operating near the fishing harbour; elderly people, children and women who cross the Valco dedicated road from Abonkor and Manhean areas to defecate in the bush around the Chemu stream and Gridco power line corridor due to poor sanitation situation in the local communities.

### **5.4.4 Project Affected Persons (PAPs)**

The pipeline line corridor outside the port boundary comprises of farms, fallow and bare areas and strips of mangrove swamps at sections of the Chemu stream. During the last visit for the preparation of the draft ESIA on 26<sup>th</sup> June, 2018, the construction of the pipeline was identified to affect six (6no.) subsistence farms. The farm sizes are about 0.5 ha or less. The common crops identified were vegetables (e.g. the key ones being okro and onions), cassava, maize, plantain. The vegetable farms are located within the VALCO property near the VALCO drain, which cross the VALCO dedicated road at the Manhean suburb. The cassava/maize farm is near the VALCO fence wall where the railway line and existing TOR pipelines veer towards the industrial area/TOR. Two of the likely affected farmers were on retirement, three are in their youth but are currently not engaged in any other business or work. The farmer near the VALCO fence wall work in a duty free shop at the fishing harbour as a night security person.

There are temporary wooden structures located after the Chemu stream, at the opposite end of Abonkor waste dumps site, along the Gridco power line being used for pig rearing. The wooden structures (pigsties) are located in the same compound but have various compartment/pens used

by different pig owners. Eight pig owners were identified. The wooden structures do not serve as places of accommodation. The pig owners live with their families in the local communities. The pig owners are involved in other jobs including fish mongering, and visit the pig farms at their free times to take care of the pigs. During the day, the pigs are usually allowed to roam and fend for themselves. The details of the PAPs and the affected properties within the RoW are provided in **Annex 5-4**.

## 6.0 STAKEHOLDER CONSULTATIONS

Stakeholder participation during project planning, design and implementation is widely recognized as an integral part of environmental and social impact assessment for projects. It is a two-way flow of information and dialogue between project proponents and stakeholders, which is specifically aimed at developing ideas that can help shape project design, resolve conflicts at an early stage assist in implementing solutions and monitor ongoing activities. Stakeholder consultation is a process and would continue through project implementation to provide information to identified stakeholders.

### 6.1 Objectives of the Stakeholder Engagement

The main objective of the consultations with stakeholders is to discuss the proposed project and the associated environmental and social implications and to identify alternatives and avenues for feedback and grievance redress. Specifically, the consultations seek to achieve the following objectives:

- Identify and categorize the stakeholders of the Project based on their level of interest and influence, and extent to which they are impacted by the project;
- Provide information about the proposed project and develop an effective two-way communication channel between project proponents and stakeholders;
- Effectively communicate key project information such as construction timelines and work schedules to stakeholders, particularly project affected communities and persons;
- Provide opportunities for stakeholders to express their views and make inputs into the project through continuous involvement and providing feedback on their contributions;
- To provide and discuss with stakeholders the alternatives considered to reduce anticipated impacts;
- To identify and verify significance of environmental, social and health impacts;
- To inform the process of developing appropriate mitigation and management options; and
- Establish a mechanism for receiving and addressing grievances in a timely manner.

### 6.2 Guiding Principles of the Stakeholder Engagement Plan

The stakeholder engagement plan for the Project is in accordance with the requirements of International Finance Corporation's (IFC) basic principles of good practice in stakeholder consultation which states that a good consultation process should be:

- Targeted at those most likely to be affected by the project;
- Early enough to scope key issues and have an effect on the project decisions to which they relate;
- Informed as a result of relevant information being disseminated in advance;
- Meaningful to those consulted because the content is presented in a readily understandable format and the techniques used are culturally appropriate;
- Two-way so that both sides have the opportunity to exchange views and information, to listen, and to have their issues addressed;
- Gender-inclusive through awareness that men and women often have differing views and needs;
- Localized to reflect appropriate timeframes, context, and local languages;



- Free from manipulation or coercion;
- Documented to keep track of who has been consulted and the key issues raised;
- Reported back in a timely way to those consulted, with clarification of next steps; and
- Ongoing as required during the life of the project.

### 6.3 Regulatory and other Requirements for Stakeholder Consultation

Some relevant provisions are summarised as follows:

- **Ghana Environmental Assessment Regulation LI 1652 (1999)** requires effective public consultation and participation as an integral component of Environmental Impact Assessment (EIA) procedures. Project proponents are required by law to effectively and continuously engage potential project affected persons and communities and other stakeholders to ensure issues of concern to them are addressed in project design and implementation. This helps in obtaining local knowledge, addresses public views, concerns and values that can influence the project design, which in turn increases public confidence and minimize conflicts. Public participation is core in achieving an efficient and effective ESIA practice and implementation.
- **IFC Performance Standard (PS) 1** underscores the importance of early engagement with project affected communities defined as any people or communities located in the project's near geographical proximity, particularly those contiguous to the proposed project facilities who are subject to actual or potential direct project-related risks and or adverse impacts on their physical environment, health or livelihoods. Engagement should be based on timely and effective dissemination of relevant project information, including results of the process of identification of environmental and social risks and impacts and corresponding mitigation measures, in languages and forms preferred by the affected communities and allow for meaningful communication. The PS also requires the need to build upon channels of communication and engagement with affected communities established during the risks and impacts identification process.

### 6.4 Stakeholder Identification

The stakeholder identification process for the project is based on an appreciation of the interest and influence of various organizations/institutions/ communities/persons in relation to the project. The main approach included reference to project documents and interactions with various groups/ persons, as follows:

- Project Proponent and Partners
- Regulatory Agencies/Institutions;
- Key sector agencies/relevant government institutions;
- Right-of-way owners/users outside the port boundaries;
- Right-of-way owners/users within the port boundaries;
- Administrative /local government authorities;
- Traditional authorities/nearby local communities/fishing community; and
- Project affected persons.

The stakeholders are grouped according to their roles, interests and influence on the project, as well as to the extent to which they will be negatively or positively impacted by the project. The

degree to which the identified stakeholders will be impacted by the project and the level of influence of the stakeholders on the project outcome are rated as *low*, *medium* or *high* as defined below.

#### Degree of Impact on stakeholder

**Low:** Based on an interaction with the stakeholder as well as a review of institutional mandates, the project is assessed to have low positive or negative impact on the stakeholder/ institution. For stakeholder institutions, positive impacts may include the institutional knowledge and experience to be gained from the implementation of the project and negative impacts may include possible losses and damage (e.g. financial, reputation) from the failure of the project.

**Medium:** The project will have measurable positive or negative impacts on the stakeholder/institution.

**High:** The project will have significant positive or negative impacts on the stakeholder/institution.

#### Degree of stakeholder influence on project outcome

**Low:** The stakeholder has minimal capability to positively or negatively influence the outcome of the project.

**Medium:** The stakeholder has measurable capability to positively or negatively influence the outcome of the project.

**High:** The stakeholder has significant capability to positively or negatively influence the outcome of the project.

The stakeholders identified for the project are listed below and in **Table 6-1**, which additionally provides for their roles and level of influence/impact.

1. Project proponent and partners
  - Tema LNG Terminal Company Limited.
2. Regulatory Agencies
  - Environmental Protection Agency (EPA);
  - Energy Commission;
  - National Petroleum Authority;
  - Ghana Maritime Authority;
  - Ghana National Fire Service (GNFS);
  - Water Resources Commission;
  - Department of Factories Inspectorate; and
  - Public Utilities Regulatory Commission.
3. Key Sector Agencies/Relevant Government Institutions
  - Ghana Ports and Harbours Authority (GPHA);
  - Ghana National Petroleum Corporation (GNPC);
  - Volta River Authority;

- Ghana Shippers Authority;
  - Ghana Navy;
  - Fisheries Commission; and
  - Land Use and Spatial Planning Authority.
4. Right of Way Users/Owners outside the Port Boundaries
- Ghana Petroleum Mooring Services (GPMS)
  - Tema Oil Refinery (TOR)
  - Ghana Grid Company Limited (GRIDCo);
  - Volta Aluminium Company (VALCO);
  - Tema Development Corporation; and
  - Ghana Water Company (GWCL);
  - WAPCo, owners of buried lines along the proposed route (especially for the 0.3 km section from the portion near the VALCO Clinic to the VRA header station).
5. Right of Way Users within the Port Premises
- Ghana Petroleum Mooring Services (GPMS) – Currently managing the oil pipeline RoW from the Port to Tema Oil Refinery for the current RoW users including:
  - Tema Oil Refinery
  - Tema Lube Oil Company Limited
  - Tema Fuel Company Limited
  - Cirrus Oil
  - Ghana Railway Development Authority.
6. Administrative/Local Government Authorities
- Tema Metropolitan Assembly; and
  - Kpone Katamanso District Assembly.
7. Representative of Nearby Local Communities in Tema New Town (Abonkor, Manhean and Bankuman)
- Traditional Authorities
    - Tema Traditional Authority
    - Local chiefs and elders
  - Project affected persons (subsistence farmers in the right of way and owners of structures used for rearing pigs near the Chemu stream opposite Abonkor), see **Plates 6-1 and 6-2**.
  - Assembly members
  - Abonkor, Manhean and Bankuman communities
  - Fishing community (artisanal fishermen)

Table 6-1: Stakeholder identification and analysis

No.	Groups of stakeholders	Stakeholder(s)	Role of Stakeholder/ Relation to the Project	Degree of project impact on stakeholder	Level of influence on project outcome
1.	Project Proponent	Tema LNG Terminal Company Limited/ [REDACTED]	<ul style="list-style-type: none"> <li>Accountable entity responsible for successful implementation of the project including design, construction and operation of the facility project.</li> </ul>	High	High
2.	Regulatory Agencies	Environmental Protection Agency (EPA)	<ul style="list-style-type: none"> <li>EPA is responsible for regulating the environment. The Agency will issue a permit for the construction and operation of the facility and will monitor the project to ensure compliance to the permit conditions and adherence to the Environmental Assessment Regulations, 1999.</li> </ul>	Low	High
		Energy Commission	<ul style="list-style-type: none"> <li>Regulation, management, development and utilisation of energy resources in Ghana. Will issue provisional license, siting permit and construction permit for project implementation.</li> </ul>	Medium	High
		National Petroleum Authority	<ul style="list-style-type: none"> <li>Regulate, oversee and monitor the petroleum downstream industry. Monitor ceiling of petroleum/gas prices and ensure compliance with NPA Act 2005, Act 691</li> </ul>	Low	Medium
		Ghana Maritime Authority	<ul style="list-style-type: none"> <li>Will provide marine safety permit for the offshore facilities. Will also provide maritime security approval for the offshore project and approval the disposal of the dredged material offshore.</li> </ul>	Medium	High
		Ghana National Fire Service (GNFS)	<ul style="list-style-type: none"> <li>To provide fire permit /certificate for project facility outside the Port premises, especially the VRA header station.</li> </ul>	Low	High
		Water Resources Commission	<ul style="list-style-type: none"> <li>To provide water use permit in case the Chemu stream will have to be blocked or diverted when crossing or any abstraction to be made from any surface water body including lagoons.</li> </ul>	Low	Medium
		Public Utilities Regulatory Commission	<ul style="list-style-type: none"> <li>Regulates utility prices for electricity and water consumption.</li> <li>PURC will monitor the standard of performance of GRIDCo, ECG and GWCL as utility service providers.</li> </ul>	Low	Low
		Department of Factories Inspectorate	<ul style="list-style-type: none"> <li>Facilities outside the port premises, especially the VRA header station, should be registered with the Factories Inspectorate. Factories Inspectorate will monitor safety of workers.</li> </ul>	Low	Medium

No.	Groups of stakeholders	Stakeholder(s)	Role of Stakeholder/ Relation to the Project	Degree of project impact on stakeholder	Level of influence on project outcome
3	Key Sector Agencies/Relevant Government Institutions	Ghana Ports and Harbours Authority (GPHA)	Provider of concession to operate within the port of Tema, and party to whom port infrastructure will be transferred to at the end of the Gazprom contract. Will also approve the various drawings of the EPC contractor before construction and provide fire/safety permits for construction activities within the port, site for dumping dredged material, approve operations of the offshore facility etc.	High	High
		Ghana National Petroleum Corporation (GNPC)	<ul style="list-style-type: none"> <li>Gazprom's customer and party to whom the terminal will be transferred to at the end of the Gazprom contract</li> </ul>	High	High
		Volta River Authority	<ul style="list-style-type: none"> <li>Owner of the header station where the LNG pipeline will be connected into, i.e. gas delivery point, before distributed or sold to industries or power plants.</li> </ul>	High	High
		Ghana Shippers Authority	<ul style="list-style-type: none"> <li>Will ensure registration, building, importation and licensing of Ships and also ensure proprietary interest in ships are in compliance with industry standards.</li> </ul>	Medium	High
		Ghana Navy	<ul style="list-style-type: none"> <li>Member of the Energy Commission Siting Committee to approve the siting of the offshore facilities.</li> </ul>	Low	High
		Fisheries Commission	<ul style="list-style-type: none"> <li>To confirm that the project will not have any significant impact on fishing activities.</li> </ul>	Low	Medium
4	Right of Way Users/Owners outside the Port Boundaries	Ghana Petroleum Mooring Services (GPMS) / Tema Oil Refinery (TOR)	<ul style="list-style-type: none"> <li>GPMS has a 15 year Concession Agreement with the Tema Oil Refinery to operate and maintain the fuel pipelines from the port to the refinery</li> </ul>	High	High
		Ghana Grid Company Limited (GRIDCo)	<ul style="list-style-type: none"> <li>Has high-tension infrastructure along sections of the proposed pipeline route outside the port premises. The pipeline route will share the right-of-way with the power line.</li> </ul>	Medium	Medium
		Volta Aluminium Company (VALCO)	<ul style="list-style-type: none"> <li>A greater portion of the pipeline route outside the port boundary passes through the property of VALCO and the company will have to allow and approve the pipeline route through its property.</li> </ul>	High	High
		WAPCo, owners of buried lines along the proposed route (especially for the 0.3	<ul style="list-style-type: none"> <li>Has a header station opposite the VRA header station and its pipelines are will be crossed at Bankuman before the proposed pipeline is connected into the VRA header station.</li> </ul>	High	Medium

No.	Groups of stakeholders	Stakeholder(s)	Role of Stakeholder/ Relation to the Project	Degree of project impact on stakeholder	Level of influence on project outcome
		km section from the portion near the VALCO Clinic to the VRA header station.			
		Tema Development Corporation (TDC)	<ul style="list-style-type: none"> <li>Owns the land for the pipeline route after the Valco property. Will have to approve the pipeline RoW through its property.</li> </ul>	Low	Medium
		Ghana Water Company Ltd (GWCL)	<ul style="list-style-type: none"> <li>Provides potable water for public use.</li> <li>Have infrastructure within the Valco property along the Valco clinic road and may share part of right-of-way with the pipeline.</li> </ul>	Low	Low
	Project affected persons (PAPs)	Two farmers and a piggery owner	Two farms, comprising a vegetable farm and a cassava farm, along pipeline route will be affected. A piggery owner rearing pigs in a wooden structure along pipeline route to be affected.	Medium	Low
5	Right of Way Users/Owners inside the Port	Ghana Petroleum Mooring Services (GPMS) / Tema Oil Refinery (TOR)	GPMS has a 15 year Concession Agreement with the Tema Oil Refinery to operate and maintain the fuel pipelines from the port to the refinery	High	High
		Tema Lube Oil Company Limited; Tema Fuel Company Limited; and Cirrus Oil	These companies have fuel pipelines from the Port to their facilities. The pipeline RoW is managed by GPMS.	Medium	Low
		Ghana Railway Development Authority	Has a railway line infrastructure within the port near the pipeline route and that could be crossed.	Low	Medium
6	Administrative/Local Government Authorities	Tema Metropolitan Assembly <ul style="list-style-type: none"> <li>Land Use and Spatial Planning Department</li> </ul>	<ul style="list-style-type: none"> <li>The project is largely located in this metropolis except for the VRA header station.</li> <li>TMA is responsible for the political administration and development of the neighbouring communities along the pipeline route, and will provide business registration license for Tema LNG Terminal to operate in the metropolis</li> </ul>	High	High
		Kpone Katamanso District Assembly.	The existing VRA header station is located in this administrative district.	Low	Low

No.	Groups of stakeholders	Stakeholder(s)	Role of Stakeholder/ Relation to the Project	Degree of project impact on stakeholder	Level of influence on project outcome
7	Traditional Authority and local communities and artisanal fishing community	Tema Traditional Council, Abonkor, Manhean and Bankuman	<ul style="list-style-type: none"> <li>• Tema Traditional Council are the original traditional land owners and have traditional/ cultural oversight of local communities along pipeline route.</li> <li>• Traditional Council facilitates development and resolution of conflicts/ disputes among community members.</li> <li>• Local communities along the pipeline route use sections of the pipeline corridor as access route and for open defecation, and have a cemetery close to the pipeline corridor.</li> </ul>	Medium	Medium
		Tema harbour fishing community	<ul style="list-style-type: none"> <li>• Have a landing beach after the fishing harbour.</li> </ul>	Low	Low





**Plate 6-1: Farming within RoW**



**Plate 6-2: Structures along the pipeline corridor.**


## **6.5 Stakeholder Engagement and Communication Strategy**

The Stakeholder process begins at the preliminary stages and would continue through to its implementation. **Table 6-2** summarizes the proposed approach for stakeholder engagement.



**Table 6-2: Stakeholder Engagement and Communication Strategy**

No.	Activity	Identified Stakeholders	Focus of Consultation/ Information to be shared	Timelines/ Frequency	Forms of communication/ method of engagement	Facilitator/ Responsibility
1.	Consultations for the preparation of ESIA/ Project design	<ul style="list-style-type: none"> <li>Energy Commission</li> <li>Ghana Maritime Authority</li> <li>Ghana Ports and Harbours Authority, Tema Port</li> <li>Ghana Navy</li> <li>Ghana national Petroleum Commission</li> <li>Environmental Protection Agency (EPA)</li> <li>[REDACTED]</li> <li>Project affected persons/ institutions</li> <li>RoW institutions/users</li> <li>Tema Metropolitan Assembly Works Department; <ul style="list-style-type: none"> <li>Urban Roads Department</li> </ul> </li> <li>Tema Development Corporation</li> <li>Nearby Local Communities</li> <li>Fishing Community</li> </ul>	<ul style="list-style-type: none"> <li>Potential environmental and social issues of concern from the proposed project's implementation</li> <li>Compliance with IFC, Energy Commission and EPA requirements for Tema LNG terminal Project</li> <li>Strategies for mitigating the potential impacts and successful maintenance of the proposed facility during their operation</li> <li>Public and occupational health and safety at construction sites</li> <li>Scope of interventions of proposed works for LNG ancillary facilities</li> </ul>	Throughout the ESIA study period	<ul style="list-style-type: none"> <li>One on one Interviews</li> <li>Field visitation</li> <li>Sharing and review of relevant reports</li> <li>Email and phone calls</li> </ul>	SAL Consult Ltd/ [REDACTED] SA/Aecom
2.	Draft ESIA Consultations	<ul style="list-style-type: none"> <li>RoW institutions/users</li> <li>Opinion Leaders from Local community /Project Affected Persons (PAPs)</li> <li>Key institutional stakeholders engaged during the preparation of the ESIA</li> <li>Fisheries Commission</li> <li>Fishing Community</li> </ul>	<ul style="list-style-type: none"> <li>Feedback on issues and concerns raised during the ESIA preparatory phase</li> <li>Presentations on findings from the ESIA study including proposed mitigation measures, community grievance redress arrangements</li> <li>Receiving of comments from participants and potentially affected people and responding to comments.</li> </ul>	After Submission of draft EIS to EPA	<ul style="list-style-type: none"> <li>Draft EIS notification in a national daily newspaper</li> <li>Public engagement forum</li> </ul>	[REDACTED] /Aecom/ SAL Consult Ltd

No.	Activity	Identified Stakeholders	Focus of Consultation/ Information to be shared	Timelines/ Frequency	Forms of communication/ method of engagement	Facilitator/ Responsibility
3.	Disclosure of the ESIA report.	<ul style="list-style-type: none"> <li>• RoW institutions- VALCO, TDC, GPMS</li> <li>• Tema Traditional Authority</li> <li>• Tema Metropolitan Assembly</li> <li>• GPHA</li> <li>• Energy Commission</li> </ul>	<ul style="list-style-type: none"> <li>• Make available copies of the approved EIS</li> </ul>	After Issuance of the environmental permit for the Project by the EPA	<ul style="list-style-type: none"> <li>• Publication of the approved EIS to inform the public where they can access the documents</li> <li>• Deliver hard and/or soft copy of the approved EIS to relevant stakeholders</li> </ul>	Tema LNG Terminal Company 
4.	Pre – mobilization/ Site preparation prior to construction	<ul style="list-style-type: none"> <li>• Ghana Ports and Harbours Authority, Tema</li> <li>• Ghana Maritime Authority</li> <li>• RoW institutions/users</li> <li>• Communities / Assembly members</li> <li>• Tema Metropolitan Assembly Works Department; <ul style="list-style-type: none"> <li>○ Urban Roads Department</li> </ul> </li> <li>• Fishing community</li> </ul>	<ul style="list-style-type: none"> <li>• Information on schedule of preparation and construction works</li> <li>• Awareness creation on the potential impacts and remedial measures to GPHA and the communities</li> <li>• Integration of the ESIA into planning for construction (impacts and mitigation measures)</li> <li>• Grievance redress procedures</li> <li>• Capacity building for stakeholders for the implementation of the ESIA (impacts and mitigation measures)</li> </ul>	At least 1 month prior to construction	<ul style="list-style-type: none"> <li>• Sharing of relevant reports</li> <li>• Institutional /Community notifications.</li> </ul>	EPC Contractor /Tema LNG terminal
5.	Start of construction	<ul style="list-style-type: none"> <li>• Row Users</li> <li>• GPHA, Tema Port</li> <li>• Community/ Assembly members</li> <li>• Tema Metropolitan Assembly Works Department; <ul style="list-style-type: none"> <li>○ Urban Roads Department</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Information on Schedule of construction works, activities and progress of construction</li> <li>• Awareness creation on the potential impacts and remedial measures to community</li> <li>• Training</li> </ul>	Throughout the construction period	<ul style="list-style-type: none"> <li>• General stakeholder meetings for and Consultants, contractor</li> <li>• Community notification.</li> </ul>	EPC Contractor /Tema LNG terminal

No.	Activity	Identified Stakeholders	Focus of Consultation/ Information to be shared	Timelines/ Frequency	Forms of communication/ method of engagement	Facilitator/ Responsibility
		<ul style="list-style-type: none"> <li>Fishing Community</li> </ul>	<ul style="list-style-type: none"> <li>PEMP Implementation (impacts and mitigation measures)</li> <li>Code of Conduct</li> <li>Grievance redress mechanism</li> </ul>			
6.	End of construction / Decommissioning of construction equipment and machinery	<ul style="list-style-type: none"> <li>RoW Users</li> <li>GPHA</li> <li>Community/Assembly members</li> <li>Tema Metropolitan Assembly Works Department;               <ul style="list-style-type: none"> <li>Urban Roads Department</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Information on Schedule of decommissioning works, activities and progress of decommissioning</li> <li>Awareness creation on the potential impacts and remedial measures to stakeholders</li> <li>Training               <ul style="list-style-type: none"> <li>PEMP Implementation (impacts and mitigation measures)</li> <li>Code of Conduct</li> </ul> </li> <li>Grievance redress mechanism</li> </ul>	Decommissioning phase	<ul style="list-style-type: none"> <li>General stakeholder meetings for Contractor, Terminal Operators and GPHA</li> <li>Community/ Institutional notification.</li> </ul>	EPC Contractor /Tema LNG terminal Company
7.	Commissioning and handing over of LNG Infrastructure	<ul style="list-style-type: none"> <li>EPC Contractor</li> <li>Tema LNG Terminal</li> <li>GPHA</li> <li>Ghana Navy</li> <li>Row Users</li> </ul>	<ul style="list-style-type: none"> <li>Roles and responsibilities in the O&amp;M</li> <li>Training on the LNG Management.</li> </ul>	Prior to commissioning	<ul style="list-style-type: none"> <li>Community Notification.</li> <li>Training workshop</li> </ul>	EPC contractor /Tema LNG Terminal
8.	Operation and maintenance of LNG facilities	<ul style="list-style-type: none"> <li>Tema LNG Terminal Operators</li> <li>Ghana Ports and Harbours Authority</li> <li>Ghana Navy</li> <li>RoW users</li> <li>Nearby Local Communities</li> <li>Fishing Community</li> </ul>	<ul style="list-style-type: none"> <li>Formulation of Environmental Health, Safety and Security Policies in compliance</li> <li>Public awareness creation/sensitisation on waste disposal and maintenance of drains</li> <li>Operation and Maintenance (O&amp;M) requirements</li> <li>Roles and responsibilities in the O&amp;M</li> <li>Training on the LNG Management and Emergency Response Measures.</li> </ul>	During operation and maintenance period	<ul style="list-style-type: none"> <li>General meetings / institutional engagements</li> <li>Community meetings and interviews</li> <li>Field investigations</li> <li>Training Workshops</li> </ul>	Tema LNG Terminal

No.	Activity	Identified Stakeholders	Focus of Consultation/ Information to be shared	Timelines/ Frequency	Forms of communication/ method of engagement	Facilitator/ Responsibility
			<ul style="list-style-type: none"> <li>• Review of grievance</li> <li>• Consultations with stakeholders and local communities on preparation of EMP</li> <li>• Disclosure of EMP to all potentially impacted parties, and training</li> </ul>			

## 6.6 Scoping Notice and Public Involvement

A Scoping Notice, which aims at inviting public comments on the proposed project was published, as required under the procedure for the conduct of EIA in accordance with Regulation 15 (1) of LI 1652. The publication was made in the Daily Graphic, a national newspaper, on 6 February 2018. A copy of the notice is provided as **Annex 6-1**.

## 6.7 Outcome of Consultations Carried Out

Extensive stakeholder consultations have been carried out by Tema LNG Terminal Company (since December 2017) and SAL Consult Ltd (since January 2018). Tema LNG Terminal Company has been engaging the key stakeholders involved in the siting of project facilities as well as owners of the pipeline RoW including Ghana Ports and Harbours Authority (GPHA), Energy Commission, Tema Oil Refinery (TOR), Ghana Petroleum Mooring Services (GPMS), Volta Aluminium Company Ltd (VALCO) and Tema Development Corporation (TDC).

As part of the engagement with the Energy Commission, the Commission issued a provisional licence to enable the company install and operate the facility at the Tema Port. The Commission later organized a siting committee meeting to enable Tema LNG Terminal Company in collaboration with SAL Consult Ltd do a presentation on the project to the members of the committee on 17<sup>th</sup> April, 2018 at the Conference room of the Energy Commission. The siting committee members included representatives from

- Energy Commission
- GPHA
- Ghana Maritime Authority
- Ghana Navy
- Ghana Police
- Environmental Protection Agency
- Geological Survey
- Water Resources Commission

After the meeting, members carried out an inspection tour at the project sites. Subsequently, the Energy Commission issued a siting permit for the project as attached in **Annex 6-4**. The series of engagement with the TDC and VALCO by Tema LNG Terminal Company also led to the issuance of Right of way (RoW) approvals from these stakeholders as provided in **Annexes 6-6 to 6-7** respectively.

SAL Consult Ltd obtained an introductory letter (**a sample letter is provided in Annex 6-2**) for further stakeholder engagement including consultations with the local communities. The list of stakeholders contacted, a summary of the outcome of the public consultations and stakeholder involvement process are provided in **Table 6-3**, and **Table 6-4** shows a summary of key issues/concerns and responses. The community engagement and impact study report is attached as **Annex 6-3a**, and evidence of stakeholder engagement provided in **Annex 6-3b**.

Table 6-3: Summary of stakeholder consultation outcome

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
<b>Project Proponents</b>					
Tema LNG Terminal Company Limited/ [REDACTED]	King Taylor	Proponent	Ongoing		<ul style="list-style-type: none"> <li>• Provided information about the project description</li> <li>• Facilitated stakeholder consultations and field investigations</li> </ul>
<b>Other Stakeholders</b>					
Ghana Ports and Harbours Authority	Ing. Kofi Inkoom	Port Engineer	Ongoing	Interview	<ul style="list-style-type: none"> <li>• Provided information on the operation of the Port in general and the oil jetty in particular.</li> <li>• Although the GPHA owns the port, TOR oversees the RoW for the pipelines.</li> <li>• The proposed works will not interfere with fishing activities as the Port entrance, where the breakwater will be extended, is out of bounds for fishing.</li> <li>• Extracts from the concession agreement has been attached as evidence of approval in <b>Annex 6-5</b>.</li> </ul>
Fisheries Commission	Matilda Quist	Deputy Director /Head of marine services	16/04/2018	Phone Call	<ul style="list-style-type: none"> <li>• There should be confirmation and an approval report on studies on the projects impact on fisheries within the area</li> <li>• The client should visit the research unit of the fisheries commission for further information required</li> </ul>
Water Resources Commission	Dr Lumor Mawuli	Principal Basin Officer	16/04/2018	Interview	<ul style="list-style-type: none"> <li>• The client must identify rivers /water bodies to be affected by the project</li> <li>• If freshwater will be used for construction or processing purposes a water use permit is required</li> <li>• If the Chemu lagoon will be affected due to the gas pipeline crossing then there is need for a water use permit.</li> <li>• However, if the construction work for the pipeline will not result in the abstraction/ blockage or diversion of the stream/lagoon then a permit is not required.</li> <li>• The forms for the application process are on the WRC website</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>The permitting duration takes about 3 months, the clients must ensure all documents required for processing are in order.</li> <li></li> </ul>
Factories Inspectorate Department	F Ohene - Mensah	Ag. Chief Inspector of Factories	16/04/2018	Interview	<ul style="list-style-type: none"> <li>The project must be registered with the factories inspectorate</li> <li>The building plan should be presented to the factories inspectorate for inspection and inputs</li> <li>The form can be obtained at the Factories Inspectorate office</li> <li>After registration an officer will be sent for a facility audit</li> <li>The contractors to be employed must all be registered with the factories inspectorate</li> <li>Normally, the Factories Inspectorate deal with contractors during the construction phase and then the client during operational phases.</li> <li>The contractor would have a series of monitoring parameters such as air/noise among others.</li> <li>The contractor will be issued a certificate prior to work commencement</li> </ul>
Ghana Petroleum Mooring Services (GPMS)	Ian Heever) Neil Frost Patrick Yeboah Comfort Wemegah	General Manager Consultant HSE Manager Office Manager	16/04/18 23/04/2018	Interview	<ul style="list-style-type: none"> <li>GPMS is requesting that Tema LNG Terminal Company communicates officially to GPMS on their intention to use the proposed pipeline servitude</li> <li>As part of the application, Tema LNG Terminal Company should provide information on the pipeline specifications and configurations, when construction activities are likely to commence and how construction activities will be carried out.</li> <li>GPMS will forward the application to the Board for discussion and approval. However, GPMS will require the EPA and NPA permits before actual construction works commences.</li> <li>GPMS has a 15 year Concession Agreement with the Tema Oil Refinery to operate and maintain the fuel pipelines from the port to the refinery</li> <li>GPMS confirmed that the current servitude can accommodate the 16 inch pipeline as desired. There are a couple of options to do this, including the decommissioning of a redundant 24 inch pipeline (to make way for our line)</li> <li>GPMS is willing and ready to collaborate with us, TLTC, to deliver this onshore pipeline project.</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>• There are both technical and commercial issues such as safety and insurance of the existing (live) pipelines within the servitude that have to be addressed amongst the parties as part of the initial discussions.</li> <li>• GPMS requested for a copy of the technical project brief (power point slides)</li> <li>• GPMS Management will require an approval from its Board of Directors to eventually engage TLTC.</li> <li>• GPMS is available (either via mail or a call) for further discussions.</li> </ul>
Tema Metropolitan Assembly (TMA)	Mr Ali Amadu	Metro Planning Officer	18/01/18	Interview	<ul style="list-style-type: none"> <li>• The project proponents should officially write the Metropolitan Chief Executive and the Member of Parliament for the Tema East Constituency about the proposed project, describing its key features, since they represent the local communities and any concerns the local communities will have on the project will ultimately be brought to their attention for redress.</li> <li>• The Assemblymen for the communities should also be informed about the project since they are usually the first point of call for all concerns the communities may raise about the project and play a key role in consultations with community members.</li> <li>• Recommends stakeholder meetings with the Chiefs and assembly members together to prevent misinformation and also reduce effects of agitation/resistance among community members.</li> <li>• There have been some complaints about encroachment of existing pipelines within the area. The proponent must therefore put in place adequate monitoring measures for the proposed pipeline.</li> </ul>
Ghana Grid Company (GRIDCO)	Ebenezer Essienyi	Director Technical services	08/2018	Phone Call/Interview	<ul style="list-style-type: none"> <li>• If the pipeline is not within the 15m easement for the power lines then GRIDCO will not be of concern.</li> <li>• There is no need for written follow-up by TLTC as there is no interface/overlap between the proposed route and the powerline RoW.</li> </ul>
Assembly member for Bankuman	Hon. John Dzogadzor	Assembly member	24/01/2018	Interview	<ul style="list-style-type: none"> <li>• There three Assembly members serving the communities along the proposed project corridor.</li> <li>• Advises that a meeting with all three Assembly members be held to brief them about the project.</li> <li>• The Assembly members can facilitate meetings with the traditional leaders.</li> </ul>



Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
Tema Traditional Council	Nii Adjei Kraku II and Elders	Paramount Chief	- 24/04/2018	Interview	<ul style="list-style-type: none"> <li>• <b>Knowledge of Project:</b> The Chief and elders had no prior knowledge of the project. The chief emphasized that their position as land owners must be appreciated and the traditional council should have been informed before feasibility and planning studies for the project.</li> <li>• <b>Acquisition of RoW:</b> The Traditional Council (TC) enquired if the RoW has been acquired from the appropriate owners(e.g. VALCO)</li> <li>• <b>Project Relocation:</b> The Council was concerned if all project options had been exhausted and the pipeline route could not go through any other route other than the proposed route near the Gridco high tension, which is close to the communities.</li> <li>• <b>Anxiety about nature of project and proximity to communities:</b> The Council expressed anxiety with the project especially as it is a gas project and was concerned about the pipeline route from behind Abonkor to the header station.</li> <li>• <b>Proposed Land use within pipeline routes:</b> The TC indicated that there are impending plans by the Council to move some mechanics within the local communities' to a location around the header station within the Kpone area.</li> <li>• <b>Employment of local residents:</b> Will the project employ residents (i.e. contractors , labourers, etc.)</li> <li>• <b>Community safety and Security:</b> The chief and elders were concerned about the safety of their community members closer to the pipeline route. They mentioned that maximum safety and security procedures should be put place to forestall any potential accidents and to minimize injuries during any accident.</li> <li>• <b>Corporate Social Responsibility (CSR):</b> The TC suggested that the company develops a Corporate Social Responsibility (CSR) to cover the local communities, which will be geared towards improving their livelihoods and reduce poverty in the communities.</li> <li>• <b>Customary rites prior to project initiation:</b> The TC indicated that some customary rites need to be performed on the land before the project can take off. The TC requested for a meeting with the client for further discussion on this and to arrange for these rites to be performed.</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>• <b>Community Sensitization:</b> The TC indicated that because of the sensitivity of the project, community sensitization must be done properly and should be throughout the project conception and implementation period including planning, construction, operation phases, and that the engagement should not be restricted to the ESIA study phase. The TC suggested that subsequent engagement must include emergency response procedures for residents, safety procedures /actions to prevent explosions. The TC recommended that key community personnel should be identified and be involved with the pipeline route monitoring and they should be able to liaise with the company and provide relevant information (e.g. safety, encroachment etc) that could help prevent any potential negative impacts occurring.</li> </ul>
Bankuman Community Members	John Dzogadzor  Stephen Kwame Opoku	Assemblyman  Representative	24/04/2018	Community meeting	<ul style="list-style-type: none"> <li>• <b>Newly constructed pipelines within the project area:</b> The members first asked if construction work for the pipelines has already started. The community members indicated that about four (4) or more weeks ago, a company unknown to the residents has laid pipelines just across the road from the Valco hospital, and the residents wanted to know if it is the same project.</li> <li>• <b>Proximity of community to pipeline:</b> Residents raised concerns about the risks associated with a gas pipeline close to their homes and wanted to know if some of their domestic activities e.g. cooking poses a risk.</li> <li>• <b>Exact Pipeline Route and community safety and security:</b> The residents want to know the exact route of the gas pipeline, security and safety measures put in place and how these will be enforced to guarantee their protection.</li> <li>• <b>Pipeline Depth and Safety:</b> The residents want to know the depth of the pipelines and implications for their safety.</li> <li>• <b>Proposed land use:</b> The residents reported that there are plans to block the untarred access road after the Valco hospital leading to Kpone. <i>However, the residents could not confirm which authority plans to undertake this activity and the Assemblyman for the area could not substantiate this claim.</i></li> <li>• <b>Rubbish Dump and Burning Activities:</b> There is some rubbish dumping near the untarred access road from Bankuman to Kpone, which will be close to the</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<p>proposed route and some people occasionally burn the rubbish as and when they like. The community members want to know if this burning activity is not a threat to the project, and suggested that if possible the project should help relocate the dump to prevent any potential accidents.</p> <ul style="list-style-type: none"> <li>• <b>Lack of toilet facilities and open defecation along sections of the pipeline route:</b> The community members confirmed that some sections of the pipeline route are used by residents as place of convenience (i.e. open defecation) because of inadequate household toilets in the local communities along the pipeline route. The community members indicated that if because of the project they cannot have access or use the area as place of convenience, the company should consider providing an alternative toilet facilities for residents use.</li> <li>• <b>Project Relocation Option:</b> The community members claimed that there are currently about four (4) gas pipelines within the same RoW, and want to know if this project cannot be moved to another location.</li> <li>• <b>Project Security:</b> According to the community members, residents were assured by the Ghana Gas project that there will be adequate security to ensure that there is no encroachment on the reserved area. However, this has not happened and encroachment on the Ghana Gas area is increasing. The residents expect Tema LNG to provide security to prevent encroachment from happening as it is unsafe.</li> <li>• <b>Community safety:</b> The community members want to know what Emergency Response Measures have been put in place for residents. An explosion is likely to affect a large area and most of their houses are wooden kiosks, and want to know how they can protect themselves and their property.</li> <li>• <b>Resettlement/Compensation:</b> The community members indicated that they are mostly settlers and since the project is a high risk, they are willing to relocate provided they will be compensated.</li> </ul>
Manhean Community Members	Godfred Tetteh-Abbey and 69	Assemblyman	3/05/2018	Community meeting	<ul style="list-style-type: none"> <li>• <b>Employment:</b> The community members were concerned if the people in the community will benefit in the area of employment under the project. The community indicated that from experience, when it's time for people to be</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
	community residents				<p>employed, even as common labourers, the people in the community are bypassed.</p> <ul style="list-style-type: none"> <li>• <b>Burning at Dumpsite:</b> The members indicated that there is an unofficial trash dumpsite near the end of the pipeline header station and were concerned if the frequent burning at the dumpsite will not pose a danger to the pipeline.</li> <li>• <b>Depth and width of Pipeline:</b> How wide is the pipeline and how deep will the pipeline be buried?</li> <li>• <b>Security:</b> The members suggested that there will be the need for a 24-hour security watch on the pipeline to ensure that dangers are spotted early.</li> </ul> <p><b>Community safety and use of pipeline route:</b></p> <ul style="list-style-type: none"> <li>• The members want to know how safe both adults/children are since the designated area for the pipeline route also serves as a free range, i.e. used as place of convenience by the people.</li> <li>• According to the community, children occasionally go to play along the proposed pipeline route using all kinds of items including safety matches and want to know if this is not going to pose a danger.</li> </ul>
Abonkor community members	Christian Y. Amoah and 31 community residents	Assemblyman	9/05/2018	Community meeting	<p><b>Employment:</b></p> <ul style="list-style-type: none"> <li>• According to the community members, a lot of people in the community are unemployed. The community suggested that they should be granted a quota of the direct jobs that will be created especially at the construction stage.</li> <li>• The community indicated that they will be displeased if they are bypassed for jobs and may render their frustration in their own way if it happens. And suggested that job requirements should be communicated to the Assemblyman.</li> <li>• The community members reiterated that as a sign of respect to the community, some members of the community be given some of the temporary project jobs.</li> <li>• <b>Depth of Pipeline and Erosion:</b> According to the community, a depth of 1 meter for buried pipes is not deep enough. They indicated that some pipes that were buried some years ago now have some portions exposed due to erosion, and that the depth needs to be re-considered.</li> <li>• <b>Pipeline proximity to communities:</b> The community was worried that the pipeline is anywhere near places with human activity or settlement, and suggested that a route along the beach or offshore needs to be seriously considered.</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>• <b>Poor maintenance culture:</b> The community indicated that there is poor maintenance culture in Ghana, and therefore what assurance can be given to the community that the right things would be done in terms of maintenance.</li> <li>• <b>Long-term impacts and compensation:</b> The members want to know what plan the project has for the people, either in the form of compensation or mitigation measures for any long-term impacts.</li> <li>• <b>Air Pollution:</b> The project should address air pollution from unpaved roads and use of large trucks.</li> <li>• <b>Community medical examination:</b> The community indicated that periodically, the residents should be given thorough medical checks, at no charge to the residents, to ascertain that they are not being adversely affected by the project. This should be a mid to long-term obligation of the project.</li> <li>• <b>Property within RoW:</b> What will happen to people whose property fall within the pipeline RoW?</li> <li>• <b>Explosion:</b> What would be done for anyone who happens to get hurt in an explosion? A member indicated that an explosion has happened at Manhean before.</li> <li>• <b>Armed robbers and pipeline security:</b> The community members indicated that robbers have cut through an oil pipeline to steal oil in recent times. They said although this pipe will be buried, a good security system needs to be put in place to discourage any kind of mischief, and ensure safety.</li> <li>• <b>Traffic Concerns:</b> The community indicated that there is only one route into and out of Tema Newtown (the bigger town in which the communities form a part), and from previous project experience, large truck going in and out of town cause heavy vehicular traffic hold-ups. Alternative roads that bypass Tema Newtown should be used to prevent such traffic inconvenience in town.</li> <li>• <b>Community awareness on safety measures:</b> The project should ensure that the community members are made aware of all precautionary safety measures.</li> <li>• <b>Commencement of Project:</b> The community should be informed about when the project will start.</li> <li>• <b>Need to address community concerns:</b> The community members indicated that the concerns raised should be addressed and that no “big man” should rubbish or</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					play down on any of the concerns that members have raised regarding this project.
Tema Development Corporation	Kwesi Impong	Surveyor	22/01/18	Interview	<ul style="list-style-type: none"> <li>Participated in a joint survey of the proposed pipeline route with the project surveyors (AECOM), representative from VALCO, SAL Consult Limited and representatives of the proponent.</li> <li>The TOR RoW is owned by the company and leased to prospective RoW users.</li> <li>Permission will need to be sought from VALCO on the section of the pipeline within their property.</li> <li>The TDC has drawings of the locations of all underground pipelines within the vicinity of the metering station. The proponent should therefore submit a Google earth (kmz) file of the proposed pipeline route for advice on the potential for conflict with other underground pipelines.</li> <li>The RoW approval from TDC has been attached as <b>Annex 6-6</b></li> </ul>
VALCO	Kwabena Sapong	Electrical Engineer	22/01/18	Interview	<ul style="list-style-type: none"> <li>Participated in a joint survey of the proposed pipeline route with the project surveyors (AECOM), representative from TDC, SAL Consult Limited and representatives of the proponent.</li> <li>Provided information on the extent of VALCO property.</li> <li>The project has to be within the allocated utility corridor, to prevent interference with VALCO future land use plans.</li> <li>The pipeline route must remain within the utility corridor</li> <li>VALCO has granted Tema LNG Terminal permission to route the pipeline through the utility corridor. Construction of these pipelines require strict planning and coordination to prevent interruptions from access to the hospital. In addition, Pipeline construction activities that interrupt the operations of VALCO at the berth and result in financial implications will be borne by Tema LNG Terminal. The response and approval letter to the request of RoW has been included in <b>Annex 6-7</b>.</li> </ul>
	Kwesi Asiedu	Safety Manager	12/04/2018	Interview	

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
Ghana National Petroleum Corporation	Seth Foli	Lead HSE Officer	8/03/2018	Interview	<p><u>Organisational arrangements</u></p> <ul style="list-style-type: none"> <li>GNPC is the buyer of the gas and will take over the terminal operations after the contract period of 12 years. GNPC in this regard will second staff to the terminal operator to gain the necessary experience to enable the successful takeover after the contract period expires.</li> <li>The terminal operator will be required to submit a maintenance programme for the facilities to assist GNPC with monitoring to ensure a smooth transition during takeover.</li> <li>GNPC is required to step in to ensure the client gets the permit in the event all the required permitting procedures are followed and yet the environmental permit is not obtained. GNPC will therefore need to be well informed at each stage of the permitting process.</li> <li>There is an Interface Committee comprising GNPC and VRA to oversee activities to be carried out at the metering station for tie-in of the proposed LNG pipeline.</li> <li>The terminal operator, GPHA and GNPC formed a committee to work towards obtaining the Port Service agreement.</li> </ul> <p><u>Social impacts</u></p> <ul style="list-style-type: none"> <li>Concerning the proposed pipeline construction, it is preferable that [REDACTED] maintains the existing right of ways (RoWs) as much as possible to reduce the potential social impacts of the pipeline construction.</li> </ul> <p><u>Health and safety</u></p> <ul style="list-style-type: none"> <li>The Petroleum Commission has recently released the Petroleum (Health, Safety and Environment) regulations to guide the sector developments. These regulations will be very useful to the consultant for the ESIA.</li> <li>It is also important to carry out an assessment of the appropriate safety distances of the proposed pipeline from other land use within the corridor.</li> </ul> <p><u>Input into the Environmental Assessment</u></p> <ul style="list-style-type: none"> <li>Noted that the scoping report has been submitted to the EPA. GNPC will be happy to receive a copy of the scoping report to study.</li> </ul>

Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>For the ESIA, it would be useful to submit a copy to GNPC for review and comment prior to submission to the EPA.</li> </ul>
National Petroleum Authority	Michael Darko Sarkwa	Licensing Officer	20/06/18	Phone Call	<ul style="list-style-type: none"> <li>The Energy Commission is in charge of licensing and permitting LNG however the client should formally write to the Chief Executive Officer to inform the Authority of the proposed project</li> </ul>
West Africa Gas Pipeline Company (WAPCo)	Ivan Addotey Samuel Buckman	-Projects Engineer -Site Supervisor	18/06/18	Interview	<ul style="list-style-type: none"> <li>WAPCo is expecting to be formally informed of the proposed LNG Terminal project</li> <li>Tema LNG should write an official letter addressed to the Managing Director of WAPCo, this is to inform the company of the proposed project and its activities and the concerns of the company will be discussed and relayed to Tema LNG</li> <li>There are pipeline crossing agreements the client has to consider.</li> <li>There are rules that guide the closeness of LNG pipelines for emergency purposes and this should be considered and discussed officially.</li> </ul>
Tema Harbour Fishing Community	Nii Odamety II	Chief Fisherman - Tema Landing Beach	18/06/18	Interview	<ul style="list-style-type: none"> <li>The fisher community would want the project implementers to come in person for a discussion because of past experiences from other projects within the area.</li> <li>Tema LNG should write a formal letter addressed to the chief fisherman requesting a meeting.( the address; The Chief Fisherman, Tema Landing Beach, Tema)</li> <li>The Concerns will be discussed thereof</li> </ul>
Subsistence Farmers (6no.)	-Amuzu Havor -Daniel Quaye -Bawa Sule -Issah Mohammed -Ibrahim Ali -John yaw Rockson	Project affected persons	26/06/18	Interview	<ul style="list-style-type: none"> <li>The crops grown are mostly vegetables (i.e. okro, onions and “ayoyo”), maize and cassava</li> <li>The farmers raised concerns about compensation payment for their crops prior to the start of construction works.</li> <li>The farmers were also concerned if they would still be able to farm at the site when the pipeline is in operation.</li> </ul>



Stakeholder/ Institution/	Contact Person	Role	Date	Consultation type	Concerns Raised/ Information Received
Pig Farmers (8no.)	Abla Nyamevor and 7 others (see Annex 5-4)				<ul style="list-style-type: none"> <li>• The area is waterlogged and this results in the area getting flooded during the rainy season</li> <li>• Madam Nyamevor stated that she had future plans to relocate from the present area to another site and is working to raise funds to enable her move with her livestock</li> <li>• Livelihood assistance will be very much appreciated by all.</li> <li>• The pig owners usually come around between 4pm and 6pm.</li> </ul>

**Table 6-4: Summary of key Issues/concerns and Responses**

<b>Institution/ Stakeholder</b>	<b>Key Issue/Concerns</b>	<b>Response</b>
Fisheries Commission	There should be confirmation and an approval report on studies on the projects impact on fisheries within the area.	The Marine Ecology study report will be included in the draft ESIA to be shared with the Commission
Water Resources Commission	<ul style="list-style-type: none"> <li>• If freshwater will be used for construction or processing purposes a water use permit is required</li> <li>• If the Chemu lagoon will be affected due to the gas pipeline crossing then there is need for a water use permit</li> <li>• However, if the construction work for the pipeline will not result in the abstraction/ blockage or diversion of the stream/lagoon then a permit is not required.</li> </ul>	<p>The pipeline route will cross the Chemu stream. However, the construction work for the pipeline will not result in the abstraction/ blockage or diversion of the stream.</p> <p>The stream crossings will be carried out by horizontal directional drilling technology.</p>
Factories Inspectorate	<ul style="list-style-type: none"> <li>• The project must be registered with the factories inspectorate</li> <li>• Normally, the Factories Inspectorate deal with contractors during the construction phase and then the client during operational phases.</li> </ul>	<p>TMA LNG will register with the Factories Inspectorate</p> <p>Tema LNG will ensure that the EPC contractor is registered with the Factories Inspectorate</p>
Ghana Petroleum Mooring Services (GPMS)	<ul style="list-style-type: none"> <li>• Tema LNG Terminal Company should provide information on the pipeline specifications and configurations, when construction activities are likely to commence and how construction activities will be carried out.</li> <li>• GPMS will forward the application to the Board for discussion and approval. However, GPMS will require the EPA and NPA permits before actual construction works commences.</li> </ul>	Tema LNG Terminal Company will officially write to GPMS with the requested project information including copies of the EPA and Energy Commission permits.
Tema Metropolitan Assembly (TMA)	<ul style="list-style-type: none"> <li>• The project proponents should officially write to the Metropolitan Chief Executive and the Member of Parliament for the Tema East Constituency about the proposed project, describing its key features, since they represent the local communities and any concerns the local communities will have on the project will ultimately be brought to their attention for redress.</li> <li>• Recommends stakeholder meetings with the Chiefs and assembly members together to prevent misinformation and also reduce effects of agitation/resistance among community members.</li> </ul>	<ul style="list-style-type: none"> <li>• Tema LNG Terminal will officially write to the TMA as requested and also register with the TMA to obtain a business operating license that will enable it operate in the Metropolis.</li> <li>• The available assemblymen for the local communities were present at the meeting with the traditional council.</li> <li>• A pipeline monitoring and maintenance plan will be put in place.</li> </ul>

	<ul style="list-style-type: none"> <li>There have been some complaints about encroachment of existing pipelines within the area. The proponent must therefore put in place adequate monitoring measures for the proposed pipeline.</li> </ul>	
Tema Development Corporation	<ul style="list-style-type: none"> <li>The TOR RoW is owned by the company and leased to prospective RoW users.</li> <li>Permission will need to be sought from VALCO on the section of the pipeline within their property.</li> <li>The proponent should submit a Google earth (kmz) file of the proposed pipeline route for advice on the potential for conflict with other underground pipelines.</li> </ul>	<ul style="list-style-type: none"> <li>Tema LNG Terminal has obtained RoW approval from TDC as shown in Annex 6-6.</li> <li>Tema LNG Terminal has also obtained RoW approval from VALCO as shown in Annex 6-7.</li> <li>Tema LNG Terminal will officially submit Google earth (kmz) files of the proposed pipeline route for advice from TDC with regard to presence of other buried pipelines in the project area.</li> <li>Engagement with WAPCo has confirmed buried pipeline after the Bankuman road before the VRA header station.</li> </ul>
GNPC	<p><u>Social impacts</u></p> <ul style="list-style-type: none"> <li>Concerning the proposed pipeline construction, it is preferable that [REDACTED] maintains the existing right of ways (RoWs) as much as possible to reduce the potential social impacts of the pipeline construction.</li> </ul> <p><u>Health and safety</u></p> <ul style="list-style-type: none"> <li>The Petroleum Commission has recently released the Petroleum (Health, Safety and Environment) regulations to guide the sector developments. These regulations will be very useful to the consultant for the ESIA.</li> <li>It is also important to carry out an assessment of the appropriate safety distances of the proposed pipeline from other land use within the corridor.</li> </ul> <p><u>Input into the Environmental Assessment</u></p> <ul style="list-style-type: none"> <li>Noted that the scoping report has been submitted to the EPA. GNPC will be happy to receive a copy of the scoping report to study.</li> <li>For the ESIA, it would be useful to submit a copy to GNPC for review and comment prior to submission to the EPA.</li> </ul>	<ul style="list-style-type: none"> <li>The pipeline route RoW selection takes into consideration minimization of social impacts and safety distances from adjoining properties.</li> <li>The ESIA Consultant will try and access the Petroleum (Health, Safety and Environment) regulations for review to confirm usefulness to the ESIA study.</li> <li>GNPC can request for a copy of the Scoping Report and ESIA from Tema LNG Terminal</li> </ul>
National Petroleum	<ul style="list-style-type: none"> <li>The Energy Commission is in charge of licensing and permitting LNG However the client should formally write to the Chief Executive Officer to inform the Authority of the proposed project</li> </ul>	<ul style="list-style-type: none"> <li>Tema LNG Terminal will officially communicate in writing to NPA on the Project</li> </ul>

Authority (NPA)		
WAPCO	<ul style="list-style-type: none"> <li>Tema LNG should write an official letter to WAPCo, to inform the company of the proposed project and its activities and the concerns of the company will be discussed and relayed to Tema LNG</li> <li>There are pipeline crossing agreements the client has to consider.</li> </ul>	<ul style="list-style-type: none"> <li>Tema LNG Terminal will officially communicate in writing to WAPCo on the Project, to discuss the pipeline crossing agreement.</li> </ul>
GRIDCO	<ul style="list-style-type: none"> <li>If the pipeline is not within the 15m easement for the power lines, here is no need for written follow-up by TLTC .</li> </ul>	<ul style="list-style-type: none"> <li>The GridCo RoW is 15m either side of the powerlines and the pipeline is 30m from the powerlines. The pipeline route does not impinge on the powerlines RoW.</li> </ul>
Tema Traditional Council	<ul style="list-style-type: none"> <li>Acquisition of RoW</li> <li>Project Relocation</li> <li>Anxiety about nature of project and proximity to communities</li> <li>Proposed Land use within pipeline routes</li> <li>Employment of local residents</li> <li>Community safety and Security</li> <li>Corporate Social Responsibility (CSR)</li> <li>Customary rites prior to project initiation.</li> <li>Community Sensitization</li> </ul>	<ul style="list-style-type: none"> <li><b>Acquisition of RoW:</b> The RoW has been acquired from VALCO and TDC as shown in Annexes 6-6 and 6-7 respectively.</li> <li><b>Project Relocation:</b> A detailed pipeline route study options were carried out with stakeholder involvement to inform the selection of the proposed route.</li> <li><b>Anxiety about nature of project and proximity to communities:</b> Pipeline route monitoring and maintenance arrangement will be put in place to minimise the risk of explosion.</li> <li><b>Proposed Land use within pipeline routes:</b> The local land use and spatial planning authorities, TDC and TMA are involved with the selection of the proposed route.</li> <li><b>Employment of local residents:</b> The EPC Contractor will be required to engage labourers from the local communities.</li> <li><b>Community safety and Security:</b> Adequate safety, security and monitoring measures will be put in place during construction and operation of the pipeline.</li> <li><b>Corporate Social Responsibility (CSR):</b> The Tema LNG Terminal will develop a CSR policy to ensure that project impacted communities benefit from the project.</li> <li><b>Customary rites prior to project initiation:</b> The Tema LNG Terminal will engage the traditional council further on this.</li> <li><b>Community Sensitization:</b> The local communities are key stakeholders and will be engaged throughout the project implementation including operation/maintenance phase</li> </ul>

Local communities	<p><b><u>Bankuman, Abonkor and Manhean</u></b></p> <ul style="list-style-type: none"> <li>• Commencement of project</li> <li>• Proximity of communities to pipeline</li> <li>• Exact Pipeline Route and community safety and security</li> <li>• Pipeline Depth and Safety</li> <li>• Proposed land use and intention to block untarred access road behind Valco Hospital by Traditional authorities</li> <li>• Rubbish Dump and Burning Activities near the proposed pipelines</li> <li>• Lack of toilet facilities and open defecation along sections of the pipeline route</li> <li>• Project Relocation Option because of existing gas pipelines in RoW</li> <li>• Project Security and encroachment on RoW</li> <li>• Employment and jobs especially for temporary jobs</li> <li>• Air Pollution from unpaved roads and traffic concerns through Tema Newtown</li> <li>• Community medical examination</li> <li>• Community awareness on safety measures</li> <li>• Poor maintenance culture</li> <li>• Community safety, long term impacts and Emergency Response Measures</li> <li>• Resettlement/Compensation for properties within RoW. Community is willing to relocate</li> </ul>	<ul style="list-style-type: none"> <li>• Tema LNG Terminal Company is presently acquiring the necessary permits and approvals for the project inclusive of the EPA permit. The project shall commence once all the necessary requirements are approved and finalized</li> <li>• The pipeline route finalization process is still ongoing. Tema LNG will ensure that all necessary monitoring and maintenance works and risks assessment are conducted to ensure the safety of community members.</li> <li>• The pipeline will be buried at a depth of 1m along the VALCo private road to the VRA header station.</li> <li>• TMA and TDC will have to be informed about the future land use plans by the Tema Traditional Council for the untarred access road behind the VALCO hospital in view of the proposed pipeline project.</li> <li>• It is an unsafe practice for communities to burn rubbish at the dumps along the pipeline route. Tema LNG will create awareness for community members on safe practices within RoW of the proposed pipeline route.</li> <li>• Tema LNG Terminal Company will liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs for use.</li> <li>• The proposed pipeline route is still being finalized, Tema LNG Terminal will consider existing gas pipelines within the RoW. Feasibility studies conducted show that the location options are the most preferred.</li> <li>• The EPC contractor will be required to ensure that a preferential recruitment plan will be adopted to optimize the use of local skilled and unskilled labour</li> <li>• The contractor will be required to adhere to mitigation measures provided for air pollution and traffic to minimize impacts.</li> <li>• Tema LNG Terminal will ensure extensive awareness creation among communities to ensure that emergency, response, safety and security procedures are well known and adequately managed.</li> </ul>
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		<ul style="list-style-type: none"> <li>Tema LNG will prepare and implement a livelihood restoration plan for PAPs</li> </ul>
Artisanal fishing community	<ul style="list-style-type: none"> <li>The fisher community want the project implementers to come in person for a discussion because of past experiences from other projects within the area, and should channel the letter requesting for the meeting through the Chief Fisherman, Tema Landing Beach, Tema.</li> </ul>	Tema LNG Terminal will write through the GPHA requesting for a meeting with the fisher community.
PAPs	<ul style="list-style-type: none"> <li>The crops grown are mostly vegetables (i.e. okro, onions and “ayoyo”), maize and cassava</li> <li>The farmers raised concerns about compensation payment for their crops prior to the start of construction works.</li> <li>The farmers were also concerned if they would still be able to farm on when the pipeline is in operation.</li> <li>The pig farms area is waterlogged and this results in flooding in the rainy season</li> <li>Madam Nyamevor (one of the pig owners) stated that she had future plans to relocate from the present area to another site and is working to raise funds to enable her move with her livestock.</li> <li>There are seven other pig owners around.</li> <li>Livelihood assistance will be very much appreciated according to Madam Nyamevor.</li> </ul>	Tema LNG Terminal will prepare and implement a livelihood improvement plan for identified affected persons. The livelihood improvement plan will take into consideration concerns of the PAPs, with regard to compensation and relocation

## 7.0 IMPACT ANALYSIS APPROACH AND METHODOLOGY

This chapter presents the methodology used to assess the significance of impacts that may result from the Tema LNG terminal project. It outlines general assessment methods and presents the criteria for determining receptor sensitivity, impact magnitude and impact significance.

### 7.1 Impact Assessment

The impact assessment for this study includes;

- Identification of Potential Environmental and Social Issues and Impacts;
- Evaluation and interpretation of impacts; and
- Impact Mitigation and Control.

#### 7.1.1 Identification of Potential Environmental and Social Issues and Impacts

The potential environmental and social impacts of the proposed project have been identified and assessed as positive/beneficial or negative/adverse. The potential impacts of the Project have been identified and described for the various phases of the Project including impacts resulting from:

1. Preparatory/planning phase activities;
2. Construction phase activities;
3. Operational phase activities; and
4. Decommissioning phase activities.

#### 7.1.2 Evaluation and Interpretation of Impacts

The significance of each impact has been evaluated and compared with national, international as well as applicable industry standards. The methodology for evaluating an impact is outlined below:

##### 7.1.2.1 Impact Identification and Characterisation

Impacts are described in terms of their characteristics, including the impact's type and the impact's spatial and temporal features (namely extent, duration, scale and frequency). The definitions of the terms used are described in Table 7-1.

Table 7-1: Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	<p><b>Direct</b> - Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).</p> <p><b>Indirect</b> - Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).</p>

Characteristic	Definition	Terms
		<p><b>Induced</b> - Impacts that result from other activities (which are not part of the Project) that happen because of the Project.</p> <p><b>Cumulative</b> - Impacts that arise because of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect.</p>
Duration	The time period over which a resource / receptor is affected.	<p><b>Temporary</b> - (period of less than 3 years - negligible/associated with the notion of reversibility)</p> <p><b>Short term</b> - (period of less than 5 years i.e. production ramp up period)</p> <p><b>Long term</b> - (period of more than 5 years and less than 15 years i.e. life of plant)</p> <p><b>Permanent</b> - (a period that exceeds the life of plant – i.e. irreversible. Or may last for a very long time)</p>
Extent	The reach of the impact (i.e. physical distance an impact will extend to)	<p><b>On-site</b> - impacts that are limited to the Project site.</p> <p><b>Local</b> - impacts that are limited to the Project site and adjacent properties.</p> <p><b>Regional</b> - impacts that are experienced at a regional scale, i.e. beyond adjacent properties, covering the metropolis and beyond</p> <p><b>National</b> - impacts that are experienced at a national scale.</p> <p><b>Trans-boundary/International</b> - impacts that are experienced outside of Ghana</p>
Scale	Quantitative measure of the impact (e.g. the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.). or the professional viewpoint of the measure of impact	Quantitative measures as applicable for the feature or resources affects/ professional viewpoint of expert as applicable for the feature or resource in terms of severity of impact measure (i.e. minor, moderate, severe)
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.
Likelihood	Characteristic that pertains to unplanned events determined either qualitatively or quantitatively estimated on the basis of experience and/or evidence that such an outcome has previously occurred.	<p><b>Unlikely</b> – The event is unlikely but may occur at some time during normal operating conditions.</p> <p><b>Possible</b> – The event is likely to occur at some time during normal operating conditions.</p> <p><b>Likely</b> - The event will occur during normal operating conditions (i.e., it is essentially inevitable).</p>

#### 7.1.2.2 Determining Impact Magnitude

Once an impact's characteristics are defined, the next step in the impact assessment phase is to assign each impact a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

1. extent;
2. duration;
3. scale; and
4. frequency.



Magnitude (from small to large) is in practice a continuum, and evaluation along the spectrum requires the exercise of professional judgement and experience. Each impact is evaluated on a case-by-case basis, and the rationale for each determination is noted. The universal magnitude designations, for negative effects, are: negligible, small, medium and large. The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a positive impact.

### 7.1.2.3 Determining Receptor Sensitivity

The other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The sensitivity of receptor used is low, medium and high as shown in the table below.

**Table 7-2: Sensitivity Criteria**

Value / Sensitivity	Low	Medium	High
<b>Biological and Species Value / Sensitivity Criteria</b>			
Criteria	Not protected or listed as common / abundant; or not critical to other ecosystem functions (e.g. key prey species to other species).	Not protected or listed but may be a species common globally but rare in Ghana with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under Ghana legislation and/or international conventions e.g. CITIES Listed as rare, threatened or endangered e.g. IUCN
<b>Socio-Economic Sensitivity Criteria</b>			
Criteria	Those affected are able to adapt with relative ease and maintain pre-impact status.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Those affected will not be able to adapt to changes and continue to maintain pre impact status.
<b>Physical Sensitivity Criteria</b>			
Criteria	The resource remains unaffected and maintains pre-impact status.	Pre-impact status is temporarily altered. May be restored over time naturally or through specific interventions.	Pre impact status is permanently altered by the development. Receptor or resource is held in high-esteem by stakeholders

### 7.1.2.4 Assessing Significance

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating was determined, using the matrix provided in **Table 7-3**.

### Impact Minor Significance

An impact of minor significance, hereafter referred to as a ‘minor impact’ is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. The repercussions on the environment are not significant and may or may not require the application of mitigation measures.

### Moderate Significance

An impact of moderate significance hereafter referred to as a ‘moderate impact’, will be within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching an established (legal) limit. The repercussions on the environment are substantial but can be reduced through specific measures.

**Table 7-3: Impact Significance**

		Sensitivity / Vulnerability of Resource / Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

### Major Significance

An impact of major significance, hereafter referred to as a ‘major impact’ is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. The repercussions on the environment are very strong and cannot easily be reduced.

#### **7.1.3 Mitigation and Control**

All significant impacts identified have been considered for mitigation and control through preventive, reductive/enhancement and curative strategies and control measures. Measures have been identified, described and recommendations incorporated into the proposed development to minimise or avoid the key impacts. Where the effectiveness of mitigation measures is uncertain, or depends on assumptions about operational procedures, monitoring programmes and/or operations/management procedures will define the required practice.

A provisional environmental management plan (PEMP) has been developed for the project and its facilities in accordance with the Environmental Assessment Regulations 1999, LI 1652. An Environmental Monitoring Plan section of the PEMP presents detailed plans to monitor the implementation of mitigating measures and the identified impacts of the project during the construction and operation phases. The plan includes an estimate of capital and operating costs.

## **8.0 POTENTIAL IMPACT IDENTIFICATION AND ASSESSMENT**

This Chapter discusses potential impacts that have been identified through baseline assessments carried out in specific relation to the works/ activities anticipated.

### **8.1 Introduction**

The ESIA serves principally to identify those impacts most likely to be significant and therefore needs to be addressed. In undertaking the ESIA, the team has drawn upon:

- its knowledge of sources of potential impacts associated with storage terminal and pipeline developments;
- an identification of the main environmental and social resources and receptors from the preliminary baseline data collection work; and
- the results of the initial scoping stakeholder engagement.

### **8.2 Environmental and Social Resources and Potential Receptors**

For this Project the following main resource / receptor types: physical environment, biological environment and human/socioeconomic environment.

### **8.3 Physical Environment**

The proposed marine works will have an impact on the seabed, coastal erosion, as well as marine sediment and water quality. The Chemu Stream and its associated wetland will be the recipient of any run off water from the project site. The air quality may also be affected by dust and exhaust emissions from project activities.

#### ***8.3.1 Biological Environment***

Construction activities could have an impact on marine ecology including plankton and benthic communities, pelagic and demersal fish. Onshore pipeline construction will affect terrestrial fauna and flora within the pipelines RoW.

#### ***8.3.2 Human/Socioeconomic Environment***

About 4 km of the proposed pipeline RoW is within 100 m of human settlements.

Land use within 100 m of the RoW of the gas pipeline include subsistent farms, community cemetery, park, temporary structures and access roads/route. There is also a potential impact on local economy, including employment and business opportunities and occupational, and community health and safety.

## **8.4 Project Activities of Environmental and Social Concern**

### ***8.4.1 Preparatory Phase Activities***

Preparatory phase activities of environmental concern include among others:

- Survey works and feasibility studies to determine the pipeline route, optimal location and FSU/FRU alignment, the extent of breakwater, dredging requirements, the final mooring configuration and the manoeuvrability of approaching LNGCs;
- Stakeholder consultations;
- Acquisition of RoW; and
- Statutory permitting activities from Energy Commission, EPA and GMA.

#### **8.4.2 Construction Phase Activities**

Construction phase activities of environmental/social concern include among others:

- Procurement of labour;
- Construction of site office, work camp and storage facilities;
- Site and RoW preparation: vegetation clearing & topsoil removal and storage;
- Equipment/material/ worker transport;
- Resource utilisation;
- Pipeline installation: trenching and backfilling;
- Pipeline installation: horizontal directional drilling;
- Construction of mooring and floating infrastructure (in reference to impact piling);
- Dredging;
- Supply of quarry materials to the site;
- Under water blasting (if it becomes an optional during dredging);
- Disposal of dredge materials;
- Extension of breakwater;
- Hydrostatic testing;
- Stream crossings;
- Post –construction activities including dismantling of construction work camps;
- Road crossings; and
- Waste storage and disposal.

#### **8.4.3 Operational and Maintenance Phase Activities**

Operational and maintenance phase activities of environmental/social concern include:

- Loading/offloading of LNG to FSU;
- General maintenance of FRU and FSU;
- General maintenance of pipeline;
- Thermal (cold water) discharge from the FRU;
- Boil-off gas handling;
- LNGC mooring;
- Venting and flaring;
- Pipeline RoW management;
- Wastewater treatment, storage and disposal;
- Solid waste generation and disposal;
- Maintenance dredging (once every five years);

- Resource utilisation;
- The imposition and patrol of an exclusion zone around the LNG carrier, FRU and FSU; and
- Emergency response.

#### **8.4.4 Decommissioning Phase Activities**

Decommission activities to potentially impact on the environment during post construction and post operational phase activities include:

- Post construction: Dismantling of construction work camps, relocation of equipment and disposal of wastes.
- Post operation/maintenance: Dismantling and relocation of offshore/onshore infrastructure and waste disposal.

### **8.5 Evaluation of Potential Positive Impacts**

The potential positive impacts from the constructional phase activities include:

- Employment opportunities, local resource use and improved local economy;
- Availability of natural gas; and
- Improved institutional & national revenue.

#### **8.5.1 Employment Opportunities, Local resource use and Improved Local Economy**

The Contractor may employ about 500 Ghanaians during the peak period (Month 11) for the various aspects of construction activities out of an expected peak employee level of 591. Some unemployed youth within the project area may also have the opportunity to be gainfully employed as unskilled workers during the pipeline construction.

Local contractors/consultancy companies will be contracted individually or be required to collaborate with International firms with high experience to carry out various project activities (e.g. Bathymetry surveys, geotechnical investigation, ESIA study, environmental monitoring during construction and operation, dredging works etc) and these will create job opportunities for the local firms and individuals.

Local workshops will also be engaged to help repair machines/equipment and components if necessary. The hospitality industry will also benefit from the presence of expatriates/foreign workers.

As part of the local content policy of [REDACTED]/Tema LNG Terminal, the contractor will be required to purchase several materials from the local market to shorten the supply time and reduce the cost, such as sand, aggregates, stones, rocks, and part of equipment. The major materials and plant to be procured/rent from the local companies are listed as follows:

- 1) Crushed stone, 27883 m<sup>3</sup>
- 2) Rock, 903683 m<sup>3</sup>
- 3) Sand, 16440 m<sup>3</sup>
- 4) Cement, 8675t

- 5) Fuel, 185t
- 6) Water, 14450 m<sup>3</sup>

The operation of the LNG terminal will provide direct and indirect job opportunities over its useful life to both skilled and unskilled persons nationwide as it will provide valuable fuel to industry.

### **8.5.2 Availability of Natural Gas**

The proposed project is expected to help the nation to meet its natural gas demand. The availability of natural gas to the power generating plants in Tema will facilitate the ongoing electricity grid expansion programme and provide an adequate reserve margin. A LNG import facility that ties into the existing pipeline grid is the most feasible and reliable source of natural gas.

### **8.5.3 Improved Institutional & National Revenue**

Revenue will accrue to the State in the form of tax deductions from wages of workers and Contractor fees. Government agencies e.g., Energy Commission and EPA will charge processing and permit fees, which will increase the revenue base of these institutions.

In the medium to longer term, government will earn tax revenue both directly from the project and indirectly from the expanded industrial and commercial activities. Resources, which were hitherto used to import fuel for combustion in thermal plants and in industry, could be channelled into other areas of the economy.

## **8.6 Evaluation of Adverse Impacts from the Proposed Project**

The evaluation of the adverse environmental and social issues which could possibly arise from the implementation of the proposed project are described in **Table 8-1** with respect to the planning/preparatory phase activities, construction phase activities, operational phase and decommissioning phases. The magnitude, sensitivity and significance rating have been determined as per **Table 7-3**, and the impact ratings are prior to mitigation being applied.

## **8.7 Cumulative Impact Issues**

With regard to the proposed Project, Cumulative impacts may arise especially due to the ongoing Tema Port Infrastructure Development and Dredging Project (commonly referred to as the Tema Port Expansion Project), which started in 2014. The Tema Port Expansion Project comprises of the following project scope:

- I. Construction of breakwaters;
- II. Dredging and reclamation;
- III. Construction of quay;
- IV. Cargo handling and berthing furniture at all the respective berths;
- V. Cargo handling and operations terminals;
- VI. Upgrading of ports' access roads and the development of new major dedicated access roads to the Port of Tema; and
- VII. Coastal reclamations and/or reformations, especially near the Sakumo beach as a result of possible accretion and growth of sandy beach landforms.

The valued environmental and social components of concern considering the two projects include:

- Marine ecology/water quality and aquatic life within the port;
- The coastal zone/shoreline; and
- Truck traffic and congestion issues.

About 3,600,000 m<sup>3</sup> of dredged material are expected to be generated from the proposed Tema Port Expansion Project, and parts of the dredged material used for reclamation of coastal areas as compared to 636,400 m<sup>3</sup> of dredged material that will be generated from the proposed Tema LNG Terminal Project, which dredge material will be disposed of offshore.

The Tema Port Expansion will involve the construction of over 4km of breakwater as against 800m under this project. The impact of the Tema Port Expansion Project on marine ecology/water quality and marine life within the port environs and the coastal areas during the construction phase is expected to be far greater than the impact from the proposed project during the construction phase.

The Tema Port Expansion Project has been permitted by the EPA, with EPA Permit No. CI0025240102. It is expected that the implementation of the permit schedules will help minimise impact on the marine ecology/water quality and aquatic life during the construction phase.

However, it is recommended that the following should be considered in order to minimise cumulative impacts on marine ecology/aquatic life and water quality and coastal zone/shoreline:

- Dredging activities under the two projects should not be done at the same time, - when one project is doing dredging, the other project should hold on or agree to carry out dredging at different times.
- If there is any underwater blasting for the two projects, it should not be done at the same time.

The construction of the breakwater will involve transport or supply of quarry products to the Port. The port currently has three entrance routes via the main harbour road, via the beach road and via the fishing harbour road. It is recommended that the traffic management plan to be developed by the EPC Contractor for Tema LNG Terminal should liaise with GPHA with regard to the use of different roads or same road but different times for the transport of quarry products to the port in order to minimise truck traffic congestion at the port.

The project area of influence for the air quality monitoring as captured in the final EIS for the port expansion project (July, 2015) include:

- Community 3 Site B Block 39A
- Sakumono Cluster of Schools
- Sakumono lagoon outlet bridge

The monitoring sites are all over 3km away from the location of the proposed LNG Terminal project facilities within the Port. There is no overlap with the monitoring sites of the Tema LNG terminal project (Ref: Oil Jetty and pipeline route monitoring site). The proposed project does not anticipate any influence on air quality from the ongoing Port Infrastructure Development Project.

Table 8-1: Potential Impact Evaluation

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
<b>Preparatory and Planning Phase</b>							
1.	Land/wayleave Acquisition	RoW acquisition	Informal land users, TOR, VALCO, VRA, GRIDCo	<ul style="list-style-type: none"> <li>The construction of the proposed 8 km pipeline will require a temporary right of way of about 20 -40 m width for construction space. The operational phase will require a general right of way of 20 m for accessibility, and a restricted RoW of 3.5m. The construction RoW will not affect the ability of local people to move around. It is to enable Tema LNG to lay the pipelines for the project.</li> <li>The proposed RoW within the port boundary and the VALCO fence wall is within existing RoW of Tema Oil Refinery (TOR) and GRIDCo, as well as on VALCO property. Land acquisition will therefore not be necessary but permission will need to be sought from the identified RoW and land owners for the required easement.</li> <li>Temporary wooden structures within the VALCO RoW near the Chemu stream and opposite Abonkor waste dump site are being used for rearing pigs, and these will have to be relocated to make way for the construction activities. Eight pig owners use the single compound of wooden structures comprising of different compartments for each pig owner.</li> <li>Six subsistence farmers were identified within the corridor growing vegetables and cassava/maize (as at 26<sup>th</sup> June, 2018) on less than 0.5ha land each. The cassava/maize farm is located near the VALCO wall around the railway area whiles the vegetable farms are around the VALCO drain opposite Manhean community. The project will not permanently displace the farmers. However, during construction, trenching for the pipeline route will impact sections of the farm.</li> </ul>	Medium	Medium	Moderate



No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<ul style="list-style-type: none"> <li>The ROW acquisition will interfere with the current use of the area as places of convenience (Open defecation).</li> <li>The impact is direct, the RoW acquisition is likely and long term, the extent is local because it will be limited to the project site and adjacent properties.</li> </ul>			
2.	Anxiety on the part of potentially affected persons/institutions	Survey works and feasibility studies, stakeholder consultations	RoW users, VALCO clinic and offices, Tema New Town (Bankuman, Abonkor, Manhean)	<ul style="list-style-type: none"> <li>Inadequate dissemination of information with regards to the scope, schedule and impact of the proposed project, as well as measures in place to safeguard the interests of nearby communities and potentially affected institutions could result in strong resistance to the implementation of the project. This could be expressed in terms of obstruction of workers from carrying out their respective services, vernalisation of equipment, public demonstration and violent behaviour.</li> <li>Failure to reach an amicable agreement with the project affected persons could result in recurrence of these issues</li> <li>The impact is indirect, the duration could be short or long term. The extent is local and the likelihood is possible.</li> </ul>	Medium	Medium	Moderate
3.	Occupational Health & Safety	Survey works and feasibility studies	Technical teams	<ul style="list-style-type: none"> <li>Exposure of technical teams carrying out topographical survey works, geotechnical survey, and environmental baseline studies to injury and bites from insects and dangerous reptiles such as snakes, scorpions, bees, ants, etc.</li> <li>This effect can be prevented or minimised through the use of appropriate personal and protective equipment such as safety boots and gloves.</li> <li>The impact could be direct or indirect, the duration could be temporary. However, it is unlikely that fatalities may occur except for some minor injuries</li> </ul>	Small	High	Moderate
<b>Construction Phase</b>							

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
1.	Air quality deterioration	Construction of site office, work camp and storage facilities; Site and RoW preparation; Transportation of materials and equipment; Road crossing; waste disposal, pipeline installation	Project affected communities, VALCO clinic and offices, construction workers	<ul style="list-style-type: none"> <li>Dust generation will arise from site preparation, excavations, general construction works and topsoil handling by mechanical equipment and portable auxiliary equipment. Vehicular/truck movements and transport of materials/ equipment to and from site on the untarred routes/roads and cleared will also generate dust.</li> <li>Loading, haulage and dumping of sand/stone aggregates as well as cement handling will also generate dust that can increase the air borne particulate in the vicinity.</li> <li>Use of construction vehicles, trucks and generators will generate fumes/gaseous emissions from combustion of diesel engines of such equipment. Inhalation of fumes and gaseous emissions such as carbon monoxide, sulphur oxides and nitrous oxides can affect the health of persons exposed to these gases for prolonged periods.</li> <li>The airshed along the pipeline route experiences dust pollution. The baseline PM<sub>10</sub> sampling results show that with the exception of the Valco clinic, all other sampling areas along the pipeline route were non-compliant with EPA permissible level of 70 µgm<sup>-3</sup>, and none was compliant with the WHO guideline value of 50 µgm<sup>3</sup>. The noxious gases (NO<sub>2</sub> and SO<sub>2</sub>) were below the EPA permissible limits for industrial area of 150 µg/m<sup>3</sup> but SO<sub>2</sub> was above WHO guideline value of 20 µg/m<sup>3</sup>.</li> <li>The impact is direct, temporary and likely, lasting during the constructional phase; the impact is also local in extent i.e. limited to the project site and adjacent properties.</li> </ul>	Medium	Medium	Moderate

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
2.	Vibration and noise nuisance	Construction of site office, work camp and storage facilities; Site and RoW preparation; Equipment/material/worker transport; Pipeline installation; Construction of mooring and floating infrastructure; Dredging and extension of breakwater; Hydrostatic testing; River crossings; and Road crossings	Project affected communities, VALCO clinic and offices, construction workers, Oil terminal users	<ul style="list-style-type: none"> <li>Activities that will contribute to increased noise levels during the construction phase include; vehicular and truck movement, site clearing and preparation, Dredging works, piling, construction of breakwater, underwater blasting, subsea trenching for pipeline installation, etc.</li> <li>Typical noise level from construction activities range from 80dBA to 112dBA (BS 5228-1:2009) within the operational areas and is expected to significantly reduce to 30dBA to 62dBA at a distance of about 80m from the site. The most sensitive receptor, Valco clinic is about 80m from the pipeline route, and with a background noise level of 59.7 LA<sub>Feq</sub> dBA, the predicted noise level range at the clinic will be 59.2 to 63.8 dBA, assuming equipment noise level range from 80dBA to 112dBA. The upper limit 63.8 dBA, slightly exceeds permissible limit of the maximum background noise level of 63 LAF<sub>90</sub> dBA measured at the clinic.</li> <li>The impact is direct, temporary and likely, moderate in scale; the impact is also local in extent i.e. limited to the project site and adjacent properties.</li> <li>The application of standard noise control measures will assist to ensure that these issues are reduced</li> </ul>	Medium	Medium	Moderate
3.	Loss of vegetation and impacts on flora and fauna	Pipeline route RoW preparation; Stream crossings	Flora and fauna, within pipeline RoW	<ul style="list-style-type: none"> <li>The pipeline RoW is highly disturbed as the pipeline route passes near human settlements, through industrial areas and farms, fallow areas and farm-regrowth.</li> <li>Eight of the species according to IUCN threat categories (<i>Avicennia germinans</i>, <i>Aeschynomene indica</i>, <i>Hygrophila auriculata</i>, <i>Paspalum vaginatum</i>, <i>Typha domingensis</i>, <i>Dichrostachys cinerea</i>, <i>Fuirena umbellata</i> and <i>Eleusine indica</i>) are of Least Concern, with</li> </ul>	Small	Medium	Minor

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>decreasing population trends (10.4%) and 1 (<i>Mangifera indica</i>, 1.3%) is Data Deficient.</p> <ul style="list-style-type: none"> <li>Majority of the species have not been yet assessed (NA) by the IUCN (88.3%). Thus, no species of global conservation concern was recorded during the survey.</li> <li>The project site qualifies for classification as Modified habitat in accordance with IFC Performance Standard 6.</li> <li>The project site is deficient in fauna largely due to the degradation of the original habitat due to human activities and therefore impact on terrestrial fauna will be limited.</li> <li>Disturbed fauna can migrate to nearby bushes.</li> <li>Removal of any remaining mangrove swamps along the Chemu stream will further diminish the mangrove forest.</li> <li>The impact is direct, temporary and likely, lasting during the constructional phase; the impact will occur on-site i.e. limited to the project site, and minor in scale.</li> </ul>			
4.	Sanitation/ Waste Generation Concerns	Dredging and extension of breakwater, Construction of mooring and floating infrastructure	Marine environment	<ul style="list-style-type: none"> <li>It is expected that 560,000 m<sup>3</sup> of dredged material will be generated from the dredging of the basin and approach channel as well as dredging of trench for breakwater toe.</li> <li>The dredged spoil will be dumped offshore after acquiring the necessary approvals from GPHA/ GMA and EPA.</li> </ul>	Medium	High	Major
		Construction of site office, work camp and storage facilities; Site and RoW preparation; Road Crossing and Pipeline installation.	Soil/disposal site, Chemu Stream, Valco and Bankuman Roads	<ul style="list-style-type: none"> <li>Waste to be generated include vegetation/biomass from clearing activities along the pipeline route, general waste including food wastes, packaging and food containers, water packaging, office wastes, waste from construction and installation activities such as pieces of pipes, waste from workshop, warehouses, construction management facilities, Construction and installation activities, workshops, warehouse, maintenance of</li> </ul>	Medium	Medium	Moderate

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>equipment/machinery, solid and liquid waste among others</p> <ul style="list-style-type: none"> <li>It is expected that <b>64,000m<sup>3</sup></b> of material will be excavated along the pipeline from the GPHA boundary to the VRA header station.</li> <li>The impact is direct, temporary and likely, lasting during the constructional phase; the impact is also local in extent i.e. limited to the project site and adjacent properties and disposal site, and moderate in scale.</li> </ul>			
5.	Marine water contamination/ impact on aquatic organisms and biodiversity	<p>Pipeline installation; Construction of mooring and floating infrastructure; Dredging and extension of breakwater; Hydrostatic testing; waste storage and disposal, underwater blasting (if it becomes optional)</p>	Marine environment, port environment	<ul style="list-style-type: none"> <li>There is expected to be some disturbance to marine life, especially fish resources that are in the harbour vicinity due to dredging, breakwater construction and piling activities that results in increased noise and turbidity.</li> <li>The construction/dredging activities at the offshore sits may have limited or no impacts on marine mammals as marine mammals are not expected in such busy navigation area around the port entrance. However, the disposal of dredged materials further offshore, about 15 km could displace marine mammals around the disposal site to noise and increased turbidity.</li> <li>The Tema Port/ fishing harbour is not a known area where sea turtles come to lay eggs unlike the Sakumo II wetland/ beach, and therefore the impact is minimal or negligible.</li> <li>Dredging works, extension of breakwater, trench excavation, seafloor levelling and anchoring are likely to release sediment contaminants and create benthic habitat loss in the marine environment temporarily.</li> <li>The associated re-suspension of sediment could further impact the benthos since settling sediment could smother them. This impact, however, is expected to be transient and localized to the construction areas. The EPC contract</li> </ul>	Medium	Medium	Moderate

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>will develop a Dredging Management Plan to minimise dispersal.</p> <ul style="list-style-type: none"> <li>Discharge of untreated hydrostatic testing water into the marine environment could adversely affect marine water quality.</li> <li>Other constructional phase impacts include the leaching of chemical pollutants that may be in the fill materials and improper disposal of wastes generated from the construction works. These impacts are however expected to be localized to the constructional areas.</li> <li>The project will not have any impact on fisher livelihoods because fishing is not allowed in the Port Area. Illegal fishing does not occur in the area.</li> <li>It is expected that fish and invertebrate populations will be temporarily affected by the dredging and construction of facilities but will be able to re-populate the area within few months as soon as work is completed.</li> <li>The impact in general is direct, temporary and likely, lasting during the dredging/constructional phase. The impact is also local in extent i.e. limited to the project site and adjacent areas and moderate in scale.</li> </ul>			
6.	Under water blasting effects	Under water blasting (if blasting becomes an option)	Marine life and ecology	<p>Blasting under water requires greater care and experience than similar operations above water. Underwater blasting has a high transmission of pressure waves through the water column. Vibration hazards are more severe. Controlling vibration in underwater blasting is a very difficult task. The possibility of tidal surges due to underwater blasting has to be thought of since this will be akin to a very shallow earthquake. The blasting effects on the marine life and ecology can be significant especially within the blasting area or exclusion zone.</p>	Large	Medium	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				The impact is direct, temporary and likely, lasting during the dredging/constructional phase; the impact is also local in extent i.e. limited to the project site and adjacent areas, but could be significant in scale.			
7.	Surface water contamination/ impact on aquatic organisms	Site and RoW preparation; Equipment/ material/ worker transport; Pipeline installation; Stream crossings; Road crossings; waste storage and disposal	Chemu Stream/ lagoon	<ul style="list-style-type: none"> <li>Site preparation, comprising clearance of vegetation in the RoW, as well as trenching works for pipeline would result in loosening and exposure of top soil. This could facilitate erosion and sediment transport into the nearby Chemu Stream/lagoon.</li> <li>Potential disposal of discharge water from hydrotesting into natural water bodies may also adversely affect the flow regime of the affected water bodies and its aquatic life.</li> <li>The impact is direct, temporary and likely, lasting during the constructional phase; the impact is also local in extent i.e. limited to the project site and nearby stream/lagoon, and moderate in scale.</li> </ul>	Medium	Medium	Moderate
8.	Impact on Ecologically Sensitive Sites	RoW preparation; Equipment/ material movement, Pipeline installation; Stream crossings; Road crossings; waste storage and disposal	Chemu Stream/ lagoon	<ul style="list-style-type: none"> <li>The pipeline construction activities will affect the Chemu Stream during crossing of the stream. The Chemu Stream/lagoon is polluted and almost silted.</li> <li>Erosion of excavated material during trenching may further add to siltation challenges of the stream/lagoon.</li> <li>The impact is indirect, temporary and likely, lasting during the constructional phase; the impact is also local in extent, extending to nearby streams/lagoon, and moderate in scale.</li> </ul>	Medium	Medium	Moderate
		Dredging, Construction of	Chemu Lagoon	<ul style="list-style-type: none"> <li>Construction of the breakwater and dredging works may affect the transport of sediment and hence could potentially impact the Chemu lagoon outfall. The EPC</li> </ul>	Small	Medium	Minor

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
		mooring and floating infrastructure; extension of breakwater; Hydrostatic testing; waste disposal		<p>contractor will develop a Dredge Management Plan to minimize impact.</p> <ul style="list-style-type: none"> <li>The Chemu lagoon is located about 1.8 km east of the proposed dredging site, and it may likely experience minimal impact.</li> <li>Portions of the mangrove swamp vegetation along the Chemu lagoon has been converted into a waste dumping site and therefore the lagoon's primary ecological functions have been substantially modified.</li> <li>The impact is indirect, temporary and likely, lasting during the dredging/constructional phase; the impact is also local in extent and may be minor in scale as it gets to the lagoon, which is 1.8 km away.</li> </ul>			
			Gao Lagoon	<ul style="list-style-type: none"> <li>Construction of the breakwater and dredging works may affect the transport of sediment and hence could potentially impact the Gao lagoon outfall. The EPC Contractor will develop a dredge management plan to minimize impacts.</li> <li>Gao lagoon located 5.4 km further east of the dredging site may not experience any significant impact as sediments may be deposited prior to the outfall.</li> <li>The impact is indirect, temporary and likely, lasting during the dredging/constructional phase; the impact is local in extent and may be minor in scale as it gets to the lagoon, which is 5.4 km away.</li> </ul>	Small	Medium	Minor
9.	Labour influx issues	Procurement of labour; construction phase activities	Local communities	<ul style="list-style-type: none"> <li>Speculative job seekers, mainly unskilled youth and some skilled persons will throng the project area to look for jobs and may end up residing in the local communities putting pressure on existing social facilities and could induce anti-social behaviours.</li> <li>Non-locals, mainly unskilled youth, who will be engaged are likely to reside in the nearby local communities due to</li> </ul>	Medium	Medium	Moderate



No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>proximity to project sites, and this will put pressure on the existing social amenities and environmental resources in the communities and could induce anti-social behaviours. About 500 Ghanaians are planned to be engaged during the peak period and most of them may be non-locals.</p> <ul style="list-style-type: none"> <li>Indirect labour influx will result from mainly non-local traders, especially women who will bring food/water and goods to sell to construction workers could generate some conflict between them and the locals.</li> </ul>			
10.	Occupational health, safety and labour issues	Construction of site office, work camp and storage facilities; Site and RoW preparation; Equipment/ material/ worker transport; Pipeline installation; Construction of mooring and floating infrastructure; Dredging and extension of breakwater; Hydrostatic testing; Stream crossings; Road crossings; waste storage and disposal	Construction workers,	<ul style="list-style-type: none"> <li>Workers will be exposed to risks during construction works. The risks include hazards from operation of construction machinery/ equipment, transportation of construction materials, inhalation of dust and fumes, drowning from marine works, accidents from falling objects, etc.</li> <li>Unhygienic working conditions, discriminatory practices, engagement of child labour could bring about social and labour conflicts and may trigger labour rights concerns.</li> <li>Electrocution and fire risks from welding works may also occur.</li> <li>Poor management of waste could also significantly affect safety in the workplace</li> <li>Risk of accidents from the materials management at the work camps, including accidents from poorly managed workspace and fire from fuel storage facilities, overtopping of trucks during breakwater extension works</li> <li>The improper handling of hazardous materials is also a health threat to workers.</li> <li>Site preparatory activities such as vegetation clearance exposes workers to dangerous reptiles such as snakes and other animals.</li> </ul>	Medium	High	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<ul style="list-style-type: none"> <li>The impact is direct, temporary and likely, lasting during the constructional phase; the impact is local and may also involve foreign nationals as well. In terms of number of people to engaged, the scale could range from minor to severe.</li> </ul>			
11.	Public health & safety issues	Construction of site office, work camp and storage facilities; Site and RoW preparation; Equipment/ material/ worker transport; and Pipeline installation	VALCO workers, VALCO clinic, Tema New Town (Abonkor, Manhean and Bankuman)	<p><u>Road Safety Impacts</u></p> <ul style="list-style-type: none"> <li>The road leading to the Oil Jetty from Tema Township is an asphalt road and in good condition to contain the movement of the haulage trucks. However, the roads leading into the communities (Abonkor and Bankuman) accessing the project site are untarred and may be worsened by the frequent movement of haulage trucks transporting equipment to the project site.</li> <li>Due to the narrow nature of the main Tema Newtown road, any unattended mechanical breakdown of cargo trucks on the roads can induce traffic and serious accidents.</li> <li>The road corridors close to the proposed pipeline RoW are private roads for GPHA and VALCO. Public access to these roads is therefore limited to only pedestrians.</li> <li>The transportation of construction materials and the movement of heavy equipment to the project site may pose risk of accidents along the affected routes.</li> <li>The transport of rock materials from the quarries in Shai Hills will require about 500 truckloads per day (inbound and outbound). This could increase traffic and traffic related incidents along the Shai Hills – Afiencya road.</li> <li>Any unattended mechanical breakdown of trucks on the VALCO road could interfere with access to the VALCO clinic and offices.</li> <li>Nearby settlements in Tema New Town (Abonkor, Manhean and Bankuman) use the VALCO roads to access</li> </ul>	Medium	High	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>their communities by foot. Open trenches could create falling hazards.</p> <p><u>Spread of HIV/AIDS and other Sexually Transmitted Diseases (STDs)</u></p> <ul style="list-style-type: none"> <li>Construction activities may result in the movement of workers to the project area and people from other communities in search of job opportunities.</li> <li>Influx of people during the construction period may promote irresponsible sexual behaviour which could lead to teenage pregnancies HIV/AIDS and other STD infections. The impact may be permanent or irreversible in nature.</li> </ul> <p><u>Public health issues</u></p> <ul style="list-style-type: none"> <li>The existing practice in the area is open defecation. However, poor sanitation conditions may further pollute the environment and ultimately the Chemu stream if adequate toilet facilities are not provided for construction workers.</li> <li>The presence of construction workers along the proposed pipeline route sections near the local communities may interfere with the use of the place for open defecation.</li> <li>Improperly covered trenches may result in stagnant water and breed mosquitoes. Unsecured excavations may compromise public safety.</li> <li>This impact on public health is long term and severe but probability of occurrence depends on the number of workers expected for the construction stage.</li> <li>The impact is likely, direct and indirect, temporary and permanent depending upon injury/hazard, lasting during or beyond the constructional phase; the impact is local and the impact scale from minor to moderate.</li> </ul>			

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
12.	Road crossing and traffic impact	Trenching and pipeline installation	VALCO vehicles, and commercial and private vehicles	<ul style="list-style-type: none"> <li>The paved VALCO exclusive road will be crossed at three points before the VALCO clinic. This road carries people to and from the clinic and therefore sensitive.</li> <li>The untarred road after the VALCO clinic connecting Bankuman to the Tema Oil Refinery area and two other local minor roads will be crossed to enable the pipeline connect to the VRA header station. These roads are used by taxis and other commercial vehicles as well as private vehicles. The crossing of these roads can generate minor to moderate traffic impacts.</li> <li>The impact is likely, direct, temporary, local and minor to moderate in scale.</li> </ul>	Medium	Medium	Moderate
13.	Destruction of crops/farms and pigsty structures and loss of livelihood and access to land/property	Site and RoW preparation	Subsistent farmers and pig owners within GRIDCo RoW	<ul style="list-style-type: none"> <li>Subsistence farmers (6no.), currently occupying portions of the proposed RoW for the pipelines /power lines will have sections of their farms/standing crops destroyed by construction/excavation works for pipe laying. The construction period, it is likely the farmers may not be able to farm effectively and may have suspend farming until pipeline construction is completed.</li> <li>The project will not permanently displace the farmers. They will be allowed to use sections of the RoW during operations for annual food/vegetable crops except the 3.5m RoW, which will be restricted.</li> <li>The temporal wooden structures being used for pig rearing by eight pig owners will have to be removed during construction. This will temporarily displace the pigs and affect operations of the pig owners.</li> <li>The impact is likely, direct, and temporary and will occur on-site; the scale is moderate.</li> </ul>	Medium	Medium	Moderate
14.	Impact on cultural heritage	RoW preparation; Pipeline installation	Tema New Town	<ul style="list-style-type: none"> <li>Field investigations indicate that the Tema Manhean community cemetery is located about 40m to the Gridco power line. The pipeline has therefore been routed to the</li> </ul>	Small	Medium	Minor

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<p>other side (i.e. Valco end) of the Gridco power line to prevent impact on the cemetery.</p> <ul style="list-style-type: none"> <li>No other culturally sensitive areas have been identified to be potentially affected by the proposed project.</li> <li>However, a chance find procedure will be put in place to ensure that any cultural resource chanced upon is retrieved, identified and appropriately accounted for.</li> <li>The impact is unlikely, direct and local, and of a minor scale.</li> </ul>			
15.	Visual intrusion/ attraction	<u>Pipeline route outside port boundaries</u> Trenching/ excavation of pipeline route; Presence and movement of equipment/ material/ and construction workers; Pipeline installation	Valco clinic, local community residents near pipeline route, Users of the Valco dedicated road, Trespassers	<ul style="list-style-type: none"> <li>RoW preparation and construction activities of vegetation clearance, movement of materials and equipment/machines to and from Project sites and presence of vehicles, trucks, construction / earthmoving machinery and equipment, and workers along the pipeline route will attract the attention of local residents and users of the Valco dedicated road. However, these receptors are used to construction activities associated with gas projects such as the WAPCo, installation and maintenance of power lines along the project sites. The impact is not expected to be significant.</li> <li>The impact is direct, likely, temporary and local in extent. The scale is minor as pipeline will be done in segments.</li> </ul>	Small	Medium	Minor
		Offshore facilities and pipeline within the Port boundary	Port users, Vessels calling at the oil berth	<ul style="list-style-type: none"> <li>Dredging, construction of offshore facilities, trenching/excavation and installation of pipeline may attract little attention of port users nearby. The nature of the proposed project within the port during construction is largely consistent with the ongoing port expansion project which also include dredging, construction of offshore infrastructure like breakwater and construction of new berths and container terminals.</li> </ul>	Small	Low	Negligible

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<ul style="list-style-type: none"> <li>The impact is direct, likely, temporary and local in extent, and minor in scale.</li> </ul>			
16.	General Disturbance of Port Operations	Pipeline installation within the Port; Construction of mooring and floating infrastructure; Dredging and extension of breakwater; Hydrostatic testing; waste disposal	Port users	<ul style="list-style-type: none"> <li>About 1500 ships enter the Port annually with an average of approximately 4 vessels per day.</li> <li>Dredging, piling and construction of breakwater and disposal of dredged material offshore if not planned properly could lead to delays in berthing of vessels calling at the harbour during the construction/dredging phase.</li> <li>The dredging and other marine construction activities will be appropriately scheduled with the Harbour Master and relevant GPHA entities to prevent delays to vessels calling at the Port. Port operations contribute significantly to the economy of the country. GPHA, on behalf of its stakeholders, will be stringent on minimising any potential impacts through suitable and efficient planning and communications.</li> <li>The impact is direct, likely, temporary and local in extent; the scale of impact is considered minor.</li> </ul>	Small	Medium	Minor
<b>Operation and Maintenance Phase</b>							

1.	Air quality deterioration	<p>Loading/offloading of LNG to FSU;</p> <p>General maintenance of FRU and FSU;</p> <p>General maintenance of pipeline;</p> <p>Boil-off gas handling;</p> <p>Wastewater treatment, storage and disposal</p> <p>Emergency response.</p>	Port Users /Workers	<ul style="list-style-type: none"> <li>No natural gas venting is required during normal operations; limited venting only in an emergency scenario or for gas freeing during scheduled maintenance. The electricity will be generated with modern, highly efficient dual fuel reciprocating engines, which will burn natural gas. Emissions are expected to be primarily CO<sub>2</sub> (1.900kg/hr), and N<sub>2</sub>, O<sub>2</sub> and water vapour, which are not pollutants. Exhaust gas residues such as soot, Ash, NO<sub>x</sub>, CO, HC will contribute approximately 300g/hr to atmospheric emissions. There will be essentially no Sox as the generators are running in gas mode, using natural gas as their primary source of fuel. Diesel fuel mode will only be used as backup or to start the engines, i.e. where minor SO<sub>x</sub> and particulates, especially PM<sub>2.5</sub> may be produced. In the diesel mode however, the generators will comply with IMO Tier II Nox emission limits.</li> <li>Fugitive emissions of natural gas may also occur during product transfer as well as through leaks in valves, pumps, tanks, pressure relief valves, flanges, and coupling joints as provided in <i>Table 3-7 of Section 3</i>.</li> <li>Volatile organic compounds (VOC) may also be emitted from FSU/FRU.</li> <li>The impact is likely, direct, long-term, and regional in extent due to dispersion; and minor in scale.</li> </ul>	Small	Medium	Minor
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No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
2.	Greenhouse Gas Emissions and impact on climate change	Loading/offloading of LNG to FSU; General maintenance of FRU and FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater treatment, storage and disposal; and Emergency response.	General climate	<ul style="list-style-type: none"> <li>Emissions from LNG transfer (especially at the VRA header station) is expected to generate 1600kg/hr of CO<sub>2</sub>.</li> <li>Carbon dioxide and fugitive emissions of methane could contribute to climate change in the long term.</li> <li>It is estimated that about 45,140 tonnes of CO<sub>2</sub> equivalent will be released annually from the project during operations. This is less than the annual 100,000 tonnes of CO<sub>2</sub> equivalent emissions under the Equator Principle which will hence not require mandatory reporting on the CO<sub>2</sub> equivalent emissions.</li> <li>Adherence to standard maintenance and monitoring measures will assist in early detection and remediation.</li> <li>The IPCC (AR4) reports natural gas exceptionally produces the lowest amount of GHG per unit energy consumed.</li> <li>Greenhouse gas emissions are therefore expected to be minimal from the proposed project.</li> <li>The impact is likely, direct with regard to GHG emissions and indirect with regard to impact on climate change, long-term, and international in extent; and minor in scale.</li> </ul>	Small	Medium	Minor
3.	Contamination of Marine Environment/ impact on marine flora and fauna	Loading/offloading of LNG to FSU; General maintenance of FRU and FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater treatment, storage and disposal; and	Marine water quality, marine flora and fauna	<ul style="list-style-type: none"> <li>Seawater intake for heating during the regasification process, as well as discharge of cold water from the process (approx. 3600m<sup>3</sup>/hr average send out cap) into the marine environment will not affect the habitat of marine flora and fauna. Based on the cold-water simulations conducted, the water temperature could be reduced by a few tenth of a degree only. Impacts on seawater temperature reductions are minor.</li> <li>Garbage made up of litter, fine dust, plastic bags, metal cans etc. may also be introduced into the marine environment by illegal disposal of waste by vessels at anchorage.</li> </ul>	Medium	High	Major



No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
		Emergency response.		<ul style="list-style-type: none"> <li>Accidental spills of oils, lubricants, fuels and other oily liquids may also contaminate the water quality at the harbour, and cause damage to fishery resources and aquatic biota.</li> <li>Biodegradation of oil also generates polymerized oil particles and possibly toxic aromatic fractions using dissolved oxygen in the water, and eventually form dense particles, which indirectly cause damages to bottom biota and habitat after sinking.</li> <li>Maintenance dredging will be needed when it becomes necessary for the restoration of the depth at the terminals. This will result in temporary increase suspended solids, since soft sediments will be remobilised. The resulting increased turbidity will block access of light and disrupt oxygen dissolution which can threaten marine life.</li> <li>General maintenance and replacement of dysfunctional equipment for the FSU/FRU/subsea pipeline will also result in temporary increase suspended solids, since soft sediments will be remobilised resulting in increased turbidity.</li> <li>The impact is possible, direct and cumulative (i.e. from ongoing Port operations), long-term and local in extent. The scale could be minor to severe due to level of contamination and cumulative effects.</li> </ul>			

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
4.	Introduction of Invasive Marine Pest Species	Increased vessel traffic at the Port	Marine flora and fauna	<ul style="list-style-type: none"> <li>Transfer of LNG from LNG carriers overseas to the FSU at the Tema Port will occur twice a month. Marine species are usually transported in ships ballast water and also transported via biofouling. Introduction of new invasive species could result in impacts to the marine environment through competition for resources, predation or disease. The intentional or accidental transport and subsequent introduction of invasive marine pest species (IMPS) to new regions is one of the primary threats to marine biological diversity (GHD, 2013).</li> <li>Following invasion by a marine pest, impacts are typically cumulative, irreversible and at times synergistic with other impacts (Neil et al. 2008). Hewitt et al. (2009) reflect that the scale and global spread of introductions throughout the world's oceans means that no region can be considered untouched by this issue (GHD, 2013).</li> <li>There will be no ballast water exchange for the FSU.</li> <li>The impact is possible, direct, long-term, and minor in scale and local in extent.</li> </ul>	Small	Medium	Minor
5.	Waste management issues	Loading/offloading of LNG to FSU; General maintenance of FRU and FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater treatment, storage and disposal; and	Soil/land, water, air	<ul style="list-style-type: none"> <li>Hazardous wastes to be generated from the proposed project include waste equipment and facility maintenance chemicals (e.g., paints, lubricants, and cleaners), used chemical containers, waste oils, oil-contaminated rags, hydraulic fluids, used batteries, oily sludge from oil-water separators and scrap metals</li> <li>Other waste to be generated from the LNG facility include general office waste, packaging waste (wood, plastics etc.) and food wastes</li> <li>The solid and liquid wastes pose disposal challenges. Inappropriate disposal of the wastes will contaminate the sea water and create sanitation problems within the port environment.</li> </ul>	Medium	High	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
		Emergency response.		<ul style="list-style-type: none"> <li>About 2.3 m<sup>3</sup>/ day of garbage, 0.15 m<sup>3</sup>/day of sludge expected from the FSU and 5 m<sup>3</sup>/ month of sewage expected from the FRU. Other quantities of waste/effluent streams to be generated are provided in Table 3-6 of Section 3.</li> <li>The impact is direct, likely, long-term, local in extent due to disposal and moderate in scale.</li> </ul>			
6.	Occupational health and safety concerns and labour issues	Loading/offloading of LNG to FSU; General maintenance of FRU and FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater treatment, storage and disposal; and Emergency response.	Workers	<p>Occupational health and safety issues associated with the proposed project operation include:</p> <ul style="list-style-type: none"> <li>Fires and explosions from ignition of combustible gases during loading and unloading activities, and/or leaks and spills of flammable products. Possible ignition sources include sparks associated with the build-up of static electricity, lightning, open flames and deliberate ignition by a saboteur and accidental.</li> <li>Structural damage to storage tanks or tank failure as a result of roll over phenomenon: rapid release of LNG vapours from a storage tank caused by stratification.</li> <li>Hazards from cold burns as a result of contact with very low-temperature surfaces</li> <li>Risk of injury from slips, falls and drowning during operation and maintenance activities.</li> <li>Confined space hazards (poor air quality, limited oxygen, excessive heat) may occur during maintenance and testing exercise for tanks, wastewater treatment facilities.</li> <li>The quantitative risk assessment (GRA) and the Hazard identification (HAZID) reports have identified potential hazards and their associated risks. These include, gas leakages, types of fires and explosions, operational hazards, equipment failure among others.</li> <li>The impact is direct, possible, on-site, and could be minor to severe in scale due to level of injuries or fatalities. The</li> </ul>	Medium	High	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				duration of impact could be temporary or short-term or long-term or permanent.			
7.	Public health & safety issues	Loading/offloading of LNG to FSU; General maintenance of FRU and FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater treatment, storage and disposal; pipeline RoW maintenance	VALCO offices, VALCO clinic, residents of nearby local communities, Port users	<ul style="list-style-type: none"> <li>• Fire/explosion risk as a result of pipelines leakage/bursts near residential areas will affect the local population and also disrupt pedestrian and vehicular movement from the communities to Kpone/Industrial Area.</li> <li>• Accidents at the terminal or accidents from loaded tankers during transfer of products could disrupt activities at the Port.</li> <li>• Collision between LNG carrier and large vessel close to Port Entrance.</li> <li>• This impact on public health and safety is long term and severe but depends on probability of occurrence.</li> <li>• Based on the risk acceptance criteria from the preliminary QRA report, the process hazards that may be caused by the FRU/FSU facilities at the port. The risks are considered tolerable “<b>tolerable</b>” as the Location Specific Individual Risk (LSIR) contours at a frequency <math>\geq 1E-06</math> and therefore does not reach any populated area. Studies are still ongoing for this assessment.</li> <li>• The impact is direct, possible, local in extent, and could be minor to severe in scale due to level of injuries or fatalities. The duration of impact could be temporary or short-term or long-term or permanent.</li> </ul>	Large	High	Major
8.	Accidental Events and impacts on nearby properties and marine/terrestrial ecology	Offloading of LNG to FSU; General maintenance of pipeline; Boil-off gas handling; Wastewater	Port users, marine flora and fauna, coastline, GPHA, GPMS, GRIDCo Powerlines, WAGPCo Header station, VALCO	<ul style="list-style-type: none"> <li>• Fire/explosion risk as a result of pipelines leakage/bursts could result in destruction of the other existing pipelines within the RoW in the Port, disruption of VALCO operations /vehicular movement on the VALCO dedicated road and damage to GRIDCO power lines</li> <li>• Any major explosion at the VRA header station could trigger explosion at the nearby WAGPCo station and</li> </ul>	Large	High	Major

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
		treatment, storage and disposal; pipeline RoW maintenance	(Clinic, Smelter and dedicated Road) and Bankuman Road.	<p>disrupt vehicular traffic on the Bankuman Road to industrial area.</p> <ul style="list-style-type: none"> <li>Loss of LNG containment from FSU with freezing temperature will adversely impact on marine ecology.</li> <li>A Qualitative Risk Analysis has been conducted to identify risk contours for fire and explosion in case of leak, spillage, or vapour cloud. The critical risk contour is clear of the port approach channel hence ignition risk is reduced.</li> <li>Boil-off of gas and subsequent ignition could damage offshore facilities but will not interrupt movement of vessels calling at the Port.</li> <li>The design of the facilities have incorporated adequate safety and security considerations as provided in Section 3.8 to minimise potential accidents.</li> <li>The pipeline QRA also identified critical risk contours which are clear of any industries along the pipeline route in the Port, clear of any neighbouring communities along the pipeline route and at the VRA header station.</li> <li>The impact is direct, unlikely, local in extent, and could be minor to severe in scale due to level of damage to properties/ecology. The duration of impact could be temporary or short-term or long-term or permanent.</li> </ul>			
9.	Visual intrusion/ attraction	Operations of onshore and offshore facilities	Local communities, Valco clinic, Port users	<ul style="list-style-type: none"> <li>The pipeline will be buried and therefore not expected to attract any significant attention during operation.</li> <li>The VRA header station is an existing facility and not expected to attract new attention. The VRA header station is also close to the WAPCo header station which the local communities especially residents of Bankuman are already associated with.</li> </ul>	Small	Low	Negligible

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
				<ul style="list-style-type: none"> <li>With regard to the offshore operations and facilities, the nature of the project is consistent with the surrounding port development.</li> <li>The impact will be insignificant and minor and no mitigation measures will be required.</li> <li>The impact is likely, direct, long-term, local and minor in scale.</li> </ul>			
10.	General Disturbance of Port Operations	LNG carriers manoeuvring	Port users	<ul style="list-style-type: none"> <li>STS transfer from an LNG carrier to the FSU will occur twice every month. Typical STS transfer time is roughly estimated to be around 20 hours. It is unlikely that this operation can take place without any passing traffic by during the transfer. The current Port traffic is averagely 4 vessels/ day and 1500 vessels/annually.</li> <li>Safety clearances between the LNGC at the terminal and the port entrance channel, which are recommendations in the traffic impact study, have been incorporated in the layout. This should reduce risk of interference with port traffic.</li> <li>The navigation simulation indicates that the sheltered water behind the new breakwater should assist in improving the vessel maneuverability. This should reduce the risk of transit delays in the channel.</li> <li>Vessels entering the port should already be lined up to pass through the existing breakwaters, the terminal berth is inside of the turning path of the inbound vessels. This should reduce risk if collision.</li> <li>The impact is direct, local, long-term, and moderate in scale.</li> </ul>	Medium	Medium	Moderate
<b>Decommissioning Phase</b>							
<i>Post construction phase</i>							

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
1.	Occupational/ public safety and traffic and labour issues	Post –construction activities (dismantling and relocation of construction work camps)	Workers, public	<ul style="list-style-type: none"> <li>The relocation of all construction facilities and remaining materials including the concrete mixer, trucks, and water tanks to new sites or to his/her head office for future works could result in accident and injury to workers.</li> <li>The transportation of such equipment and materials could also pose traffic risks and public safety concerns within the vicinity.</li> <li>The duration of the impact is temporary and or permanent.</li> <li>The impact is possible, direct, temporary or permanent, will occur on-site, and the scale could be minor to severe depending on injuries and fatalities.</li> </ul>	Small	High	Moderate
2.	Marine water contamination/ impact on aquatic organisms and biodiversity	Post –construction activities (dismantling of construction work camps and disposal of site wastes)	Marine environment	<ul style="list-style-type: none"> <li>The relocation of all construction equipment and remaining equipment/materials including dredgers, piling and mooring equipment, barges and subsea equipment such as trenchers may result in temporary increase suspended solids, since soft sediments will be remobilised. The resulting increased turbidity will block access of light and disrupt oxygen dissolution which can threaten marine life.</li> <li>The impact is direct, temporary and likely, lasting during the decommission phase. The impact is also local in extent i.e. limited to the project site and adjacent areas and minor in scale.</li> </ul>	Small	Medium	Minor
3.	Waste disposal	Post –construction activities (dismantling of construction work camps and disposal of wastes)	Soil, marine environment, surface water	<ul style="list-style-type: none"> <li>The dismantling and removal of work camp facilities, equipment and materials at the site could generate waste such as scraps metal, wood, concrete debris and garbage (pieces of plastic bags, food wrappers, etc.).</li> <li>The impact is direct, temporary and likely, lasting during the demobilisation/post-constructional phase; the impact is also local in extent i.e. limited to the project site and adjacent properties and disposal site, and minor in scale.</li> </ul>	Small	Medium	Minor

No.	Potential Impact	Activities	Key Receptor(s)	Evaluation of Impact	Magnitude	Sensitivity	Rating
4.	Air pollution	Dismantling of construction work camps and disposal of wastes)	Ambient air, Workers, public, port users	<ul style="list-style-type: none"> <li>The dismantling and removal of work camp facilities, equipment and materials at the site could generate dust and movement of vehicles will generate fumes.</li> <li>The duration of the impact is temporary, the extent local.</li> <li>The impact is direct, temporary and likely, lasting during the demobilisation/post-constructional phase; the impact is also local in extent i.e. limited to the project site and adjacent properties</li> </ul>	Small	Medium	Minor
5.	Disturbance of port operations	Dismantling of construction work camps and disposal of wastes)	Port users	<ul style="list-style-type: none"> <li>The dismantling and removal of work camp facilities at the GPHA premises, equipment and materials at the site may disturb port operations. The impact is temporary, local in extent and negligible.</li> <li>The impact is direct, likely, temporary and local in extent; the scale of impact is minor.</li> </ul>	Negligible	Medium	Negligible
6	Loss of employment	All preparatory and construction activities	Consultants and Construction workers	<ul style="list-style-type: none"> <li>The estimated 500 people to be involved during the peak construction period will lose their jobs as such engagements are temporary. All labourers will be affected.</li> </ul>	Medium	Medium	Moderate
<i>Post operation/ decommissioning phase</i>							
1	Loss of job/ employment	Laying-off workers and ending contracts during decommissioning	Operation/ decommissioning g workers and consultants	<ul style="list-style-type: none"> <li>Staff to be engaged during the operation phase will be laid off after operation and decommissioning activities are over, and will include all maintenance contractors and consultants.</li> <li>The impact is likely, direct and indirect, temporary, local in extent and significant in terms of employee layoffs</li> </ul>	Large	High	Major
2	All other impacts	Decommissioning of both offshore and onshore facilities, disposal of wastes	Bio-physical/ social environment, port users and the general public	(Decommissioning if it happens will occur in the distant future when baseline conditions and project facilities would have changed or be modified. A detailed EIA will be carried out for approval and permitting by the operator before final decommissioning of both offshore and onshore facilities to confirm significance of all identified impacts).			



## 9.0 IMPACT MITIGATION AND MANAGEMENT

The anticipated impacts from the proposed project have been evaluated in the previous chapter in line with the objectives of this environmental study. Mitigation and management measures have been proposed as part of the EIA study to ensure that the project impacts are managed within reasonable and acceptable limits.

The general rules followed in designing the mitigation measures are:

- a. Avoidance of major impacts: major impacts are generally considered unacceptable, impacts that would endure into the long-term or extend over a large area;
- b. Reduction of major and moderate impacts to as low as reasonably practicable (ALARP) by planning, designing and controlling mitigation measures. This implies that mitigation measures will be applied until the limitations of cost effectiveness and practical applications are reached. The limitations are established by best international practice; and
- c. Implementation of good contractor practices for impacts rated as minor, in order to ensure that impacts are managed within good reason.

### 9.1 Type of Mitigation Measures

The mitigation measures adopted may be classified as preventive, control and compensatory measures.

#### 9.1.1 Preventive Measures

These are measures adopted during the design and pre-construction phase. The measures are aimed at avoiding or minimising potential major impacts at source. Avoiding or reducing an impact at source is essentially ‘designing’ the project so that a feature causing an impact is designed out or altered or avoided.

#### 9.1.2 Control Measures

These are measures adopted to abate or remedy the impacts occurring during construction and operation/ maintenance phases. Impacts can be abated on site or at receptor end. Repair or remedy of impacts involves unavoidable damage to a resource, e.g. sediment transport from dredging activities. In this case, the control essentially involves engineering controls and implementation of best practices to reduce sediment transport.

#### 9.1.3 Compensatory Measures

Where other mitigation measures are not possible or fully effective, then compensation in some measure for loss, damage or general intrusion might be appropriate. This will mainly be ‘in cash’. Monetary compensations will be paid to individuals whose legal properties or legal occupancy of a place will be affected by the project.

## **9.2 Summary of Significant Potential Adverse Impacts**

The significant adverse impacts (rated as moderate or major) identified from the analysis and evaluation of the potential impacts from the proposed project in the preceding Chapter are summarized below.

### **9.2.1 Preparatory Phase**

The significant potential impacts from this phase of the project development include

- RoW acquisition
- Anxiety on the part of potentially affected persons /institutions

### **9.2.2 Constructional Phase**

The identified significant adverse impacts during the construction phase of the proposed project are as follows:

- Air quality deterioration
- Vibration and Noise Nuisance
- Loss of vegetation and impacts on flora and fauna
- Sanitation issues
- Occupational Health and Safety Issues
- Public Health and safety issues
- Road crossing and traffic impact
- Loss of livelihood and access to land
- Marine water contamination/impacts on aquatic organisms and biodiversity
- Underwater blasting effects
- General Disturbance of port operations

### **9.2.3 Operational and Maintenance Phase**

The identified significant adverse impacts during the operational and maintenance phase of the proposed project are as follows:

- Air quality deterioration;
- Contamination of marine environment/impacts on marine flora and fauna;
- Introduction of invasive marine pest species;
- Waste management issues;
- Occupational Health and safety issues;
- Public health and Safety Issues;
- Accidental events and impact on nearby properties and ecology; and
- General disturbance of Port operations.

### **9.2.4 Decommissioning Phase Impacts**

The post-operational decommissioning phase impacts will be addressed in a separate section. The significant adverse impacts during the post-construction decommissioning phase will be similar to the construction phase impacts in general, in addition to loss of jobs.

### 9.3 Recommended Mitigation Measures

**Table 9-1** provides a summary of the significant impacts, as per the evaluation, the impact receptors and the recommended mitigation measure for each impact. The application of the mitigation measures in general is expected to reduce major and moderate impacts to minor or negligible impacts that may not require further mitigation.

### 9.4 Timeline for Implementation of Mitigation Measures

#### Pre-Construction Phase

Mitigation actions proposed for potential adverse impacts identified at the pre-construction phase must be implemented at the stage before construction work begins without any exceptions.

#### Construction Phase

Mitigation actions for construction phase impacts will generally be implemented between 16 – 20 months duration for the construction phase, with few exceptions. The mitigation measures associated with identified construction phase activity such as dredging, breakwater construction etc. will be implemented as and when such activity is being implemented.

The few exceptions are subsequently identified as follows: (i) Even though affected crops and structures belonging to affected farmers and pig owners will be destroyed during the construction phase, mitigation measures associated with such destructions must be implemented at the pre-construction phase, before destruction of the affected properties in line with IFC PS 5. (ii) It is the construction activities that will generally interfere with the use of the pipeline route environs for open defecation, but the proposed mitigation measure that requires Tema LNG Terminal to liaise with TMA to provide a place of convenience (toilet facility) for the nearby local communities (especially Abonkor and Manhean suburbs) has to be implemented at the pre-construction phase.

#### Operation Phase

Tema LNG Terminal will prepare and submit an Environmental Management Plan (EMP) within 18 months of commencement of operations to the EPA for approval and subsequent implementation, and thereafter every three years in accordance with Regulation 24 of LI 1652. The EMP will identify and itemise mitigation actions with objectives, timelines, cost and specific responsibilities being implemented or to be implemented within the first three years and subsequent EMPs will also indicate same.

**Table 9-1: Proposed mitigation measures for potential impacts**

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>	<b>Residual Impact</b>
Row Acquisition	All institutions within RoW	<ul style="list-style-type: none"> <li>• Ensure all stakeholders are engaged in the early stage of the project.</li> <li>• Project plans and designs must be discussed and agreed by RoW owners.</li> <li>• All permits and necessary documentation needed for acquiring RoW must be approved.</li> <li>• Prepare and implement a livelihood restoration plan which will also include compensation for potentially affected structures and farms within RoW, and livelihood assistance programmes for loss of proven income and suspension of farming and piggery activities.</li> <li>• Ensure affected persons are well informed to remove crops and structures prior to the start of construction.</li> <li>• Tema LNG Terminal Company and the EPC contractor will liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs for use to prevent open defecation if the existing open pits are disturbed.</li> <li>• Disclose public information of the project.</li> </ul>	Negligible
Anxiety on the part of potentially affected persons/institutions	Institutions /Potentially affected persons	<ul style="list-style-type: none"> <li>• Stakeholder interactions to educate all on proposed project activities, impacts and proposed mitigation measures.</li> <li>• Will develop and implement grievance mechanism as a part of a wider Stakeholder Engagement Plan enabling community concerns to be documented and resolved in a timely fashion.</li> <li>• Will ensure liaison with all stakeholders and nearby communities in the project area is maintained throughout project life.</li> <li>• The Tema Traditional Council will be consulted prior to the commencement of work to ensure that all the necessary customary rites are performed and a mechanism found/agreed with the stool to ensure peaceful coexistence.</li> </ul>	Negligible
Occupational health and safety	Tema LNG Terminal Company Staff and consultants	<ul style="list-style-type: none"> <li>• The various contractors to be engaged will be required to comply with the GPHA Occupational Health and Safety Policy when working within the Port environment.</li> <li>• The consultants will be required provide first Aid Kits on site to treat minor ailments and cuts. However, major cases will be referred to the GPHA clinic for treatment or referral to the Tema General Hospital.</li> <li>• The owner as well as their various contractors will be required to provide the appropriate personal protective equipment such as safety boots and coats, hand gloves, earplugs and</li> </ul>	Negligible

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<p>nose masks when carrying out their studies. Supervisors will be mandated to ensure the use of these protective devices and implement sanctions when necessary.</p> <ul style="list-style-type: none"> <li>Ensure that well-trained workers will be engaged for the various construction roles.</li> </ul>	
<b>Construction Phase Impacts</b>			
Air Quality Deterioration	Workers/ Local communities and road users	<ul style="list-style-type: none"> <li>Dust emissions from trucks, will be controlled and minimized by the use of designated routes in order to minimize impacts to residents, construction workers, port workers/users and institutions along the transport route.</li> <li>The proposed road construction and road upgrade works will be done using mitigation and control techniques, such as standard dust suppression measures e.g. dampening of unpaved surfaces</li> <li>Ensure vehicular speed limits of 30mph over any unpaved landscape to minimise dust generation. Material dumping will be regulated to reduce dust emissions.</li> <li>Owners / operators of construction equipment and vehicles will implement the manufacturer recommended engine maintenance programmes to minimize the emission of fumes into the environment.</li> <li>Contractor will monitor dust and remedial action will be taken whenever dust generating activities take place.</li> <li>Dust-related grievances will be investigated and managed as part of the Grievance Mechanism.</li> </ul>	Minor
Vibration and noise nuisance	Workers/ Local communities and road users	<ul style="list-style-type: none"> <li>The contractor should employ standard noise abatement measures and engineering best practices to ensure that the impact of these issues are minimized and reduced to acceptable limits.</li> <li>The contractor should ensure that earthworks and other construction activities will be phased out or controlled to reduce noise generation during construction.</li> <li>All equipment and vessels shall be operated and maintained in accordance with appropriate industry and equipment standards including specifications for noise levels and manufacturer's specifications (including regular checks and maintenance).</li> <li>Machines in intermittent use shall be shut down in the intervening periods between works or throttled down to a minimum.</li> </ul>	Negligible

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
	Aquatic life/marine environment	<ul style="list-style-type: none"> <li>Marine mammal/ sea turtle observation and regular monitoring will be conducted to observe any appearance of such animals along the coast/ shoreline or in the waters during dredging and major offshore construction activities. If sea turtles are observed especially during the evenings/night, the time will be noted and the Wild Life Division (which is in charge of protected species) in Accra will be alerted and their recommendations sought for implementation.</li> <li>The contractor will include consideration of soft-starts for noise generating activity. E.g. During piling activities, soft start procedures will be adopted (i.e. commencing with reduced noise level to allow fishes to move away from the area before increasing the noise levels.</li> <li>To reduce underwater noise levels associated with percussive piling, the following steps will be taken: <ul style="list-style-type: none"> <li>Quieter hydraulic hammers should be used instead of the noisier diesel hammers;</li> <li>Acoustic decoupling of noisy equipment on work barges should be undertaken. These techniques can include the use of a soft sling to retain the pile driving hammer, rubber-tired air compressor for bubble jacket/curtain, rubber pads on barge leaders and guides, and an air curtain around the pile barge.</li> </ul> </li> </ul>	Minor
Loss of vegetation and impacts on flora and fauna	Terrestrial Flora, Fauna	<ul style="list-style-type: none"> <li>Undertake pre-clearing survey and assessment of the flora to be impacted especially if construction will be carried out in the rainy season to help identify sensitive areas such as vegetation with active nesting.</li> <li>The contractor will develop construction code of practice and ensure critical areas such as the remaining mangrove swamps along the Chemu stream/lagoon is avoided.</li> <li>Allow an appropriate buffer distance between any construction activity and remnant native vegetation, where practicable.</li> <li>Limit construction activities to only designated places and clearly mark out all vegetation, which will not be cleared, so that they are clearly visible as “no-go areas” to construction staff and vehicles.</li> <li>Dismantle and remove all equipment and machinery after construction from site.</li> <li>Rehabilitate trenches and disturbed areas as soon as possible.</li> </ul>	Negligible
Sanitation/Waste Generation concerns	Soil, Chemu River, Valco and Bankuman Roads	<u>General Waste</u> <ul style="list-style-type: none"> <li>The contractor must appoint a waste management coordinator. The coordinator shall prepare and implement a Waste Management Plan which specifies procedures and, incorporates the</li> </ul>	Negligible

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<p>existing waste management plan for the Tema Port. This is to facilitate tracking of loads, and protocols for the maintenance of records of the quantities of wastes generated, recycled and disposed.</p> <ul style="list-style-type: none"> <li>Waste remaining after implementation of the waste hierarchy measures will be collected by private waste management companies operating at the port for onward disposal.</li> <li>The contractor should provide adequate waste bins at the temporary work camps to minimise littering of the port and also littering along the pipeline route. The collected refuse will then be transferred to the GPHA approved disposal site.</li> <li>Good site practices shall be implemented to avoid waste generation and promote waste minimisation.</li> </ul> <p><u>Construction Waste</u></p> <ul style="list-style-type: none"> <li>All scraps or other solid wastes will be disposed of at the approved disposal site of the TMA.</li> <li>Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction.</li> <li>Contaminated soil will be considered as waste material and disposed of accordingly at the Kpone Landfill Site.</li> <li>Excavated material shall be used on site to the extent practical.</li> </ul> <p><u>Hazardous Waste</u></p> <ul style="list-style-type: none"> <li>All hazardous waste (e.g. oily waste) generated during construction/installation will be appropriately stored as per manufacturer's instructions. For onward recycling, treatment or disposal, EPA approved hazardous waste collectors will be engaged for collection and disposal of all hazardous waste.</li> </ul>	
	Marine environment	<p><u>Dredged material</u></p> <ul style="list-style-type: none"> <li>The contractor will be required to develop a detailed dredge management plan to guide the dredging and disposal of dredged materials.</li> <li>The dredging works will generate about 560,000 m<sup>3</sup> of material. The Dredged spoil will be dumped offshore after acquiring the necessary approvals from GPHA and GMA.</li> <li>Construction workers will be instructed not to dispose or dump of any kind of waste into the marine waters and waste storage bins will be provided at conspicuous locations.</li> </ul> <p><u>Hazardous Waste</u></p>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>The waste generated during construction/installation of the Project will be transported to land for re-use, recycling, treatment or disposal in alignment with the contractors waste management plan.</li> </ul>	
Labour influx issues	Local communities	<ul style="list-style-type: none"> <li>Tema LNG will implement a labour influx management plan to holistically address labour influx issues.</li> <li>Tema LNG will implement a stakeholder engagement plan that will include: <ul style="list-style-type: none"> <li>informing stakeholders of increases in workforce and potential for influx.</li> <li>Engaging with local government/traditional authorities on issues, risks and opportunities regarding labour influx</li> <li>Engaging local communities to understand their concerns, raise awareness of risks and opportunities, and identify solutions to issues relating to labour influx</li> <li>Developing a feedback and grievance mechanism to collect any feedback or complaints related to labour influx associated with the project</li> </ul> </li> </ul>	Minor
Occupational Health and Safety Concerns and Labour Issues	Workers	<p><u>Adoption of Health and Safety Policies</u></p> <ul style="list-style-type: none"> <li>It is the policy of GPHA and for that matter the Port of Tema to establish and maintain high standards of occupational health, safety and environmental protection at work, to prevent personal injury or illness, property damage, fires, security losses and environmental pollution.</li> <li>The contractor will be required to prepare and implement health, safety and environmental protection at the workplace to guide the construction activities in compliance with the policy of GPHA. The responsibility for implementing this policy lies directly and personally with the contractor through its workers. The policy objectives shall include the following:</li> <li>Conduct activities in the Ports in accordance with relevant national and international laws and regulations on occupational health and safety. This includes Labour Act, 2003 (Act 651), the Factory, Offices and Shops Act, 1970 (Act 328), the Fire Service Act, 1997 (Act 537), Building Regulations, 2003 (LI 1724), MARPOL Convention 73/78, ILO Convention 152, 155 and 160; <ul style="list-style-type: none"> <li>establish regulatory and organizational framework for the efficient and effective management of occupational health, safety and environment issues;</li> <li>maintain safe plant, machinery and equipment;</li> <li>maintain safe and healthy work place for all Port workers and Port users</li> </ul> </li> </ul>	Minor



Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>○ maintain incident and injury-free working environments;</li> <li>○ prevent occupational related diseases/ illness among workers; and</li> <li>○ promote and maintain a clean, healthy and hygienic environment.</li> </ul> <p><u>The Contractors OHSP</u></p> <ul style="list-style-type: none"> <li>• The contractor will be required to develop an Occupational Health and Safety Plan to international standards, including requirements for PPE, task risk assessment, mandatory training, audit and monitoring, incident reporting etc.</li> <li>• The Contractor will apply the hazard hierarchy when planning work to avoid/eliminate risks and reduce risk to as low as reasonably practical.</li> <li>• The contractors will educate workers on its health and safety policy. Workers will therefore be required to follow the health and safety policy of the Authority. The adoption of the health and safety policy at site will serve as a precautionary measure to prevent/ minimize the possibility of accidents and reduce health associated risks. The EPC contractor will ensure compliance with the Health and Safety Policies between the contractor and GPHA.</li> <li>• The contractors will train selected workers as first aid givers and provide adequate first aid kits at the construction areas to treat minor ailments and cuts. However, major cases will be referred to the GPHA clinic for treatment or referral to the Tema General Hospital.</li> </ul> <p><u>Use of Experienced Personnel</u></p> <ul style="list-style-type: none"> <li>• The contractors will ensure that well-trained workers will be engaged for the various construction roles. Only drivers with the requisite licenses will be allowed to handle vehicles and earth-moving equipment into the port. Initial training and testing in machine/ equipment handling and safe working procedures will be given to all new drivers, operators and other field workers to help minimize the occurrence of accidents on site.</li> <li>• The contractors will ensure that regular defensive driving training sessions are organized for the drivers to ensure their safety and the safety of the general public.</li> </ul> <p><u>Provision of Personal Protective Equipment (PPE)</u></p> <ul style="list-style-type: none"> <li>• The contractor will ensure that workers are provided with the appropriate personal protective equipment such as safety boots and coats, hand gloves, earplugs and nose masks. Supervisors will be mandated to ensure the use of these protective devices and implement sanctions when necessary.</li> </ul> <p><u>Phasing out of Material Movements/ Scheduling Material Movements</u></p>	

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<p>Movement of tanks, pipes and other construction materials to site or storage areas will be carried out in phases and properly regulated to control the number of cargo vehicles coming into the project site at any given time to reduce the risk of accidents. Tema LNG Terminal intends to carefully plan materials movement with GPHA activities to minimise these impacts. Materials and equipment will be transported to the sites during off peak periods.</p> <p><u>Use of Equipment</u></p> <p>All equipment's to be used will be in good condition and scheduled regular maintenance will be ensured to reduce/minimize of accidents.</p> <p><u>Worker Rights and Wellbeing</u></p> <p>The Contractor will develop and implement a Human Resource Policy and plan that adheres to the requirements of IFC PS2, including requirements for workers to have contracts, Workers Grievance Mechanism and develop retrenchment plans if there is a requirement for collective dismissals.</p>	
Public Health and Safety and Security Impacts	Public/Communities	<p><u>Restriction of Access</u></p> <ul style="list-style-type: none"> <li>• GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area.</li> <li>• The security personnel will be trained to respect the human rights of the local people</li> <li>• IFC PS4 will be used as the standard in relation to hiring, training and monitoring of security personnel</li> </ul> <p><u>Pipeline Design and Depth</u></p> <ul style="list-style-type: none"> <li>• The pipeline is to be constructed from carbon steel and will be externally coated for corrosion protection to minimize damage.</li> <li>• The pipeline will be laid to a minimum depth of 1m (yet to be confirmed by the final designs) to minimize the risk of exposure through soil erosion and there will be some restrictions to RoW usage.</li> </ul> <p><u>Provision of temporary crossings over trenches</u></p> <ul style="list-style-type: none"> <li>• The pipeline contractor will be required to provide temporary crossings over trenches at the Abonkor community section to enable pedestrians or residents to easily cross over open trenches crossing their footpaths.</li> </ul> <p><u>Public Health /Toilet facilities</u></p>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>The contractor will provide mobile toilet facilities for workers during construction of the pipeline route.</li> <li>Currently TMA is promoting “toilet at half price” as part of the access to improve sanitation project under the GAMASWAP in the local communities around the project area in order to minimize open defecation.</li> <li>Tema LNG Terminal Company will liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs near the Valco fence wall for use to prevent open defecation.</li> </ul> <p><u>Use of warning signs</u></p> <ul style="list-style-type: none"> <li>Uncovered trenches or deep excavations will be protected using indicator linings or illustrative warning notices or wire mesh (whichever best suits the situation) to prevent fall hazards. All trenches and excavation will be covered as soon as possible.</li> <li>As much as possible the contractor will adopt progressive opening of trenches to reduce risks to as low as reasonably practicable</li> <li>Caution/warning signs should be placed at vantage points around the project site</li> </ul> <p><u>Scheduling of Work</u></p> <p>The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods.</p> <p><u>Announcement and Notification of Work</u></p> <p>The TMA and TDC will be informed at least seven days before start of work. All port users will also be informed of the schedule of work through their respective organisations. Tema LNG will make announcements and give notices for work schedule on affected roads through local FM stations as well as some nationwide stations, Assemblymen as well as Unit Committee leaders.</p> <p><u>Transport of Equipment and Materials</u></p> <p>Traffic impacts resulting from carting of equipment and materials (e.g. quarry materials) to the oil jetty site from local quarry sites will be limited to the Harbour roads and will be managed in line with the Traffic Management Plan to be prepared by the contractor for the movement of materials.</p> <p>The traffic management plan will be prepared in consultation with GPHA in order to minimise trucks congestion at the port as a result of the ongoing port expansion project.</p>	

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<p>Flagmen will be employed to man all major intersections to assist with passage of trucks conveying materials and equipment, on the route to the construction site and storage area. All the vehicles to be used for the project and especially in transporting equipment and materials will be serviced regularly and all the drivers to be engaged/ assigned would be required to hold the requisite driver's license as prescribed by the Drivers and Vehicles Licensing Authority (DVLA), and would be educated on public safety issues. Adequate traffic management measures will be instituted to caution the public and to create safety awareness. Some adequate measures and conditions to be instituted by the contractor in the transport of materials include the following:</p> <ul style="list-style-type: none"> <li>• All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and MTTD;</li> <li>• Haulage of materials including quarry products to the port area will be limited to off-peak hours;</li> <li>• Trucks transporting quarry products and other friable materials to the port will be covered;</li> <li>• All trucks conveying materials to the port will carry appropriate warning signals such as red flag and rotating amber lights;</li> <li>• Road worthy dump trucks will be used;</li> <li>• Very experienced drivers will be engaged;</li> <li>• Traffic wardens will monitor dump truck movements and ensure public and traffic safety; and</li> <li>• Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks.</li> <li>• Carry out regular inspections of haulage roads</li> </ul> <p>In the event truck failure along haulage routes, such trucks will be towed within 24 hours.</p>	
Road crossing and traffic impact	VALCO vehicles, commercial and private vehicles	<ul style="list-style-type: none"> <li>• VALCO will be informed and will agree to the date and time of crossing the road</li> <li>• The contractor will be required to use appropriate methodology to cross the VALCO exclusive road to minimise or avoid delays in transport of people to and from the clinic.</li> <li>• The local communities will be informed on the schedule for the crossing of the untarred access road connecting Bankuman to the TOR area.</li> <li>• The contractor will be required to schedule its work such that crossing of the untarred access road is done when traffic is low to minimize inconvenience to motorists.</li> </ul>	Minor

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>	<b>Residual Impact</b>
		<ul style="list-style-type: none"> <li>Where the untarred access road has to be blocked for work to proceed smoothly, adequate signs and notices will be strategically placed at diversion routes.</li> <li>Any damaged sections of the roads will be reinstated by the contractor</li> </ul>	
Destruction of crops/farm, pigsty, loss of livelihood and access to land	Affected subsistence farmers and pig owners	<ul style="list-style-type: none"> <li>Tema LNG will implement a livelihood improvement plan for potentially project affected persons that will take care of compensation, relocation, and livelihood assistance arrangements as required</li> <li>Appropriate compensation for affected standing crops and pigsty/pigpen at proven value will be paid.</li> <li>Monitoring will be undertaken to determine potential compensation/livelihood assistance measures required and verify they have been effective.</li> </ul>	Negligible
Under water blasting effects	Marine life and ecology	<p>The first option is to avoid underwater blasting as much as possible and consider other alternatives such as hammering. However, the following mitigation measures will be adopted to minimize the effect of underwater blasting:</p> <ul style="list-style-type: none"> <li>The Inspectorate Division of the Minerals Commission will be consulted, and approve of the blasting design;</li> <li>Technical persons from the Ghana Navy/Coast Guard and the Inspectorate Division of the Minerals Commission will be around to supervise and observe the blasting operation;</li> <li>Blasting will be conducted during time when marine animals are least likely to be in the blasting area;</li> <li>In tidal areas, blasting will be conducted during the recommended tidal phase deemed appropriate for the area (i.e. slack or low-tide conditions);</li> <li>If multiple charges are required, time-delays will be used to reduce the overall detonation pressures to a series of smaller explosions;</li> <li>All shock-tubes and detonation cord or electric wires will be recovered and removed after each blast;</li> <li>All blasting events shall be weather dependent. Climatic conditions must be suitable for optimal viewing and minimal impact. Blasting will be prohibited under windy conditions, during periods of fog and heavy rain. The Meteorological Agency or the Port Meteorological Unit will be contacted to confirm conditions prior to initiation of the survey for each blast event;</li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>○ All blasting events will occur during daylight hours to ensure that optimal observation conditions occur; and</li> <li>○ If there are any problems encountered during blasting, the problems shall be evaluated by the technical persons from the Inspectorate Division of the Minerals Commission and the Navy as well as the explosive engineers. Solutions to the problems should be identified prior to the next blasting event.</li> <li>○ Marine mammal/ sea turtle observance and monitoring will be carried out during any underwater blasting to observe any appearance of such animals along the coast/ shoreline or in the waters</li> </ul>	
Marine water contamination/ impacts on aquatic organisms and biodiversity	Marine environment	<p><u>Dredging</u></p> <ul style="list-style-type: none"> <li>• A Dredge Management Plan will be developed in line with the requirements of IFC EHS Guidelines for Ports Harbours and Terminals to guide the project. The dredging management plan will include sampling and monitoring of sediment and will include measures to address exceedences.</li> <li>• Dredging will be done in small sized enclosed areas at a time, protected with silt curtains, blasting mats, fine meshed films and other BMPs, to shut out spread of fine sand/silt and re-suspension of any chemical contaminants in the marine bed.</li> <li>• The contractor shall ensure that the dredge cuts and lifts are designed such as to prevent undercutting of material at the cutterhead. The cutter head shall be selected in accordance with the material to be dredged and to minimise spillage and maximise the transport of dredged material to the suction mouth.</li> <li>• The contractor shall reduce the level of re-suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity to ensure that the cutter advancement rate is not greater than the ability of the suction pump to remove the material that has been cut; <ul style="list-style-type: none"> <li>• The contractor(s) will ensure that the works cause no visible foam,</li> <li>• oil, grease, litter or other objectionable matter to be present in the</li> <li>• water within and adjacent to the dredging s</li> </ul> </li> <li>• All boats shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.</li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>All effluent from the project site should be contained in a digester for some days (up to 3 days) to help bring down temperature to that of receiving water as well as settle any solids before release into the environment.</li> <li>Marine mammal/ sea turtle observance and monitoring will be carried out during dredging to observe any appearance of such animals along the coast/ shoreline or in the waters</li> </ul> <p><u>Trenching</u></p> <ul style="list-style-type: none"> <li>Restricting trenching times, particularly during periods of high wave/wind activity</li> <li>To reduce turbidity and spill, design and implement a trenching management plan which is informed by geotechnical and geophysical knowledge of the pipeline route</li> <li>Install appropriate silt curtains around offshore works</li> </ul> <p><u>Oil spills</u></p> <p>The contractors, prepare a spill prevention and control plan, incorporating measures outlined in the emergency response plan of GPHA, to minimize increased turbidity and surface pollution through oil spills. Monitoring and spill prevention drills will be required to ensure impacts are avoided to the maximum extent practical.</p> <p><u>Movement of ships</u></p> <ul style="list-style-type: none"> <li>A dedicated navigation route will be used by ships/fishers to move in and out of the port.</li> </ul>	
General Disturbance of Port Operations	Port users	<ul style="list-style-type: none"> <li>The contractor will elicit the assistance of the Harbour master, GMA as well as representative bodies of the port users to ensure that construction activities are scheduled so that port operations are not unduly interrupted.</li> <li>The harbor master will ensure all passing vessels are well informed of construction work, e.g. dredging, piling etc., and are cautious when moving in and out of the port facility.</li> </ul>	Negligible
Contamination of Marine Environment	Marine environment	<p><u>Specific measures</u></p> <ul style="list-style-type: none"> <li>The terminal operator shall ensure regular maintenance of the sewage treatment plant, manhole for runoff clarification and coalescence separator for the treatment of runoff in areas where fuels and light liquids are handled (e.g. fuel station, workshop).</li> <li>The terminal operator will ensure that the waste reception facilities for the collection, storage, treatment and transfer of waste at the port are utilized by vessels arriving at the port. The Captains will be adequately informed of this.</li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>Where necessary, filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) will be installed to prevent sediment and particulates from reaching the port water.</li> <li>The terminal operator shall ensure regular inspection of storm water drains to remove settled materials to avoid blockage and ensure the proper discharge in the drainage systems</li> </ul> <p><u>General measures</u></p> <ul style="list-style-type: none"> <li>The terminal operator will ensure that the likelihood of oil spills is reduced to the barest minimum through regular monitoring and audits of vessels being used.</li> <li>The terminal operator will implement its oil spill contingency plan when required to promptly clean up oil spills and avoid contamination of the marine environment. Oil pollution control equipment on hand include Boom, Skimmer, Tug Boat, Dispersant units,</li> <li>GPHA has established of a Port community network, which brings together major stakeholders that impact on operations in the Port. This will be utilised to ensure pollution of the marine environment is quelled.</li> <li>Punitive measures will be enforced for all persons observed to throw waste into the port waters.</li> <li>The polluter pays principle is in place at the port and education of port users will be intensified to increase awareness. The principle implies that –Person(s), Institution and Companies that spill oil or pollute any part of the Port will be made responsible for the clearing of the pollutant and subsequently fined</li> </ul>	
Air Pollution	Workers/ Port users	<ul style="list-style-type: none"> <li>Terminal operator will incorporate the Air Quality Management Plan into standard operations. The plan will include the following:               <ul style="list-style-type: none"> <li>dust from vehicular movement</li> <li>dust from cleaning activities</li> <li>exhaust emission from vehicles and machinery</li> <li>fumes from chemicals and welding</li> <li>VOCs from fuel storage and dispensing areas</li> <li>noise from operation of machinery</li> <li>monitoring</li> </ul> </li> <li>Regular maintenance of machinery/equipment in accordance with manufacturer specifications to ensure minimum levels of emission from the terminal operations.</li> </ul>	Minor



Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>Maintaining stable tank pressure and vapour space by coordinating filling and withdrawal schedules (offshore)</li> </ul>	
Waste Management	Workers/Port user	<u>Education campaigns</u> <ul style="list-style-type: none"> <li>The terminal operator will ensure proper management and disposal of waste generated and will continue to educate workers on its waste management plan.</li> </ul> <u>Waste Collection and Disposal</u> <ul style="list-style-type: none"> <li>The terminal operator will appoint a waste management coordinator. The coordinator shall prepare and implement a Waste Management Plan which specifies procedures and, incorporates the existing waste management plan for the Tema Port. This is to facilitate tracking of loads, and protocols for the maintenance of records of the quantities of wastes generated, recycled and disposed</li> <li>Ensure different types of waste are segregated in different containers or skip to enhance recycling of material and proper disposal of waste.</li> <li>Ensure chemical wastes are stored, handled and disposed of in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes</li> <li>All the collected wastes shall be transferred to the Port Waste Reception and Treatment Facilities</li> </ul>	Minor
Noise Nuisance	Port Users, terminal workers	<ul style="list-style-type: none"> <li>The terminal operators will ensure that silent equipment (low noise versions, which may cost a little extra) are used for the terminal operations. Additionally, silencers, mufflers and other appropriate engineering control devices shall be used on the noise generating equipment. Where possible, electrical instead of diesel or diesel-electric moving equipment will be used.</li> <li>Reduce noise levels through optimizing the terminal layout</li> <li>Regular site inspections will be carried out to audit the compliance with regard to noise control.</li> <li>Will provide appropriate PPEs for workers use.</li> </ul>	Minor
Occupational Health and Safety Concerns and Labour Issues	Terminal workers and subcontractors	<u>Training in equipment and chemical handling</u> <ul style="list-style-type: none"> <li>Risk assessments will be undertaken and avoidance / elimination of hazards prioritised to reduce the need for manual handling of chemicals.</li> <li>The terminal operator will also ensure that workers handling fuels, chemicals, machinery and equipment are well trained. Such workers will be provided with the necessary</li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<p>documentations including Material Safety Data Sheet (MSDS)) to serve as reference sources on the dangers and ways of handling these chemicals, fuels etc.</p> <p><u>Provision of appropriate PPEs</u></p> <ul style="list-style-type: none"> <li>○ The terminal operators will ensure that the Management of the various terminals provide workers with adequate personal protective equipment including overalls, earplugs, overalls and anticorrosive gloves etc. as their particular operations would require.</li> <li>○ Non-conductive hand tools rated for the voltage at which live electrical work is being performed at the substation will be provided.</li> <li>○ Caution/warning signs should be placed at vantage points around the site</li> </ul> <p><u>Preventive Measures</u></p> <ul style="list-style-type: none"> <li>○ The terminal operator will prepare comprehensive maintenance programme on commencement of operations to put in place measures to avert any serious breakdowns or failures. The required maintenance for the systems will include among others:</li> <li>○ Environmental incident/accident investigation;</li> <li>○ Routine equipment maintenance/inspection schedule;</li> <li>○ Annual equipment inspection and maintenance record;</li> <li>○ Procedure for pre-arranged repair service;</li> <li>○ Procedure for preventive maintenance; and</li> <li>○ Regular calibration of equipment.</li> <li>○ The following safety precautions will be implemented to minimise danger of electrocution at the substation:</li> <li>○ As much as possible avoid working on live electrical parts except when de-energizing the equipment creates additional hazards or when the equipment must be energized to allow for testing that can only be performed live.</li> <li>○ Permit to work system will also be implemented for hot works, electrical works and work at height.</li> <li>○ Prior to initiation of hot works, it will be checked that there is no flammable material, gas or dry woodwork which could catch fire; and that surfaces which have been in contact with hydrocarbons or toxic substances are completely clean.</li> </ul>	

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>○ Ensure that all staff working on live equipment or lines will be without conductive apparel (watches, bracelets, rings, key chains, necklaces, zippers, cloth with conductive thread, etc.)</li> <li>○ Provide barricades and signage for all live electrical equipment</li> </ul> <p><u>Emergency Provisions</u></p> <ul style="list-style-type: none"> <li>○ The terminal operators will implement its emergency response plan (to be developed from the framework plan provided in section 11). The plan which will incorporate the emergency response plan of GPHA will handle all emergency situations including fire, mechanical failures etc. that will arise from operations to minimize any hazards to humans and the environment. Management will ensure a triennial review of the plan.</li> </ul> <p><u>Housekeeping</u></p> <ul style="list-style-type: none"> <li>○ Good housekeeping practices will be an integral part of ports operations to maintain a well laid out working space and avert accidents resulting from slippage, fires from torn electrical wires, cobwebs etc.</li> </ul>	
Public Health, Safety and security	Port Users, Local communities, General Public	<ul style="list-style-type: none"> <li>• The design of the facilities has incorporated adequate safety and security considerations as provided in Section 3 (project description), and the operations of the terminal will incorporate a scheduled inspection, monitoring and maintenance regime to avoid accidents.</li> <li>• Tema LNG Terminal Company will collaborate with GPHA security personnel to maintain security of the facilities within the Port environment to ensure that only authorised persons have access to the facilities.</li> <li>• Tema LNG Terminal will engage private security firms and also involve key local community members in maintaining security of the facilities.</li> <li>• The security firm and the key community members will be hired and trained to comply with IFC PS4 requirements. The security people will also be trained to respect human rights of the local people to avoid conflicts and human right abuses.</li> <li>• Will define a protocol for community reporting of observed incidents (e.g. sight, smell or sound of pipeline leaks and procedures for community grievance redress mechanism.</li> <li>• Will identify emergency scenarios and develop emergency preparedness and response plans with allocation of responsibilities to local communities and authorities, (where appropriate)</li> <li>• Will continue safety awareness and education programs for impacted communities.</li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>Will develop clear guidelines as to what level of public access and activity along the RoW is acceptable for maintaining pipeline safety and integrity, and ensure that this is enforced to help avoid encroachment and other potentially dangerous activities.</li> <li>Will carry out community awareness /sensitization on the above guidelines to be developed regarding public access/use restrictions and safety. This will prevent encroachment of Right of Way over time with potential to compromise safety of pipeline and safety of people in the event of accident.</li> <li>Will organise, in collaboration with the respective Tema Metropolitan Assemblies and the GPHA Port Health Department, awareness creation seminars and educational programmes for all workers and the general public on the behavioural changes required to prevent the spread of HIV/AIDS and other STDs.</li> </ul>	
Accidental Events and impacts on nearby properties, marine/terrestrial ecology	Port Users, Valco, Gridco, GPHA, GPMS, WAPCo, Local communities	<ul style="list-style-type: none"> <li>The design of the facilities has incorporated adequate safety and security considerations as provided in Section 3 (project description) to minimize potential accidents.</li> <li>Tema LNG will develop and implement an emergency preparedness and response plan in collaboration with relevant stakeholders including GPHA, GPMS, Valco, Gridco, and WAPCo as appropriate.</li> </ul>	Minor
Introduction of Invasive Marine Pest Species	Marine water	<p><u>Ballast water</u></p> <ul style="list-style-type: none"> <li>Ensure extensive dissemination of information on Ballast water management as prescribed in the International Convention for the Control and Management of Ships Ballast Water and Sediments.</li> </ul> <p><u>Biofouling</u></p> <p>Training and education of ships masters and crews regarding the risks associated with biofouling transference of marine pests and procedures of minimising risk such as:</p> <ul style="list-style-type: none"> <li>Using anti-fouling systems appropriate to a ship hull and activity</li> <li>Applying appropriate operational management practices to reduce the development of biofouling (e.g. maintaining seawater intake system cleaning)</li> <li>Maintaining a biofouling management plan and record book to identify procedures prescriptive to each ship regarding biofouling management and to maintain records of procedures and measures being applied for each ship's biofouling management</li> </ul>	Negligible

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>Ensuring ship maintenance (e.g. of the anti-fouling system or other vessel components where biofouling accumulates) is completed on an appropriate life cycle to minimize growth of biofouling</li> <li>Where in-water inspection of ships is required, consider whether targeted maintenance of areas where biofouling accumulates is appropriate. Risks associated with environmental harm from in water cleaning are acknowledged by the biofouling guidelines and a number of measures to reduce risk of harm are identified including completion of risk assessments, avoidance of cleaning where harm is likely</li> <li>Ensure effective dissemination of information of relevance to biofouling management to ensure appropriate biofouling management systems are implemented by all vessels</li> </ul>	
General Disturbance of Port Operations	Port users	<ul style="list-style-type: none"> <li>The existing port operation procedures such as slow approach and departure speeds and tug escort for certain vessels will continue to be relied upon to limit the risk of collision</li> <li>The extension of the breakwater will correspondingly shift the turn further away from the harbour entrance, thus creating a greater distance between the LNG facility and the turn for moving vessels.</li> <li>During STS transfer to FSU, passing vessels should as much as possible aim to maximize clearance of the LNGC. That would imply a safe clearance of at least 100-150 m from the traffic lane.</li> </ul>	Negligible
Sustainability of the Tema LNG Terminal Project	GPHA/Ministry of Transport	<ul style="list-style-type: none"> <li>The Management of Tema LNG Terminal will seek to operate profitably by implementing a system to collect appropriate user charges to cover the running and maintenance cost of its facilities.</li> <li>The terminal will develop and implement an emergency response plan to handle all emergencies including fire, and oil spills that will arise from all its operations to minimize any hazards to humans and the environment. Management will ensure a triennial review of the plan.</li> <li>A comprehensive maintenance programme will be put in place to avert any serious breakdowns or failures or accidents. The required maintenance for the systems will include among others: <ul style="list-style-type: none"> <li>Environmental incident/accident investigation;</li> <li>Carry out mock oil spill response drills</li> <li>Routine equipment maintenance/inspection schedule;</li> </ul> </li> </ul>	Minor

Anticipated Environmental & Social Impacts	Receptor(S)	Proposed Mitigation And Management Measures	Residual Impact
		<ul style="list-style-type: none"> <li>○ Annual equipment inspection and maintenance record;</li> <li>○ Procedure for pre-arranged repair service;</li> <li>○ Procedure for preventive maintenance;</li> <li>○ Procedures for handling materials; and</li> <li>○ Regular calibration of equipment;</li> <li>● Coordinate with other agencies and organizations to provide technical assistance to inform activities and programs that can support the project</li> <li>● Ensure resource use efficiency influencing supply chain sustainability</li> <li>● Adopt a comprehensive monitoring plan to ensure effective implementation of mitigation and management measures.</li> </ul>	
Loss of jobs after preparatory and construction phases	Preparatory and construction phase workers	All workers to be engaged by the EPC contractor will be informed that their engagement is temporary and ends after construction, and that their engagement is not a guarantee for reemployment during the operational phase.	Minor
		The contracts for all consultants to be involved during the preparatory and construction phase will clearly indicate the duration of their assignment.	Minor
Occupational health and safety	(Similar to construction phase)	(apply mitigation measures for construction phase)	Negligible
Public safety and traffic issues	(Similar to construction phase)	(apply mitigation measures for construction phase)	Negligible
Marine water contamination	(Similar to construction phase)	(apply mitigation measures for construction phase)	Negligible
Waste disposal	(Similar to construction phase)	(apply mitigation measures for construction phase)	Negligible
Air pollution	(Similar to construction phase)	(apply mitigation measures for construction phase)	Negligible

<b>Anticipated Environmental &amp; Social Impacts</b>	<b>Receptor(S)</b>	<b>Proposed Mitigation And Management Measures</b>	<b>Residual Impact</b>
Loss of job	Operation and decommissioning phase workers	A retrenchment policy will be developed and included in the condition of service/service agreement for workers for them to know what they will be entitled to during retrenchment and closure of the affected company/ operator.	-
All other impacts	Bio-physical and social environment	(a detailed EIA will be carried out for approval and permitting by the operator before final decommissioning of both offshore and onshore facilities to confirm all impacts and appropriate mitigation measures to be implemented)	-

## **10.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN (PEMP)**

A Provisional Environmental Management Plan (PEMP) is developed for the project in accordance with the Environmental Assessment Regulations of 1999, LI 1652 to assist the project to be carried out in an environmentally safe and sustainable manner. The provisional EMP outlines management commitment and the required training programmes for the sustainable implementation of the proposed project. An estimated budget for the PEMP is also included in this section.

The implementation of the PEMP is expected to meet the following objectives:

- provide the platform to accommodate changes and uncertainties during project implementation;
- manage actual impacts during project implementation phase;
- ensure proper implementation of project permitting conditions;
- ensure satisfactory environmental performance; and
- serve as a source of background information for future projects.

A detailed Environmental Management Plan (EMP) will be prepared and submitted to the EPA within 24 months of commencement of operations as per Regulation 24 of LI 1652. The EMP will clearly set out steps and action plans to be taken to manage any significant environmental impacts from the operations. The EMP will be updated every three years thereafter throughout the project life. The laid-out management organisation and procedural and contingency measures to be put in place to ensure that the impacts are mitigated and managed appropriately are discussed below.

### ***10.1.1 Environmental Health and Safety and Security (EHSS) Management Structure***

#### ***10.1.1.1 Formation of an EHSS Department during Operation***

The company will set up an Environmental Health and Safety and Security Department or Unit that will seek to implement proactive sustainable practices with the purpose to ensure compliance with internal and external requirements to drive continuous improvement. The EHSS Department will ensure that all policies are in conformity with the GPHA policies.

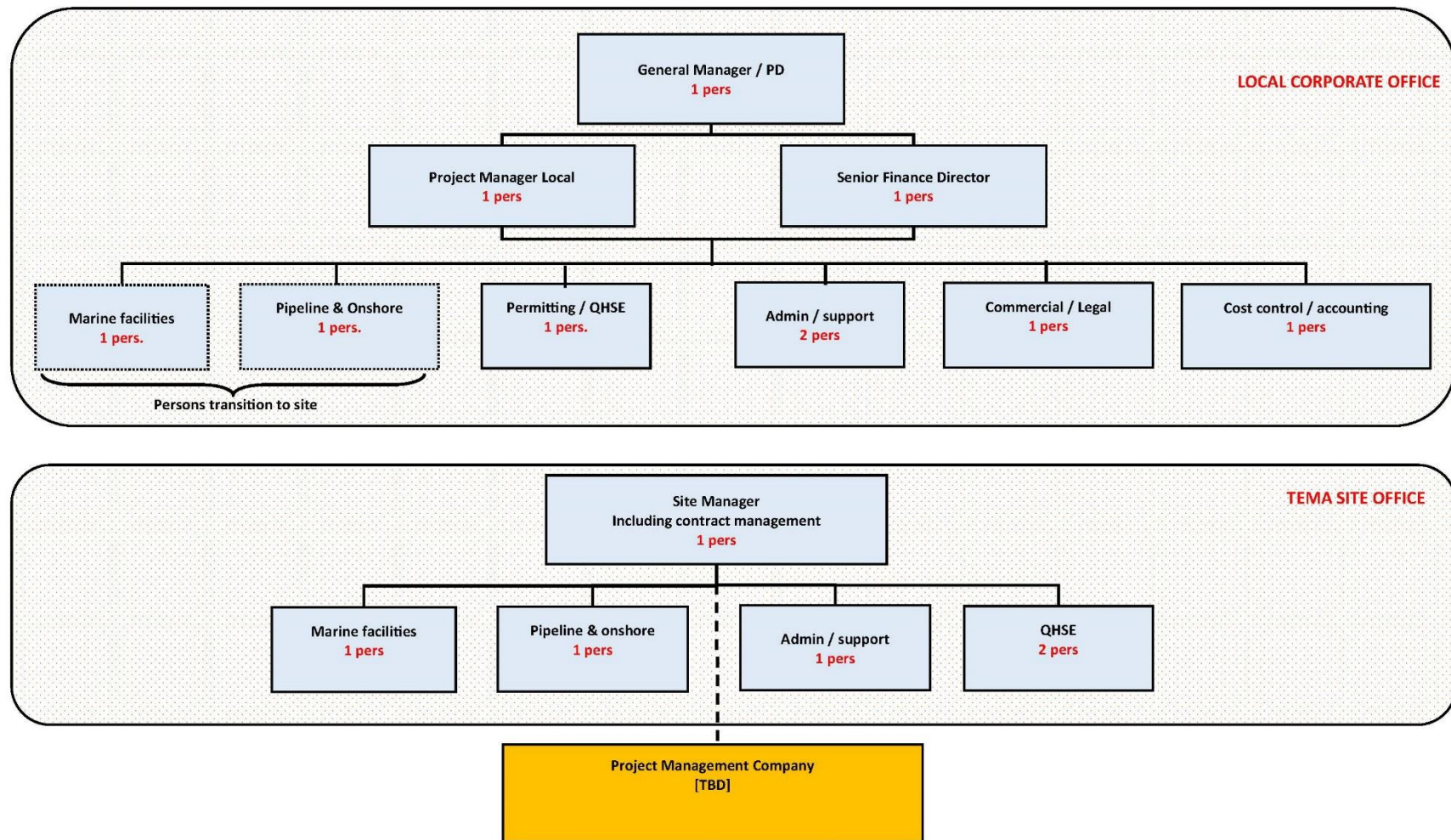
The functions of the EHSS outfit include:

- Establishing the EHSS Policy;
- Setting objectives and targets for EHSS performance and improvement;
- Assigning responsibility and authority for implementation activities;
- Providing the adequate resources needed to implement the policy;
- Ensuring knowledge and skills are developed to effectively apply the EHSS systems and standards;
- Reviewing the EHSS system to ensure its continuing suitability, adequacy, effectiveness; and
- Actively communicating leadership and commitment that is visible to the organization.



The General Manager shall have overall responsibility for the formulation, implementation, monitoring and evaluation of Health, Safety and Environmental Issues of the Tema LNG Terminal project. The marine facilities manager, Pipeline Onshore manager, Permitting/ Quality Assurance, Health, Safety and Environment (QHSE) manager shall be responsible for ensuring the implementation of HSE activities in the different departments and will report directly to the Project Manager Local at the Local Corporate office. The functions of the QHSE Manager, QHSE Officer and QHSE Supervisor are presented in **Table 10-1**.

At the Tema Site office, the QHSE officer, assisted by two persons (i.e. QHSE supervisor and representative) will liaise with the Site Manager for the management of the environment, health and safety of farmers and workers, and security at the project site. The site manager will liaise with the QHSE/Permitting manager at the Local Corporate office. **Figure 10-1** shows the Operational phase management organisational structure showing the position of the QHSE.



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Figure 10-1: Management Organogram for the Operation Phase

**Table 10-1: Functions of the Permitting/QHSE manager, site Manger and QHSE Officer**

<b>Permitting/QHSE Manager</b>	<b>Site Manager</b>	<b>QHSE Officer</b>
1. Lead the implementation of environment, health, safety and security policies of the project, including technical and non-technical operations.	1. Liaising with the QHSE officer to ensure implementation of environment, health and safety policies at the site.	1. Liaising with the Site Manger ensure implementation of EHS policies
2. Liaise with the General Manager to ensure all required PPEs and other EHS logistics are provided for the project.	2. Ensuring adherence to environment, health and safety procedures and the correct use of PPEs provided for workers in carrying out their activities.	2. inspect and evaluate the environment, equipment and processes in working areas to ensure compliance
3. Ensure all machinery and equipment are in good condition and well serviced and the operators adhere to environment, health and safety procedures.	3. Develop training strategy for EH&S group. Includes new hire safety training as well as annual refresher trainings for all employees on a variety of safety and environmental topics.	3. Organizing and coordinating EHS training and awareness program for workers.
4. Liaise with regulatory institutions such as EPA and GPHA EHS services.	4. Keeping records and reporting all incidents/accidents and illnesses	4. Keeping records and reporting all incidents/accidents and illnesses to the site manger
5. - Monitor all operation procedures, QA and EHS documents, other critical documents & records; 6. - Coordinate with departments for vendor quality management;	5. Preventing unauthorized access to the site.	5. Reporting all complains from the workers concerning environment, health and safety systems
7. Supervise the site manager to ensure implementation of environment, health, safety and security procedures.	6. Reporting all non-compliances to environment, health and safety procedures to the permitting /QHSE for appropriate action.	6. Reporting all non-compliances to environment, health and safety procedures to the site manager for appropriate action.

#### ***10.1.1.2 Construction Phase Site Organisational Chart and Formation of an Environment Health and Safety Committee***

The EPC Contractor site organisation chart for the construction phase is provided in **Figure 10-2**, showing the positions of the Safety Manager, Environmental officer and Safe officer.

The Project Director will generally link up the communication between the various Departments and the Project Team particularly in the aspects of the finance, resources, quality, environment, health and safety. The Project Director is required to stay in Ghana and frequently visit the project sites to assist the Project Manager to resolve problems and to attend the meetings with Tema LNG Terminal Company, the Supervising Engineer and or any relevant authorities such as GPHA and GMA.

The Project Manager (PM) will be resident on site to lead the Project Team and be bestowed with sufficient authority for the overall management of the contract within the constraints of efficient, safe, environmental and economic operation. He will also be responsible for all the formal liaisons and communications with Tema LNG Terminal, the Supervising Engineer, and with other stakeholders who will be affected by the works.

The designated Construction Manager will also be full time on site supported by the Survey Manager, Plant Engineer, and Works Managers in-charge of the Breakwater, Dredging, Marine Facilities and Marine Pipeline which will form the core team for the execution of works. The Construction Manager will report to the Project Manager and be responsible for the execution of construction activities in accordance with approved designs, standards, methods, specifications, plans, programme and budgets.

The Construction Manager will also take the responsibility for ensuring the protection of the environment, health and safety of all persons affected by the works, whether directly or indirectly, by providing a safe working environment, safe plant and equipment, thorough training, suitable protective equipment, and all other measures required by Statutory Regulations and the Project HSE Plans.

#### **Formation of an Environment, Health and Safety Committee**

The Tema LNG Terminal will establish an Environmental, Health and Safety Committee in collaboration with the EPC Contractor to formulate policies and draw up programs and procedures to manage the project during the construction phase. The EPC contractor and sub-contractors of the project will implement the EHSS Committee during this phase of the project.

The Committee shall have monthly meetings to discuss and deliberate on environment, health, safety and security issues. The functions of the Environment, Health, Safety and Security Committee shall among other things include:

- Carry out routine construction inspections and audits
- Implementing Environment, Health, Safety and Security Policies during the construction phase;
- Implementing the environmental permit conditions and mitigation, monitoring and management measures in the ESIA report for the construction phase;

- Provide appropriate awareness creation programmes for the workers;
- Reviewing monthly data collated on environmental management, workers' health and safety and security issues;
- Addressing environment, health, safety and security complains and concerns of workers and communities; and
- Undertaking disciplinary actions against workers who do not comply with health and safety procedures.

The EHS committee for the construction phase of the project will be made up of an eight (8) membered committee. The committee shall have monthly meetings inside the Port area to review the performance of the EPC contractor during construction work. The Estate and Environment Manager of GPHA will serve as the chairman of the committee. The members of the committee will include:

- A representative of [REDACTED]/Tema LNG Terminal Company
- A representative from AECOM
- A representative from GPMS
- Three (3) representatives from the EPC contractor
- Three (3) representatives from GPHA, preferably
  - Estate and Environment Manager (Committee Chairman)
  - Fire/Safety Manager
  - Harbour Master

## 10.2 Programme to meet Requirements

The programmes proposed to meet mitigation measures and monitoring programmes will include the following:

- Adoption of Environmental Health and Safety Policies and Operational Procedures;
- Adoption of Environmental Health and Safety Management System;
- Development of Specific Environmental and Social Management Plans;
- Technical Co-operation;
- Staff Information and Awareness Creation;
- Public and community participation;
- Construction and operational Phases Impact Mitigation Action Plan;
- Environmental Monitoring Programme;
- Audits and Reviews;
- Capacity Building and Training;
- Grievance Redress Mechanism;
- Community Development/Social Responsibility Arrangement;
- Environmental Reporting;
- Document control and tracking;
- Emergency Response Planning; and
- Environmental and social management budgeting.

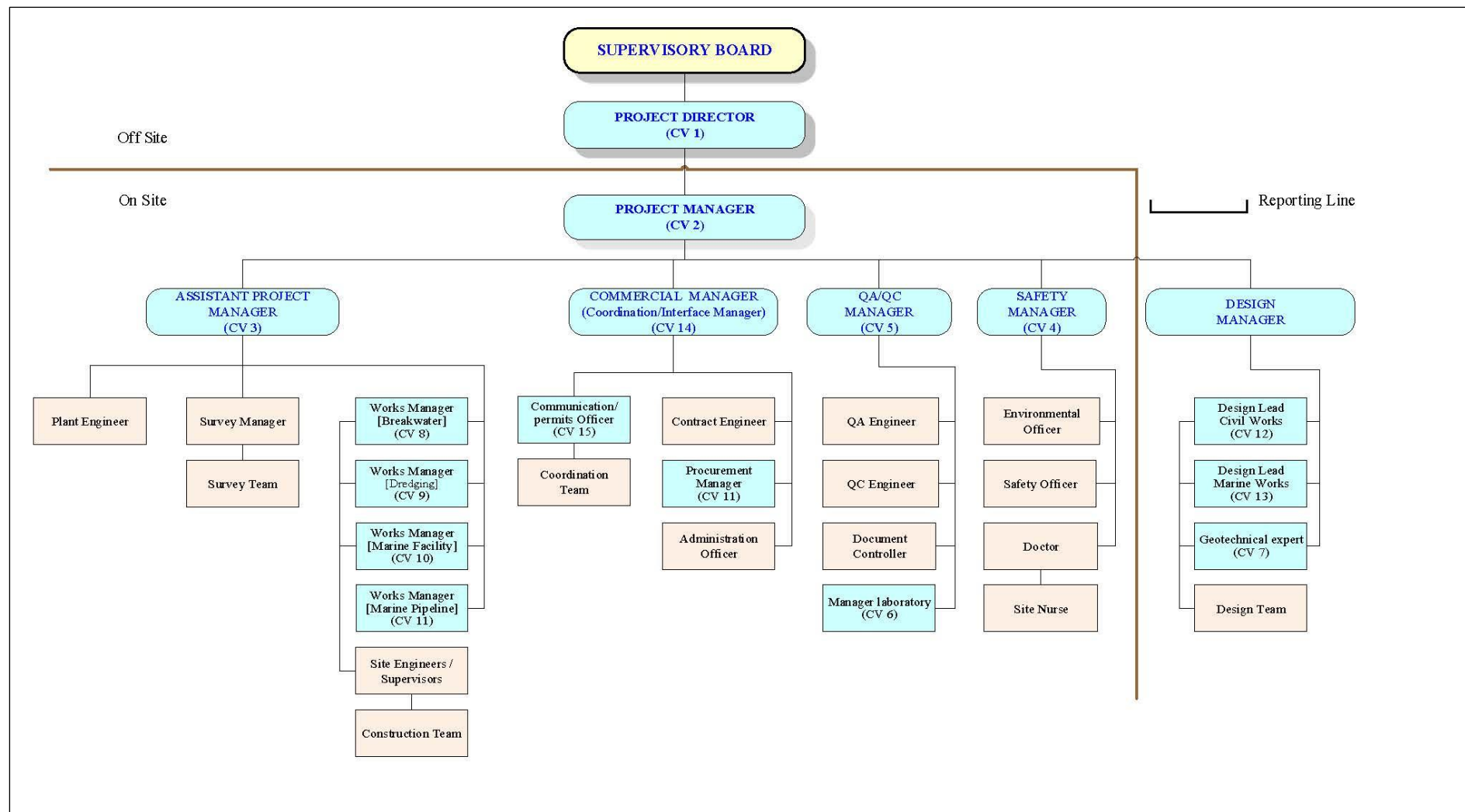


Figure 10-2: Organizational Structure for Construction Phase – EPC Contractor

### ***10.2.1 Health and Safety Policies for Ghana Ports and Harbours Authority, Tema Port***

Tema LNG Terminal will develop their policies prior to the project implementation. However, the GPHA, Tema Port policies will be guiding policies for Tema LNG policy formulation. The GPHA environmental and Occupational health and Safety policies are presented below.

#### **Environmental Policy**

GPHA recognizes that protecting its environment is critical to the survival of its Ports. It is therefore committed to engaging in environmentally conscious practices in the operation and development of its Ports. It will ensure compliance with all relevant environmental conventions and legislations aimed at achieving cleaner water, air and soil through integrated co-operative approaches for the sustainable development of its Ports and make them leaders in environmental performance in the sub-region.

In this respect, the Port of Tema shall:

- Incorporate environmental considerations into its planning, management and operational activities;
- Have an Environmental Management System (EMS) to stimulate the Port into efficient and effective environmental management through systematic environmental care and continuous improvement;
- Allocate and maintain resources for the effective implementation of environmental management and compliance programme;
- Ensure environmental knowledge, communication and participation among Port employees, Port users, Port tenants, Port operators, transporters' and the Port community, and encourage them to actively give due regard to the environment in their daily activities;
- Demand that operational activities and services are done in a way that minimizes negative environmental impacts;
- Influence, specify demands and cooperate with clients, suppliers, Port users, Port operators, Port tenants, transporters and the entire Port community to fulfil the port's environmental policy;
- Encourage and sensitize Port employees, Port users, Port tenants, Port operators, transporters and the Port community on use of energy water, natural resources and raw materials in a judicious and efficient manner;
- Relate with the EPA and other related bodies and also ensure to make environmental contribution to communities in which our Port is located;
- Prevent environmental accidents and maintain a high level of preparedness to reduce the effect, in case of an accident; and
- Build International, Regional and Sub-regional partnerships on environmental collaboration and performance.

In addition, the GPHA and for that matter the Port of Tema shall ensure that:

- Every effort is made to reduce waste generated from port operations;
- All wastes generated are collected and disposed of in an environmentally responsible manner and in compliance with appropriate national legislation;

- Facilities are available in the port for the reception and treatment of ship waste and other waste generated from its operations;
- All licensed port operators and contractors working in the port undertake their operations in full compliance with appropriate national legislation on the protection and sustainable use of the environment;
- Good housekeeping practices are observed by all port workers, licensed port operators, users of the port facilities;
- Every effort is made to ensure that all workplaces minimize spillages of substances that are hazardous to the environment;
- No form of waste or pollutant is disposed of into the harbour basin;
- Vehicles and all powered industrial trucks e.g. forklift trucks, mobile cranes tractors, etc. that emit excessive smoke and/ or spill oil are prohibited from working in the Port;
- The emission of dust and hazardous chemical into the atmosphere are monitored and controlled to prevent any environmental emergencies;
- The cost of polluting the environment are transferred and directly recovered from the polluter. Consequently, all licensed port operators and contractors shall be responsible for cleaning the place of work after work. Shore operators shall also be responsible for the cleaning and maintenance of the environmental hygiene of the terminals and other areas leased to them for their operations;
- Licensed port operators and contractors practice responsible and environmentally sound port operations; and
- Industries located in the precincts of the port adopt and practice sound environmental management practices.

#### Occupational Health and Safety Policy

At the Port of Tema, the Authority's policy on Occupational Health and Safety Administration shall be applied. Thus, the Port of Tema will lead the drive for improvement in the occupational health of all persons employed to work in the port, whether or not they are employees of GPHA.

It will institute measures that make it mandatory for all licensed port operators, vessel operators, contractors, suppliers, and visitors on its premises to comply with its occupational health and safety regulations and standards. In this regard, the Port of Tema shall institute appropriate measures to:

- Mobilize Port workers for active involvement and participation in occupational health education programmes and activities;
- Reduce or eliminate occupational related diseases and personal accidents through education, training, enforcement of rules and regulations;
- Conduct medical examination on every one of its own employees at the time of entry into employment to determine their medical condition and fitness;
- Conduct routine and curative medical examinations on every one of its own employees during employment to monitor their medical condition and fitness;
- Conduct medical examinations on every employee at the time of exit to ascertain their medical conditions and fitness for post- service care;
- Educate all port workers on the risks and dangers of HIV/AIDS. As part of this, the Authority shall set up Peer Education Programme Unit to be responsible for HIV/AIDS education and counselling for port workers infected and affected by HIV/AIDS; and



- The HIV/AIDS Peer Education Programme Unit shall adequately be resourced and supported to achieve its objectives

### ***10.2.2 Adoption of Environmental and Social Management System***

Tema LNG Terminal recognizes that protecting its environment is critical to the sustenance of the Project and the Port in general. It is therefore committed to engaging in environmentally conscious practices in its development and operations. Tema LNG Terminal, in collaboration with GPHA, shall develop environmental, health and safety policies to guide the sustainable implementation of the project. It will formulate standard procedures for all its operations from construction phase to the different operational phase activities. The standard operational procedures will serve to guide the workers in their daily activities and serve as a training manual for employees and will ensure compliance with all relevant environmental conventions and legislations aimed at avoiding or minimising adverse impacts to water, air and soil, and ensuring worker health and safety as well as community health safety and security.

Tema LNG Terminal Company Limited in collaboration with GPHA will establish and maintain an Environmental and Social Management System (ESMS) as appropriate to its scale of operations and level of its environmental and social risks and impacts. The ESMS to be put in place will conform to good international industry practice and will incorporate the following elements:

- Tema LNG Terminal Company policies;
- Identified risks and impacts;
- Management programs;
- Organisational capacity and competencies;
- Emergency preparedness and response;
- Stakeholder engagement and grievance redress; and
- Monitoring and reviews.

### ***10.2.3 Development of Specific Environmental and Social Management Plans***

Tema LNG Terminal will develop specific Environmental and Social Management Plans to help address specific environmental and social issues, risks and impacts related to its activities during both construction and operational phases. The specific ESMPs to be developed will conform to good international industry practice and will cover the following:

- Livelihood Improvement Plan for the Project affected persons (PAPs);
- Labour Influx Management;
- Biodiversity Management Plan;
- Construction E&S Management Plan;
- Community Health and Safety Plan;
- Cultural Heritage, Chance Finds Procedures;
- E&S Monitoring plan;
- Health & Safety Management Plan;
- Stormwater Management Plan (Onshore);
- Water Quality Management Plan;

- Dredging Management Plan;
- Waste Management Plan;
- Stakeholder Engagement Plan;
- Traffic Management Plan; and
- Incident Notification Plan.

#### ***10.2.4 Technical Co-operation***

The Tema LNG Terminal shall ensure it maintains a close linkage with the Port of Tema and other Ports in the sub-region and elsewhere, which will provide opportunity to source any good environmental practice for its benefit.

#### ***10.2.5 Staff Information and Awareness Creation***

The General Manager through the QHSE/permitting manager will make available all operational manuals needed by staff and organize on the job training programs for staff. Management is aware that a well-informed and educated will contribute greatly towards environmental management through the judicious use of resources and the prevention of accidents that might damage equipment, personnel and the environment.

The objective of the EMP will only be achieved if every worker is adequately informed on the impacts or effects of the activities or operations of the system on the environment. The company will ensure that personnel to be engaged on the various project activities are educated and well sensitized on environmental issues arising from its operations and activities. This will be done through series of scheduled meetings, seminars and workshops.

#### ***10.2.6 Public Participation and Community Engagement***

It is the desire of Management that the public will appreciate the on-going environmental changes at the port and along the pipeline routes and would be able to adjust accordingly. Management will consider suggestions, advice from all stakeholders, its contractors, subcontractors, visitors, and the public/local communities, which will help improve its operations in order to minimise impact on the environment, the public and worker health and safety.

The company will implement a stakeholder engagement plan to periodically share project information with the local communities and relevant stakeholders. The project manager will ensure that information is available to the public and appropriate channels are created for complaints reporting and suggestions.

#### ***10.2.7 Construction and Operational Phases Impact Mitigation Action Plan***

The impact mitigation action plan for the construction and operational phases of the project are provided in **Table 10-2**. About **GHC515,700** excluding some cost embedded in the contractor bill of quantities (BoQ) will be required to implement the construction phase mitigation actions.

**Table 10-2: Construction and Operational Phases Impact Mitigation Action Plan**

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
Construction Phase							
Air Quality Deterioration	Minimize dust emissions by using designated routes in order to minimize impacts.	VOCs, Noxious gases (NOx, COx, SOx), and particulate matter (PM10 and TSP)	Quarterly	EPC Contractor	Supervising Engineers	Tema LNG	-
	Dampen unpaved sections during construction with water						5,000.00
	Limit vehicular speed to 30mph on unpaved routes to minimise dust generation						-
	Regulate material dumping to reduce dust emissions						-
	Maintain and service construction equipment and vehicles in line with manufacturer’s recommendation						Part of contractor equipment maintenance cost
	Investigate dust-related grievances from the public	Dust related complaints	As and when	Contractor/ Supervising Engineers	Tema LNG	Tema LNG	5,000.00
Vibration and noise nuisance	Employ standard noise abatement measures and engineering best practices	Sound levels in dBA	Quarterly	EPC Contractor	Supervising Engineers	Tema LNG	10,000.00
	Phase out the earthworks and other construction activities to reduce noise generation.						-
	Operate and maintain all equipment in accordance with equipment standards including specifications for noise levels and manufacturer’s specifications.						Part of equipment maintenance cost
	Shut down machines in intermittent use in the intervening periods between works or throttled down to a minimum						-
	Monitor marine mammal/ sea turtle observation to observe any appearance	Marine mammals/ sea turtles	Weekly	EPC Contractor	Supervising Engineers	Tema LNG	10,000.00

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	of such animals along the coast/shoreline or in the waters during dredging and major offshore construction activities.						
	If sea turtles are observed especially during the evenings/night, note the time and inform the Wildlife Division (which is in charge of protected species) in Accra for their recommendations					Tema LNG/ Wildlife Division	-
	During piling activities, commence with reduced noise level to allow fishes to move away from the area before increasing the noise					Tema LNG/ GPHA	-
	Reduce underwater noise levels associated with percussive piling by the following: <ul style="list-style-type: none"> <li>○ Use quieter hydraulic hammers instead of the noisier diesel hammers;</li> <li>• Ensure Acoustic decoupling of noisy equipment on work barges.eg. Use a soft sling to retain the pile driving hammer, rubber-tired air compressor for bubble jacket/curtain, rubber pads on barge leaders and guides, and an air curtain around the pile barge</li> </ul>					Tema LNG/ GPHA	-
Loss of vegetation and impacts on flora and fauna	Conduct a pre-clearing survey of the flora to be impacted especially if construction will be carried out in the rainy season to identify sensitive vegetation with active nesting.	Area of land cleared or disturbed outside authorization(m <sup>2</sup> )	Weekly	EPC Contractor	Supervising Engineers	Tema LNG	7,000.00

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Develop construction code of practice to avoid critical areas such as the remaining mangrove swamps along the Chemu stream/lagoon.						-
	Allow an appropriate buffer distance between any construction activity and remnant native vegetation, where practicable.						-
	Limit construction activities to only designated places and clearly mark out all vegetation which will not be cleared as “no-go areas” to construction staff and vehicles.						-
	Dismantle and remove all equipment and machinery after construction from site.						Part of Contractor BoQ
	Rehabilitate trenches and disturbed areas as soon as possible						Part of Contractor BoQ
Sanitation/Waste Generation concerns	<b><u>General Waste</u></b> Appoint a waste management coordinator to prepare and implement a Waste Management Plan which specifies procedures and, incorporates existing waste management plan for the Tema Port.	-Metallic wastes -Garbage -Waste oil -Hazardous waste  - Construction Spoil	Daily	EPC Contractor/ Selected Contractors	Supervising Engineers	Tema LNG	Part of Contractor BoQ
	Engage a private waste management firm to collect and dispose of waste						7,000.00
	Provide adequate waste bins at the work camps and workplaces to minimise littering.						3,000.00
	Implement good site practices and housekeeping						-
	<b><u>Construction Waste</u></b>	Disposal sites selected	As and when required	EPC Contractor	Supervising Engineers	Tema LNG	Part of EPC contractor BoQ

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Dispose all scraps or other solid wastes at the approved disposal site of TMA						
	Reuse excavated soils/concrete as much as possible for backfilling trenches if possible						-
	Dispose of contaminated soil at the Kpone Landfill Site						Part of EPC contractor BoQ
	<b><u>Hazardous Waste</u></b> Temporary store all hazardous waste (e.g. oily waste) generated during construction/installation per manufacturer's instructions.	Storage facilities for hazardous wastes	As and when required	EPC Contractor	Supervising Engineers	Tema LNG	2,000.00
	Engage EPA approved hazardous waste collectors/existing hazardous waste collectors at the Port for collection and disposal of all hazardous waste.	Hazardous waste collection firm engaged					5,000.00
	<b><u>Dredged material</u></b> Develop a detailed dredge management plan to guide the dredging and disposal of dredged materials.	_ Dredge Management Plan -Permits and necessary Approvals for dumping dredge material  -Waste management plans  -Waste Storage bins	Weekly during dredging phase	EPC Contractor	Supervising Engineers	Tema LNG	Part of EPC contractor BoQ
	Dump dredged materials offshore after acquiring the necessary approvals from GPHA and GMA						
	Instruct construction workers not to dispose or dump any kind of waste into the marine waters						-
	Provide and waste storage bins at conspicuous locations						1,000.00
Labour influx issues	Develop and implement labour influx management plan	Labour influx management plan in place	As provided in the labour influx management plan	Tema LNG/ EPC Contractor	Tema LNG	Tema LNG/ TMA	20,000
	<b><u>Adoption of Health and Safety Policies</u></b>	Health and Safety Policies and	Daily	EPC Contractor		Tema LNG/ GPHA (only	Part of EPC Contractor BoQ

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
Occupational Health and Safety Concerns and Labour Issues	Prepare and implement health, safety and environmental protection at the workplace to guide the construction activities in compliance with the policy of GPHA.	Procedures in line with international and national laws in place  Contractor OHSP in place and workers educated on the Plan			Supervising Engineers/ Tema LNG	within the Port)	
	Conduct activities in the Port in accordance with relevant national and international laws and regulations on occupational health and safety.						
	<b><u>The Contractors OHSP</u></b> Develop an Occupational Health and Safety Plan to international standards, including requirements for PPE, task risk assessment, mandatory training, audit and monitoring, incident reporting etc.						
	Apply the hazard hierarchy when planning work to avoid/eliminate risks and reduce risk to as low as reasonably practical						
	Educate workers on the health and safety policy/ plan.						
	Train selected workers as first aid givers and provide adequate first aid kits at the construction areas. Refer major cases to GPHA clinic /Tema General Hospital.						
	<b><u>Use of Experienced Personnel</u></b> Engage well trained workers for the various construction roles.	Qualification of workers and drivers specified					
	Only drivers with the requisite licenses will handle vehicles and earth-moving equipment into the port						

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Test and train all new drivers, operators and other field workers in machine/ equipment handling and safe working procedures.	Training/testing program for new drivers					5,000.00
	Organize regular defensive driving training sessions for drivers to ensure their safety and the safety of the general public	Number of defensive driving trainings organised					5,000.00
	<b><u>Provision of Personal Protective Equipment (PPE)</u></b> Provide workers with appropriate personal protective equipment such as safety boots and coats, hand gloves, earplugs and nose masks etc.	PPEs in use					Daily
	Supervisors should be mandated to ensure the use of these protective devices and implement sanctions when necessary.						
	<b><u>Phasing out of Material Movements/ Scheduling Material Movements</u></b> Carry out movement of tanks, pipes and other construction materials to site or storage areas in phases and control the number of cargo vehicles coming into the project site at any given time to reduce the risk of accidents.	Construction material movement schedule	Weekly	EPC Contractor	Supervising Engineers	Tema LNG	-
	Plan material movement with GPHA activities to minimize impacts within the Port.			EPC Contractor	Supervising Engineers/ Tema LNG	Tema LNG	-
Transport materials and equipment to the sites during off peak periods.	-						



Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	<b><u>Use of Equipment</u></b> Ensure all equipment’s to be used are in good condition with scheduled regular maintenance to reduce/minimize of accidents	Equipment maintenance schedule					Part of contractor BoQ
	<b><u>Worker Rights and Wellbeing</u></b> Develop and implement a Human Resource Policy and Plan that adheres to the requirements of IFC PS2 and AfDB OS 5.	Human Resources Policy in place	As and when required				Part of EPC contractor BoQ
Public Health and Safety and Security Impacts	<b><u>Restriction of Access</u></b> Maintain security at the proposed Port site to ensure that only authorized persons are allowed into the construction area.	-Human and vehicular traffic -Port related road accidents/ incidents -Public complaints -Records on training of security personnel -Records of human rights abuses -Records to show that security providers have been vetted	Daily	EPC Contractor/ GPHA	Supervising Engineer	Tema LNG/ GPHA	
	Train security personnel to respect the human rights of the local people						
	Use IFC PS4 as the standard in relation to hiring, training and monitoring of security personnel						
	<b><u>Pipeline Design and Depth</u></b> Construct the pipeline from carbon steel and externally coat it for corrosion protection to minimize damage.					Tema LNG	
	Lay pipeline to a minimum depth of 1m (yet to be confirmed by the final designs) to minimize the risk of exposure through soil erosion						
	Adhere to restrictions to RoW usage						

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	<b><u>Provision of temporary crossings over trenches</u></b> The pipeline contractor will be required to provide temporary crossings over trenches at the Abonkor community section to enable pedestrians or residents to easily cross over open trenches crossing their footpaths	Temporary crossings provided	Weekly	EPC Contractor	Supervising Engineers	Tema LNG	200.00
	<b><u>Public Health /Toilet facilities</u></b> Provide mobile toilet facilities for workers during construction of the pipeline route	Mobile toilet facilities provided	Daily	EPC Contractor	Supervising Engineer	Tema LNG	20,000
	Liaise with TMA to prevent open defecation by the communities by promoting “toilet at half price” as part of the access to improve sanitation project under the GAMASWAP.	TMA engaged on options for Community toilet facilities	Quarterly	EPC Contractor/ Tema LNG	Tema LNG		
	Liaise with TMA to access the option of providing a toilet facility for Abonkor and Manhean suburbs near the Valco fence wall for use to prevent open defecation.						
	<b><u>Use of warning signs</u></b> Protect uncovered trenches or deep excavations using indicator linings or illustrative warning notices or wire mesh (whichever best suits the situation) to prevent fall hazards.	Warning signs in place	Daily	EPC Contractor	Supervising Engineers	Tema LNG	Part of contractor BoQ
	Cover all trenches and excavation as soon as possible	Trenches not left uncovered over 48 hours					
	Place caution/warning signs at vantage points around the project site						
	<b><u>Scheduling of Work</u></b>	Schedule for					-

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods	works in place		Tema LNG	Tema LNG	Tema LNG/ TMA/ TDC	2,000.00
	<b><u>Announcement and Notification of Work</u></b> Inform the TMA and TDC at least seven days before start of work on onshore pipelines.	Announcement and notification schedule in place					
	Inform all port users of the schedule of work through their respective organizations						
	Make announcements and give notices for work schedule on affected roads through local FM stations, Assemblymen as well as Unit Committee leaders						
	<b><u>Transport of Equipment and Materials</u></b> Limit traffic impacts resulting from carting of equipment and materials (e.g. quarry materials) to the oil jetty site from local quarry sites to the Harbour roads.						
	Manage traffic in line with the Traffic Management Plan to be prepared by the contractor						
	Prepare the traffic management plan in consultation with GPHA in order to minimise truck congestion at the port as a result of the ongoing port expansion project.						
	Employ flagmen to man all major intersections to assist with passage of trucks conveying materials and	Flagmen engaged					

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	equipment, on the route to the construction site and storage areas	Drivers with required license				Tema LNG	
	Engage drivers with the requisite driver's license as prescribed by the Drivers and Vehicles Licensing Authority (DVLA) and educate them on public safety issues.						
	Institute adequate traffic management measures to caution the public and to create safety awareness						
	Measures to be followed by the contractor in the transport of materials include the following:	Traffic Management Plan in place	Weekly				
	<ul style="list-style-type: none"> <li>○ Consult Department of Urban Roads (DUR) and MTTD for all temporary traffic controls.</li> <li>○ Limit haulage of materials including quarry products to the port area to off-peak hours;</li> <li>○ Cover trucks transporting quarry products and other friable materials to the port.</li> <li>○ Ensure all trucks conveying materials to the port carry appropriate warning signals;</li> <li>○ Use road worthy dump trucks</li> <li>○ Traffic wardens should monitor dump truck movements and ensure public and traffic safety;</li> <li>○ All trucks to adhere to speed limits of between 20-30 km/hour to the fishing harbour area.</li> </ul>						

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	<ul style="list-style-type: none"> <li>Tow trucks within 24 hours in the event truck failure along haulage routes.</li> </ul>						
Road crossing and traffic impact	Inform VALCO and have them agree to the date and time of crossing the road	-Communications with VALCO	As and when required	EPC Contractor	Supervising Engineer	Tema LNG	-
	Use thrust boring or appropriate technology as agreed with VALCO to cross the VALCO exclusive road to minimise or avoid delays in transport of people to and from the clinic	-Dissemination of project schedule to surrounding communities effected					20,000.00
	Inform the local communities of the schedule for the crossing of the untarred access road connecting Bankuman to the TOR area	-Adequate signs and notices for diversion routes provided					500.00
	Schedule all work such that crossing of the untarred access road is done when traffic is low to minimize inconvenience to motorists	-Reinstatement of damaged sections of roads effected					-
	Provide adequate signs and notices for diversion routes where the untarred access road has to be blocked for work to proceed smoothly						3,000.00
	Reinstate any damaged sections of the roads						15,000.00
Destruction of crops/farm, pigsty, loss of livelihood and access to land	Prepare and implement a livelihood improvement plan for project affected persons	-Livelihood improvement plan	Prior to commencement of construction	Tema LNG	Tema LNG	Tema LNG	120,000.00
	Pay appropriate compensation for affected standing crops and pigsty/pigpen at proven value	-Valuation of affected properties for compensation -Grievances Redress					
Under water blasting effects	Avoid underwater blasting as much as possible and consider other alternatives such as hammering.	Underwater blast management and	As and when required	EPC Contractor	Supervising Engineer/ Inspectorate	Tema LNG	To be part of EPC Contractor BoQ

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	In case of any underwater blasting, adhere to the details provided under the mitigation chapter.	monitoring plan in place			Division of the Minerals Commission/ Ghana Navy		
Marine water contamination/ impacts on aquatic organisms and biodiversity	<b><u>Dredging</u></b> Develop a Dredge Management Plan in line with the requirements of IFC EHS Guidelines for Ports Harbours and Terminals to guide the project. The plan should include sampling and monitoring of sediment and measures to address exceedances.	-Dredge Management Plan  -Marine mammal/sea turtle observance -Spill prevention Drills	Weekly	EPC Contractor	Supervising Engineers	Tema LNG/ GPHA	To be incorporated into Contractor BoQ
	Dredge in small sized enclosed areas at a time, protected with silt curtains, blasting mats, fine meshed films and other BMPs						
	Ensure that dredge cuts and lifts are designed such as to prevent undercutting of material at the cutterhead						
	Select the cutter head in accordance with the material to be dredged and to minimise spillage and maximise the transport of dredged material to the suction mouth						
	Ensure that the works cause no visible foam						
	Size all boats such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash						

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Contain all effluent from the dredger in a digester for some days (up to 3 days) to help bring down temperature to that of receiving water as well as settle any solids before release into the environment.	Oil spill prevention and control plan					
	Monitor marine mammal/ sea turtle observance during dredging to observe any appearance of such animals along the coast/ shoreline or in the waters						
	<b><u>Trenching</u></b> Restrict trenching times, particularly during periods of high wave/wind activity						
	Reduce turbidity and spill, design and implement a trenching management plan which is informed by geotechnical and geophysical knowledge of the pipeline route						
	Install appropriate silt curtains around offshore works						
	<b><u>Oil spills</u></b> Prepare a spill prevention and control plan, incorporating measures outlined in the emergency response plan of GPHA, to minimize increased turbidity and surface pollution through oil spills.						
	<b><u>Movement of ships</u></b> Ensure the dedicated navigation route is used by ships/fishers to move in and out of the port	-	-	GPHA	GPHA/Tema LNG	GPHA/Tema LNG	-

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
General Disturbance of Port Operations	Indulge the assistance of the Harbour master, GMA as well as representative bodies of the port users to ensure that construction activities are scheduled so that port operations are not unduly interrupted.	-Schedule of construction activities with port activities -Dissemination of Information	Weekly during dredging	EPC Contractor/ GPHA	Supervising Engineers/ GPHA	Tema LNG/ GPHA	-
	The harbor master to ensure that all passing vessels are well informed of construction work, e.g. dredging, piling etc., and are cautious when moving in and out of the port facility						
Sub-total							515,700.00
Operations/ Maintenance Phase							
Contamination of Marine Environment	<b><u>Specific measures</u></b> The terminal operator to ensure regular maintenance of the sewage treatment plant, manhole for runoff clarification and coalescence separator for the treatment of runoff in areas where fuels and light liquids are handled (e.g. fuel station, workshop).	-Maintenance program for sewage treatment plant	Quarterly	Terminal operator	GPHA/ Tema LNG	Tema LNG	To be part of the operation and maintenance cost for the terminal
	The terminal operator to ensure that the waste reception facilities for the collection, storage, treatment and transfer of waste at the port are utilized by the gas delivering vessels arriving at the port.	Waste receptacles available at the port	Monthly				
	Install filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps etc) where necessary to prevent sediment and particulates from reaching the port water	Filter mechanisms installed					



Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	The terminal operator should ensure regular inspection of storm water drains to remove settled materials to avoid blockage and ensure proper discharge in the drainage systems	Settled materials in stormwater drains	Weekly				
	<b>General measures</b> The terminal operator to ensure that the likelihood of oil spills is reduced to the barest minimum through regular monitoring and audits of vessels being used	Monitoring and audit reports	Quarterly				
	Implement oil spill contingency plan when required to promptly clean up oil spills and avoid contamination of the marine environment.	Incidence of oil spills and number of times contingency plan has been activated	As and when required	Terminal Operator/ GPHA	GPHA/ Tema LNG	Tema LNG	20,000.00
	Utilize GPHAs Port community network, which brings together major stakeholders that impact on operations in the Port to ensure pollution of the marine environment is quelled.	Engagement with port community network	Annually				
	Enforce punitive measures for all persons observed to throw waste into the port waters	Punitive measures in place	As and when required	Terminal operator	Terminal Operator/ GPHA	Tema LNG	-
	Intensify education of port users on the polluter pays principle which is in place to increase awareness.	Polluter pays principle in place	Annually	GPHA	GPHA	Tema LNG	5,000.00
	Terminal operator to incorporate the Air Quality Management Plan (see details under mitigation chapter) into standard operations.	Air Quality Management Plan in place	Quarterly	Terminal operator	Terminal operator/ GPHA	Tema LNG/ GPHA	10,000.00
Air Pollution							

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		Part of operational cost of terminal
	<p>Regularly maintain machinery/equipment in accordance with manufacturer specifications to ensure minimum levels of emission from the terminal operations</p> <p>Maintain stable tank pressure and vapour space by coordinating filling and withdrawal schedules (offshore)</p>	Equipment maintenance schedule in place					
Waste Management	<p><u>Education campaigns</u></p> <p>The terminal operator to ensure proper management and disposal of waste generated and educate workers on its waste management plan.</p>	-Waste Management Plan	Weekly	Terminal operator	Terminal operator/ GPHA	Tema LNG/ GPHA	To be incorporated in the operation and maintenance cost for the terminals
	<p><u>Waste Collection and Disposal</u></p> <p>The terminal operator to appoint a waste management coordinator to prepare and implement a Waste Management Plan which specifies procedures and, incorporates the existing waste management plan for the Tema Port.</p>	Waste management coordinator in place					
	Segregate waste in different containers or skip to enhance recycling of material and proper disposal of waste.	-Segregated waste bins at vantage points					
	Store, handle and dispose of chemical waste in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes						
	Transfer all collected waste to the Port Waste Reception and Treatment Facilities						
Noise Nuisance	The terminal operators to ensure that silent equipment (low noise versions are	Sound levels in dBA	Annually		Terminal operator/ GPHA	GPHA/ Tema LNG	Incorporated in the operation and

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	used for the terminal operations. Additionally, use silencers, mufflers and other appropriate engineering control devices on the noise generating equipment. Where possible, use electrical instead of diesel or diesel-electric moving equipment.			Terminal operator/ GPHA			maintenance cost for the terminals
	Reduce noise levels through optimizing the terminal layout					Tema LNG	-
	Conduct regular site inspections to audit the compliance with regard to noise control						10,000.00
	Provide appropriate PPEs for workers use						-
Occupational Health and Safety Concerns and Labour Issues	<u>Training in equipment and chemical handling</u> Conduct risk assessments and avoid / eliminate hazards to reduce the need for manual handling of chemicals.	Risk assessment checklist	As and when required	Terminal operator	Terminal operator/ GPHA	Tema LNG	15,000.00
	Ensure that workers handling fuels, chemicals, machinery and equipment are well trained. Provide such workers with the necessary documentations including Material Safety Data Sheet (MSDS)) to serve as reference sources on the dangers and ways of handling these chemicals, fuels etc.	Workers training program and MSDS made available	Annually				10,000.00
	<u>Provision of appropriate PPEs</u> The terminal operator to provide workers with adequate personal protective equipment including overalls, earplugs, overalls and anticorrosive gloves etc. as their respective operations would require.	PPEs in use	Daily				100,000.00

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		To be incorporated in the operation and maintenance cost for the port
	Provide non-conductive hand tools rated for the voltage at which live electrical work is being performed at the substation	Non-conductive hand tools made available	As and when required				
	Provide caution/warning signs at vantage points around the site.	Warning signs in place	Daily				
	<u>Preventive Measures</u> The terminal operator to prepare comprehensive maintenance measures/actions (see details under mitigation chapter) on commencement of operations to put in place measures to avert any serious breakdowns or failures.	- Scheduled maintenance program in place	-				
	<u>Emergency Provisions</u> The terminal operators to implement its emergency response plan that incorporates GPHA emergency response plan as well	Emergency response plan in place	As and when required				
	Management to conduct a triennial review of the plan	Review schedule in place					
	<u>Housekeeping</u> Ensure good housekeeping practices						
Public Health, Safety and security	Organise, in collaboration with Tema Metropolitan Assembly and the GPHA Port Health Department, awareness creation seminars and educational programmes for all workers and the general public on the behavioural changes required to prevent the spread of HIV/AIDS and other STDs.	-Number of engagements or sensitisation programmes organised	Annually	Terminal operator/ GPHA	Terminal operator/ Tema LNG	Tema LNG	15,000.00

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	The operations of the terminal should incorporate a scheduled inspection, monitoring and maintenance regime to avoid accidents.	Scheduled inspection, maintenance and monitoring program in place					Part of operational and maintenance cost of terminal
	Collaborate with GPHA security personnel to maintain security of the facilities within the Port environment to ensure that only authorised persons have access to the facilities	Evidence of collaboration with GPHA security					
	Engage private security firms and involve key local community members in maintaining security of the pipeline facilities.	Private security firm and community members engaged for security services					
	Hire the security firm and key community members and train them to comply with IFC PS4 requirements and to respect human rights of the local people to avoid conflicts and human right abuses	Protocol for community reporting in place					
	Define a protocol for community reporting of observed incidents (e.g. sight, smell or sound of pipeline leaks and procedures for community grievance redress mechanism.	Emergency preparedness and response plan in place					
	Identify emergency scenarios and develop emergency preparedness and response plans with allocation of responsibilities to local communities and authorities, (where appropriate)	Safety awareness program in place					
	Continue safety awareness and education programs for impacted communities						
	Develop clear guidelines on the acceptable level of public access and	Guidelines for access and use of					

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	activity along the RoW pipeline for safety and integrity, and ensure that this is enforced to help avoid encroachment and other potentially dangerous activities	RoW and community sensitization program in place					
	Carry out community awareness /sensitization on the above guidelines to be developed regarding public access/use restrictions and safety to prevent encroachment of RoW over time with potential to compromise safety of pipeline and safety of people in the event of accident.						15,000.00
Accidental Events and impacts on nearby properties, marine/terrestrial ecology	Tema LNG to develop and implement an emergency preparedness and response plan in collaboration with relevant stakeholders including GPHA, GPMS, Valco, Gridco, and WAPCo as appropriate.	-Emergency preparedness and response plan in place	Triennially	Terminal operator/ GPHA	Terminal Operator/ GPHA	Tema LNG	To be part of the operational cost for the terminal
Introduction of Invasive Marine Pest Species	<u>Ballast water</u> Ensure extensive dissemination of information on Ballast water management as prescribed in the International Convention for the Control and Management of Ships Consider targeted maintenance of areas where biofouling accumulates is appropriate if in-water inspection of ships is required.	Ballast water management plan  -Biofouling management plan	As prescribed in the plans	Terminal operator/ GPHA	Terminal operator/ GPHA	Tema LNG/GPHA	Incorporated in the operation and maintenance cost for the terminal/ gas delivering vessels
	<u>Ballast Water and Sediments.</u> <u>Biofouling</u> Train and educate of ship masters and crew members regarding the risks						

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
General Disturbance of Port Operations	Continue to rely on port operation procedures such as slow approach and departure speeds and tug escort for certain vessels to limit the risk of collision	-	-	Terminal operator/ GPHA	Terminal Operator /GPHA	Tema LNG/ GPHA	As part of the operational cost for the terminal
	Ensure that the extension of the breakwater correspondingly shifts the turn further away from the harbour entrance, thus creating a greater distance between the LNG facility and the turn for moving vessels						
	Aim to maximize clearance of LNGC during STS transfer to FSU for passing vessels to allow a safe clearance of at least 100-150 m from the traffic lane						
Sustainability of the Tema LNG Terminal Project	Implement a system to collect appropriate user charges to cover the running and maintenance cost of facilities.	-Sustainable user charges determined	Quarterly	Terminal operator	Terminal operator/ Tema LNG Terminal	Tema LNG	As part of the operational cost for the terminal
	Develop and implement an emergency response plan to handle all emergencies including fire, and oil spills that will arise from operations to minimize any hazards to humans and the environment	Emergency response plan in place with a scheduled review plan	Every three years				
	Ensure triennial review of the plan						
	Provide a comprehensive maintenance programme (see details under the Mitigation Chapter) to avert any serious breakdowns or failures or accidents.	Schedule maintenance program in place					

Anticipated Environmental & Social Impacts	Mitigation and Management Actions	Monitoring Indicators	Monitoring Frequency	Responsibility		Verification	Mitigation Cost (GH¢) Annum
				Mitigation Actions	Monitoring		
	Coordinate with other agencies and organizations to provide technical assistance to inform activities and programs that can support the project	-					
	Ensure resource use efficiency influencing supply chain sustainability						
	Adopt a comprehensive monitoring plan to ensure effective implementation of mitigation and management measures	Resource use efficiency determined					
		Terminal and pipeline monitoring plans in place					
<b>Sub-total (operational phase)</b>							<b>200,000.00</b>
<b>Total</b>							<b>715,700.00</b>



### ***10.2.8 Environmental Monitoring Programme***

Comprehensive monitoring programmes will be developed based on the monitoring plan provided in **Table 10-3** for relevant environmental and social monitoring parameters. The monitoring programme shall also be in accordance to the directives of the EPA in the environmental permit conditions.

#### ***10.2.8.1 Responsibility for Environmental Monitoring Programme***

The responsibility for implementation of the Environmental Monitoring Programme during the Construction Phase is the EPC Contractor. Tema LNG terminal will ensure the monitoring activities are carried out to acceptable standards through the project's engineering consultants and Managers. The EPC Contractor will be required to assign an officer responsible for implementation of the Health, Safety and Environmental considerations, including the EMP and other lending covenants.

The Terminal Operators have the primary responsibility for environmental monitoring during the project operational phase. They will be supervised by the GPHA in collaboration with the Ghana EPA.

Although the responsibility for implementation of the monitoring programme will be devolved to the contractors (during the construction phase) and terminal operators (during the operational phase), the contractor shall be required to prepare a Site-Specific Dredging Management Plan. The Contractor's Site-Specific Dredging Management Plan shall describe the resources allocated to and the responsible personnel for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities will be.

#### ***10.2.8.2 Summary of Environmental Monitoring Programme***

The environmental and social monitoring programme proposed for the construction and operational phase of Tema LNG terminal are presented in **Table 10-3**.

**Table 10-3: Environmental monitoring programme**

Environmental component	Parameters to be monitored	Monitoring Sites	Methodology/ standards	Frequency/ Responsibility	Estimated cost/ annum (GH¢)
<b>Construction Phase</b>					
Noise Levels	Sound levels in dBA	Tema Port at established Sampling Points	Noise Level Data Logger /EPA guidelines	Quarterly /EPC contractor /EHS Officer	15,000.00
Air quality	VOCs, Noxious gases (NO <sub>x</sub> , CO <sub>x</sub> , SO <sub>x</sub> ), and particulate matter (PM <sub>10</sub> and TSP)	Tema Port at established Sampling Points	HiVol Sampler and Draeger Tubes/ EPA guidelines	Quarterly /EPC contractor /HSE Officer	
Loss of vegetation and impacts on flora and fauna	Area of land cleared or disturbed outside authorization(m <sup>2</sup> )	Pipeline route to header station	Field Observations and measurements.	Weekly / Contractor /EHS Officer	-
Water quality	General physicochemical parameters including Oil/grease and trace metals	Port basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/Contractor /EHS Officer	16,000.00
Sediment quality	General physicochemical parameters, heavy metals (V, Cu, Zn, Pb, Mn, Fe and Cd)	Port basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA or internationally accepted guidelines, e.g. CEQG	Quarterly/Contractor /EHS Officer	24,000.00
Invertebrate biota	Mollusc and crustacean	Harbour area at specified locations	field work and laboratory analysis	Quarterly/Contractor /EHS Officer	11,000.00
Port area and Coastline (eastwards)	Marine mammals/ sea turtles	From Fishing harbour through landing beach to Gao lagoon	Field inspections/ observations	Weekly	-
Rate of shore recession at down-drift areas and material accretion upstream	Physical inspection of accretion and erosion of windward and leeward areas of the port respectively	Area around the port basin	Physical inspections and reporting	Biannually/	8,000.00

<b>Environmental component</b>	<b>Parameters to be monitored</b>	<b>Monitoring Sites</b>	<b>Methodology/ standards</b>	<b>Frequency/ Responsibility</b>	<b>Estimated cost/ annum (GH¢)</b>
Sanitation /Waste generation Concerns	-Metallic wastes -Garbage -Waste oil -Hazardous waste -Dredged material - Construction Spoil	-Port basin -Along the pipeline routes,	Record quantity and type of waste generated. Inspect quantity of waste. -Inspect quantities and conditions of waste bins Keep records of time and place of final disposal -Assessment of KPIs	Daily /EHS Officer Contractor	25,000.00
Occupational Health and Safety concerns and Labour issues	-Type, frequency and cause of injuries /accidents -Availability /Use of Personal protective gears (Life jackets, Safety boots, gloves, earplug, Helmet etc.) -Occupational health and safety training records -Worker grievance mechanism records -Records of worker contracts and payments.	Harbour area, Pipeline route, header station	Observation, audits, complaint/ incident records/ Safety Policy of GPHA/Safety Policy of Contractor /Local Labour Laws/ IFC PS2	-Daily-Contractor /EHS Officer -Quarterly Daily /Quarterly	40,000.00
Public Health and Safety and security	-Human and vehicular traffic -Port related road accidents/ incidents -Public complaints, Type and nature of complaints and concerns -Records on training of security personnel -Records of human rights abuses -Records to show that security providers have been vetted.	Harbour area/ communities along pipeline route	Observations and complaints/incidents records/ Safety Policy of GPHA/Contractor Records of grievances and implemented actions Stakeholder meetings IFC PS4 requirements	-Daily –EHS officer	5,000.00
<b>Operations Phase</b>					

<b>Environmental component</b>	<b>Parameters to be monitored</b>	<b>Monitoring Sites</b>	<b>Methodology/ standards</b>	<b>Frequency/ Responsibility</b>	<b>Estimated cost/ annum (GH¢)</b>
Air quality	VOCs, Noxious gases (NO <sub>x</sub> , CO <sub>x</sub> , SO <sub>x</sub> ), and particulate matter (PM <sub>10</sub> and TSP	Tema Port at established Sampling Points	HiVol Sampler and Draegger Tubes/ EPA guidelines	Quarterly/ QHSE officer	15,000.00
Contamination of marine environment	-Heavy metals (V, Cu, Zn, Pb, Mn, Fe and Cd),	Port basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines/ CEQG	Quarterly/QHSE officer	26,000.00
Invasive marine species	Marine ecology (Mollusc and crustacean)	Port basin	field work and laboratory analysis	Annually /QHSE officer	6,000.00
Occupational Health and Safety Concerns and Labour Issues	Type and frequency of injuries /accidents/incidents /near misses -Availability /Use of PPE's -EHS Training programmes -Scheduled monitoring and maintenance work -Worker grievance mechanism records -Records of worker contracts and payments. -Worker training records.	FSU, FRU, Header station	Observation, audits, complaint/ incident records/ Safety Policy of GPHA/ Tema LNG Terminal/Local Labour Laws/ IFC PS 2 requirements.	Continuous / QHSE Officer -Quarterly -Quarterly	25,000.00
Pipeline	-Erosion along pipeline route -Safety and security threats	Pipeline corridor	Field inspections	Quarterly	4,000.00
Corporate Social Engagement	-Number of engagements or sensitisation programmes organised -Grievances received and resolved. -Development benefits provided to local communities	Local communities/ general public	Corporate social responsibility policy of Tema LNG Terminal Company	Annually	20,000.00
<b>TOTAL</b>					<b>240,000.00</b>

### ***10.2.9 Pipeline Monitoring and Management***

#### **Construction Phase**

During the construction phase, the EPA, TMA, TDC, Valco and the Energy Commission will be involved in the periodic monitoring of the construction activities to ensure that the RoW is complied with and PAPs are adequately compensated or taken care of. The EPC Contractor will directly be supervised by the Engineering Consultant to be selected by Tema LNG Terminal. The EPC Contractor will be required to organize monthly meeting, in which the above key stakeholders will be represented.

#### **Operation Phase**

A pipeline integrity management system will be developed to ensure the safe operations of the pipeline. The integrity management plan will include weekly routine inspection and regular ROW surveys with hand held gas detection, cathodic protection surveys (close interval protection surveys and direct current voltage gradient surveys) as well as in-line inspection with intelligent pigs. The integrity management activities will be planned and scheduled in accordance with the guidance in ASME B31.8S for the onshore pipeline and DNF RP F116 for the subsea pipeline, as well as any conditions identified in the Energy Commission Operating Licensee.

### ***10.2.10 Audits and Reviews during Operation***

Environmental, health, safety and security audits and reviews will be conducted to assess the performance of the environment, health, safety and security policies and operational procedures implemented. The findings and recommendations of the audits will assist in correcting any lapses detected. The routine monitoring programme will form the basis for effective auditing and reviews and will inform the schedule for auditing and reviews. However, it is proposed that the auditing and reviews be carried out biannually or annually. The outcome of the audits and reviews will underpin the periodic update of the EMP of the proposed project.

Management will engage recognized firms (local or foreign) to carry out the periodic auditing of the facilities. Management will be responsible for the periodic reviews prior to environmental and safety management meetings.

### ***10.2.11 Capacity Building and Training***

Capacity building and training of key actors in the implementation of the project will be organized to enhance and develop their capabilities to successfully implement the Project in an environmentally sound and socially acceptable manner. The training will cover relevant components of the ESIA/ESMP/ESMS including the potential impacts/risks, mitigation and management measures, grievance redress mechanism, EPA permit schedules as well as the triggered AfDB and IFC Performance Standards for the project. The capacity building and training program is provided in **Table 10-4**.

**Table 10-4: Capacity Building and Training Program**

No.	Activity	Target Group/ Participants	Timeline/ Frequency	Proposed Facilitator	Estimated Cost/(GH¢)
CONSTRUCTION PHASE					
1.	Training Workshop on ESMP/ESMS, grievance redress mechanism, public health and safety issues, ESMP monitoring and reporting, EPA permit Schedule, AfDB operational safeguards, IFC PS	-TEMA LNG workers -EPC Contractor -Sub-Contractors	At the onset of Construction Phase	Tema LNG HSE Manager/ Environmental Consultant and or AfDB Safeguard Staff	20,000.00
2.	Health and Safety Policy/Plan training/ induction	Construction workers	Construction phase	Tema LNG HSE Manager/ EPC Contractor	10,000.00
3.	Security, safety and human rights training	Security personnel, drivers/operators	Construction phase	Tema LNG HSE Manager /EPC Contractor	8,000.00
4.	Site meetings to discuss and review ESHS issues and develop corrective actions	- EPC Contractor -Sub-Contractors -Tema LNG (HSE Team and Engineers) -GPHA representatives	Monthly	EPC Contractor and Tema LNG Project Manager	10,000.00
5.	Community sensitization on project, Environment/Social & Health/ Safety/ Security issues, grievance redress mechanism.	Affected project Communities	Annually during construction phase at Abonkor, Manhean and Bankuman	Tema LNG Terminal Company	20,000.00
6.	Sub-total (Construction Phase)				68,000.00
OPERATIONAL PHASE					
1.	Training Workshop on ESMP/ESMS, grievance redress mechanism, public health and safety issues, monitoring plans, EPA Permit Schedule, IFC Performance Standards /AfDB Operational Safeguards	-Tema LNG Terminal workers -Health and Safety and Environment (HSE) Officers -Security Coordinator	One-off training at the commencement of operations	Tema LNG Project Manager and HSE Manager/ Environmental Consultant	10,000.00

No.	Activity	Target Group/ Participants	Timeline/ Frequency	Proposed Facilitator	Estimated Cost/(GH¢)
2.	Environmental Health and Safety Trainings	Environmental, Health and Safety Representatives (EHSRs) -Environmental, Health and Safety Officers (EHSOs)	Annually	HSE Consultant or made to attend a refresher course	30,000.00
3.	Community sensitization on project, environmental and health & safety issues, grievance redress mechanism, field demonstrations on emergency response procedures	-Affected Project communities	Annually at Abonkor, Manhean and Bankuman	Tema LNG Terminal Site Manger and HSE Manager	20,000.00
4	Sub-total (Operational Phase)				60,000.00
TOTAL COST					128,000.00

### 10.2.12 Environmental Reporting

In order to comply with internal, statutory as well as international reporting obligations, periodic reporting will be done. Reports to be prepared to serve as sources of environmental and safety information for stakeholders will include:

- Production data – statutory requirements to the Energy Commission
- Quarterly Environmental Monitoring Returns – statutory requirement to EPA;
- Annual Environmental Reports – statutory requirement to EPA;
- Annual Environmental Audit Report – for in-house reporting; and
- Environmental Management Plan will be submitted within 24 months of commencement of operations and thereafter after every three years in line with the legislative instrument.

### 10.2.13 Document control and tracking

#### Documentation

The HSE Manager will keep records on all environmental and public health/safety data including, environmental emergencies. Environmental data will be kept in both electronic and hard copy formats. A format for documentation of information in electronic form will be developed to capture daily/weekly information on climate, environmental sampling/monitoring, environmental quality results, waste generation and disposal, environmental resource use (water, energy, raw materials, chemicals), environmental incidences and emergencies, training and awareness creation programmes such as workshops, seminars and meetings.

### Document Tracking and Control

Tema LNG Terminal Company will establish and maintain procedures to control all documents and permits that are required to ensure compliance and to make sure that:

- All documents and permits are easily traceable;
- All statutory documents are periodically reviewed, revised as necessary and approved as adequate by the relevant regulatory agency;
- All permits and approvals are renewed as and when necessary;
- Current versions of relevant documents or literature for workers use are available on site; and
- Any obsolete document or part of a document retained for legal and/or information preservation purposes is correctly labelled and identified.

Documentation will be legible, dated (with dates of revision) and readily identifiable, maintained in an orderly manner and retained for specified periods.

### ***10.2.14 Provisional Grievance Redress Mechanism***

The objective of the Grievance Redress Mechanism (GRM) is to provide an effective, transparent and timely system that would give aggrieved persons redress, minimize bad publicity, avoid/minimizes delays and avoid litigation in execution of the Tema LNG Terminal project. This ensures public health and safety, and sustainability of the project. The GRM will provide all affected stakeholders avenues through which they can express their concerns and receive the needed corrective actions in an appropriate and timely manner.

The projects manager will make public the GRM through public sensitization, particularly to the project affected persons and communities. This will be done in collaboration with the Tema Metropolitan Assembly. The sensitization on the GRM will be done in the local languages of the area in addition to English Language to enable all stakeholders understand the content. This will ensure that approaches, ways and contact information for all stages of the GRM are clearly spelt out.

The GRM will consist of a five-tier resolution arrangement as follows:

- Local (project site) level;
- Complaint lodged at Tema LNG Terminal Office;
- Metropolitan Assembly level grievance resolution;
- Ministry-level grievance resolution; and
- National legal level.

The general process is that a project affected person and/or other stakeholders should first raise a grievance at the project site office. If unresolved, it is referred to Local Corporate office. Beyond this level, the issue will be referred to the Grievance and Redress Committee (GRC). If this proves unsuccessful in resolving the grievance, the complainant may seek legal redress at the law court to resolve the issue. The levels of the GRM are explained as follows and summarized in **Figure 10-3**.



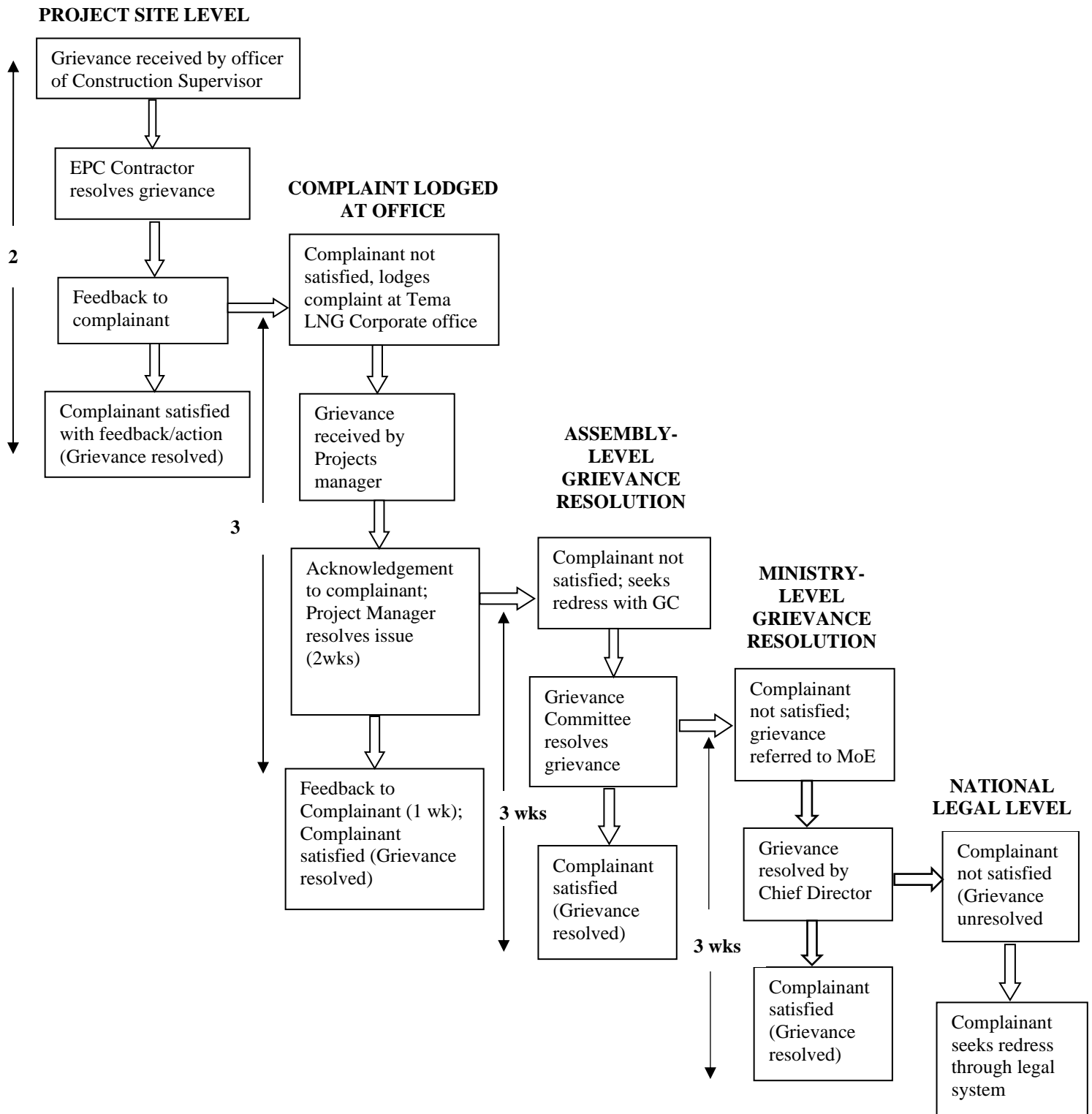


Figure 10-3: Proposed Grievance redress Mechanism Levels

### Local (project site) level

A complaint made to the project site office shall be received by an assigned officer from the Supervising engineer/. The procedure shall be as follows:

- A complaint form shall be filled, dated and signed, a copy of the same shall be deposited in the Supervising engineer's office and a copy sent to the EPC contractor.
- An acknowledgement of complaint form shall also be filled, signed and given to the complainant.

The contractor shall resolve the grievance or rectify the anomaly within two (2) weeks of receipt of complaint. The Contractor's monthly project report will contain the complaint, the solution proffered, and the results of follow-up to determine whether the complainant is satisfied with the outcome. The location shall also be listed as a site to be inspected during the next site inspection that precedes monthly site meeting.

The Supervising engineer will ensure that contractor provides adequate information to affected communities in respect of names, telephone numbers, and office locations where questions and complaints can be directed. The Supervising engineer will also ensure that the contractor makes this information available by appropriate means including signboards, leaflets, community meetings, etc.

### Complaint Lodged at Tema LNG local Corporate Office

A written, email, or verbal complaint shall be delivered to permitting/QHSE Manager. This shall be recorded, dated and signed to acknowledge receipt. An acknowledgement of complaint form shall be sent by post to the complainant within two (2) weeks. Within this time the QHSE Manager shall liaise with the Project Manager to have the issue(s) resolved. When a solution is reached, the complainant shall be informed verbally and/or in writing within one (1) week thereafter. A written record of the proposed resolution shall be made. The solution proffered shall be recorded and dated. The QHSE manager will follow up to find out whether the complainant is satisfied, and the results of the follow-up will be recorded.

For construction issues, the EPC contractor shall investigate the issue with the Supervising engineer and ensure that the proffered solution is communicated to the contractor through a site instruction. The monthly site report for the month in question shall report on the complaint and what has been done to remedy the situation. A visit to the location of the problems shall be included in areas to be visited during the monthly site inspections that precedes the monthly site meeting. The site inspection shall be attended by QHSE staff to verify confirmation of the resolution to the issue(s).

### Metropolitan Assembly-level Grievance Resolution

For issues that could not be resolved either directly with the EPC Contractor on-site or through lodging of complaint at the Tema LNG Corporate office, a project level Grievance Committee (GC) will be set up to handle such cases. The committee will be set up within the Tema so that stakeholders do not have to travel long distances to attend committee meetings. The GC will include the following:

- A representative of Tema Metropolitan Assembly (the Coordinating Director);
- Local Assembly Men for the affected communities;
- Representative of Tema LNG Terminal

- Representative of GPHA; and
- Representative of affected stakeholder/stakeholder group within the project area;

The representative of Tema LNG Terminal will chair the GC. Membership of the GC will be made known to the public/stakeholders as part of the sensitization on the GRM. The GC shall provide a response within three (3) weeks of receiving formal notification of a grievance. In cases where further site visits, investigations or discussions with the aggrieved stakeholder are deemed necessary in order to arrive at an amicable resolution, a date shall be planned with the complainant for the follow-up visit which will fall within the mandated three (3) weeks.

#### Ministry-level Grievance Resolution

Any unresolved grievances from the Metropolitan Assembly-level will be referred to the Ministry of Energy (MoE) for resolution. An acknowledgement of the complaint shall be sent to the complainant within two (2) weeks. The Chief Director at MoE shall further investigate the issue with Tema LNG terminal and will be responsible for mediating and resolving the complaint. The entire process shall be within three (3) weeks of receipt of complaint and the solution reached shall be communicated to the complainant.

#### National legal level

If the aggrieved stakeholder is not satisfied with the outcome of the GC's intervention in resolving the grievance, the stakeholder will be advised to seek redress through the appropriate legal system/law court.

#### ***10.2.15 Community Development /Social Responsibility***

Tema LNG will implement a community development program as part of its corporate social responsibility policy intended to enhance the social, cultural and economic well-being of local communities. Key stakeholders such as local communities, traditional authorities, TMA, GPHA will be engaged as part of the stakeholder engagement plan, to provide recommendations and suggestions on key environmental/social thematic areas or issues requiring urgent support to inform the community development program.

#### ***10.2.16 Environmental and Social Management Budgeting***

The environmental and social management plans described above require detailed cost analysis after project development to determine the budget needed for implementation. About **GH¢1,233,700** annually (excluding some contractor/terminal cost or budget) will be required for environmental management including reporting as shown in **Table 10-5**. This figure is subject to review following confirmation from cost studies to be carried out after project development and does not include the contractor's estimates.

**Table 10-5: Environmental Management Budget**

<b>No.</b>	<b>Programme</b>	<b>Cost/year (GH¢)</b>
1.	Implementation of mitigation actions (refer to <b>Table 10-2</b> )	715,700+
2.	Environmental monitoring (refer to <b>Table 10-3</b> )	240,000
3.	Staff Information and Awareness Creation Program	30,000
4.	<u>Environmental Auditing and Reporting</u> <ul style="list-style-type: none"> <li>• Annual environmental, health and safety audits</li> <li>• Returns of Monitoring Reports to EPA (in line with LI 1652)</li> <li>• Preparation of Annual Environmental Reports (in line with LI 1652)</li> <li>• Preparation of Environmental and Social Management Plan (in line with LI 1652)</li> </ul>	20,000
5.	Capacity Building and Training	128,000
6.	Implementation of Grievance Redress mechanism	10,000
7.	Implementation of Stakeholder Engagement Programme	20,000
8.	Community Development Program/Social Responsibility	20,000
9.	Preparation and Implementation of emergency response plan	50,000
<b>Total</b>		<b>1,233,700+</b>

## 11.0 FRAMEWORK FOR EMERGENCY RESPONSE PLAN

The Emergency Response Plan is aimed at addressing potential accidental occurrences during the development and operational phases with the general objective of minimizing hazards to workers, local communities, the public and the general environment.

The specific objectives of the emergency response plan are to:

- Identify all stakeholders and their roles.
- Identify the key persons to be involved and clearly define their roles and the procedures that must be followed during an emergency;
- Identify all the likely emergency scenarios associated with the operations and provide effective response procedures for each identified emergency scenario;
- Save human life and minimize damage to equipment, property and the general environment;
- Identify training needs of personnel and resources required to ensure emergency preparedness at the site;
- Establish notification procedures and communication arrangements;
- Establish evacuation procedures
- Provide clean-up and remediation arrangements;
- Put in place emergency response plan review arrangements; and
- Develop budget for the implementation of the ERP.

The emergency response plan will be based upon all the different operational facilities in place. The ERP shall be linked with the existing GPHA emergency response plans to ensure effective and efficient responses to emergencies. The ERP will be disclosed to all potentially impacted people including the neighbouring local communities (Abonkor, Manhean and Bankuman).

The quantitative risk assessment study carried out had the following objectives:

- To Identify all credible fire events associated with the TLTG project;
- To Assess the relevant frequencies of occurrence and consequences; and
- Calculate the resulting risk to both operators and public and associated conclusions

The hazard identification study covered the following assets and operations:

- FRU (Hull, mooring to the jetty, Regasification plant and utilities);
- FRU interfaces with the shore pipeline (send out);
- FSU interfaces with FRU (mooring, LNG transfer); and
- LNG-C interfaces with the FSU (mooring, LNG transfer).

Additional hazard identification study will be carried out to include:

- Pipeline emergencies
- Header station emergencies (LNG delivery/distribution)

The objective of the hazard identification study is to ensure that the safety and operational risks of the FRU, the FSU, and the onshore pipeline and header station are eliminated or reduced to as low as reasonably practicable (ALARP).

The ERP will cover the following risk situations:

- Fire risk
- Explosion
- Damage to pipeline and leakage from the pipeline
- Oil/fuel spillage
- Fall from offshore terminal facilities and drowning
- Terrorist Attack
- Natural disasters – earthquake/seismic activity, Tsunamis etc. and
- Medical emergencies

Management will report, as appropriate, emergencies/accidents to relevant stakeholders/regulatory bodies such as the GPHA, EPA, the Energy Commission, Ghana National Fire Service (GNFS), the Metropolitan Assembly, NADMO and Ghana Police Service.

Work location Managers would be required to ensure that procedures are revised to reflect changes in personnel, facilities or desired action. It is expected that details of particular actions required in the various emergency plans would be reproduced in easy-to-read type and posted at areas where they are required.

It is also expected that drills and practices of the various procedures would be carried out, at least, twice a year. After the drills, there should be discussions of what transpired, and any shortcomings pointed out. Suggestions for any improvements to the procedures are welcomed and encouraged.

All authorised hard copies of the ERP document must have the signatures of the review and approval authorities. Authorised electronic copies of the document will have the approval date and the date printed as a footer on every page.

## **12.0 DECOMMISSIONING**

### **12.1 Work Camp Facilities**

GPHA will provide space within its premises for Tema LNG Terminal Company to construct temporary work camp facilities to house mainly equipment and materials and also serve as site offices during the construction phase of the project. The camp facilities will be dismantled and relocated by the contractor(s) to other project sites. All debris and waste generated will be disposed of at GPHA and TMA designated waste disposal sites.

Tema LNG Terminal in collaboration with GPHA will carry out a pre-mobilisation survey with the contractor, to record the status of the proposed site for the work camp (e.g. photo log). Demobilisation check will be carried out with the contractor to compare status of site after demobilisation to that of the pre-mobilisation survey condition recorded. Tema LNG Terminal Company will ensure that the contractor rectifies any significant gaps or concerns prior to payment of final contractor invoice for the assignment. A prescriptive rehabilitation will be developed for the decommissioning of any construction related facility.

### **12.2 The Pipeline and Other Port Facilities**

Tema LNG Company is expected to handover the terminal to GNPC after 12 years of operating the facility as per the current contract arrangement. During this period, Tema LNG Company does not expect to decommission any project assets. The project assets of interest include:

- Floating LNG terminal comprising a floating regasification unit (FRU) and a floating storage unit (FSU);
- Breakwater and mooring facilities; and
- Subsea and onshore gas pipeline to the gas delivery point at the VRA header station.

The facilities will be rehabilitated and or decommissioned as the need arises due to depreciation, worn out, damage or becomes dysfunctional. Any major rehabilitation or decommissioning work by Tema LNG Terminal or GNPC in the long term will be undertaken in line with the environmental assessment procedures of the country. The intended project will be registered with the EPA to enable the Agency advice on the level of environmental assessment and reporting to be carried out.

Relevant stakeholders will be engaged under any decommissioning or rehabilitation arrangement. The key stakeholders initially identified include:

- EPA – National Environmental Protection Regulator
- TMA – Local government authority in charge of the project area
- GNPC - Gazprom's customer and party to whom the terminal will be transferred to at the end of the Gazprom contract
- GPHA - Regulator and provider of concession to operate within the port of Tema, and party to whom port infrastructure will be transferred to at the end of the Gazprom contract
- VRA - Owner of header station (gas delivery point)
- VALCO – Owner of land where section of onshore pipeline will pass

- Abonkor, Manhean and Bankuman – Neighboring local community suburbs close to the pipeline route outside the Tema Port boundaries.



### 13.0 CONCLUSION

Tema LNG Terminal is fully aware of its corporate responsibility to sound environmental practices, and will undertake this project in compliance with Ghanaian laws and in accordance with good international industry practice. The dredging and construction activities and operation of the facilities will satisfy the relevant local environmental protection laws and international conventions.

The major potential environmental and social risks and impacts associated with the proposed project have been identified and duly assessed in this ESIA Report. The major environmental, safety risks and impacts associated with the Project during both construction and operation stages include noise nuisance, air pollution, water pollution, erosion and accretion, occupational health/safety risks, sanitation problems, traffic impacts/public safety concerns, solid waste generation/disposal problems, disturbance of other port operations, impact on the fisheries/ marine organisms in the catchment area and security risks.

Mitigation and management measures for the identified impacts have been recommended and will be implemented in order to minimise significant adverse effects. An environmental monitoring programme to help detect changes arising from the predicted adverse impacts and to help maintain environmental quality within acceptable guidelines has also been prepared for implementation. A stakeholder engagement program and grievance redress mechanism will be implemented to ensure that stakeholder concerns and grievances are managed effectively to minimise potential conflicts during project implementation.

The implementation of the proposed project will significantly improve the generation of thermal power at a more competitive cost to the consumer. The project will provide competitively priced LNG from the global market to displace expensive liquid fuels currently constraining the electrical generation and industrial sectors. In addition to direct cost benefits, the project will also improve the diversity fuel supply sources, improve environmental performance (lowest emission fossil fuel) and improve security of supply for natural gas to Ghana

Generally, stakeholders are willing to participate in project implementation where necessary to help ensure that the project is implemented in an environmentally friendly and socially acceptable manner to the benefit of the country. The local communities and PAPs however expect that appropriate measures will be put in place to address the potential risk especially explosion and compensation respectively identified during the engagement

## 14.0 REFERENCES

1. Aggrey-Fynn, J., Galyuon, I., Aheto, D. W., Okyere, I. (2011) Assessment of the environmental conditions and benthic macroinvertebrate communities in two coastal lagoons in Ghana. *Annals of Biological Research* 2; 5, pp. 413-424.
2. Anderson, K. (2010) Clearing House mechanism of Ghana. Accessed in February, 2017 at: <http://gh.chm-cbd.net/biodiversity/faunal-diversity-ghana/ecosystem-diversity/mangrove-and-tidal-forests>
3. Anon. (2000) *The IUCN Red List of Threatened Animals*. The IUCN Conservation
4. ANZECC & ARMICANZ 2000a. National Water Quality Management Strategy, Australia and New Zealand Guidelines for Fresh and Marine Water Quality. In: ZEALAND, A. A. N. Z. E. A. C. C. A. A. R. M. C. O. A. A. N. (ed.). Artarmon, NSW, Australia: Australian Water Association
5. Armah, A. K., Darpaah, G. A., Wiafe, G., Adomako, J. K., Quartey, S. Q., Abotchie, C., Ansah, F., Fiagbedzi, S., (1997) Traditional and modern perspectives of marine turtle conservation in Ghana Biodiversity Conservation: traditional knowledge and modern concepts (eds. Amlalo, D.S., Atsiatorne, L. D., and Fiati, C.), EPA/MAB/UNESCO. pp. 80-87:
6. Basset, A., Galuppo, N., Sabetta, L., (2006) *Transitional Waters Bulletin* 1; pp, 48-63.
7. Booth, A.H. (1958) Zoogeography of West African primates. *Bull. IFAN*, 20: 587-622.
8. Cansdale, G.S. (1948) Field notes on some Gold Coast snakes. *Niger. Fld.*, 13: 43-50.
9. Cansdale, G.S. (1951) Some Gold Coast lizards. *Niger. Fld.*, 16: 21-34.
10. Decher, J. (1997a) Bat community patterns in the Accra Plains. *Z. Saugetierkunde*, 62: 128-142.
11. Decher, J. (1997b) Conservation, small mammals, and the future of sacred groves in West Africa. *Biodiversity and conservation*, 6: 1007-1026.
12. Decher, J., D.A. Schlitter & R. Hutterer (1997) Noteworthy records of small mammals from Ghana with emphasis on the Accra Plains. *Annals of the Carnegie Museum*, 66: 209-227.
13. EAF Nansen Survey (2009) Marine Environmental Survey of Bottom Sediments in Ghana.
14. Environmental Resources Management (ERM) (2014) Final ESIA Report and Environmental Impact Statement for the Ghana Oil Services Terminal. Accessed February, 2017 at [http://www.atuabofreeport.com/docs/AFP%20ESIA%20Vol%20I\\_Chapters\\_April%202016.pdf](http://www.atuabofreeport.com/docs/AFP%20ESIA%20Vol%20I_Chapters_April%202016.pdf)
15. Fontaine, B., Janicot, S., Roucou, P., (1999) Coupled ocean-atmosphere surface variability and its climate in the tropical Atlantic region. *Climate Dynamics* 15; pp. 451-473.
16. Fretey, J., (2001) Biogeography and Conservation of Marine Turtles of the Atlantic Coast of Africa. CMS Technical Series Publication 6, UNEP/CMS Secretariat, Bonn, Germany.
17. Ghana Investment Promotion Centre (GIPC) (nd) Investing in Ghana's Fishing Industry. Accessed February, 2017 at <http://gipcghana.com/21-investment-projects/agriculture-and-agribusiness/fishing-and-aquaculture/300-investing-in-ghana-s-fishing-industry.html>
18. Hall, J.B and Swaine, M.D. 1981. Distribution and Ecology of Vascular Plants in Ghana. W. Junk, The Hague
19. Hawthorne, W. 1995. Forest of Ghana Geographic Information Exhibitor manual. IUCN/ODA/Forest Dept. Republic of Ghana Norad - FAO project GCP/INT/003/NOR cruise reports "Dr. Fridtjof Nansen" EAF N2009/5.
20. International Union for Conservation of Nature (IUCN) (2011) IUCN Red List of Threatened Species. Accessed February, 2017 at <http://www.iucnredlist.org/>

21. Kutu, J.M. (2013) Seismic and Tectonic Correspondence of Major Earthquake Regions in Southern Ghana with Mid-Atlantic Transform-Fracture Zones\*, International Journal of Geosciences, Vol.4 No.10, Article ID:41164,7 pages
22. Merle, J., Arnault, S., (1985) Seasonal variability of the tropical South Atlantic and linkages to the Pacific Geophysical Research Letters 13; pp. 1039-1092.
23. Monitoring Centre, Cambridge, U.K.
24. Sackey, I., Laing, E., Adomako, J.K., (1993) Status of the Mangroves of Ghana. In E.D. Diop, editor. Conservation and Sustainable Utilization of Mangrove Forests in Latin America and Africa Regions. Part II – Africa. International Society for Mangrove Ecosystems and Coastal marine Project of UNESCO. Mangrove Ecosystems Technical Reports volume 3.
25. Saenger, P., Bellan, M.F., (1995) The Mangrove Vegetation of the Atlantic Coast of Africa. Toulouse (France): University of Toulouse Press
26. World Bank Group (2015) Environmental, Health, and Safety Guidelines for Offshore Oil And Gas Development.
27. World Bank Group (2017) Environmental, Health, and Safety Guidelines for Harbours and Terminals.
28. Yankson, K., (1999) EA Obodai. Journal of the Ghana Science Association 2: 26; pp. 26-31.
29. C. Caplat, H. Texier, D. Barillier, C. Lelie`vre, An inventory of sediment pollutions in a French harbour—Comparison to a non polluted local area identified in bay of eine, Journal of Coastal Research (inpress).
30. C. Savvides, A. Papadopoulos, K.J. Haralambous, M. Loizidou, Sea sediments contaminated with heavy metals:
31. Commonwealth Science Council (CSC) (2001). *Nutrient analysis in water*. Commonwealth Secretariat, Marlborough House, Pall Mall, London, U.K. pp. 13–22.
32. E Nyarko, A Fletcher, S Addo, B A K Foli and E Mahu, Department of Marine and Fisheries Sciences, University of Ghana, Accra, Ghana. *Geochemical Assessment of Heavy Metals in Surface Sediments: A Case Study of the Tema Port, Ghana*, Journal of Shipping and Ocean Engineering 4 (2014) 79-92
33. Emmanuel O. Kombat, Francis K. E. Nunoo, Joseph A. Ampofo and Phillis G. A. Addo (2013). Effects of environmental conditions on the microbiological quality of two small marine pelagic fishes landed in Accra and Tema, Ghana. Archives of Applied Science Research, 2013, 5 (2):180-188
34. G.W. Bryan, W.J. Langston, Bioavailability, accumulation and effects of heavy metals in sediments with special reference to United Kingdom estuaries: A review, Environmental Pollution 76 (1992) 89-131.
35. Ghana Ports and Harbours Authority: Strategic Environmental Assessment Report (SEA) for the Port of Tema, June 2008 by AY&A Consult Limited.
36. Ghana Ports and Harbours Authority: Summary of Phases: Takoradi Port Development July 2012.
37. Ghana Ports and Harbours Authority: Master Plan for the Port of Takoradi, Draft Final Report, June 2012, by Sellhorn Ingenieurgesellschaft mbH and HPC Hamburg Port Consulting GmbH
38. Ghana Ports and Harbours Authority: The Development Study of Ghana Sea Ports in the Republic of Ghana, Final Report Vol. 1 - 4, February 2002, by the JICA -Overseas Coastal Area Development Institute of Japan (OCDI)
39. Ghana Statistical Service: 2010 Population and Housing Census, Summary Report of Final Results, May 2012.

40. GHD 2013, *Environmental Best Practice Port Development: An Analysis of International Approaches*, report prepared for the Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia
41. JICA. The Preparatory Survey for Outline Design on the Project for Fisheries Promotion in Sekondi.
42. Klake R.K. et al (2012). *Correlation between Heavy Metals in Fish and Sediment in Sakumo and Kpeshie Lagoons, Ghana*, Journal of Environmental Protection, 2012, 3, 1070-1077.
43. Metal speciation and removal, Water Science and Technology 32 (1996) 65-73.
44. Ministry of Finance and Economic Planning (MoFEP): The Environmental and Social Management Framework (ESMF) and the Resettlement Policy Framework (RPF) of the Ghana Public Private Partnership (PPP) programme reports prepared for the Public Investment Division (PID) of MoFEP, November 2012.
45. Muff et al (2006). Ghana-Germany Technical Cooperation Project: Environmental and Engineering Geology for Urban Planning in the Accra-Tema Area. [Ghana]: Ghana Geological Survey Department.
46. Nartey et al. (2011) *Nutrient load of the Sakumo lagoon at the Sakumo RAMSAR site*, West African Journal of Applied Ecology, vol. 19, 2011
47. Nunoo FKE, Eggleston DB, Vanderpuye CJ. *Abundance, biomass and species composition of nearshore fish assemblages in Ghana, West Africa*, African Journal of Marine Science 2006, 28(3&4): 689–696
48. P. Adamo, M. Arienzo, M. Imperato, D. Naimo, G. Nardi, D. Stanzione, Distribution and partition of heavy metals in surface and sub-surface sediments of Naples city port, Chemosphere 61 (2005) 800-809.
49. Seismic and Tectonic Correspondence of Major Earthquake Regions in Southern Ghana with Mid-Atlantic Transform-Fracture Zones\*, Jacob M. Kutu, **International Journal of Geosciences**, Vol.4 No.10(2013), Article ID:41164,7 pages
50. UNEP (1997). *Global Environmental Outlook “for Life on Earth”*. Oxford University Press, New York.

**ANNEXES**

- Annex 1-1: EPA Response Letter on Project Registration**
- Annex 1-2: EPA review Comments on Scoping Report**
- Annex 1-3: EPA review comments on the draft ESIA Report**
- Annex 1-4: Response to the EPA review comments on the draft EIS**
- Annex 3-1: Dredging Layout and General Arrangement of FRU**
- Annex 3-2: Typical Cross section and drawings of onshore pipeline**
- Annex 4-1: Pipeline Selected Route**
- Annex 5-1: Ambient Air Quality and Noise Level Monitoring Report**
- Annex 5-2: Marine Ecology Study Report**
- Annex 5-3: Terrestrial Ecology Study Report**
- Annex 5-4: Details of PAPs and affected Properties within the RoW**
- Annex 6-1: Scoping Notice**
- Annex 6-2: Introductory letters for Consultations**
- Annex 6-3a: Community Engagement and Impact Study Report**
- Annex 6-3b: Evidence of stakeholder consultations**
- Annex 6-4: Energy Commission Siting Permit**
- Annex 6-5: Extracts from GPHA and Tema LNG Concession Agreement for pipeline use within the Port**
- Annex 6-6: TDC RoW Approval Letter**
- Annex 6-7: VALCO RoW Approval Letter**