ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SUMMARY

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AFRICAN DEVELOPMENT BANK GROUP

PROJECT: PARTIAL RISK GUARANTEE PROGRAM IN SUPPORT OF GAS TO POWER

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PROJECT NUMBER: P-GH-F00-008

COUNTRY: GHANA

DEPARTMENT: ONEC

DIVISION: ONEC 1

PROJECT CATEGORY: 1

1. INTRODUCTION

Quantum Power Ghana Gas Limited plans to undertake a Liquefied Natural Gas (LNG) Project in Tema, in the Greater Accra Region of Ghana. The project is scheduled for an initial period of ten years within which LNG will be imported, stored, re-gasified and delivered to Independent Power Producers (IPPs) and industrial consumers within the Tema metropolis. The planned location of the project will comprise a Floating Storage and Regasification Unit (FSRU), offshore mooring and support for floating units (FSRU as well as LNG supply vessels), subsea gas pipelines; landing and distribution facilities and ancillary infrastructure. The project's facilities and services will cut across two administrative districts of the Greater Accra Region, namely, the Ningo Prampram and Kpone Katamanso Districts.

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This Summary presents an overview of the project, key impacts (negative and positive) identified during the EIA process and the proposed mitigation and management measures.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The Tema LNG project is to be undertaken under compliance to relevant national and international legislation as well as industry performance good practice.

2.1 The Ghana Constitution, 1992

The Constitution1 of Ghana sets out the first source of Environmental Protection requirements in Ghana. Under Article 36(9): (9) The State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek co-operation with other states and bodies for purposes of protecting the wider international environment for mankind. In addition, Article 41 (k) requires that all citizens protect and safeguard the natural environment of the Republic of Ghana.

2.2 The National Environmental Policy, 2010

The National Environmental Policy (NEP) sets out a new vision for environmental management in Ghana and is based on an integrated and holistic management system for the environment. It is aimed at sustainable development now and in the future. The policy seeks to unite Ghanaians in working toward a society where all residents of the country have access to sufficient and wholesome food, clean air and water, decent housing and other necessities of life that will further enable them to live in a fulfilling spiritual, cultural and physical harmony with their natural surroundings. The NEP is defined under key operational principles of; accountability, equity, environmental justice, inclusivity and open information, precautionary and polluter pays principles. Within the NEP are sector specific environmental protection policies. The NEP is intended to serve as the roadmap for Ghana towards protection, management and ensuring sustainability of environmental objects.

2.3 Environmental Protection Act, 490 of 1994

The Environmental Protection Act (*Act 490 of 1994*) came into being to establish the Environmental Protection Authority (EPA) as a body for the protection, conservation and

management of environmental resources for the Republic of Ghana. The Act mandates the EPA with the formulation of environmental policy, prescribing of standards and guidelines, issuing of environmental permits and pollution abatement notices. Section 2(i) of the Act further mandates the EPA to ensure compliance with established Environmental Impact Assessment (EIA) procedures among companies and businesses in the planning and execution of development projects, including existing projects. Section 10(2) of the Act promulgates the establishment of a Hazardous Chemicals Committee with functions monitor the use of hazardous chemicals by collecting information on the importation, exportation, manufacture, distribution, sale, use and disposal of such chemicals.

2.4 Environmental Assessment Regulations (LI 1652), 1999

The Environmental Assessment Regulations is established to provide a framework for Environmental Assessment of development projects in Ghana. The LI 1652 is organised into five schedules of categorised projects which may either be subjected to a complete EIA or a Preliminary Environmental Assessment (known as PER). Regulation 1(2) of LI 1652 mandates that no person shall commence an undertaking which in the opinion of the Agency has or is likely to have adverse effects on the environment or public health unless, prior to the commencement, the undertaking has been registered by the EPA and an environmental permit has been issued by the Agency in respect of the undertaking. Regulation 11 and 12 sets out requirements for submission of scoping report which shall set the scope or extent of the EIA to be carried out by the applicant, and shall include a Draft Terms of Reference (ToR), which shall indicate the essential issues to be addressed in the environmental impact statement.

2.5 Environmental Guidelines

The Environmental Protection Agency has also issued a number of formal guidelines on regulatory requirement for the protection of the environment. They include guidelines for Ambient Air; Discharges into Natural Water Bodies; Standards for Industrial or Facility Effluents, Air Quality, Noise Levels; Oil Spill Contingency Plan (under review); Environmental Assessment and Management in the Offshore Oil and Gas Development etc..Other relevant legislation includes Energy Commission Act 1997 (Act 541); Fisheries Act 2002 (Act 62); Fisheries Regulation Act 2010 (LI 1986); Oil in Navigable Water Act 1964 Act 235; Wetland Management (RAMSAR sites) Regulation 1999; Water Use Regulations 2001 (LI 1692); Ghana Shipping (Protection of Offshore Operations and Assets) Regulation 2011; Maritime Zones Delimitation Law, PNDCL 159 1986; Lands (Statutory Wayleaves) Act 1963 (Act 186); Petroleum Local Content and Local Participation Regulation, 2013 (LI 2204).

A number of international conventions to which Ghana is signatory to and that are relevant to the project include United Nations Convention on the Law of the Sea (UNCLOS) (1994); Convention on the International Regulations for Preventing Collisions at Sea, 1972; International Convention for the Safety of Life at Sea, 1974; International Convention for the Prevention of Marine Pollution from Ships, 1973, as amended by the Protocol of 1978 relating thereto – MARPOL; International Convention of Oil Preparedness, Response and Co-operation, 1990; International Convention for the Control and Management of Ships' Ballast Water and Sediments; The Convention of the Prevention of Marine Pollution by

Dumping of Wastes and Other Matter (London Convention)(1972); Stockholm Convention on Persistent Organic Pollutants (POPs) (2004); International Convention on the Safety of Life at Sea (SOLAS), 1974.

3. PROJECT DESCRIPTION AND JUSTIFICATION

The project is designed to encompass a Floating Storage and Regasification Unit (FSRU) permanently moored offshore, which will receive LNG, re-gasify it and then export it via a 16" riser, Pipeline End Manifold (PLEM) and 24" pipeline to an onshore metering and distribution terminal where the gas will be supplied to end users via an onshore 20" diameter pipeline network. The 16 inch flexible riser is required for the gas export from the FSRU to the subsea PLEM which consists of piping, valves, a Subsea Isolation Valve (SSIV) and control equipment for the operation of the SSIV. The onshore reception/metering facilities are designed for the reception of gas from the FSRU via the subsea pipelines and comprises among other things inlet and pressure letdown facilities, metering systems and generator and back-up systems. The metering skid component at the end users (onshore) end will ensure appropriate metering of the gas supply. Gas from the Metering Station, routed into a distribution manifold, will be transported via dedicated pipelines to the end users.

3.1 Project Location

The Tema LNG project has both offshore and onshore infrastructure components, with the project's landfall site located approximately 2.5km northeast of Tema New Town and approximately 10km southeast of Prampram. The 20km^2 offshore site is located approximately 6 km south west of Tema Port. Located in close proximity to this proposed LNG project is the West Africa Gas Pipeline (WAGP) project.

3.2 Project Components

The proposed project is comprised of the following main components:

- Floating Storage And Regasification Unit (FSRU);
- Offshore Mooring and Support for Floating Units (FSRU as well as LNG Supply Vessels);
- Subsea Gas Pipelines;
- Landing Facilities and Distribution;
- Ancillary infrastructure.

3.2.1 Floating Storage and Regasification Unit (FSRU)

The FSRU resembles a marine vessel, both in appearance and design, and is approximately 295 m long and 44 m wide. The FSRU would remain moored in place for the entire Project lifetime. The FSRU would be designed to accommodate storage of up to approximately 170,000 m^3 of LNG, equivalent to 100 million cubic meters of natural gas. With a 750 Million Standard Cubic Feet per Day (MMscfd) designed/peak throughput, the FSRU will operate at an initial throughput capacity of 250 MMscfd and at a maximum steady state throughput capacity of 500 MMscfd with potential for added capacities. The FSRU will be permanently held in position on a spread mooring and connected to a 24 inch subsea pipeline via a flexible riser pipe and LNG delivered into the FSRU from a delivery carrier approximately every two weeks and steadily re-gasified. The LNG re-gasification on the

FSRU will be carried out in heat exchangers mounted on the terminal, using sea water as a heating medium. The regasification unit encompasses booster pumps and steam heated vaporisers with the booster pumps helping to increase the pressure before the high pressure LNG is vaporised after which the gas is sent to the subsea pipeline via jumpers and flexible risers. The offshore mooring platform is designed for long-term mooring of the FSRU and for receipt of large size LNG carriers.

Primary support facilities and systems on the FSRU include power generation equipment and associated selective catalytic reduction (SCR) systems, re=condensers and boil-off gas compressors, metering and odourisation equipment and systems, an emergency flare, a ballast system, utilities/seawater system, waste and water treatment systems, and crew quarters and command control facilities.

3.2.2 Offshore Mooring and Support for Floating Units

The FSRU will be spread-moored and the LNG carrier will berth alongside for the LNG transfer via ship-to-ship transfer. The spread mooring chains or wires will be anchored to the seabed allowing the spread mooring to hold the FSRU permanently in position. Specific components include berthing fenders and mooring and breasting dolphins at berth; LNG loading arms, LNG drain tanks, and LNG piping; utility platforms providing docking facilities for lifeboats and service vessels; utility systems, including process support systems, electrical systems, safety systems, and laydown and work areas.

3.2.3 Gas pipelines and Landing Facilities

The subsea system includes a 24 inch subsea pipeline and tie-in spool for transporting gas from the Pipeline End Manifold Structure (PLEM) to the onshore terminal. The PLEM structure consists of piping, valves, a Subsea Isolation Valve (SSIV) and control equipment for the operation of the SSIV. The subsea pipeline terminates at an Onshore Reception Facility where a temporary pig receiver may be connected to allow for periodic inspections of the subsea pipeline. The gas import pipeline is to be routed inside the existing fishing and anchor exclusion zone which was allotted for the existing WAGP pipeline. The onshore reception/metering facilities are designed to receive the gas from the FSRU via the subsea pipelines. The onshore reception facilities comprise of inlet and pressure let-down facilities; metering system, back-up diesel generator and battery back-up system, analyser house, manual vent system, communication system, etc.

3.3 Project Activities

The main site preparation or construction activities will encompass equipment transport to site especially by barge as part of a marine fleet for the onshore components. Crane barges will be used for fabrication of the offshore terminal and the lowering of some pipeline segments; dive support vessels, typically a spud barge, will also be employed for tie-ins, hydro-testing, and related activities. A barge-mounted crane would be used to lift the offshore berthing platform components from transport barges and for lowering into the water. Offshore pipelines will be laid on the seabed and will involve trenching/rock dumping/mechanical backfilling, mattress protection/concrete weight coating processes. Onshore pipelines will be laid in trenches with minimum 1.2 m top of pipe cover. Additional ground works involving use of excavators, front-end loaders, rippers, dozers,

graders, rollers, water trucks and dump trucks are an absolute necessity in the site construction with excess spoil being re-used as trench backfill whenever possible, especially for landfall works. Construction will generally be during daylight hours, however final stages of installation and commissioning may see working beyond daylight hours. To the extent practically and financially possible, raw materials for site construction will be sourced locally.

Following site preparation and necessary installations, system testing and pre-commissioning activities will be undertaken in line with all requisite legislative requirements and standards. Activities will include, but not limited to, appropriate system components cleaning, gauging, hydro-testing and dewatering, system leaks and pressure testing, system drying and purging electrical tests, as well as monitoring and system performance tests necessary in confirming components general operating and shutdown functionalities. The operation stage of the project will see the importation and transfer of the LNG to the FSRU from the LNG carriers, regasification of the LNG on the FSRU, and transfer of the re-gasified LNG into the 24" subsea pipeline and ultimately into the onshore distribution pipeline network. This will, however, be preceded by first conditioning the pipeline system and other system components for the start-up. The arrival and berthing of tankers with LNG cargo will be performed against the wind and preferably in daylight. A gas metering facility is located at the end user end and comprises inlet and outlet emergency shutdown valves, a pressure control valve to ensure constant supply pressure and a metering skid consisting of 2 x 100% ultrasonic flow meters.

Uninterrupted power supplies shall be depended on with power sourced from the National grid and a back-up diesel generator at the Import terminal and each individual metering station. Inmarsat satellite system or a microwave communications system will be depended on for communication purposes between system components such as individual metering stations, the import terminal, the FSRU, etc. At the end of the project's life, a decommissioning and rehabilitation plan approved by relevant authorities will be implemented in line with local regulations and accepted industry practices. It is expected that all salvageable equipment or project component will be reused or resold and those that cannot be salvaged will be recycled or scrapped. As deemed appropriate and in accordance with approved industry standards, equipment will be depressurized, purged and flashed of hydrocarbons and other potentially hazardous products to reduce or eliminate the risk of contaminations or explosions.

3.4 Need for the Proposed Project

The project derives its justification principally on the high need in recent times for additional non-hydropower electricity generation capacities in order to meet and sustain the ever increasing generation deficit and high demand for power in Ghana to support growth of the economy. Ghana in recent times has been saddled with a serious energy crisis, partly attributable to decades of over reliance on hydroelectric power. The challenge facing the power sector has been communicated by Ghana's Ministry of Energy to include an inadequate power supply infrastructure requiring huge investments, high generation costs imposed by high cost of fuel, inadequate regulatory capacity and enforcement, as well as operational and management difficulties in utility companies. The dire nature of the

situation has warranted Government's plan of increasing the country's generation capacity to 5,000 MW by 2015, achieve gas-based generation for at least 50% of thermal power plant production by 2015 and also increase participation of independent power producers in the Power Sector through transparent procurement, among other options.

New investments in generation capacity (especially gas-based generation instead of expensive Light Crude Oil generation) and power-network expansions are therefore required in meeting the country's future electricity needs. Though the country is witnessing increasing gas-based generation projects to address the high energy deficit, industry predictions from investigations into development of new domestic gas fields forecast limited supply availability in coming years especially because of the current policy of Nigeria (the significant source of gas for Ghana) which seeks to first meet its own gas demand before considering exports to neighbouring countries, including Ghana. Thus, Ghana is likely to experience continued gas supply shortfalls right up to 2020 or even beyond. It is on the basis of the dire energy situation of the country that the Tema LNG project is considered a very critical and justifiable project for the country. This is because Ghana's Energy Commission has indicated that the country's gas supply balance of 312 MMscfd (36,812m3/h) as a result of the shortfall of natural gas from Nigeria to WAGP creates the opportunity for the development of viable LNG terminals such as the proposed Tema LNG project. In the view of the Energy Commission, the import of LNG is the only cost effective option to address current shortages in Ghana and in augmenting the country's energy situation. LNG imports are expected to augment domestic gas to make up adequate supplies to meet both power and industry requirement.

The project does not also only fall in line with the plans laid out by Government and with Ghana's Energy Commission recommendations, but is also necessary in providing needed employment opportunities for the citizenry aside contributing to the growth of the country's already existing power supply capacity. The employment opportunity potential of the Tema LNG project is also in line with Ghana's Poverty Reduction Strategy and will be necessary in enhancing infrastructural development as well as private sector development. The project also provides economic gains to the country as income from the project in the form of gas sales, taxes and royalties will have positive impacts on the country and will facilitate economic development and growth. The project also boasts a team with world-class technologies and expertise and thus will also provide good training and skills enhancement opportunities for Ghanaian citizens and as such will further enhance the development of Ghana's oil and gas industry and related businesses.

The location of the project in Tema is also very vital and justifiable as the projected gas deficit for Tema in 2017 and by 2020 is estimated at 320 MMscfd and 440 MMscfd respectively, if WAGP continues delivery at 40 MMscfd. Weighed against these projected deficits, the Tema LNG project is expected to meet the needed gas demand deficit for thermal plants in Tema, even in its initial years of operations as it is expected to deliver first gas by early 2016 in volumes sufficient to fuel up to 1,000MW of base load generation. The Tema LNG project weighs well in health and environmental aspects as well. This is because natural gas continues to be favoured as an environmentally attractive fuel compared with other hydrocarbon fuel. Compared to fuels like coal and oil, natural gas has

lower carbon intensity after combustion and thus presents better atmospheric greenhouse gas emissions and acid rain dangers. It also serves as a more attractive alternative fuel for new power generation plants because of its relatively low capital costs and high energy efficiency due to its high calorific value.

4. DESCRIPTION OF THE PROJECT ENVIRONMENT

Terrestrial:

4.1 Geology

The project's affected areas (Tema, Kpone and Ningo Prampram) are underlain by the Precambrian rocks of the Dahomeyan formation, metamorphic rocks mainly consisting of granite gneiss and schist probably derived from sedimentary layers. These rocky formations are weathered or decomposed at the surface with a thickness of the weathered component not exceeding 12 meters. Exposure of rock units at the coast around Tema Newtown shows well bedded quartz schist and biotitic quartz schist with sub-horizontal schistosity and bedding. The pipeline feeding Asogli power plant crosses an area of consolidated sediments around the Gyrokorgyor Stream that feeds the Gao Lagoon. Around the Gao Lagoon, marine, fluvial or lagoonal sediments occur around its shores and extends a few metres along the Gyrokorgyor Stream.

4.2 Landscape and Visuals

The project cuts across three districts: Tema, Kpone Katamanso, and Ningo Prampram. The landscape in Tema is characterised with low lying lands with long beach stretches. The topography of the Tema Metropolitan area is generally flat and forms part of the coastal plains. The terrain of the district does not rise above 65m above mean sea level. Similarly, the landscape of Kpone Katamanso is also characterized by low lying lands and long stretches of beaches, with industrial (Power plant) and commercial activities such as schools and real estate developments. The Ningo Prampram area also has low lying landscapes with the project influenced by a stretch of wetlands and a beach shore. The proposed right of way (RoW) for the pipeline facilities has significant ecological features such as the Laloi Lagoon which runs through to Dawhenya.

4.3 Climate

The project area shows climate characteristics of the dry equatorial type with mean annual rainfall ranging between 730mm to 790mm. Temperatures are high all year round with significant daily and seasonal variations. The annual average temperature ranges between 25°C and 30°C in the major rainy season while in the minor season temperatures range between 34˚C and 40˚C. Humidity varies from 60%- 80% or more in the wet season to less than 30% in the dry season. Winds generally of low velocity blow over the area from the south during the day and evening and from the west in the night and early morning.

4.4 Terrestrial Ecology and Soils

The project site is characterised by patches and stretches of mangroves vegetation and other marshy areas. Majority of the areas for the proposed pipeline routes are occupied and dominated by forbs (herbaceous flowering plants that are not grasses, sedges or rushes).

The proposed gas landfall site is predominantly occupied with rocky intertidal zone, sandy shore, coastal shrub and grassland species. The sandy and humus nature of the soil support the cultivation of vegetables and it is very characteristic of high vegetable farms within the proposed landfall RoW. Soils in the Metropolitan area have clay and loamy characteristics. There is even distribution of vegetation mainly grassland and mangrove (*Avicenna germinans)* across the RoW and wetland patches of the project area. A rapid assessment of vascular plant species was conducted at the proposed project site and proposed pipeline routes. Floral and vegetation species observed at the Tema landing site consisted of characteristic mangrove species, mainly of *Avicenna sp.*and *Sesuvium spp*. Along the Tema gas landing site are grass species with interspersed *Ammophila sp*. along the beach shore.

There are sea grasses and attached algae on the rocky shore. Mangrove zones and areas within the project proposed right of way lies within the proposed site for CEN Power Plant and Asogli Power Company. There were no observed significant species lying in the proposed right of way of the LNG pipeline to the Kpone Thermal Plant except for large grown grass species. There are key significant ecological zones within the proposed right of way of the gas pipeline to Prampram. The Prampram gas pipeline site is dominated by white sands and dispersed *Ammophilia sp.* The landform is dominated by growing *Sesuvium spp*. The faunal survey of the gas pipeline right-of-way was conducted using direct/opportunistic observation, identification of animal spoors, interviews, and desk surveys of available literature. A number of species of both national and global (IUCN, CITES) conservation significance were observed to occur in the area. However, from the assessment and from a terrestrial ecology perspective, the Tema LNG project development site is not considered highly sensitive. Notable aquatic fauna found in the study include the land crab *Cardiosomaarmatum*, fiddler crab *Ucatangerii* and the gastropod *Tympanostonusfuscatus* as well as aquatic insect populations such as the water boatman, *Notonecta* sp. and the water strider, *Gerris* sp.

4.5 Surface Water and Hydrology

There are a number of surface water bodies within the proposed project areas. The water bodies in the catchment are the Gyrokorgyor stream which runs from near Afienya through Kpone, Dawhenya and Prampram; entering the wetlands prior to the Laloi and Gao Lagoons in Tema and subsequently ending in the sea through a sand bar which is semi-closed because it is open for most time of the year. The total length from the start of the stream to the Gao Lagoon is 11.15 km and the Gyrokorgyor stream is widest around Dawhenya with a width of 0.14 km. The stream is usually fast flowing in the main channel, and slows at the banks, which are over-hanged or overgrown with grasses, shrubs and sometimes trees. The stream is silted at many points due to dumping of solid waste from various human activities at many points. Streams in the Metropolitan Area are seasonal in nature as they do not flow throughout the year. The GAO lagoon, an important ecological resource, is located South-West of the proposed point for QPRGG gas metering station. It is very significant and runs along the Tema and Kpone Katamanso sections of the project areas. The proposed RoW of the gas pipeline lies in the catchment areas of the Gao Lagoon and Laloi Lagoon.

4.6 Air Quality

The Tema Heavy Industrial area is occupied with several industrial activities such as power generating stations, steel and aluminium smelting, port facilities, cement manufacturing and other manufacturing facilities which generate large amounts of particulates and other air pollutants (NO_X, CO, PM_{10}, SO_2, fugitive CH_4 and various VOCs) into the atmosphere. Landside construction activities will generate particulate matter emissions as well as other gases from earth moving activities. Results of baseline studies showed average concentrations (µg/m3) of particulate matter (PM10) at sample stations GPS1, GPS2 and GPS3 were 14.8, 46.4 and 75.4, respectively. Taking as reference the national standard for the average 24-hour period (Ghana EPA Guidelines: 110 µg/m3), the concentrations reported by the stations comply with national standards; however, station GPS3 shows concentrations above the IFC standard for the average 24-hour period (50 µg/m3) that, due to the station location, the main emission source could be related to vehicle traffic over access roads. The Kpone Katamanso project area is not characterised by much industrial and emission producing activities. The main source of air quality degradation can be linked to vehicular emissions from the main Kpone-Aflao Road. Compared to the air quality in Tema, Kpone Katamanso District (KKD) has relatively good air quality. There are a few constructional activities within the Ningo Prampram project area which generate some amount of dust emissions.

4.7 Noise

Existing ambient and background noise levels within and surrounding the LNG Facilities site were monitored between October 20 and October 25, 2014 as part of a noise assessment conducted for the project with background noise levels described in terms of dBA and compared with the Ghana EPA noise permissible standards and the IFC Noise Level Guidelines. Equivalent noise levels (LAeq) for daytime period recorded at stations GPS1, GPS2 and GPS3 were within the environmental standards for industrial zones (<70 dBA), in a range from 46.2 dB(A) to 60.1 dB(A). LAeq levels in the night-time period were between 46.9 dB(A) and 50.4 dB(A). The Heavy Industrial Area of Tema was found to be characterised with noise activities and operations. Baseline noise conditions within the project are high from the activities of production and manufacturing companies. The Ningo Prampram and Kpone Katamanso areas on the other hand have less industrial activities on going so the noise levels generated are very low.

4.8 Land Use

The total land coverage of Tema Metropolitan Area is approximately 369 km2. The major land uses that make up of the Metropolis are residential, industrial, commercial, agricultural and social accessible facilities. The proposed project is situated within the heavy industrial area. The project affected areas is occupied with power installation activities such as electricity pylons and gas pipes. For Kpone Katamanso area, landuse features are characterised by a few industrial and construction facilities. Significant within the district is the construction of the Kpone Thermal Plant. There are vast open spaces for agricultural development. The predominant land use characteristics of Ningo Prampram are long stretches of beach.

4.9 Traffic

Traffic assessment studies conducted showed that traffic in the project affected communities is significantly high. The proposed pipeline RoW from Tema will cross the main Accra-Aflao road from CENIT Energy and travel to the Kpone Thermal Plant through the Tema Golf Course. The road is predominantly used by high speed transport vehicles, cargo trucks and fuel cargo tankers.

Marine:

4.10 Oceanography and Bathymetry

The nearshore wave climate is dominated by the offshore swells that arrive from a southerly direction. Ocean temperatures range between 26 – 280C (average annual temperature in the nearshore environment) based on National Oceanic and Atmospheric Administration Drifting Buoy Data Assembly Centre near-surface buoys, archived data from 1978 to 2003. The study area ranges from 0 to 40m depth. The sea level in Ghana is rising at a rate of approximately 2 mm/yr (Appeaning Addo 2009), which is in conformity with the global estimate (Armah et al. 2005). Alternatively, other global climate models estimate sea-levels along Ghana will increase 8.6 cm (range, 3.8 - 14.4 cm) by 2030, 12.0 cm (range 5.5 - 20.2 cm) by 2040, and 34.5 cm (161 - 58.4 cm) by 2080 (Minia 2008).

4.11 Noise and Air Quality

Current baseline (current shipping and boat traffic) already has an impact on the movement of fish, marine mammals and marine reptiles within the study area. Noise as well as emission sources of gases and particulate to the atmosphere are associated with the operation of the FSRU system, LNG transfer to the FSRU and ships required for transport of crews as well as tugboats to be used in positioning manoeuvres of ship for LNG supply to FSRU. Additional noise emissions in the coastal zone will originate from the gas pressure regulation system (controlled by valves) at the metering station.

4.12 Offshore Traffic/Shipping Movement

Offshore traffic assessment conducted revealed that shipping movement (traffic) is dominated by vessels calling on Tema Port, the busiest port in Ghana. The port is operated by Ghana Port & Harbours Authority (GPHA) and receives an average of over 1,650 vessel calls per year. Vessels include container vessels, general cargo vessels, tankers, Roll-on/roll-off (Ro-Ro) and cruise vessels. The port is thus divided into three sections or basins, namely commercial cargo, commercial fishing and the Canoe Basins. The 1,650 vessel calls per annum does not include daily shipping movements by the commercial and artisanal fishing fleets. Increased shipping movement is also anticipated due to the proposed port expansion programme, as well as the current maintenance and future expansion dredge material disposal needs for the port.

4.13 Water Quality

It is understood that Ghana's near-shore waters contain pollutants that arise from human activities. Previous research has indicated that heavy metals that are discharged into the ocean from industrial and mining activities, along with urban and agricultural runoff is a significant problem within the Accra / Tema region. Trace metal and hydrocarbon

concentrations have also been detected. These have been attributed to industrial and residential area run-off that also aid in nutrient enrichment (eutrophication) due to sewage discharge. Water quality was thus assessed during the baseline assessment, with reference to specific impacts related to the oil and gas industry, shipping activities (waste disposal from moored ships), accidental spills and construction impacts related to the seabed pipeline.

4.14 Benthic and Planktonic Environment

The nearshore environment, to a depth of 50m is dominated by soft silt and mud deposits and is colonised by several benthic (bottom living) organisms, some living within or on the benthic sediments and are largely filter feeders. The assessment provides detailed accounts of the benthos along the West African coastal line and evaluated the present community structure within the study area and how important these are in terms of the regional food chains. Changes in Planktonic primary producers, the main food source for zooplankton will cause seasonal changes in zooplanktonic biomass and will reflect in seasonal changes to secondary consumers such as fish.

4.15 Fisheries, Marine Mammals and Reptiles

The West African region supports a diverse marine mammal fauna. Marine fisheries in Ghana are affected by these seasonal upwelling that result in increased production of fish food and abundance of most marine fish species. Over 300 different species of commercially important fish are caught from marine sources in Ghana. Coastal areas offshore West Africa are possible breeding and nursery areas for the humpback whale, which migrates along the coast of Southern Africa to mate, calve, and nurse its young during the austral winter. While the project infrastructure will impede on local artisanal and industrial purse seine fishing within the inshore exclusive zone in the Tema area, existing regulations restrict fishing and anchoring activities within the proposed offshore development area for this project.

Socio-Economic:

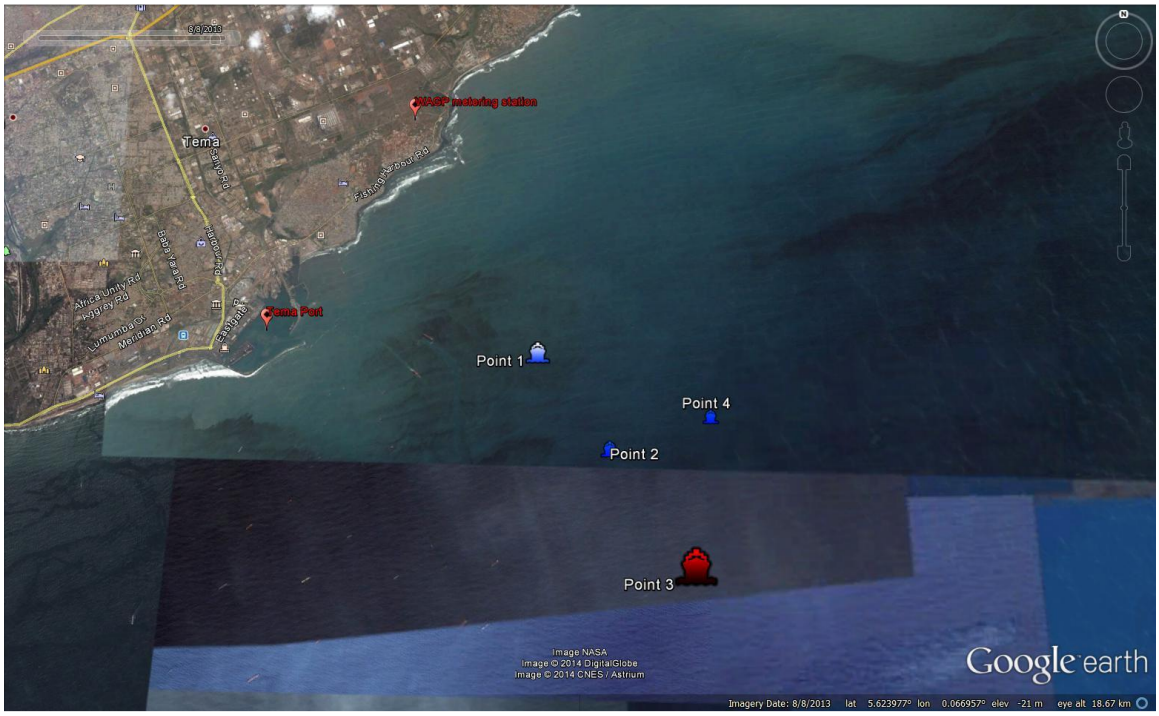
4.16 Social Receiving Environment

A socio-economic baseline study was undertaken during the EIA based on a review of available secondary information and primary data collected in the local communities and respective project affected Metropolitan and District assemblies. Primary data collected for thisanalysis are both qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions. The proposed project location is Tema in the Greater Accra Region of Ghana, but spans three districts, Tema, Kpone Katamanso, and Ningo Prampram Districts. The Tema Metropolitan Assembly, (TMA) was created from the erstwhile Tema Municipal Assembly. The Metropolitan Assembly is currently divided into two Sub-Metropolitan District Councils namely: Tema West and Tema East. The population of the Metropolitan area is projected at 428,084 (2010 census) with an annual growth rate of 2.6%. It is made up of 205,480 males and 222,604 females in the proportion of 48% and 52% respectively. The local economy of Tema is made up of Agriculture, Industry and Commerce/Services. The industrial and the service sectors form the backbone of the local economy as it employs the majority of the labour

force. The Kpone Katamanso District has Kpone as its administrative capital and was carved out from the Tema Metropolitan and forms part of the new districts and municipalities created in the year 2012. The Kpone Katamanso District is located only 38km drive from Accra. The main occupation in the area includes fishing, fish mongering and farming (crop production and livestock rearing).

5. PROJECT ALTERNATIVES

The Tema LNG Project all through its conceptual design phase evaluated a number of alternatives to the project before defining the approach for final project design as depicted in the map below.



The analyses did not consider unselected alternatives as unviable, but only presents them as least favourable with respect to the other options evaluated. The alternatives evaluation carefully weighed safety, engineering, technical, financial, social and environmental considerations with the final choice based on the option resulting in the best overall performance against evaluated criteria. The ESIA includes a consideration of alternatives by providing a comparative analysis of the no project alternative, location alternatives, and other project alternatives. With regards to the optimal location of the FSRU and mooring, including the configuration of the gas pipeline for instance, two location alternatives P1 (up to 20 m deep) and P3 (up to 40 m deep) were critically evaluated and the P3 alternative found to be the best location alternative. The project location was found to be very appropriate per the nature of the proposed project. The optimal project location was selected taking into account environmental, social and economic variables. The no project or No-Go alternative was assessed not to be viable due to current critical national demand for power supply and the project's high potential of contributing to the country's economic

growth. The no project alternative would also entail gas supply deficiencies for independent power providers ("IPP") and industrial consumers in the area of Tema and surroundings. Natural gas also serves as a more favourable source compared with other fuel types such as coal and oil as it is cheaper, more readily available and associated with lower emissions and residual environmental impacts.

6. RESULTS OF COMPARISON OF ALTERNATIVES

Regarding the location, on technical aspects, Alternative 1 (P1) was more optimal mainly due to the shallower zone depth which provides greater advantages regarding the infrastructure location. It also requires less piping and, therefore, a shorter construction, installation and work time. By contrast, Alternative 2 (P3) has a more profound depth and requires a larger number of works due to the greater length of piping. The distance to the port of Tema also involves advantages with respect to the transportation of personnel, materials, and inputs. As such, Alternative 1 (located at an approximate distance of 4.8 km) is more beneficial than Alternative 2. Economically, Alternative 2 would require greater investment than Alternative 1. With regards to environmental aspects, both alternative 1 and alternative 2 have similar climatic ratings. In relation to waves, Alternative 2 could be more beneficial as there is a lesser frequency of waves with a height greater than 2 and 2.5 m, which facilitates the manoeuvring for operations as well as transportation and construction. Alternative 2 would result in fewer environmental risks such as spills and by and large it presents fewer complications in terms of environmental management due to the nature of the site. With regard to social aspects, Alternative 1 presents fewer advantages due to its proximity to the commercial and fishing ports, involving potential interference with fishing and commercial vessels which could generate, among other issues, expectations in the fishermen population or the risk of interference with fishing and commercial vessel routes. From the perspective of the landscape, Alternative 1 is visually accessible so its impact would be greater in comparison to Alternative 2, taking into account that the distance of Alternative 1 to the coast is around 4.2 km. Alternative 2 represents the less complex option for managing social impacts due to its remoteness from the coast and port. Other alternatives and methodology are detailed in chapter 4 of the ESIA.

7. POTENTIAL IMPACTS

Anticipated impacts during the construction, operation and decommissioning phases are as follows:

TERRESTRIAL IMPACTS

Impacts	Phase
Degradation of air quality due to emissions associated with site development and construction activities	Construction
	Operation
Potential for increase in noise at nearby sensitive receptors due to site development construction activities	Construction
	Operation
Change in soil structure due to clearing and grading activities during pipeline construction	Construction
Alteration of topography due to trenching and backfilling to install the pipeline	Construction
Contamination of soils due to solid and hazardous waste disposal	Construction
Change in soil surface and topography from land preparation activities for onshore reception/metering facilities construction	Construction
	Operation

Impacts	Phase
Terrestrial habitat loss	Construction
Aquatic habitat degradation	Construction
Degradation of coastal habitats	Construction
Loss of terrestrial fauna during construction	Construction
Loss of flora during construction	Construction
Alien and invasive species colonisation	Operation
Gas flaring impacts	Operation
Spoil disposal	Construction

MARINE IMPACTS

Impacts	Phase
Shipping movement and noise	Cons & oper
Water quality changes due to disturbance of the bottom sediments	Cons & oper
Mechanical/physical disturbance of benthic in faunal communities during construction	Construction
Impact of construction on fish assemblages	Construction
Impact of construction activities on artisanal and semi-industrial fisheries	Construction
Impact of pipeline and FSRU operation on artisanal and semi-industrial fishing activities	Operation
Creation of new habitat for fishery resources	Construction
Offshore air quality during construction phase	Cons & oper
Noise	Cons & oper

SOCIO-ECONOMIC IMPACTS

Impacts	Phase
Increased income generation opportunities from direct and indirect job creation at local, regional and national levels	Cons & oper
Reduced income generation opportunities related to fishing	Cons & oper
Loss of subsistence crops within the Right of Way	Cons & oper
Impact on traditional governance mechanisms and structures	Cons & oper
Loss of Local 'Sense of Place' and Decreased Social and Cultural Cohesion	Cons & oper
Potential Increase in Anti-Social Behaviours	Cons & oper
Increase in vector borne and communicable diseases	Cons & oper
Increased Injuries and Mortality from Traffic Accidents	Cons & oper
Potential Physical Displacement along Pipeline Corridors	Cons & oper
Reduced Access, Pressure and Overburdening of Physical and Social Infrastructure	Cons & oper
Improvements Related to Community Development Initiatives	Cons & oper
Impact to Landscape and Visual Environment during Construction	Construction
Exposure of workforce to sufficient Health and Safety Standards	Cons & oper

CUMULATIVE IMPACTS

Generally, the positive cumulative impact of the project will be moderate, but with high job creation opportunities for nearby communities. The impacts of majority of assessed future developments and projects are considered not to be directly attributable to the Tema LNG project, hence, presenting little or no directly significant negative impact.

8. MITIGATION/ENHANCEMENT MEASURES AND COMPLEMENTARY INITIATIVES

Mitigation measure are detailed in the ESMP and they include development of a basic environmental and social best practice presentation to go along with the site health and safety induction. Safety and health will also be maintained through doing pre-screening

for alcohol and substance abuse. Discoveries of any artefacts thought to be of cultural, archaeological or heritage significance is to be brought to the attention of the EM. Separate areas for the storage of hazardous or potentially polluting fuels / chemicals and hazardous waste shall have a bund, an impervious floor and shall accommodate 150% of the volume of the containers that will be stored within. These areas are to be suitably signposted, and secured to prevent unauthorised access. Hazardous substances shall be stored on an impermeable surface with a bund wall in a secure (locked) facility. A secure waste facility shall be provided away from neighbours for the overnight storage of domestic waste. For visual impacts, the choice of location for pipe yards and site offices / camps shall consider the visual impacts on neighbouring residents. The facility shall be animal and weather proof.

Stakeholders shall be kept abreast of E&S issues through on-going communication with regards to construction fronts affecting their properties, planned service / access disruptions, road deviations, and blasting or other dangerous activities. There shall be establishment of a complaints mechanism for all public complaints/concerns Contingency Plans for the evacuation of severely injured staff to designated medical facilities are to be determined. Regarding air quality, vehicles travelling to and from the construction site shall adhere to the speed limits so as to avoid producing excessive dust. To prevent fugitive air emissions, all valves, flanges, seals and connectors shall be monitored to ensure that they are air tight and the same for LNG storage tanks and ship loading systems. Vehicles transporting overburden, spoil or any extraneous material such as rock mixed with sand or fine grained materials are to have covered to prevent dangers to other road users (dust, falling sand / rocks). Clearing activities must only commence immediately prior to works to reduce the exposure of soils to wind / water, thereby reducing dust. Areas must be rehabilitated immediately after works.

Emergency procedures for fuel / oil / hazardous waste spills, or environmental pollutants shall be drawn up and communicated to all relevant stakeholders. Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site. All vehicle / plant is to be maintained in good working order, and vehicle service histories are to be kept up to date to reduce potential noise and air pollution from emissions. Should minor repair work occur *in situ*, they shall be conducted over drip trays / pans to prevent soil contamination. Spill kits are to be provided to contain and clean up any hazardous substance spillage. Soil stockpiles are not to be placed in road or municipal drainage systems, excavated soils are to be placed on the upslope of the trench to avoid any possible transport of soils into adjacent wetland areas. Topsoil and subsoil is to be stockpiled separately on site. Soil stockpiles must not exceed 4m in height, and topsoil stockpiles must not exceed 3m in height. If loose material stockpiles are likely to be exposed to extended periods of windy conditions or heavy rain, they shall be covered either by vegetation or appropriate material. No trees are to be cut solely for the purpose of providing firewood. Disturbance to any fauna is to be prohibited. No animals or their nests should be approached, disturbed, injured or killed.

The general approach for mitigating and managing potential cumulative impacts will require coordination of all relevant stakeholders including industries, enterprises and

agencies under the direction of the Ghana Government. Strategies to help manage potential future cumulative impacts will include but not limited to capacity building of local administration to plan effectively for future developments in the area; undertaking a structured programme of data gathering and monitoring studies for the proactive management of potential negative trends that could arise over time; and collaborating with Government and other relevant institutions to agree on common standards and approaches for the management of cumulative impacts.

As part of the Landfall designs, there is the addition of extra rip-rap and erosion protection to the shoreline even though the effects of sea-level rise are fairly negligible (Refer to section 2.5.3 of Volume 1). The marine infrastructure will be a floating unit on a spread-moor, which will be held in position using mooring chains. This arrangement works perfectly in highly directional met-ocean conditions as encountered offshore Ghana and also caters for sea-level rise that may result due to climate change.

9. EXPECTED RESIDUAL EFFECTS AND ENVIRONMENTAL HAZARD MANAGEMENT

LNG is natural gas in a liquid form. The natural gas is cooled to minus 259 degrees Fahrenheit (-162 degrees Celsius), where it becomes a clear, colourless, odourless liquid. LNG is neither corrosive nor toxic. When LNG is exposed to the environment or spilled, it will rapidly and completely evaporate leaving no residue in water or soil. The only health risks associated with LNG are cold burns and asphyxiation. Actions taken in response to a major chemical spillages shall include compilation and implementation of appropriate spill risk assessment, response and management plans.

10. MONITORING PROGRAM AND COSTS

A provisional budget for the proposed environmental monitoring programme is provided in the table below. This covers monitoring across the entire project footprint (both offshore and onshore). An estimated **Eighty Five Thousand US Dollars (USD 85,000)** will be required annually for undertaking project environmental monitoring.

Provisional Environmental Monitoring Budget

Environmental Component	Monitoring Site/Location	Monitoring Parameters	Frequency	Responsibility	Monitoring Cost/Year (USD)
Air Quality	FSRU area and Metering Station Area	NO_x, SO_x, CO_x, PM_{10}, TSP, VOCs, GHGs, Toxic metals, etc.	Monthly monitoring throughout life of Project.	HSE team / Environmental Manager	20,000
Noise Levels	FSRU area, Metering Station Area and Nearby Communities	Noise generating operations, Background Noise Levels	Monthly monitoring throughout life of Project.	HSE team / Environmental Manager	15,000

Effluent and Water Discharge Quality	FSRU Area, Construction Camp and Downstream of Metering Station Area	Effluent generation volume and rate, pH, temperature, Dissolved Oxygen, turbidity, oil/grease, DO, TDS, Chloride, Fe, Mn, Zn, Mg, Ni, Coliforms, *E. Coli*, legionella, spills/leakages inventory, etc.	Weekly and Monthly monitoring throughout life of Project.	HSE team / Environmental Manager	30,000
Land and Surface Water Pollution	Metering Station Area and Construction Camp, Offices	Volumes of waste streams generated, soil tests, water quality tests (pH, DO, Turbidity, TDS, BOD, COD, Coliforms, Heavy metals, etc)	Weekly and Monthly monitoring throughout life of Project.	HSE team / Environmental Manager	20,000
				TOTAL	**85,000**

In addition to monitoring there will be other cost related to environmental management as shown in the table below excluding project infrastructure or system management costs because it is expected that those will be part of the project's operational cost. The Project will be requiring yearly an amount of **One Hundred and Ninety Thousand US Dollars (USD 190,000)** or more for environmental management, more than half of which will be spent on monitoring and auditing which is necessary for ensuring compliance with all requirements (legal and others) pertaining to environmental, social, health and safety aspects.

Provisional Environmental Management Budget

Activity	Management Programme	Comments	Cost/Year (USD)
Auditing and Monitoring	Environmental monitoring	Conducted throughout the Project lifespan.	85,000
	Annual environmental audit	Reflects the overall performance of the Project	25,000
Reporting and Documentation	Environmental Management Plan Preparation	A requirement of LI 1652 and must be submitted to the EPA 18 months after project completion and every 3 years thereafter	40,000
	Annual Environmental Report	Annual submission to EPA in line with LI 1652 requirements	40,000
TOTAL			**190,000**

11. PUBLIC CONSULTATIONS AND PUBLIC DISCLOSURE

Stakeholder engagement was started during the scoping phase and continued throughout the assessment. The objective was to ensure that legislative requirements and project standards were met, that sources of existing information and expertise were identified and that stakeholder concerns were sourced and accurately addressed in the assessment. A public consultation and disclosure plan was first developed and adhered to. Stakeholders consulted included: Environmental Protection Agency– Head Office, Accra; Environmental Protection Agency– Ga East Office, Tema; Ministry of Fisheries and Aquaculture Development; Energy Commission; Volta River Authority; Ministry of

Energy and Petroleum (Petroleum and Power Directorate); Ghana Maritime Authority (GMA); Ghana Ports and Harbour Authority (GHAPOHA); Public Utilities and Regulatory Commission (PURC); Tema Municipal Assembly (TMA); Tema Development Corporation (TDC) and Kpone Katamanso District Assembly; Ningo Prampram District Assembly; Sunon Asogli Power Company; West Africa Gas Pipeline Company; CENIT Energy and CEN Power.

Stakeholder issues and concerns pertained to employment, business and procurement and the plan is to give as much business to locals as possible but taking into consideration the specializations required. Other issues raised and some of which will be taken into consideration in the ESMP include marine disturbance during construction; contingency plans for spillages; cumulative impacts with the West Africa Gas project because the stakeholders had information that the pipelines from offshore have caused negative impacts; the potential impacts and likely links with experienced turtle kills and brown algae (Sargassum) in the ocean; necessity for consultation with local fishermen groups to understand location of pipeline in relation to existing fishing areas; requests for transparent compensation process etc..

12. INSTITUTIONAL CAPACITIES AND STRENGTHENING PLAN:

The Project is subject to regulations implemented and enforced by the following government organisations:

Ghana's EPA is the principal authority for regulation and enforcement of environmental laws. The EPA is empowered by law to manage, control and monitor compliance of environmental regulations by specific industries. Being the lead EIA decision maker, the EPA is responsible for issuing environmental permits for relevant projects whose operations affect the environment. The Ghana National Petroleum Corporation (GNPC) is the national body established under the Ministry of Energy to promote, explore, develop and regulate Ghana's hydrocarbon resources and also partner foreign investors to promote the economic development. The Ghana Maritime Authority (GMA) is the national body responsible for monitoring, regulation and co-ordination of all maritime activities to ensure provision of safe, secure and efficient shipping operations and protection of the marine environment from the pollution from ships. The Ghana Ports and Harbours Authority (GPHA) is responsible for the planning, managing, building and operation of all Ghana's seaports including the Tema Port. The Ministry of Energy and Petroleum (MoEP) is responsible for developing and implementing energy sector policy in Ghana and for supervising the operations of a number of governmental institutions, including the GNPC. Ministry of Fisheries and Aquaculture Development (MOFAD) is the established Ministry responsible for policy formulation and implementation, management and control of the fishing industry. The Ministry of Defence–have the ultimate authority to police Ghanaian waters and enforce Ghanaian law. The National Defence Force is also available in emergency events such as major accidents offshore, such as oil spills etc. no capacity constraints have been identified.

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13. ESMP

Issue/Aspect	Objective/ Target	Mitigation/ Management Measure	Monitoring/ Verification	Responsibility
Environmental and Social Site Induction and training	To ensure that all site workers, receives induction training which is to include good environmental practice,	The EM is to develop a basic environmental and social best practice presentation to go along with the site health and safety induction. Training is to be done with all individuals on site during construction and operational phases. Environmental awareness posters must be used on site.	A signed acceptance and acknowledgement register verified during audits	EM
Personal Conduct	To prevent private property trespassing on site.	Permission to Occupy (PTO) and LOA copies are to be kept by site supervision to ensure no trespassing occurs. Trespassing is subject to disciplinary and legal action. The consumption of alcohol and drug usage by working staff is prohibited on site. Driving under the influence of either is subject to disciplinary action.	Copies of LOA's and PTO's kept on site by site supervisors. Site personnel's behaviour visually monitored and any deviations photographed and disciplinary action should ensue.	SHE & CM/CS
Biodiversity	To ensure sufficient biodiversity protection measures are in place	Any unauthorised disturbance or damage to open space areas or flora and fauna outside of the	Site engineers/ site agents/foreman are to ensure protection of identified species	Engineers and EM
Climate variability	To protect the infrastructure against sea level rise	Inclusion of extra rip-rap and erosion protection to the shoreline and construction of a floating marine infrastructure on a spread-moor, which will be held in position using mooring chains.	Site engineers to ensure construction compliance with designs and intended objective.	Engineers and EM
Cultural Heritage	Preservation of cultural heritage artefacts and resources.	Any persons found to be deliberately or negligently defacing, damaging, painting or marking natural features such as rock formations, will be subject to disciplinary action. Discoveries of any artefacts of cultural, archaeological or heritage significance is to be brought to the attention Competent authorities.	Monitored new discoveries and establishing 'No Go' areas during construction.	EM and EPA
Pipe-yard Location and Layout	To prevent pipeyards established in sensitive areas.	The layout plans for these yards are to be designed by the Consulting Engineers to minimise visual, dust and noise impacts on adjacent residents / businesses / activities. Pipe-yard layout design is to make provision for (where applicable): Access off the road network; stockpiling; delivery and machinery parking facilities and turning areas; emergency equipment storage areas including fire extinguishers and first aid kits;etc	Design engineers are to ensure that laydown areas are located away from sensitive receptors. The EM is to be consulted when selecting pipe laydown areas.	The Client, Consulting Engineers and the EM
Site Office / Camp Location	To prevent establishment in environmentally sensitive areas & ensure adequate ablution facilities, fresh water etc. Maintain compliance with H&S practices & legislation.	Site camp/office location choices are to be approved by the Consulting Engineers and the EM; be easily accessible from existing road infrastructure; be such that visual, dust and noise impacts on adjacent residents / businesses / activities are minimized. If the Contractor chooses to locate the site office on private land, prior written permission from the land owner is required. .	Contractors site agents/Project Managers/ Engineers are to liaise with the EM and Client to approve any temporary/permanent site camp.	EM and Client
General Waste and Hazardous Substance Facilities	To prevent hazardous substance spillages, ensure responsible disposal and waste stream separation.	Separate areas for the storage of hazardous or potentially polluting substances; concreted flooring and bunds to accommodate 150% of the volume of stored volume; prevention of unauthorised access. Available overnight storage of domestic waste that is animal and weather proof. Demarcated skips are to be placed at the site office area to promote waste segregation and recycling.	Upon initial site setup, contractor to ensure compliance & the EM is to inspect for waste separation & spillages on a weekly basis and inform the contractor of any steps that need to be taken.	EM and the Contractor.

Impact	Objective/ Target	Mitigation/ Management Measure	Monitoring/ Verification	Responsibility
General Awareness.	All contractors are to be familiar with the relevant bylaws regarding health and safety. Prevent injuries and public disturbances.	All activities undertaken on this project are to be in compliance with the relevant legislation and general Code of Conduct compiled by the client and contractor. The Contractor is responsible for on-going communication with interested / affected parties with regards to construction fronts affecting their properties, planned service / access disruptions, road deviations, and blasting or other dangerous activities. The establishment of a complaints mechanism for all public complaints/concerns.	The contractors SHE team is to ensure that complaints mechanisms are up to date and all complaints recorded. All complaints are to have close out actions and dates.	Contractors SHE team Verification by the EM.
Reporting Procedures.	To ensure full compliance with legal & other requirements and ensure all incidents (health, safety and environmental) are recorded, reported and closed out.	The establishment of an environmental incident report file (EIRF). The EIRF is to be filled in by the Contractor in the event of an environmental incident or accident. The contractor is to immediately inform the EM and site engineer of any environmental incident and request remedial assistance if needed. Emergency contact details for the local hospital, fire brigade, and police department and relevant authorities to be posted in the site office near a telephone.	The EM is to alert relevant authorities if needed and ensure that the incident is closed out. The ECO is to document any incidents / emergencies in the monthly audit, together with the remedial action taken.	Contractor's SHE team Verified by EM on a monthly basis
Emergency Plans and Equipment	To implement plans and procedures for an emergency situation e.g. fire, injury on site, pollution of a water course, major spillage etc	Evacuation Plans are to be determined by the Contractor and explained to all staff. These plans are to be appropriately displayed. First Aid Kits are to be strategically placed. Contingency Plans for the evacuation of severely injured staff to designated medical facilities are to be determined. Emergency procedures for fuel / oil / hazardous waste spills, or environmental pollutants are to be determined. Spills are to be cleaned immediately and the contaminated soils disposed of in accordance with legislation at a licensed hazardous waste disposal facility. Any soil that cannot be removed is to be treated *in situ* as determined by the EM. Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site	EM to verify with the contractor that procedures are in place. The contractor to ensure that emergency contact lists are updated regularly	EM to verify that procedures are in place.
Vehicle and Plant Storage, Management and Maintenance while on site	To prevent any potential theft of plant and machinery. To prevent spillages on site. To prevent any spillages from refuelling/plant failure occurring on site. To manage plant and vehicle breakdown, refuelling and maintenance on site.	All plant is to be stored within the designated secure area of the site office when not in use. No unauthorised access to the machinery is permitted. If any vehicles / machinery are refuelled on site, then refuelling is to be undertaken at the designated dispensing area in the construction site office / camp area, designed to prevent or contain any pollution. Machinery and vehicles service histories shall be serviced to reduce potential noise and air pollution from vehicle emissions; and a leak detection system for GHG emissions shall be implemented where there is methane storage or passage. All vehicles and plant are to be provided with a service pan to be used to trap fuel leaks in the event of a breakdown. Only very limited vehicle / plant maintenance and basic repair is permitted on site. This is to occur only in the designated area of the site office / camp, unless not practically possible. Should minor repair work occur *in situ*, it is to be conducted over drip trays / pans to prevent soil contamination Vehicles transporting overburden, spoil or any extraneous material such as rock mixed with sand or fine grained materials are to have covered loads to prevent dangers to other road users (dust, falling sand / rocks Spill kits are to be provided to contain and clean up any hazardous substance spillage on site	All incidents are to be recorded in the EIRF. Plant and vehicle service records are to be kept on file. Visual inspection of the contractor's site camp/storage area by the EM to ensure compliance.	EM to verify EIRF recordings

Hazardous Substance incidents	The development and implementation of the Emergency Preparedness and Response Plan (EPRP	Ensure specific procedures are in place to address spill events during all the phases of the project. For example, a specific procedure for fuel spillages and another response procedure for any bitumen spill. Update and maintain the EPRP as the contract progresses from construction to operational phases. Provide all employees with spill training or assign designated individuals/team to manage all incidents in a specific area on site. Inspect and assess hazardous substance storage areas as a preventative measure. Write up a method statement for hazardous substance management and dispensing on site. The EPRP is to have adequate mitigation and notification measures dealing with spillages which may affect nearby communities. Compile reports of any incidents on site to try and establish a trend.	Annual review of the EPRP. Ad-hoc on site spill training and emergency spill response drills (i.e. spill simulation drill and clean-up). Quarterly inspection of hazardous substance storage areas to ensure no leaks/spills. Ensure notification details of relevant parties are updated on a regular basis during the construction phase (linear projects are progressive and affect different communities during construction). Analyse spill reports and implement measures to prevent spills	EM and Construction Managers
Stockpile locations	To ensure that stockpiles are not in close proximity to any sensitive environmental receptors. To ensure that stockpiles do not become public nuisances	Stockpiles of any kind are restricted to the pipeyards, site office / camp areas and the working corridor. The locations of stockpiles are to consider environmental concerns such as proximity to water bodies, and social concerns such as visibility requirements or dust issues. Stockpiles are not to be placed in a manner that obstructs vehicle visibility or drivers' line of site, especially when working near intersections and sharp corners. Stockpiles are not to be placed in a manner that is visually displeasing. Where possible, stockpiles should be created in areas out of view of neighbouring residents or passing traffic. Where this is not possible, unsightly stockpiles should be screened. Stockpiles should not be situated such that they obstruct natural water pathways, in the direct flow path of surface water, near streams, rivers or wetlands, or immediately adjacent to dust hotspots. Materials are not to be stored in unstable/high risk areas e.g. floodplains or on steep slopes. Soil stockpiles are not to be placed in road or municipal drainage systems. When working in or around drainage lines and seepage areas, excavated soils are to be placed on the upslope of the trench to avoid any possible transport of soils into adjacent wetland areas	Site Engineers are to be consulted prior to stockpile areas being created.	Contractor to implement and EM to monitor

Stockpile Management	The contractor is to develop a Stockpile Management Plan (SMP) to implement on site.	Topsoil and subsoil is to be stockpiled separately on site. Soil stockpiles must not exceed 4m in height, and topsoil stockpiles must not exceed 3m in height. If loose material stockpiles are likely to be exposed to extended periods of windy conditions or heavy rain, they should be covered either by vegetation or cloth (short timeframe). Stockpiled soil should also be protected using erosion-control berms / bunds if exposed for more than 14 days during the wet season. Stockpiles should be kept clear of weeds and alien invasive vegetation growth by regular weeding, or herbicides if permitted (restrictions on herbicide use for topsoil stockpiles is to the discretion of the EM) Stockpiled soil must allow for adequate drainage. The soil stockpile gradients are not to exceed the soils natural angle of repose, and no hazardous slopes are to be created. Vehicles /plant are to be prohibited from driving across or onto topsoil stockpiles, as this will result in compaction and damage to the soil structure Topsoil is to be handled twice only, once to strip and stockpile, and once to replace, level, shape and scarify Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from different sites of different soil types must not be mixed.	Monthly inspections of stockpiles to ensure there is no weed colonisation.	Contractor and EM to verify
Waste Practices:	To ensure responsible waste disposal during construction activities. To ensure a clean, healthy and safe work area for all employees. To ensure residents property alongside the working servitude are not being used as illegal dumpsites. To ensure waste streams are separated into general and hazardous waste. To try and encourage recycling of material on site e.g. recycling of spoil for bedding material.	Designated facilities for builder's rubble, hazardous waste, and general waste as provided for in the site office areas are to be used for the storage of the appropriate waste products. Provision must be made for waste receptacles to be placed at intervals along the working corridor at the active fronts to prevent littering. Animal and weather proof bins designed to prevent the wind from blowing out the litter are to be strategically placed on site. The pipeyards, site offices, working corridor or any other area associated with this project are to be kept free of litter - the site shall be cleared of litter at the end of each working day. Bins are to be emptied into skips in the designated waste storage areas every night. The refuse in the skips housed within the waste storage areas is to be regularly disposed of at appropriate waste disposal and recycling facilities. Waybills or certificates proving disposal at approved facilities are to be retained for audit inspections. The entire works area must be cleared of all pieces of wire, metal, wood, concrete fragments or other foreign matter to the natural environment before rehabilitation commences. Builder's rubble is to be regularly removed from the working corridor, and stored in the appropriate location of the site office / camp until it is disposed of at a suitable waste disposal facility. Burying or burning of builder's rubble is prohibited. A sump must be created for concrete waste. This is to be de-sludged regularly and the waste is to be removed to an approved facility. Contaminated soil must be treated as hazardous waste and must be stored in sealed bags / containers in the hazardous waste areas (bunded), and disposed of at a permitted hazardous waste disposal site, and the area rehabilitated immediately Hazardous waste is to be contained and transported as required by the relevant legislation, and is to be labelled and stored in sealed drums or approved containers in the designated hazardous waste areas of the site offices until it is disposed of at a licensed hazardous waste facility. The hazardous waste area is to be kept under lock and key Burying or burning of hazardous waste is prohibited. Waybills or certificates proving disposal at permitted hazardous waste disposal facilities are to be retained for audit inspections. Septic tank systems and chemical toilets are to be hygienically serviced and maintained, and waste is to be collected and disposed of by an appropriate service provider	Monthly inspections of waybills to ensure responsible disposal. Daily monitoring by the contractors SHE team to ensure waste separation is taking place.	The contractors SHE team and EM to audit monthly.

		All chemical / fuel / oil spills must be contained and cleaned up by the supplier or professional pollution control unit. All liquid waste (spent oils, fuels, hazardous chemicals, and domestic liquid wastes) is to be stored in sealed and labelled drums or approved containers in the designated hazardous waste area of the construction camp until it is disposed of at the appropriate waste disposal facilities. Contaminated sand and water from wash slab drainage and repair areas, work-rags and waste fuel / oil is to be disposed of at an appropriate wastewater or hazardous waste facility. All vehicles / plant must be parked or serviced in the designated area of the site office. All vehicles are to be equipped with pans / drip trays for emergency repair on site, the contents of which are to be treated as liquid waste. Waybills or certificates proving disposal at permitted wastewater or hazardous waste disposal facilities are to be retained for audit inspections		
Social Considerations	Taking into account the public and those living close to the work area. Keeping I&APs informed of construction proceedings	**Public interaction** The general public are to be notified of the overall project, and the immediately affected parties are to be notified and informed of the activities that will directly affect them, their properties or their livelihoods. Appropriate sign boards and notices are to be displayed where required in all areas of the project activities. Health and Safety notices are mandatory. Permission to occupy (PTO) private land must be obtained before any works commence on the properties in question. Similarly, authorisation is required from landowners prior to accessing properties for any activities. All I&APs must be informed in advance of any known potential social, health or environmental risks associated with the project or activity areas. Warnings regarding dangerous activities must be issued timeously, especially with activities such as blasting. **Noise impacts:** Noise is to be kept to a minimum when constructing near homesteads/public areas. Plant is to ensure that silencers are fixed, operational and well maintained. Notice of particularly noisy activities must be given to residents / businesses adjacent to the construction site. Examples of these include: noise generated by jackhammers; blasting; drilling; dewatering pumps. All staff are to adhere to the Code of Conduct, and shall prevent unnecessary vocal or other noise (loud music) wherever possible. Acoustic barriers are to be utilised in the vicinity of schools, hospitals, residential complexes that are sensitive to noise nuisances **Visual Impacts:** The choice of location for pipe-yards and site offices / camps should consider the visual impacts on neighbouring residents / activities, and the layout of these sites should be mindful of the visual impacts to the surrounding areas. Storage facilities, stockpiles, elevated tanks and other temporary structures on site should be located such that they have as little visual impact on local residents and passing traffic as possible. Some activities may require visual screening in the form of shade cloth or other suitable materials. Similarly, active fronts must be screened when the working corridor is immediately adjacent to residencies or visually sensitive activities. Lighting should be angled downwards and inwards (focused in on the site activity) to avoid disturbance to immediate neighbours and passing traffic. All above-ground infrastructure associated with the pipeline must not be visually displeasing **Air Pollution and Dust**	The contractor is to ensure that an auditable public notification process is in place i.e. letter drops, text message services, posters, emails etc. The contractors CLO is to ensure open lines of communication with I&APs at all times	The contractor and CLM

		Vehicles travelling to and from the construction site must adhere to the speed limits so as to avoid producing excessive dust. Loads in transport are to be covered or netted to prevent dust and material from falling out of the vehicles, posing a hazard to other road users. Access roads and other cleared surfaces must be dampened whenever possible and especially in dry and windy conditions to avoid excessive dust. Dust must be suppressed during dry periods by the regular application of water or a biodegradable soil stabilisation agent. Water (of suitable quality) used for this purpose must be used in quantities that will not result in runoff and erosion, or muddied areas. If dust is unavoidable, screening will be required utilising wooden supports and shade cloth or hessian. No fires allowed on site except for the burning of firebreaks. Clearing activities must only commence immediately prior to works to reduce the exposure of soils to wind / water, thereby reducing dust. Areas must be rehabilitated immediately after works **Disruption of Infrastructure and Services:** Existing services and infrastructure are to be traced and proven prior to any works commencing, thereby reducing potential accidental disruptions. Should the construction staff be approached by members of the public or other stakeholders with regard to disruption of services, they should assist them in locating the Engineer or Contractor, or provide a number on which they may contact the Engineer or Contractor. The conduct of the construction staff when dealing with the public or stakeholders shall be in a manner that is polite and courteous at all times. The Contractor is to inform affected parties in writing of planned disruptions at least 24 hours beforehand.		
General Pipe Installation Activities	To ensure a safe work environment for site staff and the general public. To ensure quality standards are maintained when installing pipes. For the contractor to maintain best environmental practices while on site	No access into any barricaded area shall be allowed to anybody other than construction workers and members of the project team who have undergone a site induction course. The Contractor shall ensure that access at ends where vehicles have to enter and exit, are controlled. Bridges for vehicles and/or pedestrians shall be provided along the route of the work as and where may be considered necessary by the Engineer. Where construction is in, or across, public roads, barricades or barriers and temporary road signs shall be erected. All such signs and positioning thereof shall comply with the requirements of the local roads authority. Should security fences of adjacent properties require temporary relocation during construction, the landowner is to be notified. Vegetation to be cleared along steep banks should only be removed at the onset of the construction of that area, or immediately prior to landscaping, to reduce soil erosion to the site. No trees are to be cut solely for the purpose of providing firewood. Disturbance to any fauna is prohibited. No animals or their nests should be approached, disturbed, injured or killed. The process of excavation and backfilling must be carried out as a sequential process following one another as quickly as possible for progressive construction. Excavations must only remain open for a minimum period of time, and during this time they must be clearly demarcated. Measures must be taken to prevent any interference that could result in flashover of power lines due to breaching of clearances or the collapse of power lines due to collisions by vehicles and equipment. All tall structures must be properly earthed and protected against lightning strikes. Measures must be taken during thunder storms to protect workers and equipment against lightning strikes. All sites are to be reinstated to a state equivalent to or better than before construction	The contractor is to abide by all aspects of this ESMP. The EM is to audit the contractor on a monthly basis.	EM

14. CONCLUSION

The proposed mitigation and management measures to be implemented during the project design, installation and operation phases are deemed adequate in ensuring that all positive project impacts are enhanced and all negative impacts of major significance or high priority can be avoided and impacts of moderate and low significance reduced to as low or negligible as practicable levels. The ESIA observed no issues of highly negative significance that could not be mitigated such that the proposed project may not be acceptable from an environmental and socio-economic perspective. The major positive project impact related to economic aspects such as increased income generation opportunities from direct and indirect job creation at local, regional and national levels. The positive influence of the project on employment and economic impacts are considered to remain of high significance with enhancement measures. Negative impacts identified were also found not to present any detrimental effect on the environment as the project is assessed to likely generate moderate to negligible negative impacts. The severity of any of the negative impacts evaluated could be reduced to acceptable levels though the mitigation measures proposed. It is believed that the nature of the project, that is, it being a floating sea facility that is grounded through a mooring facility and gas transportation pipeline systems minimizes impacts on key aspects such as marine currents, sand deposition and removal rates on the coast, effluent generation, perturbation of the vegetation cover and effects on the habitat.

15. REFERENCES AND CONTACTS

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