Republic of Ghana

MINISTRY OF TRANSPORT

GHANA PORTS AND HARBOURS AUTHORITY

REVISED FINAL
ENVIRORNMENTAL IMPACT STATEMENT (EIS)

Environmental and Social Impact Assessment (ESIA) Studies on Port Infrastructure Development, including Dredging, at Takoradi Port, Western Region

SAL Consult Limited, P O Box GP20200, Accra, Ghana
in association with Royal Haskoning DHV, Nijmegen, Netherlands

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EXECUTIVE SUMMARY

Introduction

GPHA is carrying out a Port Infrastructure Development, including Dredging at the Port of Takoradi (The Project). GPHA was established as a statutory corporation in 1986 under the PNDC Law 160 manage the ports of Tema and Takoradi as well as the fishing harbours. The GPHA falls under the auspices of the Ministry of Transport (MoT), which has the delegated responsibility to ensure that a good transport system plays the needed crucial role in the socio-economic development of Ghana. In a 2002 report on The Development Study of Ghana Sea Ports in the Republic of Ghana prepared by OCDI of Japan and Nippon Koei Co Ltd and sponsored by JICA, the following development principles were adduced for the Port of Takoradi viz. to:

- function as the main export port of commodities produced in Western Ghana such as manganese, bauxite, cocoa and timber;
- function as an import port of commodities consumed in western Ghana such as foodstuffs and consumer goods; and
- support industrial development and agriculture by providing necessary facilities for import of materials and export of manufactured goods and crops.

With the emergence of oil and gas industry in the Western Region of Ghana, it has become even more urgent to upgrade the Takoradi Port infrastructure to meet the demands of the emerging cluster of port businesses. The improved infrastructure at the port will also enhance PPP ventures. The PPP concept, which is a key government economic reform agenda and strategy to increase private sector involvement in infrastructure and public services delivery reflects the desire of GoG to improve the quality, cost effectiveness, and timely provision of public infrastructure and services in Ghana.

Justification for the Project

In Ghana there are two major ports, the Port of Tema and the Port of Takoradi. These two ports have fulfilled important roles. Port of Tema serves as the main import port of the whole Ghana and an export port of the East of Ghana and the Port of Takoradi mainly as an export port of the West Ghana. However, a lack of deep berths, low working rate of Cargo handling equipment and physical and functional decrepitude of port facilities have made it difficult for these ports to efficiently handle the rapidly increasing volume of cargoes.

The Takoradi Port was originally built to handle timber, mineral ore, cocoa, cereals and other non-containerised or non-unitised exports. GPHA estimates that activity of oil services vessels will increase tremendously in the near-future, thereby prompting the need for a port facility that offers the vessels buoys. Currently there is pressure on the facilities at the Port of Takoradi forcing some investors and personnel of the oil exploration companies to use the Navy base and the Air Force base for accommodation purposes.

The proposed Port Infrastructure Project will not only benefit the oil sector but the transport of bauxite, clinker, manganese, limestone and cocoa, which form part of the planning and reorganization of infrastructure at the Port of Takoradi.

The Scope of the Proposed Project

The key priority areas identified for development and improvement include:

- Provision of a dedicated bulk ore and oil services terminals;
- Construction of breakwaters;
- Dredging and reclamation;
- Construction of quay walls, and where appropriate, strengthening of the existing quay walls in the port;
- Cargo handling and berthing furniture at all the respective berths;
- Bulk ore storage areas;
- Relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the ports;
- Upgrading of ports' access roads, entry and exits; and
- Coastal reclamations and the possible resettlement of, where affected, local fishing communities and/ their practices and businesses.

Alternatives Analysis

The number of alternatives considered at this stage of implementing the project were:

- constructing new port dedicated to oil and gas services
- site selection options; and
- no development/ action option.

The alternatives analysis confirms that the selection of the Port of Takoradi for expansion works is a more sustainable option to improve on its ageing facilities and that with the increasing activities in Port of Takoradi especially in the oil and gas sector, the no development option will stifle the vision and mission of GPHA, which will ultimately lower outputs and decrease revenues.

Description of the Existing Environment

Location

The project is located at the Port of Takoradi in the Sekondi-Takoradi Metropolis. The port is located at a cape on the Gulf of Guinea on longitude 4°52'60.00"N and latitude 1°43'60.00"W, with the western part formed with a rock or reef while the northern coast is sandy beach. The slope of the sea bottom is about 1% judging from about 10m fall in 0.9km distance from the shoreline. The main breakwater is located on the southern side of the port and extends about 1.5km offshore in the eastwards direction and extending further in a north-north-east direction to a distance of about 0.7m.

Climate

There are two rainfall seasons in the Sekondi-Takoradi area. The first wet period is from March to July and the minor wet season from September to November. A dry spell occurs in between these periods during the month of August. The mean annual rainfall is in the region falls between 1,200mm – 1,500mm. Relative humidity is generally high, varying from 60% - 87% in the afternoon to 90% - 99% at night/ mornings. The maximum mean monthly night-time temperature occurs between March and April, with a peak of 25.5^{0}C in April and a minimum 21.9^{0}C occurs in July. Monthly temperature distribution exhibits little seasonal variation throughout the year with a range of only 4°C. Wind speeds along the coast of Ghana range between 8km/hr and 16.1km/hr. September is the windiest month of

the year and the wind direction changes only slightly each day throughout the year in the south-west direction.

Seismicity

Generally, Ghana is a stable land mass, and features very low seismic activity. Exception is the coastal region of Ghana, 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. For all the earthquakes which have occurred in the country, the epicentres were located along the coast, in the area surrounding Accra, the Regional Capital, and Cape Coast and surrounding areas. These areas suffered comparative minor damages.
The project area is located within the coastal region, hence the recommendation for the structural design to take into account possible imposition of seismic stresses.

Tide Levels and Tidal Current

The tide in Ghana has semidiurnal pattern with two high and two low tide levels each day. It is estimated that the velocity of the tidal current is generally less than 0.1m/s but could go up to 0.5m/s.

Bathymetric Conditions

A few important features can be seen in the new bathymetry:

- For the total area there is a gentle slope from -15 mCD to 0 mCD (coastline)
- Clear set of N-S oriented sandbars in the zone between -11 mCD and -16 mCD
- A number of narrow NW to NE oriented slightly curved ridges in the zone between -11 mCD and -5 mCD.

Geological Conditions

Two distinct rock types are present in the harbour area, which were identified as (i) Rock Type A and (ii) Rock Type B. Rock Type A is made up of strongly lithified arkosic sand and occur in the south and west of the port while Rock Type B is said to be a carbonate cemented quartz sandstone, grading into sandy clay and occur in the northern part of the port

Water and Sediment Quality

Water quality studies of the port basin revealed moderately polluted conditions. Therefore management of oil spill and leakage should take the first priority for water quality management in the Port of Takoradi. Similar to the water quality assessment, bottom sediment quality also revealed heavily polluted conditions in the entire port area showing severe pollution both in organic matter and heavy metals, with COD and Lead and Mercury. The implication is that dredging and consequent disposal of the dredged silt will require careful consideration to prevent contamination.

Littoral Drift

In the port area, considerable sand accretion has occurred along the main breakwater. The accreted sand seems to have come from the southern end of the port.

Air Quality

Previous air quality studies in and around the port showed no major variation from what pertains in the metropolis although the nuisance from dust released from the clinker operations by GHACEM generally pollute the immediate surroundings of that area in the port. Similarly, the manganese jetty and cocoa

shed area also have excessive dust levels though within the EPA Ambient Air Quality Guideline (AAQG) values.

Aquatic Biota

There are no significant aquatic species endangered or academically valuable that has been encountered in the port basin.

Road Traffic

There are three access roads to the port, two fairly big roads and a smaller one. Lines of articulated vehicles and trucks parking and waiting for the loading / unloading of goods were often observed on the main access roads, though they occupy an estimated no more than 10% of total traffic volume. The speed limit within the port is 30km/hr.

Waste Management

The solid waste at the port premises is usually garbage generated by calling vessels and port users including visitors. It is estimated that averagely, about 5 tons of solid waste is generated per month. The solid waste is currently managed by Zoom Lion Company Limited, a waste management firm for disposal at STMA designated landfill site.

Sewage is generated on board vessels and by the port users including visitors. The waste management division of the Port of Takoradi has two sewage disposal tankers for the purposes of siphoning sewage from vessels on request for disposal at STMA designated disposal sites. These tankers are also responsible for collection of sewage from designated points in the port.

Oily wastes generated by calling ships are collected into skips and given to Messrs Zoil, who operates an approved oily waste management facility in the Sekondi-Takoradi Metropolis. Zoil is also able to handle the treatment of oil based mud cuttings from oil & gas drilling operations.

Another thermal desorption plant to also handle the treatment of oil based mud cuttings from oil & gas drilling operations installed by SWACO at the port is yet to be operational.

Oil Spill Management

In the event of an oil spill, the port is able to mobilize at short notice pumps and skimmers for mopping up the spill. Recently, skimmers and pumps have been provided by Tullow Oil and Zoil to handle any oil spillages.

Consultations and Key Stakeholder Concerns

Consultations have been held with some stakeholders and groups as part of the information gathering on environmental and socio-economic issues as follows:

- EPA Regional Office – Sekondi;
- EPA, Head Office – Accra;
- GPHA, Head Office – Tema;
- GPHA, Regional Office – Takoradi;
- Unicontrol Comodity Ghana Ltd at the Port;
- Sekondi-Takoradi Metropolitan Assembly (STMA); and
- Opinion Leaders and Representatives of Fisher folks of New Takoradi.

Among the key issues are congestion at the port, housekeeping and resettlement of some fisher folk activities at the Fisheries Department Workshop Area. The workshop itself may have to be relocated or incorporated into the proposed project due to its strategic location on a natural slipway at the eastern fringes of the port.

Potential Benefits of the Project

The potential benefits to GPHA and Ghana in general will be a modernized port offering employment opportunities to the citizenry and generating the required revenues for socio-economic development.

Potential Environmental Issues Identification

The nature of the proposed project, field inspections and observations, concerns from stakeholder consultations and issues from relevant literature search formed the basis for the identified potential environmental issues and impacts associated with the project, which include:

- Dredged materials management;
- Air emissions;
- General waste reception;
- Wastewater;
- Solid waste management;
- Hazardous materials and oil management;
- Noise; and
- Biodiversity.

Impact Mitigation and Management

Mitigation and management measures proposed are presented in Table below as part of the EIA study. 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.

Mitigation Measures for Potential Preparatory Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Preparatory Phase Impacts
Disturbance and Livelihood Isues	Local Community	GPHA will put in place measures in collaboration with the Ghana Maritime Authority (GMA) to facilitate the compensation proceedings to ensure that all affected parties especially the fisher folk at New Takoradi are promptly compensated/ resettled by provision of alternative landing site off the bauxite sidings. No community will be resettled but only their activities and berthing area around the fisheries department workshop will be reclaimed for port operations and this will affect their livelihoods. It is noted that the reclamation of the coastline will be tackled during the latter stages of the proposed project and will therefore afford GPHA and the EPC contractor adequate time to fashion out resettlement options for the fisheries department workshop and the boat berthing area. The available options under consideration include relocating the existing workshop and berthing area to Albert Bosumtwi-Sam Fishing Harbour in Sekondi or building a new landing site with berthing facility for bigger vessels at New Takoradi beach. A framework Resettlement/ Compensation Plan is provided as **Annex 8.**

Proposed Mitigation Measures for Potential Constructional Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Construction Phase Impacts
Marine Pollution and Impact on Aquatic Life	Marne environment	"Best management practices" (BMPs) will be required in order to contain and minimize any impacts. Messrs Jan De Nul, will bring to bear their vast experience with dredging to ensure the BMPs are abided by. Sediment loading in the harbour waters during construction of breakwater and quay walls, as well as dredging/blasting activates, may have temporary impacts, but use of BMPs will ensure that any impacts are minimized to the extent practical. • Dredging and placement of rock materials for the breakwater will be done within a short space of time and 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. (Annex 11 provides a detailed Dredging Management Plan). • Well maintained pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area. Any observed or detected leaks will be repaired as soon as practicable. Pumping will stop if a major rupture is identified (within the operational constraints of the equipment). • The operation of the dewatering process within the existing reclamation area (e.g. internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment. On observation • GPHA will require the contractors, Messrs Jan de Nul, to prepare a spill prevention and control plan 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. • Messrs Jan De Nul will be required to implement suspended sediment control if turbidity levels 150m from the construction area exceed above background levels significantly i.e. 10 NTUs. Measures such as reducing dredger delivery rate or ceasing operation, where necessary will be employed when turbidity is detected to exceed the limits. • Messrs Jan De Nul will also carry out detail geotechnical assessment of the port basin including sediment analysis before actual construction commences. Contaminated sediment will be scooped and appropriately disposed of at the approved disposal site of the STMA at Sofokrom. • In addition, shore protection measures such as carefully placed groins and rivets should be erected to protect the nearby shores from expected increased erosion.
Impacts from Accretion/Erosion/Tidal/ Wave Impacts	Eastern Coast/marine environment	
Occupational health and safety hazards/ Public and Traffic safety	Workers/ Local communities and road users	<u>Adoption of Health and Safety Policies</u> It is the policy of GPHA and for that matter the Port of Takoradi to establish and maintain high standards of occupational health, safety and environmental protection at work, so as to prevent personal injury or illness, property damage, fires, security losses and environmental pollution.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		The health, safety and environmental protection at the workplace objectives defined in this policy statement have equal status with all other primary business objectives. The responsibility for implementing this policy lies directly and personally with management through to employees. This is summarized in the Port's Occupational Health and Safety Policy (October 2005) objectives *viz* to: • 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; • establish regulatory and organizational framework for the efficient and effective management of occupational health, safety and environment issues in the Ports; • maintain safe plant, machinery and equipment in the Ports; • maintain safe and healthy work place for all Port workers and Port users • maintain incident and injury-free working environment in the Ports; • prevent occupational related diseases/ illness among Port workers; and • promote and maintain a clean, healthy and hygienic environment in the Ports of Ghana. (**see Annex 9 for the Occupational Health and Safety Policy Document**) GPHA 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 Environment and Estates Manager will ensure compliance with the Health and Safety Policy. GPHA will operate has a hospital outside the Port for use by workers. First aid centers will be set up at the construction areas manned by trained first aiders to treat minor ailments and cuts. However, major cases will be referred to the Port Hospital, which is within 2km of the port for treatment or referral to Effia Nkwanta Hospital. <u>Use of Experienced Personnel</u> GPHA will ensure that well-trained workers are engaged to operate any heavy machine or equipment. 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		GPHA will ensure that regular defensive driving training sessions are organized for the drivers to ensure their safety and the safety of the general public. <u>Provision of Personal Protective Equipment (PPE)</u> GPHA will ensure that workers are provided with the appropriate personal protective equipment such as safety boots, rain-coats, hand gloves, earplugs and nose masks. Supervisors will be mandated to ensure the use of these protective devices and to implement sanctions when necessary. <u>Phasing out of Material Movements/ Scheduling Material Movements</u> 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 port at any given time to reduce the risk of accidents. GPHA intends to carefully plan materials movement to minimise these impacts. Materials and equipment will be transported to the sites during daylight, from 6am to 6pm. <u>Use of Road Worthy Vehicles</u> Good conditioned cargo vehicles will be used to avoid any breakdown along the roads. Regular and scheduled maintenance will be done on such vehicles to reduce noise nuisance and smoke emissions, which could otherwise affect public health and safety. <u>Transport of Some Boulders on Barges</u> It is expected to reduce traffic in the Sekondi Takoradi Metropolis by sourcing boulders from the Shai Hills area about 30km from the Port of Tema for onward transport on barges to Takoradi for the breakwater construction
Air Pollution	Workers/ Local communities and road users	• Dust, emissions, will be controlled and minimized by the use of designated truck routes in order to minimize impacts to residents, construction workers, port workers/users and institutions along the RoW . • The proposed road construction and road upgrade works will be done using mitigation and control techniques, such as standard dust suppression measures through dampening of unpaved surfaces. • Speed of vehicles over any unpaved landscape will be controlled to minimise dust generation. Materials dumping will be regulated to reduce dust emissions.
Noise Nuisance	Workers/ Local communities and road users	GPHA will employ standard noise abatement measures and engineering best practices to ensure that the impact of these issues minimized and reduced to acceptable limits. • GPHA will ensure that earthworks and other construction activities will be phased out or controlled to reduce noise generation during construction. • New equipment will be used and properly maintained to reduce noise generation.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• Ear muffs will be provided for workers where necessary.
Waste generation and disposal problems	Workers	As per the IFC General EHS Guidelines, waste materials generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, will be treated and disposed of at permitted facilities specially designed to receive the waste, in order to avoid potential impacts to human health and the environment. In line with this, any unsuitable dredge material/ settled sediment/ mud which has been characterized to be low in heavy metals and PAHs/ BTEX concentration, will therefore be disposed of at the STMA approved engineered landfill site at Sofokrom. The Sofokrom landfill has approximately 36 ha of surface area and is located 9km onward to Accra from the Project site. It has the capacity of accommodating all types of wastes, including industrial hazardous wastes, except for the medical wastes, up until year 2025. The landfill operates in line with the IFC EHS Guidelines for Waste Management Facilities, e.g. garbage is presorted by three categories - solid wastes, liquid wastes and industrial hazardous wastes. <u>General Waste (non-construction waste)</u> Adequate waste bins will be provided at the temporary work-camps to minimise littering of the sites. The collected refuse will then be transferred to the GPHA and STMA approved disposal site at Sofokrom. Management has entrusted with the management of waste within port to private entities who collect and transport the waste on daily basis. GPHA will continue with this arrangement during the construction period. Management will supervise the process. <u>Construction Waste</u> • All scraps or other solid wastes will be collected and disposed of at the approved disposal site of the STMA. • Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction and also for reclamation if found to be suitable. • Contaminated soil/spoil will be considered as waste material and disposed of accordingly at the STMA approved disposal site. • All metal scraps will be sold out to third party agents for use by metal companies. Paint containers will be given out to paint manufacturers to be reused. <u>Dredging</u> • The dredged spoil which will come in a form of slurry would not be more than 30% by volume of sediment material. The water will be drained back to the ocean where it originated and the spoil used for reclamation of portions of the log pond and the northeastern coast of the port between the fisheries department workshop and New Takoradi Beach.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• Contaminated settled sediment/ mud will however be disposed at the STMA Sofokrom landfill site after investigating the metal composition to ascertain their concentrations (see Annex 11 for Dredging Management Plan).
Sanitation and hygiene	Workers	• Adequate waste bins will be provided at the temporary work-camps at the construction site to minimize littering. GPHA will ensure that waste generated is disposed of at the STMA landfill site. • Toilet and washroom facilities will be provided for workers in general to discourage "free-range" defecation and its attendant health problems. Workers will also be educated to use the waste collection and washroom facilities to be provided on site.
Traffic Impacts and Public Safety Challenges	Workers/Public	<u>Restriction of Access</u> GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area. <u>Use of warning signs</u> Uncovered trenches or deep excavations will be protected using indicator linings or picture 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. <u>Scheduling of Work</u> The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods. <u>Announcement and Notification of Work</u> The STMA 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. GPHA 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. <u>Transport of Equipment and Materials</u> Traffic impacts resulting from carting of equipment and materials (e.g. quarry materials) to the port expansion site from local quarry sites will be limited to only selected port bound roads. In consultation with the Police Motor Transport and Traffic Unit (MTTU), 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		. 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: • All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and MTTU; • Haulage of materials including quarry products to the port area will be limited to off-peak hours; • Trucks transporting quarry products and other friable materials to the port will be covered; • All trucks conveying materials to the port will carry appropriate warning signals such as red flag and rotating amber lights; • Road worthy dump trucks will be used; • Very experienced drivers will be engaged; • Traffic wardens will monitor dump truck movements and ensure public and traffic safety; and • Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks. • In an unfortunate incident of any truck failure, such trucks will be towed within 24 hours.
General Disturbance of Port Operations	Port users	• GPHA will elicit the assistance of the GMA and representative bodies of the port users to provide adequate warning to port users on the schedule of work to be carried out to ensure their operations are not unduly disturbed.

Proposed Mitigation Measures for Potential Operational Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Operational Phase Impacts
Contamination of Marine Environment	Marine environment	• GPHA will ensure that the likelihood of oil spills are reduced to the barest minimum through regular monitoring and audits of vessels being used. • storm drainage will constructed such that they do not discharge directly into port waters, using containment basins in areas with a high risk of accidental releases of oil or hazardous materials (e.g. fueling or fuel transfer locations), and oil / grit or oil /water separators in all runoff collection areas. Oil / water separators and trapping catch basins should be maintained regularly to keep them operational. • GPHA will ensure that the waste reception facilities for the collection, storage, treatment and transfer of waste at the port are utlisied by vessels arriving at the port. The Captains will be adequately informed of this. • Where necessary, Installing filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the port water • The GPHA 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, • Maintenance dredging will be controlled to reduce turbidity to the minimum possible. • GPHA will utilize will continuously conduct education campaigns for other port users to ensure the proper maintenance of vessels to prevent leakage, as well as indiscriminate disposal of waste in the port waters. • GPHA has establishment 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. • Punitive measures will be enforced for all persons observed to throw waste into the port waters. • 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
Introduction of Invasive Marine Pest Species	Marine water	<u>Ballast water</u> GPHA to 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. These strategies include • Treating ballast to remove or render inert any harmful organisms. • Exchanging coastally sourced ballast mid-ocean or in deep water and where required • Minimising uptake of organisms into ballast tanks • Routine maintenance of ballast tanks to remove sediments • Avoiding unnecessary ballast discharge, particularly when in port; using discharge to the waste reception facility at the port for treatment and disposal

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Biofouling 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: • Using anti-fouling systems appropriate to a ship hull and activity • Applying appropriate operational management practices to reduce the development of biofouling (e.g. maintaining seawater intake system cleaning) • 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 • 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 • 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 inwater 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 • GPHA to ensure effective dissemination of information of relevance to biofouling management to ensure appropriate biofouling management systems are implemented by all vessels
Impacts from Accretion/Erosion/Tidal/ Wave Impacts	Marine/ Shoreline	GPHA will liaise with the Ministry of Water Resources, Works and Housing to provide some coastal protection structures at the New Takoradi Beach and at Nkontompo to eliminate any potential erosion of the coastline. While accretion would occur along the breakwater. Threatened fish landing site at New Takoradi should be protected with coastal protection structures.
Air Pollution	Workers/ Port users	• Measures to be implemented to reduce air pollution will include the use of sysems such as mechanized cargo handling system, closed conveyor systems, covered or regular dampening of dusty cargo storage yards, closed silos, closed evacuation of dusty cargo from the ship to storage silo, direct loading of dusty cargo from the silo through electronic chute in the truck, dust suppression system, closed truck or covered truck etc. • GPHA will ensure the necessary institutional arrangements with port users for air quality monitoring within the port are in place to ensure the ambient air quality is within the maximum permissible limits of the NAAQG. • The export & import of the cargo will generally be handled by a number of exporters, importers and local transporters. The port managers will ensure the necessary safeguards are put in place during the cargo handling and transportation to reduce air emissions. • Develop a regular maintenance programme of the system to ensure that ambient levels of particulate emissions are within permissible level • Install appropriate valves, flanges, fittings, seals etc to reduce fugitive emissions from fuel installations

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
Waste Generation and Disposal Challenges	Workers/Port user	Education campaigns • GPHA will utilize the Port community network to continuously conduct education campaigns for all port users to ensure the proper disposal of waste. Waste Collection and Disposal • GPHA will provide and enforce the use of waste collection bins throughout the port area to reduce the incidence of indiscriminate disposal of waste in the port area. The collected wastes shall be transferred to the Port Waste Reception and Treatment Facilities • Picture/symbolic signage will be provided throughout the port area to alert and encourage port users to utilize waste collection bins provided. • Private entities will continue to be contracted to ensure the efficient final disposal of waste at designated dumping site of the STMA.

Occupational health and safety	Workers	Training in chemical handling
		GPHA will 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.
		
		Provision of appropriate PPEs
		GPHA 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.
		Emergency Provisions
		• GPHA will develop and implement an emergency response plan to handle all emergency situations 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.
		• Emergency shower and fire hoses will be installed and maintained, especially at the berths handling Crude Oil and Petroleum Products, Naphtha and Chemicals, fertilizer etc..
		• A comprehensive maintenance programme will be put in place to avert any serious breakdowns or failures. The required maintenance for the systems will include among others:
		  ○ Environmental incident/accident investigation;
		  ○ Carry out mock oil spill response drills
		  ○ Routine equipment maintenance/inspection schedule;

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		○ Annual equipment inspection and maintenance record; ○ Procedure for pre-arranged repair service; ○ Procedure for preventive maintenance; ○ Procedures for handling materials; and ○ Regular calibration of equipment. • Management will ensure a minimum harbour water depth is controlled and periodically measured to ensure the safety of fishing vessels using the harbour. <u>Housekeeping</u> 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.
Traffic Impacts and Public Safety Challenges	Workers/Public	• Traffic signal lights will be located at the junctions of access roads to the Port and the existing trunk roads. Speed limit signs and directional signs will be located at vantage points along these roads to guide road users. • GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the port area. • Trucks transporting friable materials to the port will be covered; • Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks. • The necessary linkages with rail will be created to enable its utilisation when the rail system is improved.
Emergency situations	Workers/ Local communities	• GPHA will develop and implement an emergency response plan to handle all emergency situations including fire, and oil spills that will arise from all its operations to minimize any hazards to humans and the environment. Management will ensure regular review of the plan. • GPHA will ensure that the likelihood of oil spills and fire outbreaks are reduced to the barest minimum through regular monitoring and audits of third party facilities and equipment. Procedures will be specified to detect and contain any leak if it did occur and define methods for clean up and disposal.
Security Risk	Port Users	• GPHA superintends over the Ghana Maritime Security Act and the Shipping Act. The Takoradi Port has a security plan in place as mandated by SOLAS and the ISPS code,to deal with maritime security threats. The plans are based on the current infrastructure, and will be updated to incorporate the master plan, as per the Maritime Security Act. • As per the plan, GPHA shall provide security to passengers, crews, and personnel in port through measures such as access control

Provisional Environmental Management Plan

Management of the port shall ensure that responsibility and tasks regarding the environment are well defined and will be followed through. Environmental matters shall be integrated in operational and maintenance decisions. The port shall secure a satisfactory level of environmental protection through planning, developing and management according to relevant national legal requirements. It will ensure that environmental information is made available for relevant stakeholders such as the EPA, GMA, GNFS, and users of the port**.**

Port of Takoradi recognises its responsibility to users of the proposed facility and employees, and will do all that is reasonably practicable to ensure their health, safety and security at the premises. Management is committed to a high level of worker health and safety as well as a safe and secure work environment in order to achieve a zero or minimal accident rate during the construction and operation of the project.

The measures that will be put in place to ensure sound environmental management requirements include:

- Formation of Environmental and Safety Committee;
- Staff Training and Education Programme;
- Environmental/ Safety Communication Programme;
- Compliance with Statutory Obligations; and
- Provision for Environmental Management Budget.

Conclusions

GPHA through its EPC contractors will carry out the project at the Port of Takoradi in accordance with Ghanaian as well as International standards governing development projects of this nature. The major environmental, safety issues and impacts associated with the Project during both construction and operation stages have been identify and mitigation measures provided.

1.0 INTRODUCTION

1.1 Background

The Ghana Ports and Harbours Authority (GPHA) is the national authority which manages the ports of Tema and Takoradi as well as the fishing harbours. It was established as a statutory corporation in 1986 under the PNDC Law 160 to succeed the then Ghana Cargo Handling Company (GCHC), Takoradi Lighterage Company (TLC), and Ghana Ports Authority (GPA). The GPHA is therefore responsible for the operation, management, and administration of the ports of Ghana and has ambitions to make the ports the maritime hub of the West African sub-region.

The law established the GPHA as a statutory government corporation and defines the Boards and function of the GPHA, the assets made available to it, the staff and its personnel and the financial arrangements of the GPHA. The GPHA falls under the auspices of the Ministry of Transport (MoT), which has the delegated responsibility to ensure that a good transport system plays the needed crucial role in the socio-economic development of Ghana.

In a 2002 report on The Development Study of Ghana Sea Ports in the Republic of Ghana prepared by the Overseas Coastal Area Development Institute (OCDI) of Japan and Nippon Koei Co Ltd sponsored by the Japan international Cooperation Agency (JICA) for GPHA, the following development principles were adduced for the Port of Takoradi viz. to:

- function as the main export port of commodities produced in Western Ghana such as manganese, bauxite, cocoa and timber;
- function as an import port of commodities consumed in western Ghana such as foodstuffs and consumer goods; and
- support industrial development and agriculture by providing necessary facilities for import of materials and export of manufactured goods and crops.

With the emergence of oil and gas industry in the Western Region of Ghana, it has become even more urgent to upgrade the Takoradi Port infrastructure to meet the demands of the emerging cluster of port businesses.

The GPHA is therefore proposing to develop the infrastructure at the Port of Takoradi which will include dredging of the port basin. The improved infrastructure at the port will also enhance Public Private Partnership (PPP) ventures at the Port of Takoradi. The PPP concept, which is a key government economic reform agenda and strategy to increase private sector involvement in infrastructure and public services delivery reflects the desire of Government of Ghana (GoG) to improve the quality, cost effectiveness, and timely provision of public infrastructure and services in Ghana.

The proposed project is the Port Infrastructure Development, including Dredging at the Port of Takoradi. The key priority areas identified for development and improvement include:

- Provision of a dedicated bulk ore terminal and oil services berth;
- Construction of breakwaters;

- Dredging and reclamation;
- Construction of quay walls, and where appropriate, strengthening of the existing quay walls in the port;
- Cargo handling and berthing furniture at all the respective berths;
- Bulk ore storage areas;
- Relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the ports;
- Upgrading of ports' access roads, entry and exits; and
- Coastal reclamations and the possible resettlement of, where affected, local fishing communities and/ their practices and businesses.

The purpose of the project is to improve the infrastructure base at the Port of Takoradi in order to:

- eliminate the current draft restrictions that lead to time consuming barge operations;
- enable the port improve on the efficiency of handling dry bulk cargo- export of manganese and bauxite and import of clinker; and
- enable the port provide the required space and services to the oil and gas industry.

In keeping with statutory regulations of the country and in line with the Ghana Environmental Assessment (EA) procedures, GPHA registered the proposed project with the Environmental Protection Agency (EPA). The EPA in a response letter referenced CI: 2050/01/02 and dated 20th June 2012 as shown in **Annex 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 Environmental Assessment Regulation (EAR) 1999, LI 1652. **Annex 2** shows the Scoping Notice, which was published to allow for public comments on the proposed project in line with LI 1652. **Annex 3 and 4a** show the EPA response on the Scoping Report and the Draft EIS respectively.

The final EIS for the proposed project was reviewed by the Overseas Private Investment Corporation (OPIC), who requested for a revision of the EIS to meet the requirement pf the Agency. This document constitutes the revised final report for submission to the OPIC. The comments of the Corporation and the sections they have been addressed are added as **Annex 4b.**

1.2 Purpose and Aim of the EIA

The purpose of the EIA is to address possible direct and indirect significant environmental and social impacts of the project during construction as well as operation of the project. The EIA also seeks to obtain an environmental permit for the execution of the project by complying with statutory provisions under Legislative Instrument (LI) 1652 including meeting EPA requirements.

SAL Consult Limited and Haskoning DHV have been engaged by GPHA to carry out the EIA Study for the proposed project.

1.3 Objectives of the EIA

The specific objectives of the EIA study are to:

- Provide adequate description of the project and identify activities of environmental/ social concerns;
- Establish the baseline environmental conditions;
- Predict and examine all the significant environmental impacts on the surrounding environment and organizations/ communities during demolitions, reconstruction and dredging activities as well as during operation of the facilities to be provided and advise on appropriate mitigation and abatement measures against potentially adverse impacts; and
- Assess the socio-economic and cultural benefits and disadvantages associated with the project for an informed decision to be made on the level of environmental compromise and permitting by relevant stakeholders.

1.4 Methodology and Approach for the EIA Study

The methodology and approach for the EIA study involved:

1.4.1 Field Studies

Field inspections and visits were undertaken to the project site and nearby harbour areas to confirm the project area of influence, existing socio-economic and cultural conditions as well as existing bio-physical and marine environment including:

- Hydrography and geotechnical conditions;
- Geology of the area;
- Seismicity of the area;
- Near-shore and marine ecology;
- Climate of the area;
- Topography and relief of the area;
- Air quality; and
- Present shoreline uses.

1.4.2 Consultations

One-on-one stakeholder consultations were carried out to obtain comments and concerns on the proposed project with some key stakeholders and are as provided in Chapter 7. A public consultation meeting was also organized in Takoradi to elicit concerns and suggestions from the public/ stakeholders on the proposed project and the report of the meeting is provided as **Annex 5**.

Consultations with stakeholders identified some important environmental and socio-economic issues and impacts that have been addressed in the EIA. Scoping notice has been published to inform the general public about the proposed project as required under the procedure for the conduct of EIA in accordance with Regulation 15 (1) of LI 1652.

1.4.3 Literature Reviews

Information from relevant documents from the GPHA, EPA Head office library, Environmental Consulting firms in Accra and other documents on Integrated Coastal Zones Management were of immense help to the EIA study. Key documents reviewed for this study included:

- Documents from the project implementers on scope of the project i.e., Summary of Takoradi Port Development and Takoradi Port Profile;
- 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 the Ministry of Finance and Economic Planning (MoFEP);
- Information from some relevant environmental reports relating to the ports expansion/improvement projects within the country and other projects in the STMA;
- Strategic Environmental Assessment Report (SEA) for the Port of Tema;
- 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); and
- Internet sources.

1.5 EIS Format

The Environmental Impact Statement (EIS) organisation and contents which is in line with EPA format covered the following major headings:

a) An Executive Summary;
b) Introduction;
c) Legal Framework
d) Proposed Project Description;
e) Description of Environmental and Social Baseline Conditions;
f) Potential Impact Identification;
g) Evaluation of Potential Impacts;
h) Proposed Mitigation and Management Measures;
i) Environmental Monitoring Measures;
j) Provisional Environmental Management Plan;
k) Conclusion;
l) Bibliography; and
m) Annexes.

1.6 Sources of Issues addressed in the EIS

The main issues addressed in the Environmental Impact Statement (EIS) include:

- Significant issues and impacts identified during the Scoping study and as presented in the Scoping Report to the EPA;
- Stakeholder concerns;
- EPA review comments on the Scoping Report; and
- Other matters as provided under Part II of LI 1652 under regulation 12.

2.0 LEGAL FRAMEWORK OF THE PROJECT

GPHA is committed to comply with the international and national policies, laws and regulations relevant to its operations. These include the World Bank's environmental and social safeguards policies, the International Finance Corporation (IFC) Performance Standards, and Environmental, Health, and Safety (EHS) General Guidelines and EHS Guidelines for Ports and Harbors. International Maritime Conventions.

It must be noted that the scope and intent of the international policies/standards such as the IFC Performance Standards are addressed in the Ghana's environmental and social regulatory framework presented in this Chapter. These include the National Environmental Policy, the Environmental Protection Act, the Environmental Assessment Regulations etc.

2.1 World Bank Environmental and Social Safeguard Policies

The World Bank's environmental and social safeguards policies covering ten (10) key categories in a form of Operational Policies (OPs) are operationalised when triggered by the proposed project's scope. The policies/procedures are to ensure the safe development of projects it is funding. That is to prevent and mitigate unintended adverse effects on third parties and the environment in the development process. These Environmental and Social Safeguard Policies are discussed briefly in **Table 1** and an indication of whether the WB policy is triggered by the proposed Tema Port Expansion Project is included.

Table 1: Summary of World Bank Safeguard Policies

No	*World Bank Safeguard Policy*	*Summary of core requirements*	*Potential for Trigger under proposed project*	*Remarks or recommendation for proposed project*
1	**OP 4.01 Environmental Assessment**	Requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects. It categorises proposed projects into categories A, B, C or FI based on the extent of adverse impacts anticipated from the project.	Triggered	This ESIA is GPHA's response to the Bank's EA policies and guidelines to identify and address the adverse environmental and social impacts.

No	*World Bank Safeguard Policy*	*Summary of core requirements*	*Potential for Trigger under proposed project*	*Remarks or recommendation for proposed project*
2	**OP 4.04: Natural Habitats**	Do not finance projects that which would lead to the significant loss or degradation of any Critical Natural Habitats. Supports projects that affect non- critical habitats only if no alternatives are available and if acceptable mitigation measures are in place. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water areas where most of the native plant and animal species are still present).	Not Triggered	The proposed project Is within the existing port area. No critical habitats identified at the proposed project location. Critical Natural Habitats include those natural habitats which are either (i) legally protected, (ii) officially proposed for protection, or (iii) unprotected but of known high conservation value.
3	**OP 4.36: Forest**	Aim is to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development. Support sustainable and conservation oriented forestry. Do not finance projects that involve significant conversion or degradation of critical forest areas.	Not triggered	Project location and design will not affect any critical forests.
4	**OP 4.11: Physical Cultural Resources**	Investigate and inventorise cultural resources potentially affected. Include mitigation measures when there are adverse impacts on physical cultural resources or avoid if possible	Not triggered	Proposed project Is within the existing port area. No cultural resources have been identified.
5	**OP 4.12: Involuntary Resettlement**	Assist displaced persons in their effort to improve or at least restore their standards of living. Avoid resettlement where feasible or minimise. Displaced persons should share in project profits. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.	Potentially triggered	No resettlement envisaged from the proposed project. Disturbance and livelihood issues envisaged

No	*World Bank Safeguard Policy*	*Summary of core requirements*	*Potential for Trigger under proposed project*	*Remarks or recommendation for proposed project*
6	**OP 4.10: Indigenous Peoples**	Screen to determine presence of indigenous peoples in project area. Policy triggered whether potential impacts are positive or negative. Design mitigation measures and benefits that reflect indigenous peoples' cultural preferences.	Not triggered	No indigenous groups have been identified within the project's area of influence.
7	**OP 4.37: Safety of Dams**	Requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures through the project cycle. The policy distinguishes between small and large dams by defining small dams as those normally less than 15 meters in height. Large dams are 15 meters or more in height.	Not triggered	Proposed does not involve the construction of a dam
8	**O P 4.09: Pest Management**	Rural development and health sector projects have to avoid using harmful pesticides. A preferred solution is to use Integrated Pest Management (IPM) techniques. If pesticides have to be used, the Bank-funded project should include a Pest Management Plan (PMP)	Not triggered	The proposed port expansion does not involve the use of pesticides.
9	**OP 7.50: Projects on International Waterways**	Ascertain whether riparian agreements are in place, and ensure that riparian states are informed of and do not object to project interventions.	Not triggered	Proposed site is neither a bay, gulf, strait, or channel bounded by two or more states nor a necessary channel of communication between the open sea and other states
10	**OP 7.60: Projects in Disputed Areas**	Ensure that claimants to disputed areas have no objection to proposed project.	Not triggered	The area to be developed is owned by the GPHA.

2.2 IFC Performance Standards and Equator Principles

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:

Table 2: Summary of IFC Performance Standards

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger under the proposed project	Remarks or recommendation for proposed project
1	***Assessment and Management of Environmental and Social Risks and Impacts***	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 established an effective ESMS, which ensures stakeholders/community participation and grievance redress mechanisms.	Potentially triggered as project will impact on both biophysical environment, and socio-cultural and livelihood.	ESIA will identify and assess expected impacts and devise workable ESMS to address identified issues
2	***Labor and Working Conditions of workers***	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.	Potentially triggered as project will involve considerable labour force. Worker's safety and congeniality of workers condition will be very cardinal in the successful project execution and acceptability	The project will take into consideration appropriate worker interest, welfare and safety measures during implementation
3	***Resource Efficiency and Pollution Prevention***	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.	Potentially triggered due to the anticipated use of heavy equipment in the marine environment, as well as the anticipated increase in port traffic	Mitigation measures in ESIA to address various issues of pollution in the marine environment and air quality.

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger under the proposed project	Remarks or recommendation for proposed project
4	***Community Health, Safety and Security***	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.	Potentially triggered as construction activities from road upgrade may pose risks to affected communities	The ESIA to address the potential impact on community health, safety and security
5	***Land Acquisition and Involuntary Resettlement***	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.	Not triggered	No resettlement envisaged from the proposed project. Disturbance and livelihood issues envisaged
6	***Biodiversity Conservation and Sustainable Management of Living Natural Resources***	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.	Potentially triggered due to the anticipated use of heavy equipment in the marine environment, as well as the anticipated increase in port traffic	ESIA to address impact on marine life
7	***Indigenous People***	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.	Not triggered	No indigenous people on the project site or within the project communities of influence
8	***Preservation of Cultural Heritage***	Client must protect cultural heritage from the adverse impacts of project activities and support its preservation. Clients should also promote the equitable	Not triggered	Proposed project Is within the existing port area. No cultural resources have been identified.

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger under the proposed project	Remarks or recommendation for proposed project
		sharing of benefits from the use of cultural heritage.		

In addition to meeting the requirements under the Performance Standards, clients must comply with applicable national laws, including those laws implementing host country obligations under international law.

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), and apply globally to development projects with a capital cost of US$10 million or more in all industry sectors. 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 of July 2006 is fully consistent with recently revised IFC Performance Standards. Currently, over 60 financial institutions have adopted the Equator Principles.

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 (2006) and (b) that the project will implement appropriate measures for the management of environmental, social and health issues during construction, operation and decommissioning phases.

By adopting the Equator Principles, financial institutions undertake to review carefully proposals for which their customers request project financing. They commit not to provide loans to projects where the borrower will not, or is unable to, comply with the requirements of the IFC Performance Standards.

2.3 Relevant National Legislation

The relevant Ghanaian environmental and other statutory laws and regulations to guide GPHA from design of the proposed project up to implementation and monitoring include the following:

- Ghana Ports and Harbours Authority Law 1986, PNDC Law 160;
- Ghana Investment Promotion Centre Act 1994, Act 478;
- Environmental Protection Agency Act 1994, Act 490;
- Environmental Assessment Regulations 1999, LI 1652;
- Fees and Charges (Amendment) Instrument, 2011, LI 1986;
- Ports Regulations, 1964, LI 352;
- Factories, Offices and Shops Act 1970, Act 328;
- Factories (Docks Safety) Regulations, 1960;
- The New Labour Act 2003, Act 651;
- The Fire Precaution (Premises) Regulations 2003, LI 1724;
- Ghana Maritime Authority Act 2002, Act 630;
- Ghana Shipping Act 2002, Act 645; and
- Oil in Navigable Waters Act 1964, Act 235.

2.3.1 Ghana Ports and Harbours Authority Law 1986, PNDC Law 160

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:

- provide in a port facilities as appear to it to be necessary for the efficient and proper operation of the port;
- maintain the port facilities and extend and enlarge any such facilities as it shall deem fit;
- regulate the use of any port and of the port facilities; and
- 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.

The law further stipulates that the GPHA could, in addition to the above functions and subject to the provisions of the law, carry on such activities as it deems necessary for the discharge of its functions. These include to:

- carry on the business of pilotage;
- supervise stevedoring, lighterage and container services, where these are provided by persons other than the authority;
- operate tugs, dredgers and other craft for towerage, salvage, fire-prevention and protection of life;
- supply water to shipping, and generate and supply electricity;
- license small ships to lie, ply for hire or otherwise be used within a port upon such terms and conditions as the authority may deem fit;
- control the erection and use of wharves, groynes, stairs or stages in any port or its approaches;

- enter into any agreement with any person (i) for the supply, construction, manufacture, maintenance or repair by that person of any property which the authority may require for the efficient discharge of its functions under this law, and (ii) for the operation or provision of any port facilities which the authority by this law is empowered to operate or provide;
- appoint, license and regulate stevedores, master porters to operate in the container terminals; and,
- establish pilotage districts, direct that pilotage shall be compulsory in any such districts, license pilots for work in such districts and establish pilotage boards and specify their duties including the duty of inquiring into the conduct of pilots.

The law thus charges the GPHA to maintain and deepen as necessary the approaches to the port and also to provide cargo storage/ handling facilities such as container terminals and warehouses.

2.3.2 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 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...".

2.3.3 Environmental Protection Agency Act 1994, Act 490

The Environmental Protection Agency (EPA) Act 1994 (Act 490) gives mandate to the Agency to ensure compliance of all investments and undertakings with laid down Environmental Assessment (EA) procedures in the planning and execution of development projects, including compliance in respect of existing ones.

2.3.4 Environmental Assessment Regulations 1999, LI 1652

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 commencement of the project.

The Environmental Assessment Regulations (EAR) 1999, LI 1652, enacted under the provisions of the EPA Act 1994, lists activities for which an Environmental Assessment (EA) is mandatory. Under Schedule 2 Regulations 3 (10) of the EAR (1999), the proposed Port of Takoradi development project falls under the undertakings for which an Environmental Impact Assessment (EIA) is mandatory as it is expected to result in an appreciable increase in port handling capacity.

2.3.5 The Fees and Charges (Amendment Instrument, 2014 (LI 2216)

The Fees and Charges (Amendment) Instrument, 2014 (LI 2216) gives regulation to the fees and charges (Miscellaneous Provision) Act 2009, Act 793. The law provides a comprehensive rates, fees and charges collectable by Ministries, Department and Agencies (MDAs) for goods and services delivered to the public. The instrument 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.

2.3.6 Factories, Offices and Shops Act 1970, Act 328

The Factories, Offices and Shops Act of 1970 (Act 328) requires all proponents to register every factory/workplace with the Chief Inspector of Factories Inspectorate Division. The Act makes provision of among others, the notification of accidents/dangerous occurrences including safe passages and the prevention of fires etc. The Act compliments the provisions made in the Factories (Dock Safety) Regulations 1960, LI 86.

2.3.7 The New Labour Act 2003, Act 651

Section 118(1) of the New 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.

2.3.8 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.

2.3.9 Ghana Maritime Authority Act 2002, Act 630

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.

2.3.10 Ghana Shipping Act 2003, Act 645

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.

2.3.11 Oil in Navigable Waters Act 1964, Act 235

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.

2.4 Relevant International Conventions

Ghana is signatory to the following International Maritime Organization (IMO) Conventions:

- International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78);
- International Convention on Standards of Training, Certification, and Watch-keeping for Seafarers (STCW), 1978;
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention Convention), 1969;
- Convention on Limitation of Liability for Maritime Claims (LLMC), 1976;
- Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972;
- International Convention for the Safety of Life at Sea (SOLAS), 1974;
- UN Convention on the Law of the Sea (UNCLOS);
- Basel Convention on Shipment of Trans boundary waste
- RAMSAR Convention (formally, the Convention on Wetlands of International Importance, especially as Waterfowl Habitat), 1975; and
- Convention for Co-Operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region.

A number of the provisions and guidance outlined in the MARPOL Convention are relevant to marine activities, including general requirements over the control of waste oil/engine oil discharges and grey and black waste water discharges. In addition, a number of the Annexes of the Convention are relevant such as Annex V (Prevention of Pollution by Garbage from Ships) and Annex VI (Prevention of Air Pollution from Ships).

Internationally, there are a number of Conventions that address the issues relating to marine environment protection. These are broadly categorised into Liability and Compensation Conventions and Marine Environment Protection Conventions.

<u>Convention on Civil Liability for Oil Pollution Damage (CLC)</u>

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.

UN 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.

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.

Basel Convention on Shipment of Trans Boundary Waste

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.

International Convention on Standards of Training, Certification, and Watch-keeping for Seafarers (STCW), 1978

The Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed. The Convention contains basic requirements which are then enlarged upon and explained in the STCW Code. Part A of the Code is mandatory, and as such will be required of all seafarers during the operational phase of the Port Infrastructure development for the Port of Tema . The minimum standards of competence required for seagoing personnel are given in detail in a series of tables. Part B of the Code contains recommended guidance which is intended to help Parties implement the Convention.

Convention for Co-Operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region

The objective of this convention is to protect the marine environment, coastal zones and related internal waters falling within the jurisdiction of the States of the West and Central African region. Parties to this convention agree to take all necessary measures to prevent, reduce, combat and control pollution of the Convention area (art. 4), particularly pollution from ships and aircraft (arts. 5 and 6), land-based sources (art. 7), and activities relating to exploration and exploitation of the sea bed (art. 8) and pollution from or through the atmosphere (art. 9). They undertake to prevent, reduce, combat and control coastal erosion (art.10) and protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other marine life in specially protected areas (art. 11). Parties are to co-operate in dealing with pollution emergencies in the Convention area (art. 12), and in exchanging data and other scientific information (art. 14). Moreover, they undertake to develop technical and other guidelines regarding environmental impact

assessment of their development projects (art. 13) and establish roles and procedures for the determination of liability and the payment of adequate and prompt compensation for pollution damage of the Convention area (art. 15).

2.5 Legal Boundaries of the Ocean

The proposed project will be in the territorial waters of Ghana as illustrated in **Figure 1**. The UNCLOS has set limits, navigation, archipelagic status and transit regimes, exclusive economic zones (EEZs), continental shelf jurisdiction, deep seabed mining, the exploitation regime, protection of the marine environment, scientific research, and settlement of disputes. The convention set the limit of various areas, measured from a carefully defined baseline. The areas are as follows:

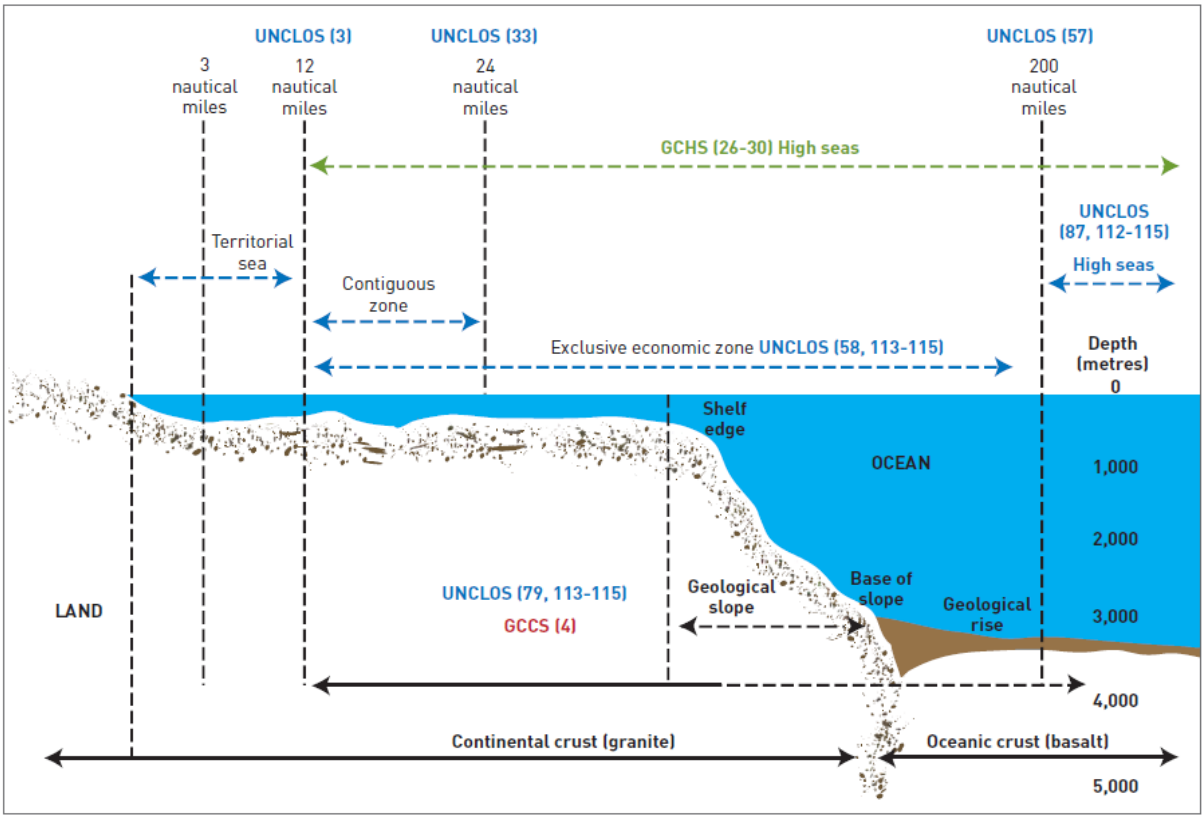
Internal waters
It covers all water and waterways on the landward side of the baseline. The coastal state is free to set laws, regulate use, and use any resource. Foreign vessels have no right of passage within internal waters.

Territorial waters
Out to 12 nautical miles from the baseline, the coastal state is free to set laws, regulate use, and use any resource. Vessels were given the right of innocent passage through any territorial waters, with strategic straits allowing the passage of military craft as transit passage, in that naval vessels are allowed to maintain postures that would be illegal in territorial waters. "Innocent passage" is defined by the convention as passing through waters in an expeditious and continuous manner, which is not “prejudicial to the peace, good order or the security” of the coastal state.

Contiguous zone
Beyond the 12 nautical mile limit there was a further 12 nautical miles or 24 nautical miles from the territorial sea baselines limit, the contiguous zone, in which a state could continue to enforce laws in four specific areas: pollution, taxation, customs, and immigration.

Exclusive economic zones (EEZs)
This zone extends from the edge of the territorial sea out to 200 nautical miles from the baseline. Within this area, the coastal nation has sole exploitation rights over all natural resources. In casual use, the term may include the territorial sea and even the continental shelf. Foreign nations have the freedom of navigation and over flight, subject to the regulation of the coastal states.

Continental shelf
The continental shelf is defined as the natural prolongation of the land territory to the continental margin’s outer edge, or 200 nautical miles from the coastal state’s baseline, whichever is greater. Coastal states have the right to harvest mineral and non-living material in the subsoil of its continental shelf, to the exclusion of others. Coastal states also have exclusive control over living resources "attached" to the continental shelf, but not to creatures living in the water column beyond the exclusive economic zone.



Source: D. Burnett

Figure 1 Legal Boundaries of the Ocean from Territorial Sea to Exclusive Economic Zone and onto the High Seas (figures in parenthesis refer to treaty articles)

2.6 Other International Law Principles

The following other International Law Principles have been considered in this scoping study:

- Polluters Pay Principle (PPP);
- Principle of Intergenerational Equity;
- Sustainability;
- Best Available Technology Not Entailing Excessive Cost (BATNEEC).

2.7 Ensuring Safe Port Environment for Growth

Legislation and guidelines concerning occupational health and safety, waste and pollution management, etc., have also been addressed in this EIS. These include:

- EPA Quality Guidelines for effluents, noise, water quality, air quality; and
- National Oil Spill Contingency Plan.

The various legislations provides guidance for the establishment of an integrated approach to building a safe and attractive port environment for businesses to grow and flourish by supporting actions that mitigate or eliminate environmental risks and liabilities and promote the environment as an economic driver towards international standards of best practice. It encourages waste management and resource management; encourage a market-based

approach towards the adoption of international health, safety, environmental and security (HSES) standards; promote sustainable traffic management; landscaping and regeneration of derelict areas.

These desired outcomes will be achieved using the following types of activity:

- Interventions to encourage waste and resource management facilities;
- Encourage businesses to make more effective and efficient use of resources and to minimise the amount of waste produced;
- Investments in increasing resource efficiency and waste management;
- Encouraging safe, clean and sustainable transport;
- Removal / demolition of make shift structures and environmental improvements of derelict buildings for economic use, with the possibility for associated limited site decontamination and reclamation; and,
- Improvement of the physical environment and improving habitats and facilitating biodiversity.

3.0 DESCRIPTION OF EXISTING PORT FACILITIES AND ACTIVITIES

Ghana has two main sea ports located in Takoradi in the Western Region and Tema in the Greater Accra Region of Ghana. **Figure 2** is a map of Ghana showing the locations of the two ports.

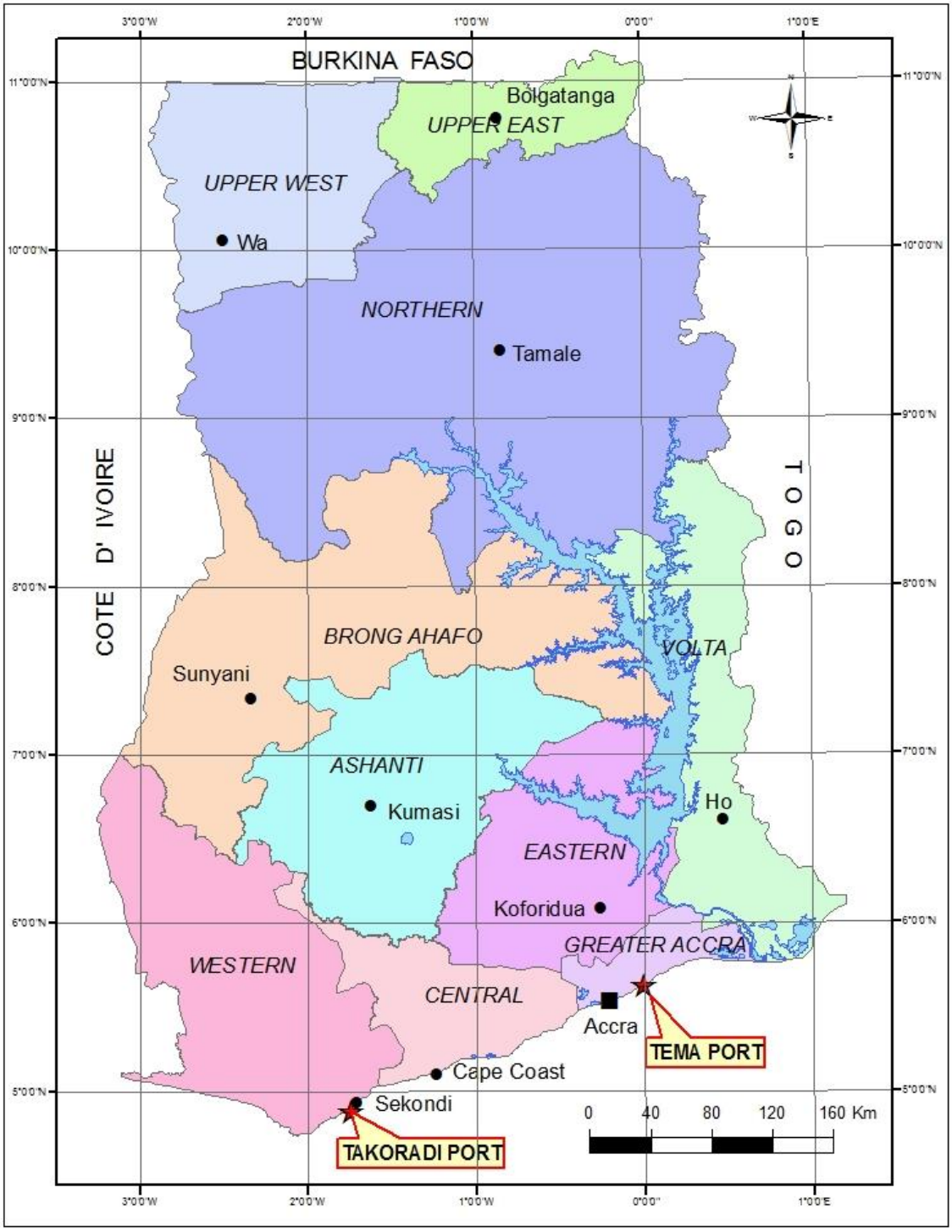


Figure 2: Map of Ghana showing the Ports of Takoradi and Tema

3.1 Project Location

The Port of Takoradi is located at a cape on the Gulf of Guinea on longitude 4°52'60.00"N and latitude 1°43'60.00"W in the present harbour city of Takoradi about 228km west of Accra the capital city of Ghana. The location map is shown as **Figure 3**.

The Port is located midway between Accra and Abidjan, the capital city of Ghana and the capital city of Côte d'Ivoire respectively. It is thus 228km west of Accra and 300km east of Abidjan. To the North, Takoradi Port is 963km from Ouagadougou in Burkina Faso. From the sister Port of Tema to Ouagadougou is 960km.

3.2 Existing Facilities at the Takoradi Port

The Takoradi Port, the older of the two ports in Ghana was built in 1928 as a commercial port to handle all types of cargo including containerised cargo. The existing facilities at the Port include the following:

- Equipment;
- Berthing Facilities;
- Storage Facilities;
- Vessel Repairs;
- Reefer Points; and
- Equipment repair workshops and offices.

The Port of Takoradi was developed originally as a base for naval operations and trade. Major parts of the existing breakwaters were constructed between 1947 to 1953 with a further extension to its present length and additional quays between 1953 and 1958. The original design and construction of the port was done by Rendell Palmer and Taylor Woodrow Limited respectively, both of the United Kingdom (UK).

The port was designed primarily as a railway port for the export of raw materials from Ghana such as bauxite, manganese, cocoa, timber and timber products such as logs and sawn timber. With a total quay length of 945m, there were 9 berths, with 3 dedicated to the handling of bulk cargo namely white oil imports, bauxite and manganese exports. Bauxite was originally handled by an overhead ropeway to the bauxite berth, but as part of the port rehabilitation exercise in the mid-1990s the company removed the ropeway and constructed a new conveyor system for direct delivery of bauxite from the bauxite sidings located at the port to barges at the clinker jetty. The Clinker Jetty is located to the north of the Lee Breakwater and is now being used for the export of bauxite and the import of clinker. There is a dedicated berth for the storage and export of manganese. The original layout of the port is as shown in **Figure 4**.

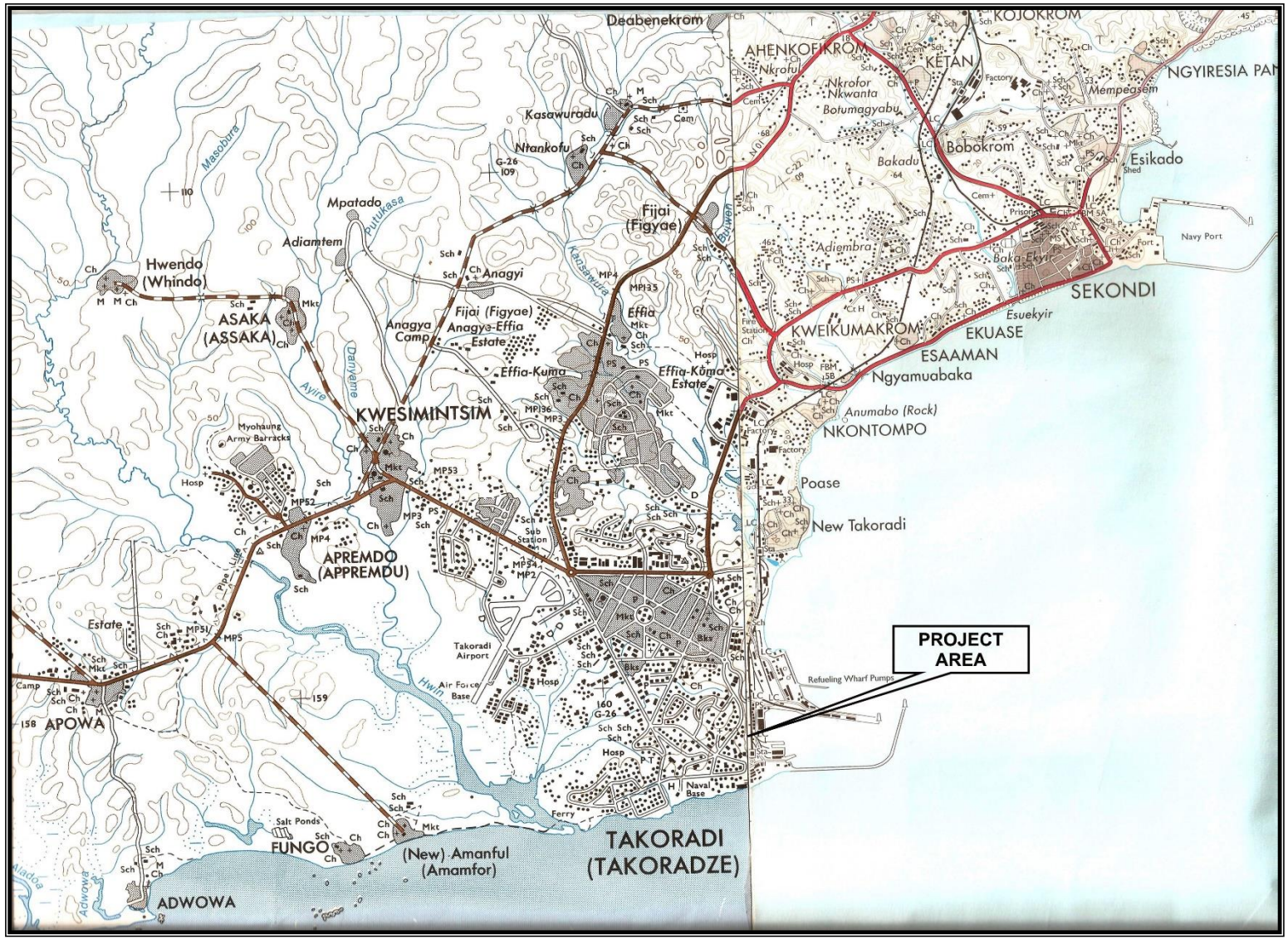


Figure 3: Topographical Map of Sekondi-Takoradi Area Showing the Port of Takoradi

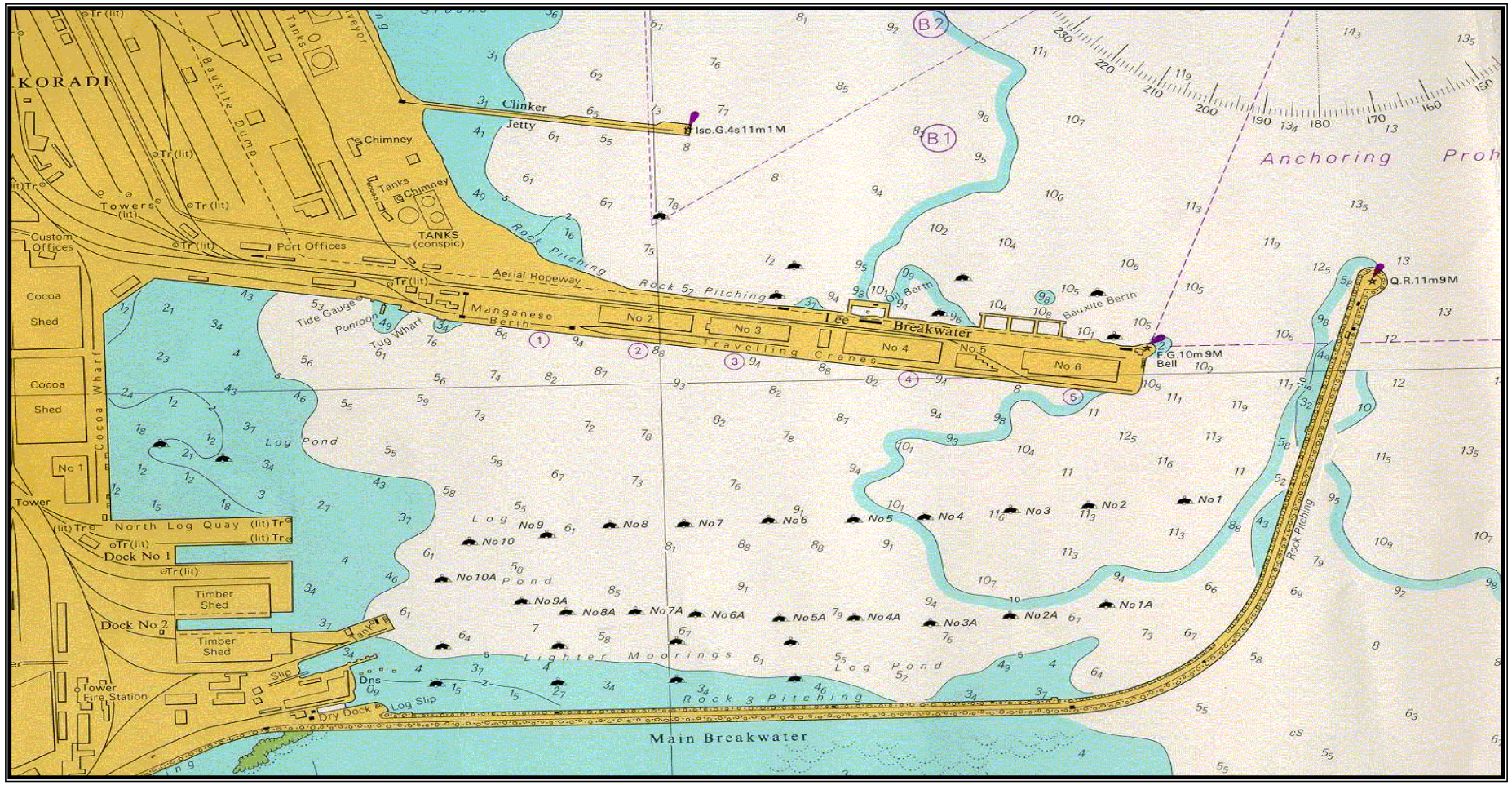


Figure 4: Original Layout of the Port of Takoradi

3.2.1 Equipment

Takoradi Port has an adequate stock of container and general cargo handling equipment like, Top Lifters, Forklift Trucks, Cranes, RoRo Trailers, RoRo Tractors, and Rail Shunters. In addition to these, the Port has a wide range of watercrafts like Tugboats, Lighter Tugs, a Water Barge, and a Patrol Boat to support its operations. These can support the handling of any kind of cargo in the port.

3.2.2 Storage Facilities and Berthing Facilities

The port has a total storage capacity of about 129,000m² of which about 60,000m² is open storage and 63,000m² is covered storage (about 10 sheds). The sheds together can hold a capacity of about 105,000t. In addition to the original cocoa storage sheds inside the port with a total holding capacity of 30,000t, GPHA has built three new sheds (sheds A, B & C) with an area of approximately 14,400m² or 40,000t primarily for the storage of transit goods to and from the landlocked countries of Burkina Faso, Mali and Niger. A private company, Unicontrol Ghana Ltd, with the approval of GPHA, demolished and reconstructed a 9,000m² shed with a holding capacity of 30,000t at berth № 2 for the storage and export of cocoa.

There are two large steel structure sheds clad with timber and originally equipped with overhead travelling cranes. These sheds are dedicated to the storage of sawn timber and together cover an area of approximately 11,408m² and can hold about 5,000t of sawn timber. Unfortunately the structures are currently in grave danger of total collapse due to heavy rust and they leak heavily during rainfall. All the overhead cranes have since been removed.

The port has a dedicated berth for the discharge, storage and export of manganese. The available area at the manganese wharf can stockpile about 75,000t of manganese which is just sufficient for two average size bulk carriers of about 40,000t that regularly call at the port to load manganese.

To the north of the port lies the bauxite depot with a holding capacity of about 100,000t. There is a jetty originally dedicated only to the handling of clinker imports but is now available for the export of bauxite also.

About 51,000m² of paved area is available in the port for container handling of which the Kampihl park is about 21,000 m² and is dedicated to the receipt and delivery of export containers; the NCP area of about 20,000 m² and dedicated to the receipt and delivery of import containers and finally about 10,000m² area at the main wharf for quayside handling of containers. There are no quay gantry cranes in the port for handling containers and all container operation is by front-end loaders and Reach stackers.

These have enabled the port to store various types of cargo. Apart from these, there are private warehouses in the Port area. The Port therefore has the capacity to handle bulk imports like rice, sugar, flour, fertilizer, cement, etc. The open storage area is for plant, equipment, vehicles and other items that are not affected by the weather.

Table 3 gives a summary of the existing infrastructure at the port. **Plates 1 - 13** show the current state of some of the principal structures at the port.

Table 3: **Summary of the Takoradi Port existing Operational infrastructure**

Item	Facility	Dimensions	Current Status & Use
1	Main Breakwater	L=2,360m	Good
2	Lee Breakwater	L=1,830m	Good
3	Navigational Channel	W=150m, D=11.3m	Good and deepened to 12m
4	Turning Basin area	84ha	Good
5	Berth No.1	L=159m, D=8.5m	Open-pile wharf: manganese only
6	Berth No.2	L=168m, D=7.9m	Good; Multipurpose use
7	Berth No.3 & 4	L=334m, D=8.5m	Good; Multipurpose use
8	Berth No.5 & 6	L=234m, D=10m	Wharf require repairs: Multipurpose use
9	Buoy No.1	195m, 11m	Good, dredged in 2001: Bulk vessel use
10	Buoy No.3	193m, 9.2m	Good, dredged to 11m: Bulk vessel use
11	Buoy No.4 to 9	181m, 8.4m	Removed and no longer in use
12	North & West Lighter Wharf	420m, 3m	Unpaved wharf; Barge use
13	North Log Quay	220m, 1.5m	Unpaved wharf; Barge use
14	Oil Berth	L=183m, D=8.8m	Good: White oil imports
15	Bauxite Berth	L=154m, D=9.1m	Removed and no longer in use
16	Clinker Jetty	L=137m, D=7.4m	Good: clinker & Bauxite exports
17	Copra Shed	562m2 Copra	Good: coffee and cocoa
18	Cocoa Shed Block A	130m x 88m	Good: cocoa export
19	Cocoa Shed Block B	124m x 88m	Good: cocoa export
20	New Cocoa shed A	136m x 24m	Good: cocoa export
21	New Cocoa shed B	196m 38m	Good: cocoa export
22	New Cocoa shed C	78m x 45m	Good: cocoa export
23	Shed No.1	2,313m2 Cocoa	Good: cocoa export
24	Sawn Timber Shed No.1	124m x 46m Timber	Heavily rusted: Sawn timber export
25	Sawn Timber Shed No.2	124m x 46m Timber	Heavily rusted: Sawn timber export
26	Global Haulage Shed	Private property	Good : Export of cocoa
27	Container Yards	Various sites: 51,000 m²	Open block pavement

Source: Takoradi Port Infrastructure

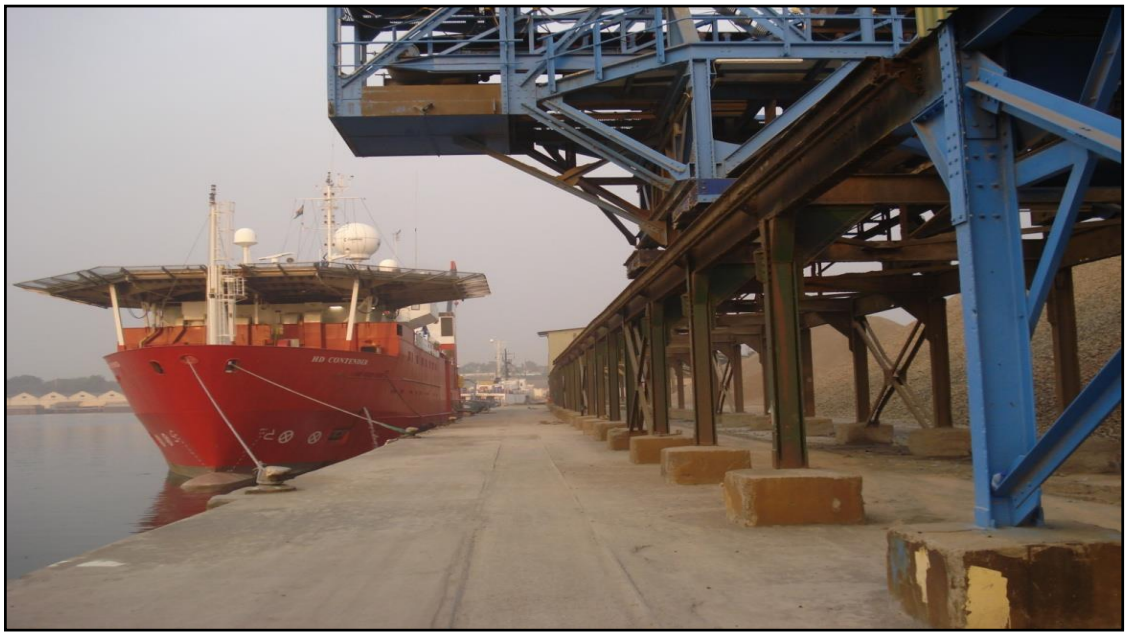


Plate 1: **Manganese Wharf at Takoradi Port (*Vessel at Berth is a Vessel for the Oil Exploration Company)***

Plate 2: **Loading of Manganese from Port to Ship by Conveyer**

Plate 3: **Tippler Plant used to offload Laden Manganese Wagons at Takoradi Port**

Plate 4: **Manganese Conveyer used to Load Barges for Transfer to Ship at Buoy 1**

Plate 5: **Very Weak Manganese storage Deck**

Plate 6: **Bauxite Sidings at the Port**

Plate 7: **Bauxite Covered Conveyor Belt to Clinker Jetty at the Port**

Plate 8: **Bauxite and Clinker conveyors at Takoradi Port**

Plate 9: **Unicontrol Cocoa Shed Showing Conveyors at Berth 2**

Plate 10: **Oil Jetty for the Import of White Oil at the Port**

Plate 11: **Cocoa Sheds at the Port of Takoradi with some of the Port Operational Plant**

Plate 12: Clinker Discharge at the Clinker Jetty from Barges by Grab Crane unto Conveyor to the Cement Factory. (*Note: Observe bauxite loading onto barges by bauxite conveyor at the far end of the jetty.)*

Plate 13: The Slipway at the Port of Takoradi with the Newly Constructed Offices Complex at the Background

3.2.3 Reefer Points

The Port has 40 reefer points for storing refrigerated containers.

3.2.4 Vessel Repairs

There is a slipway for vessels and crafts up to 300 tonne dead weight and a dry-dock for vessels up to 30m long with 7.2m breadth.

3.3 Takoradi Port Performance

Takoradi Port handles about 500 vessels yearly. Takoradi Port, with a static capacity of 5 million tons, handled a total of 3.4 million tonnes of cargo in year 2001. This comprised of 2.2 million tonnes of exports (65% of total cargo handled by the port) and 1.2 million tonnes of imports (35% of total cargo handled). Over the last 10 years, exports through the port have grown from 1.1 million tonnes to 2.2 million tonnes. Imports have also increased from 700,000 tonnes in 1992 to 1.2 million tonnes in 2001 (see **Table 4**).

The Port handles bulk imports like rice, sugar, flour, wheat, clinker, limestone and fertiliser. Typical exports handled include minerals such as bauxite, manganese, timber, wood products, cocoa, and – in smaller quantities – coffee, lime peel and lime juice.

3.3.1 Container Handling

The number of containers handled through the Port since 1992 has increased by about 440%. It rose from 8,142 boxes in 1992 to 43,126 boxes in the Year 2001. Leading imported containerised cargo includes chemicals, machines/equipment, vehicles, building materials, steel, wire, tires, paper reels and clothing among others. Key exported containerised cargo also includes wood products, sheanuts, cocoa beans, cocoa liquor and cocoa butter.

3.3.2 Vessel Calls

Vessel calls to the Port rose from 384 vessels in 1992 to 493 in the Year 2001 as shown in **Table 4,** while **Figure 5** show the number of vessel call to the Port of Takoradi from 1997 to 2008.

Table 4: Cargo Traffic at the Takoradi Port from 1992-2001

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Cargo Throughput million (M/T)	1.8	2.1	2.3	1.9	1.8	2.1	2.2	2.6	3.1	3.4
Imports-million (M/T)	0.7	0.7	0.8	0.7	0.8	0.8	1.0	1.1	1.1	1.2
Exports-million (M/T)	1.1	1.4	1.5	1.2	1.0	1.3	1.2	1.5	1.9	2.2
Containers (TEUS)	8,142	10,724	16,743	20,479	23,021	29,143	29,343	37,843	39,805	43,126
Vessel Calls	384	463	438	397	406	454	484	512	485	493

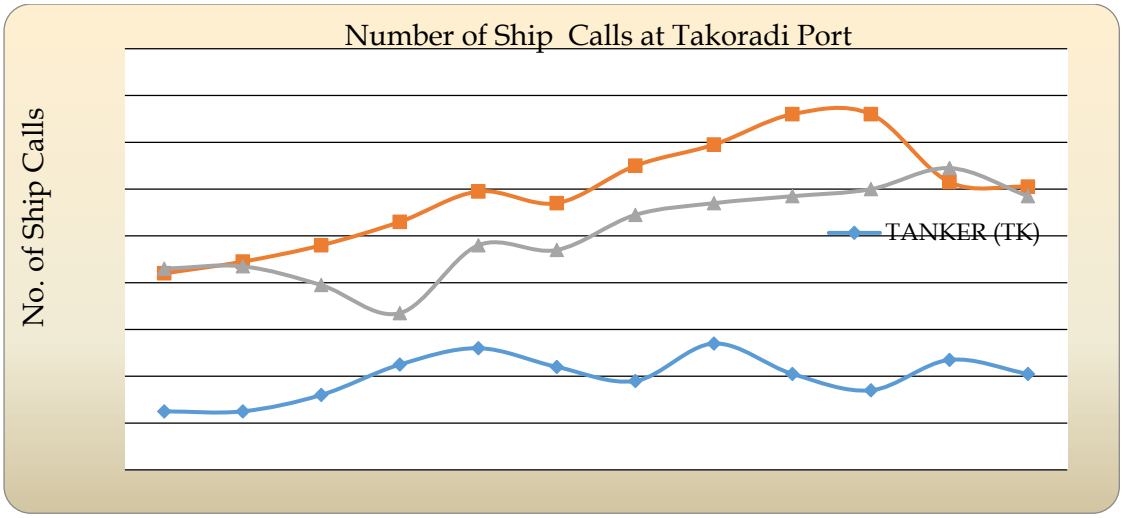


Figure 5: Number of Ship Calls at Port of Takoradi (1997 – 2008)

It is noted from **Figure 5** that:

- There is general growth in traffic but very significant after the dredging of the port in 2002 particularly with the export of dry bulk cargo including bauxite and manganese;
- Large import of grains contributed to the high increase in general cargo; and
- For each of the specialised berths, the figures show more than 50% under-utilisation of the berths as the number of ship calls in a year is less than half the available berth time in a year, which is attributable to the shallow nature of the available water depths at the berths.

However, the number of container ship calls at the Port of Takoradi continue to reduce every year especially after 2001 due to the dredging of Port of Tema to accommodate 2nd generation container vessels drawing 11.5m at the quay as shown in **Figure 6**.

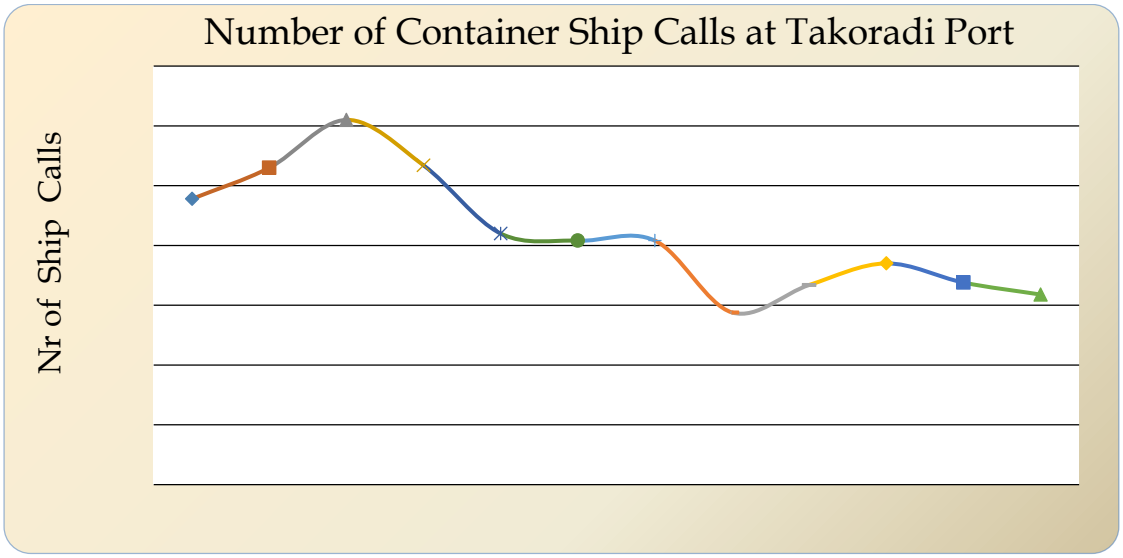


Figure 6: Number of Container Ship Calls at Port of Takoradi (1997 – 2008)

Figure 7 presents the imports through the Port of Takoradi during the period 1997 to 2008, which show about 500% rise in the import of bagged cargo mainly grains after the dredging of the harbour in 2002. However, import of Import of containerised cargo has remained stable just below 100,000t per annum.

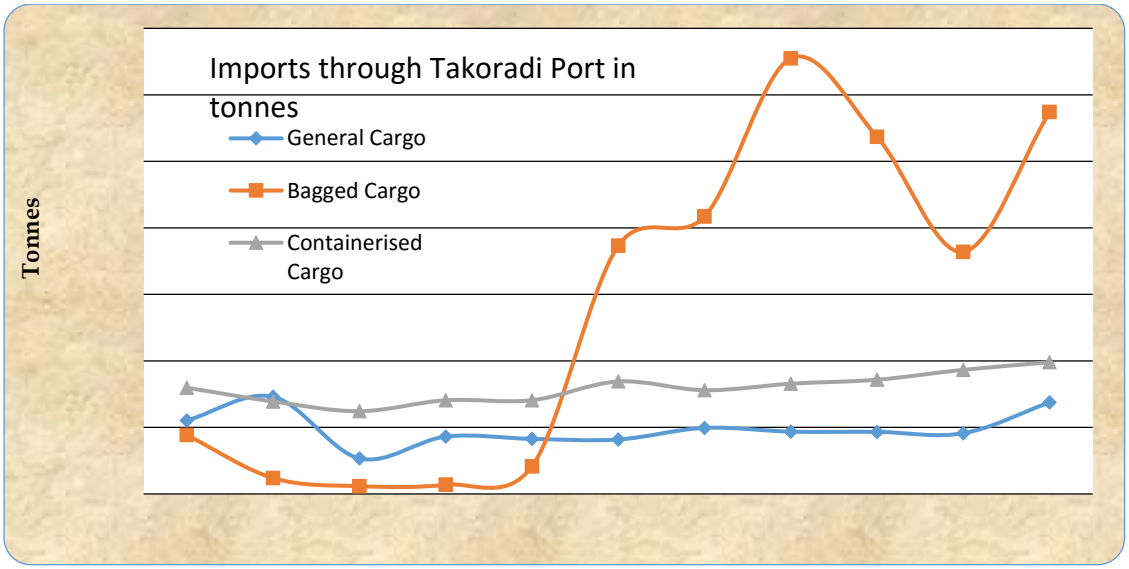


Figure 7: Imports through the Port of Takoradi (1997 – 2008)

Figure 8 also presents the exports through the Port of Takoradi during the period 1997 to 2008, which show a significant rise of about 16% in the export of containerised cargo and steep decline in the export of bagged cargo, mainly cocoa, through the Port of Takoradi after the limited deepening of the harbour. There is more cocoa export in loose beans either directly into ship hull or into containers. Also, there is significant decline recently in the export of forest products of over 80% necessitating the imports of forest products into the country.

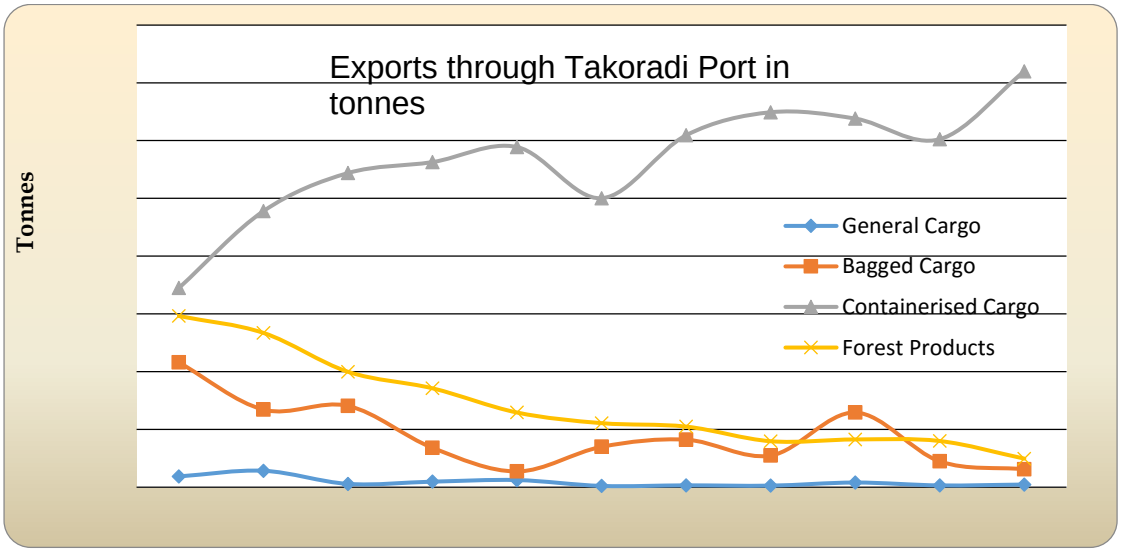


Figure 8: Exports through Port of Takoradi (1997 – 2008)

3.3.3 Ship Turnaround Time

Ship turnaround time (the time it takes the port to handle each vessel from the time of arrival to the time of departure) has drastically improved from 3.3 days in 1992 at the time the port were handling 384 vessels with 1.8 million tonnes of cargo to the current 1.5 days (for container, Ro-Ro, and break bulk vessels) as the port handle 110 more vessels with 47% increase in the cargo handled. Container and Ro-Ro vessels have an average turnaround time of less than 24 hours.

3.3.4 Labour Productivity

It is estimated that in 1992 a gang of 17 workers in Takoradi Port could handle about 19 tons of cargo in one hour while currently that same number of workers through improved equipment position, more efficient handling methods and additional skills acquisition, are able to handle 53 tonnes.

3.3.5 Safety and Security of Cargoes and Vehicles

The Port of Takoradi operates with well skilled operations staff and well-drilled security personnel who provide excellent security for cargoes. Cargoes and vehicles are therefore free from damages and pilfering. However, the Port of Takoradi is not free from hazards such as vessel collision, drowning, chemical spillage, mechanical accidents, fire and explosion, electrical faults, strong weather conditions (wind and fog), psycho-social challenges and vermin.

The security network has further been improved with the installation of a closed - circuit television network in the Port.

3.3.6 Cruise Destination

The friendliness of the shipping community of Takoradi and the abundance of tourist attractions in the Western and Central Regions has made the Port of Takoradi one of the favoured cruise destinations in West Africa.

3.4 Major Operators at the Port

Currently, there are eight operators within the Takoradi Port. A list of the companies and their operations has been presented in **Table 5**.

Table 5: List of Some Major Operators in the Port of Takoradi

Company	Operations
Ghana Manganese Company	Export of Manganese
Ghana Bauxite Company	Export of Bauxite
Tullow Ghana Limited	Mud Plants, Supply Vessels
FMC Technologies	Fabrication
Unicontrol	Export of Cocoa Beans
Cocoa Marketing Company	Export of Cocoa Beans
SCL	Shore Handling
Takoradi Flour Mills	Flour Production

4.0 DESCRIPTION OF THE PROPOSED PROJECT

4.1 The Need for the Project

In Ghana there are two major ports, the Port of Tema and the Port of Takoradi. These two ports have fulfilled important roles. Port of Tema serves as the main import port of the whole Ghana and an export port of the East of Ghana and the Port of Takoradi mainly as an export port of the West Ghana. However, a lack of deep berths, low working rate of Cargo handling equipment and physical and functional decrepitude of port facilities have made it difficult for these ports to efficiently handle the rapidly increasing volume of cargoes.

The Takoradi Port was originally built to handle timber, mineral ore, cocoa, cereals and other non-containerised or non-unitised exports. GPHA estimates that activity of oil services vessels will increase tremendously in the near-future, thereby prompting the need for a port facility that offers the vessels buoys. Currently there is pressure on the facilities at the Port of Takoradi forcing some investors and personnel of the oil exploration companies to use the Navy base and the Air Force base for accommodation purposes.

The proposed Port Infrastructure Project (referred to as the Master Plan of the Port of Takoradi - 2018) will not only benefit the oil sector but the transport of bauxite, clinker, manganese, limestone and cocoa, which form part of the planning and reorganization of infrastructure at the Port of Takoradi.

4.2 Traffic Forecast

Takoradi port provides facilities for handling of containerised and noncontainerised cargo, and since a few years, services for the emerging off-shore oil industry. Cargo volumes are dominated by four commodities, namely manganese and bauxite exports, clinker imports, and containers. Projections for this Port Master Plan are based on a review of previous analyses, information received from main stakeholders and customers of the port in February 2012 and intensive desk top research of the Consultants.

Forecasting values for a 20-year projection inevitably entail considerable uncertainties. Therefore, the forecast comprises three scenarios:

• **A low (or pessimistic) scenario** with a comparatively small probability. The macro-economic assumptions include continued power shortages, limited oil revenues, a deficit in public services and infrastructure upgrading, an increasing trade deficit, rising inflation, increasing taxation, and a slowing demand for imports.

• **A high (or optimistic) scenario** is based on very good development prospects, including continued Government policies to encourage private investment, unconstrained electricity supply, very high revenue from oil and natural gas production, heavy investments in infrastructure, and social services, a decreasing trade deficit and reduced debt service.

• **A medium scenario** which is less speculative and based on economic activities already documented or plans well advanced in the near future.Power supply shortage is assumed to overcome by 2020. Oil production royalties yields about 600 million USD per year by 2015. Rail and road infrastructure improves, especially the Western railway is rehabilitated,

but water supply continues to constrain certain industries. The trade deficit stabilizes at current levels.

For layout planning the medium scenario has been used.

With regard to **non-containerised cargo** 22 commodity groups have been analysed and for each of them detailed projections have been made. The total cargo volume projections for Takoradi Port are shown in **Figure 9.** Their structure for selected years is illustrated in **Figure 10.**

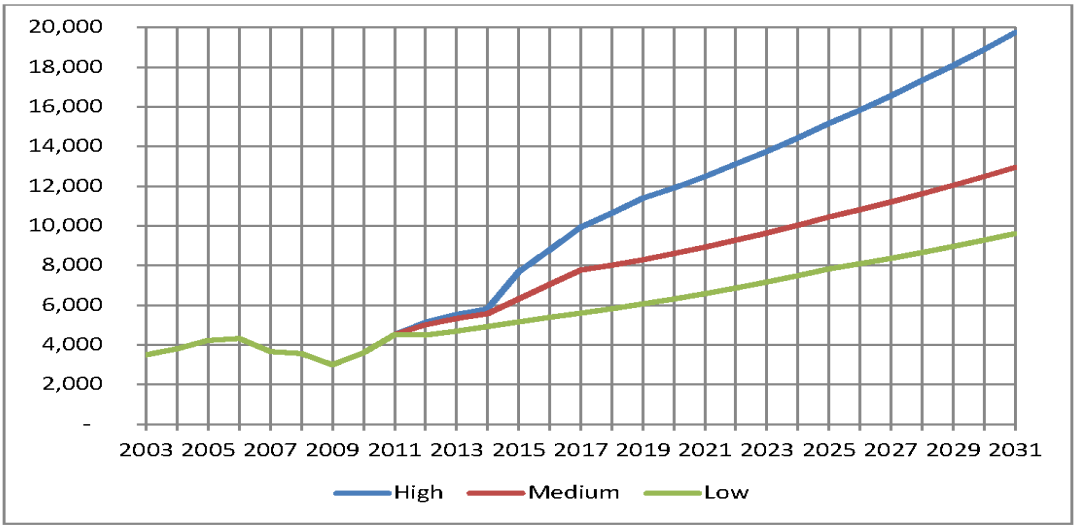


Figure 9: Non-containerised Cargo Projections until 2031 (mio tons)

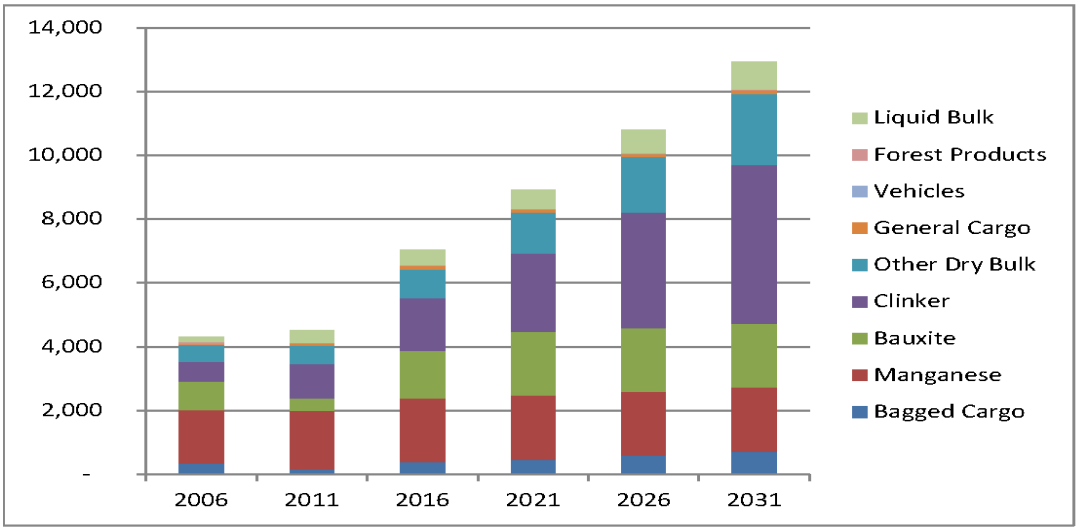


Figure 10: Non-cont. Cargo Pattern - Medium Scenario (mio tons)

From its moderate level of approximately 50,000 TEU **container traffic** is forecast to grow at an average annual rate of 6.4 percent in the next 20 years (medium scenario). All three scenarios are depicted in **Figure 11.**

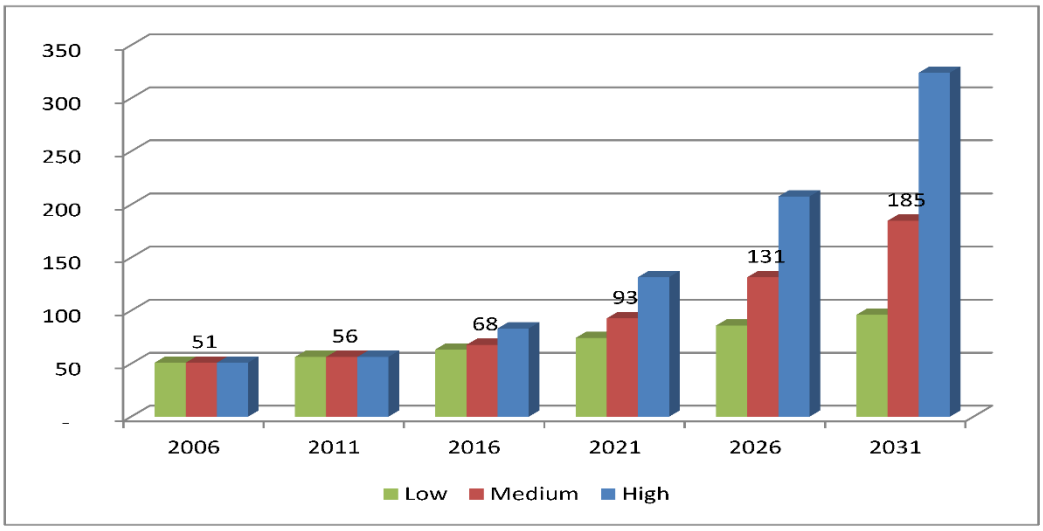


Figure 11: Container Traffic Forecast until 2031 (1,000 TEU)

For a number of years, the Takoradi Port serves as a basis for **oil and gas exploration and productions companies** working at the fields off the Ghanaian shoreline. Meanwhile approximately 2 ha of port land have been leased out to the oil industry. Oil supply vessel traffic has increased drastically since 2008. The forecasts of essential facility requirements for the oil service industry are based on a recent report prepared for TULLOW Ghana Ltd., projected investments of the oil and gas industry in Ghana as per GNPC and other information. Present plans indicate a reduction of exploration activities after 2016. For the continued market success of Takoradi as an oil service port it will be essential to attract business from the fields off the shores of Ghana's western neighbours. Projected berth requirements vary between two and eight berth with a maximum land requirement of 11ha in the medium scenario. In any case In any case the development of Takoradi Logistics Platform at New Amanful must be closely monitored in order to avoid duplication of facilities.

Current physical restrictions of the port are reflected in the ships' sizes presently calling Takoradi port. Given the anticipated increase in commercial relations to VR China especially in bulk trades, and expected developments in container pattern in West Africa the key design vessel types considered for this Master Plan are summarised in Table 6.

Table 6: vessel types considered for the Takoradi Port Master Plan

	DWT [t]	Length [m]	Width [m]	Draft [m]
Bulk Carriers	65.000	230	34	13.0
Containers	30.000	200	33	11.4
Oil Service Vessels		100		8.5

4.3 The Proposed Project

The proposed project is the Port Infrastructure Development, including Dredging at the Port of Takoradi. The key priority areas identified for development and improvement include:

- Provision of a dedicated bulk ore and oil services terminals;
- Construction of breakwaters;
- Dredging and reclamation;
- Construction of quay walls, and where appropriate, strengthening of the existing quay walls in the port;
- Construction of cargo handling and berthing furniture at all the respective berths;
- Bulk ore storage areas;
- Relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the ports;
- Upgrading of ports' access roads, entry and exits; and
- Coastal reclamations and the possible resettlement of, where affected, local fishing communities and/ their practices and businesses.

The project activities are further categorized as follows:

- Demolition of Old Structures;
- Construction of Infrastructure including extension of the Breakwater and Port Access Road Reconstruction;
- Dredging of the Port Basin;
- Relocation and Reorganisation of Port Structures and Operations; and
- Reclamation of Log pond and Northeastern side of the Port between Fisheries Department Workshop and New Takoradi Beach.

The projects as proposed represents Phases 1 and 2 of the Port of Takoradi development as illustrated in **Figure 12**.

4.3.1 Demolition of Old Structures

The activities will include demolition of old cocoa sheds and the engineering workshop as well as any old and dilapidated structures. The cocoa sheds which hitherto served as storage facility for raw cocoa beans for export has outlived their usefulness and need to be demolished to create more space for port operations.

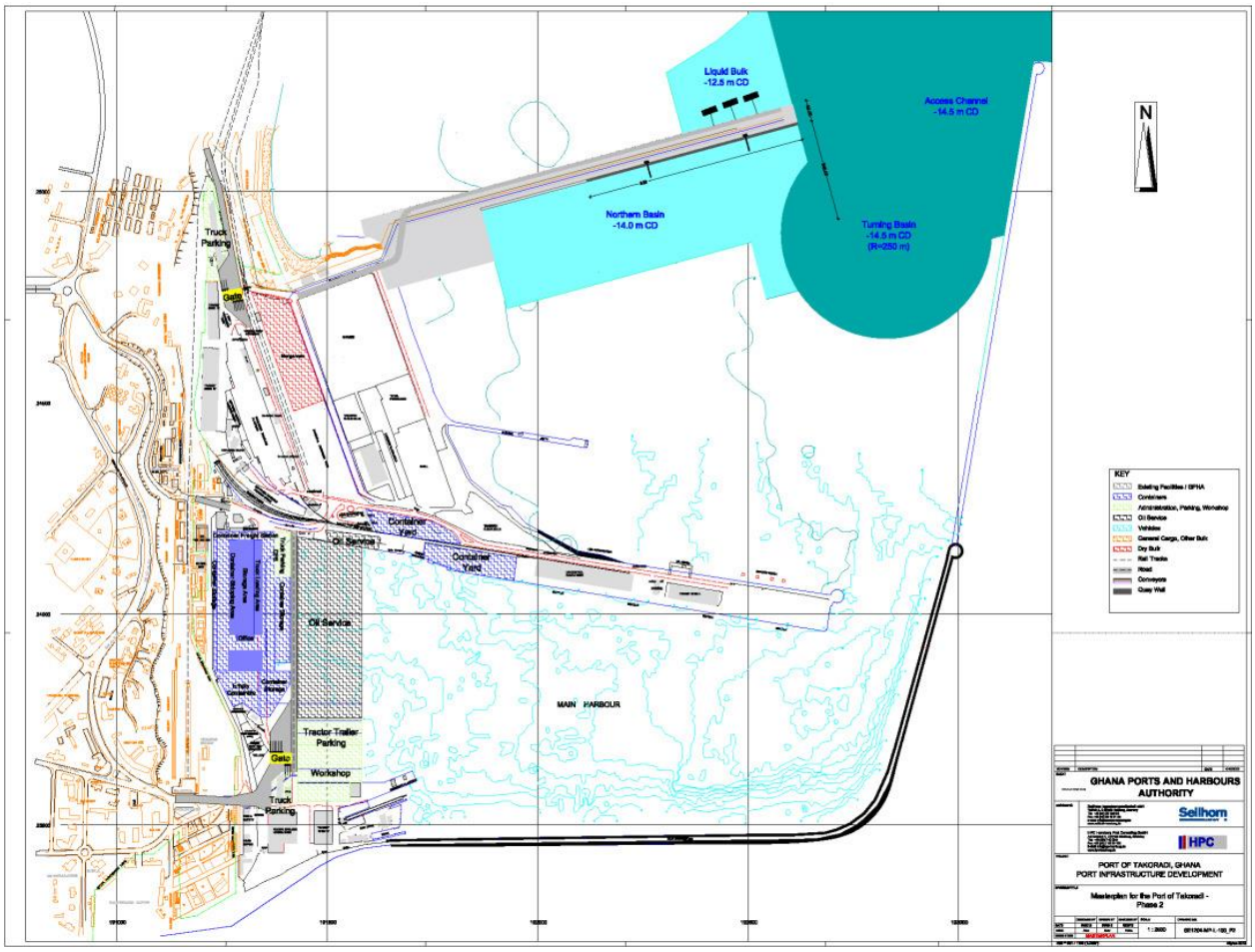


Figure 12: Proposed Layout of the Port of Takoradi Development (Phases 1 & 2) up to year 2015 (source Sellhorn/ HPC, 2012

4.3.2 Construction of Infrastructure including Extension of the Breakwater and Port Access Road Reconstruction

The project activities will include construction of an extension of the existing breakwater by about 1.15km northeastwards, which will also protect the outer entrance channel and the new habour basins against waves, swell and currents. It will also include construction of quay walls and pavement of the quays for container storage.

It is estimated that circa 1 Million tonnes of boulders/ quarry materials e will be required for the construction of the breakwater and the bulk jetty.

Two main access roads to the port will also be constructed/ improved using pavement blocks and provision of a flyover on the railway lines crossing on the port road leading to New Takoradi and onto Paa Grant Circle through the Monkey Hill Road. The road from the Shipper's Roundabout to the Port will also be reconstructed (**see Plates 14 and 15**).

Most of the quarry materials will be sourced from the Shai Hills area in the Greater Accra Region at an approximate distance of 30km from the Port of Tema and transported on barges to Takoradi for use in the construction of the breakwater. Additional quarry materials will be

sourced from the Sekondi Takoradi Metropolis and the Elmina/ Komenda area. Thus, there will be very minimal usage of haulage trucks in the Sekondi Takoradi metropolis as far as this project is concerned. It is however, estimated that about twenty five (25) trucks of 25m^3 capacity each will be utilized for haulage of quarry materials in the metropolis and the Komenda/ Elmina area when the need arises.

Plate 14: Section of the Port Access Road (Port to Shippers Roundabout) to be Reconstructed

Plate 15: Section of the Port Access Road (Port through Monkey Hill Road to Paa Grant Roundabout) to be Reconstructed

4.3.3 Dredging of the Port Basin

It is proposed to dredge the port basin to a draft of between -14m and -16m CD to ensure that the water depths in the habour basin and at the berths become generally sufficient for safe manoeuvering. Based on various studies carried and the design considerations, it is proposed to dredge the entrance channel of the port to -14.5m CD.

A detailed dredging management plan has been provided as **Annex 11** to:

1. Reduce impacts of dredging on the marine life and water quality;
2. Reduce sediment (turbid plume) mobilisation during dredging; and
3. Propose appropriate disposal methods for dredge material.

Location

The proposed site for the dredging activity site is located in Ghana at the gulf of Guinea immediately north of the port of Takoradi, 180 km south west of Accra and 150 km east of the border with Ivory Coast. The total project covers an area of 4 km^2 (2x2 km). The actual water depth in the project area varies between -3m and -14m CD.

The dredging will also result in a new turning basin with a diameter of about 500m and a depth of 14.5m to allow safe turning of vessels with a maximum Length over all (LOA) of 250m with tugboat assistance.

Dredging Methodology and Equipment

It is proposed to dredge the port basin to a draft of between -14m and -16m CD to ensure that the water depths in the harbour basin and at the berths become generally sufficient for safe manoeuvering. Based on various studies carried and the design considerations, it is proposed to dredge the entrance channel of the port to -14.5m CD.

It is proposed the dredging will be carried out by means of a cutter suction dredger (CSD).
The CSD is equipped with a rotating cutter head, which is able to cut hard soil or rock into fragments. The cut soil is then sucked in by dredge pumps. CSDs cut the soil according to a pre-set profile. The dredged material is then pumped ashore using pumps and a floating pipeline or loaded into a split hopper barge moored alongside, which in turn can then offload the dredged sediment at the designated location. The cutting action of a CSD is powerful and, combined with the suction action, the material can be ‘cut’ into suitably sized pieces. These pieces are then sucked into the suction pipe as a solid/water slurry (70% water and 30% solids) and pumped to the surface using pumps mounted on a structural device which extends towards the seabed known as ‘the ladder’.

4.3.4 Disposal of Dredge Material/Reclamation Management

It is expected that the whole dredged material would be good enough as reclamation material, and would therefore not be "cut to spoil" but to be reused for reclamation purposes.

The dredge material will be devoid of any heavy metal contaminants since the sediments will be scooped for disposal at STMA designated landfill site before dredge materials will be used.

Best management measures outlined in Chapter 9 and Annex 11 will be implemented to ensure the marine environment is not contaminated as a result of dredging and reclamation activities.

Land reclamation works will require about 4,370,000 m^3 of fill material. The dredge materials therefore falls short of the reclamation requirements by 1,143,000 m^3. Additional fill materials will therefore be obtained from quarry sites to supplement the dredge materials to be obtained. The proposed reclamation area includes Log Pond and Northeastern side of the Port.

The JICA study of 2002 confirmed contamination of the bottom sediments in the port basin especially the innermost part which showed severe pollution both in organic matter and heavy metals. The contractor will therefore be required to conduct sediment analysis prior to the commencement of dredging activities to confirm the suitability of the dredge materials for reclamation.

The baseline environmental conditions at the port, potential impacts from the dredging activities and propose mitigation and management measures such as; utilisation of curtains, blasting mats, fine meshed films, internal bund walls for the reclamation area; are outlined in the dredging management plant (Annex 11), as well as relevant Chapters of this report.

In this regard, GPHA has secured the services of Messrs Jan De Nul, a vastly experienced dredging company to ensure dredging Best Management Practices (BMPs) are abided by.

4.3.5 Reclamation of Log Pond and Northeastern side of the Port Between Fisheries Department Workshop and New Takoradi Beach

A major activity under this project will be the reclamation of the log pond and the northern side of the port to extend to the current location of the Fisheries Department Workshop. It is expected to use the dredge material to reclaim the area adjacent to the Fisheries Department Workshop and midway between the workshop and the New Takoradi landing beach. The dredge material will be devoid of any heavy metal contaminants since the sediments will be scooped for disposal at STMA designated landfill site before dredge materials will be used.

It is noted that the reclamation of the coastline will be tackled during the latter stages of the proposed project and will therefore afford GPHA and the EPC contractor adequate time to fashion out resettlement options for the fisheries department workshop and the boat berthing area. The available options under consideration include relocating the existing workshop and berthing area to Albert Bosumtwi-Sam Fishing Harbour in Sekondi or building a new landing site with berthing facility for bigger vessels at New Takoradi beach.

4.3.6 Relocation and Reorganisation of Port Structures and Operations

The activities will include relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the port. This will ensure that all like activities e.g., bulk cargo is brought to one area within the port and to create enough space for oil and gas operations at the Port of Takoradi.

4.4 Overall Outlook of the Port of Takoradi development Based on Master Plan, 2012

The Master Plan being prepared by Messrs Sellhorn and HPC indicates that the completion of the projects up to the Phase 3 activities, which is expected to be completed/ operational in 2018 will cover the following activities:

- Extension of the main breakwater by 1,150m
- Deepening of the access channel to -14.5m CD;
- Dredging of a new 500m turning basin;
- Construction of two harbour basins in the north of the existing main pier;
- Construction of (a) a deep water pier with 780m of berths for dry bulk and 260 m for liquid bulk and (b) a total of 1,050m of container and multipurpose berths;
- Reclamation of 48 ha of terminal area at the new harbour basins;
- Building of a state-of-the art container terminal including a 7.5ha devanning area;
- Relocation of the mechanical workshop, storage yard for imported vehicles, and the manganese yard;
- Construction of 3.2 ha of new sheds;
- Preparation of 6.5 ha storage and working area for the oil and gas service industry;
- Improvements of access roads, internal roads and gates; and
- Relocation and rehabilitation of railway tracks.

Upon completion of the projects, the traffic flows through the new port arrangement separate container and non-container traffic. The proposed traffic management thus avoids crossings between railroad and truck traffic.

The outlook is further illustrated in **Figure 13**.

4.5 Project Management and Schedule

Two contractors have been selected for the project namely:

- Jan De Nul of Belguim (JDN) who will carry out the construction of the breakwater, dredging of the port basin and construction of the bulk Jetty; and
- China Harbour Engineering (CHE) of China who will carry out all the land based civil infrastructure including the road construction and some reclamation of the coastline within the current port jurisdiction.

Messrs Sellhorn/ HPC consortium of Germany have been procured to supervise the contractors on behalf of GPHA.

The project is expected to be completed within 36 months after commencement.

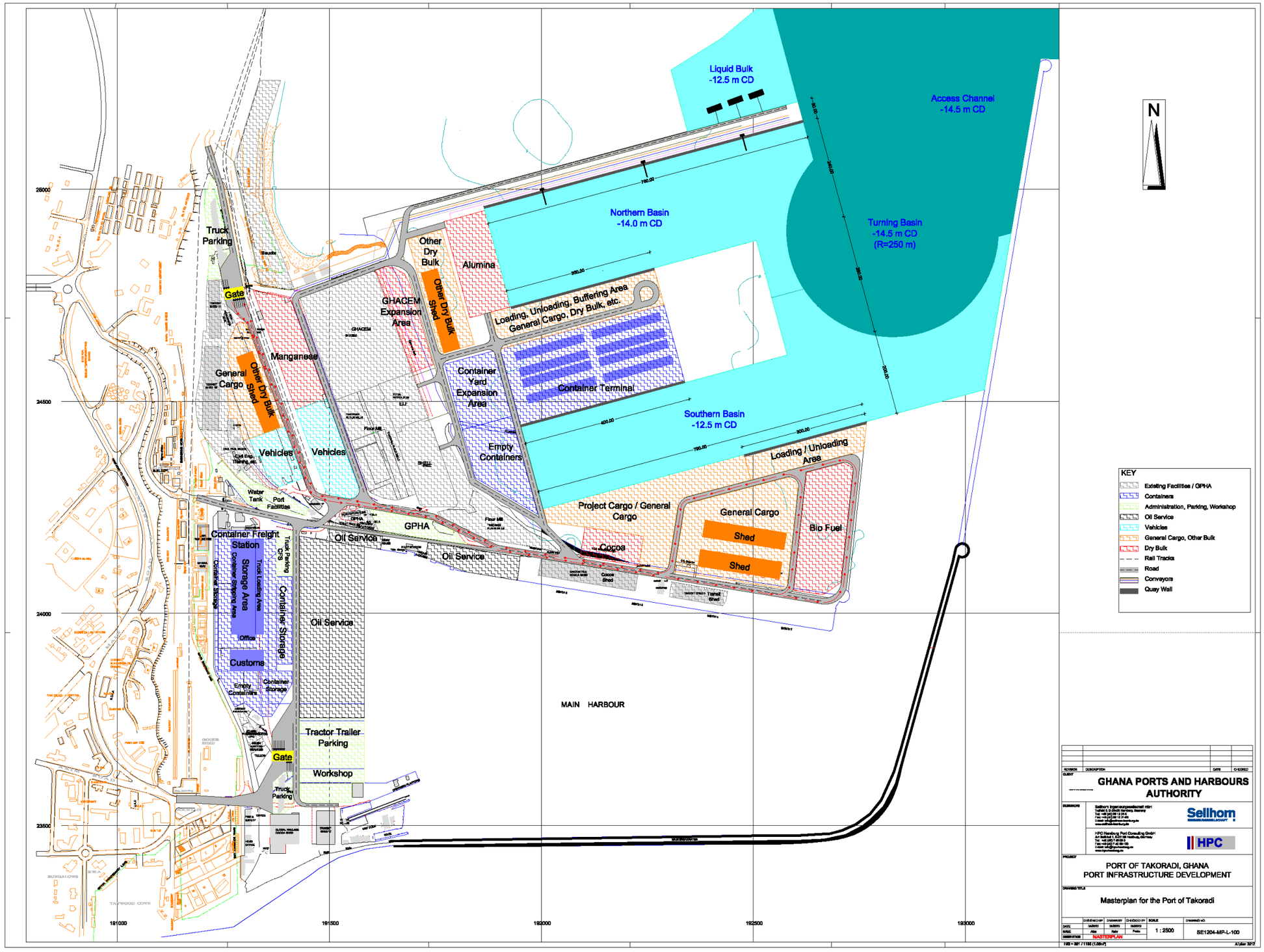


Figure 13: Outlook of the Port of Takoradi Development as of 2018 (Phases 1, 2 and 3)

5.0 ALTERNATIVE CONSIDERATION

The number of alternatives considered at this stage of the implementation of this project including:

- constructing new port dedicated to oil and gas services;
- site selection options; and
- no development/ action option.

5.1 Constructing New Port Dedicated to Oil and Gas Services

The possibility of constructing entirely new port dedicated to the oil and gas services has been considered.

This option would avoid any dredging activities and expansion works at the Port of Takoradi. However, this project would require huge capital and would also take a much longer time to complete as it would involve the construction of entirely new quays, berths etc. This option is therefore considered appropriate for the medium to long term development beyond 10 years as the port requirements expand.

Also, a new location (Greenfield) will involve many resettlement issues, which will require huge compensation payments.

5.2 Site Selection Options

The other option considered would be to relocate all oil and gas services operations to the Port of Tema. This will however make such operations very expensive and put more pressure on the existing facilities at the Port of Tema. This option is therefore not sustainable as the oil and gas fields are located closer to the Port of Takoradi than Tema.

Again, the proximity of the Port of Abidjan to the oil and gas fields would provide a better services point for the oil and gas firms as a more competitive port than the Port of Tema.

Therefore, the selection of the Port of Takoradi for expansion works is a more sustainable option to improve on its ageing facilities.

5.3 No Development/ Action Option

The vision of GPHA is to become the preferred port in the West African sub-region and the mission is to provide efficient port facilities and ensure quality services to customers at its ports including Port of Takoradi. With the increasing activities in Port of Takoradi especially in the oil and gas sector, the no development option will stifle the vision and mission of GPHA.

With the patronage of the Port of Takoradi by the oil and gas developing companies, the time is ripe for the Government of Ghana (GoG) to carry out the various development projects at

the port to: (i) modernise the port, (ii) improve outputs, (iii) increase revenues, (iv) create jobs, (v) generate incomes as well as hard currency.

The no development of the project will thus stifle all these laudable outcomes.

6.0 DESCRITION OF THE EXISTING ENVIRONMENT

The existing physical and socioeconomic environment of the project area of influence i.e., the Sekondi-Takoradi Metropolis is presented in this chapter.

6.1 Sekondi-Takoradi Metropolis

6.1.1 Location and Size

The Sekondi Takoradi Metropolitan Area, with Sekondi as the administrative capital, occupies the south-eastern part of Western Region. It shares boundaries with Ahanta West, Mpohor Wassa East and Shama District. It has a land area of 385km^2. This makes it the smallest, but easily the most highly developed of the 13 districts of the Western Region. Indeed, it is the third largest metropolis in the whole of Ghana. It is strategically located in the South-Western part of Ghana.

6.1.2 Topography and Drainage

The Sekondi Takoradi Metropolis is of varied topography, with the central area of Takoradi being low lying and occupied by muddy lagoons interspersed with ridges and hills. The metropolis is bordered to the west by the Whin River, with its main tributary, the Ayire, joining the Whin lagoon before entering the sea, while on the east by the Anankwari River. Close to Takoradi Polytechnic, the Kansaworado flows towards the Buthia lagoon, creating an extensive, marshland and exist into the sea around the New Takoradi area. The Essei lagoon lies between Ekuase and Takoradi.

The topographical map of the project area showing the Port of Takoradi is shown as **Figure 3.**

6.1.3 Geology & Soil

The geology of the metropolis consists of faulted shoals and sandstone of various types resting on a hard basement of granites, gneiss and schist. The land surface is well watered.

6.1.4 Seismicity

Generally, Ghana is a stable land mass, and features very low seismic activity. Exception is the coastal region of Ghana, 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. For all the earthquakes which have occurred in the country, the epicentres were located along the coast, in the area surrounding Accra, and Cape Coast and surrounding areas. These areas suffered comparative minor damages.

Seismic activity in southern Ghana is believed to be caused by movement along two active fault systems, namely the Akwapim Fault Zone along the Akwapim Mountain range, which

trends approximately NE-SW, and is located about 20 km to the west of Accra and Coastal Boundary Fault, which lies some 3 km offshore and runs almost parallel to the coastline. The fact that these two fault systems intersect close to the village of Nyanyanu to the west of Accra is believed to be responsible for the seismic activity experienced in Takoradi areas.

The project area is located within the coastal region, hence the recommendation for the structural design to take into account possible imposition of seismic stresses.

6.1.5 Climatic Conditions

This section describes both historical and current climatic data for Takoradi. A summary of the climatic data for Takoradi, the nearest climate station, for the years 1990 to 2014 are provided in **Annex 6**. The project area lies in the most humid part of the country with mean annual rainfall between 1200 mm and 1700 mm.

This region 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 originate 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). The slow and irregular north-south oscillations of the ITCZ gives rise to the regime of wet and dry seasons.

This region generally receives good 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 255.0 mm and maximum of 506.5 mm), and September to November with a second peak in October (i.e. mean of 161.9 and maximum 324.4 mm) as shown in **Figure 14**. In the dry season the region comes under the influence of the North-East Trade winds or the Harmattan. The mean annual rainfall is 1,134.71 mm and a mean monthly rainfall of 94.6 mm.

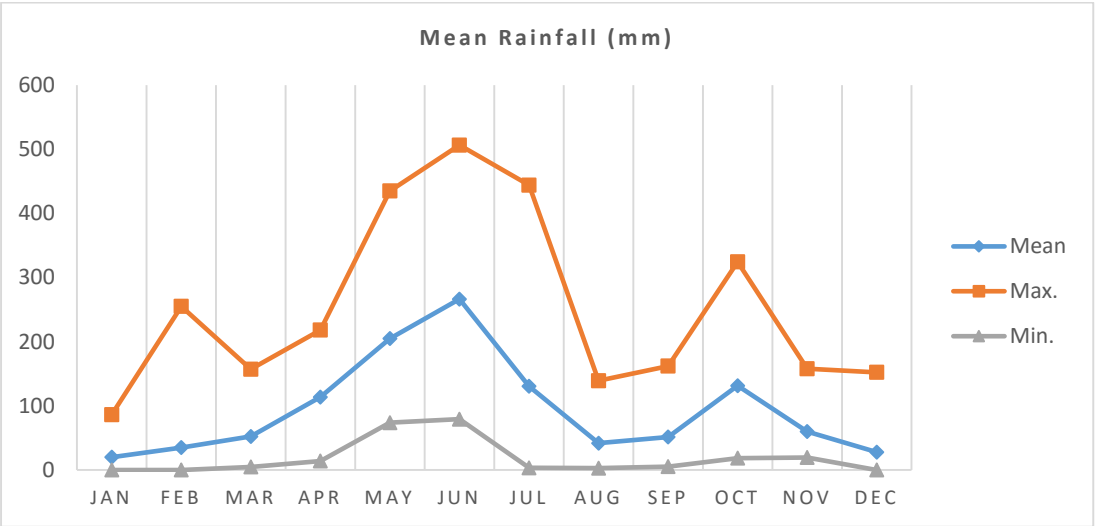


Figure 14: Monthly variation in mean rainfall quantities at Takoradi Meteorological station (1990 to 2014)

Mean daytime temperature variation is illustrated in **Figure 15**. There are two peak temperature periods from February to April and November and December. The highest mean monthly daytime temperature of about 33.0 ^{0}C occurs between February and April and the lowest of about 27.4^{0}C in September as shown in **Chart 3**.

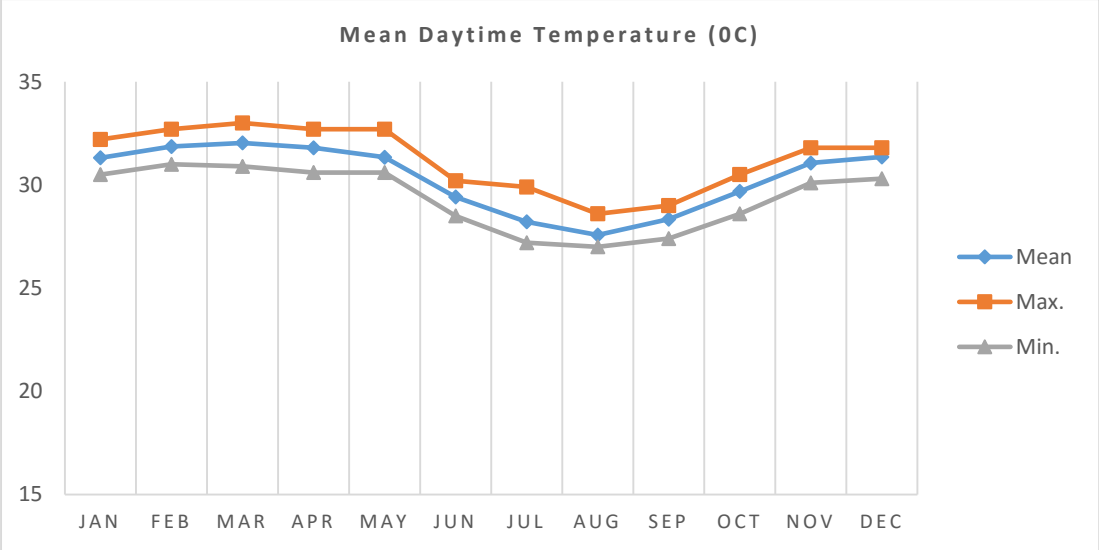


Figure 15: Plot of mean daytime temperatures at Takoradi Meteorological station from 1990 to 2014

The maximum mean monthly nighttime temperature occurs between March and April, with a peak of 26.0^{0}C in March and a minimum 21.5^{0}C occurs in August as shown in **Figure 16**.

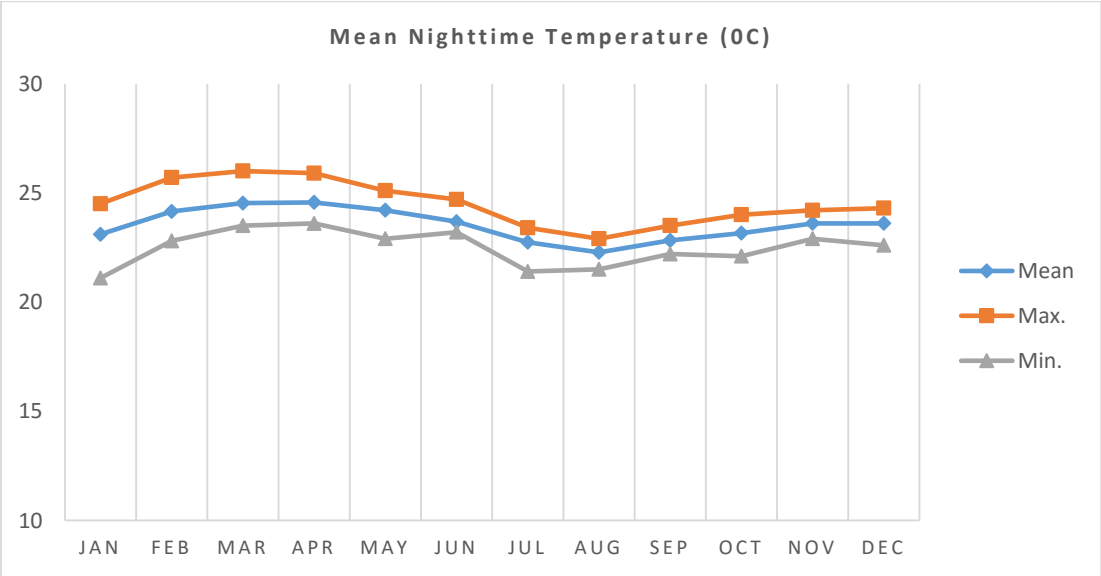


Figure 16: Monthly variation in mean daytime temperatures at Takoradi Meteorological station (1990 to 2014)

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.

Relative humidity is generally high throughout the year. The mean daily relative humidity ranges from 76% to 92% as shown in **Figure 17**. Generally the driest periods are between January and February, while August to October is the most humid.

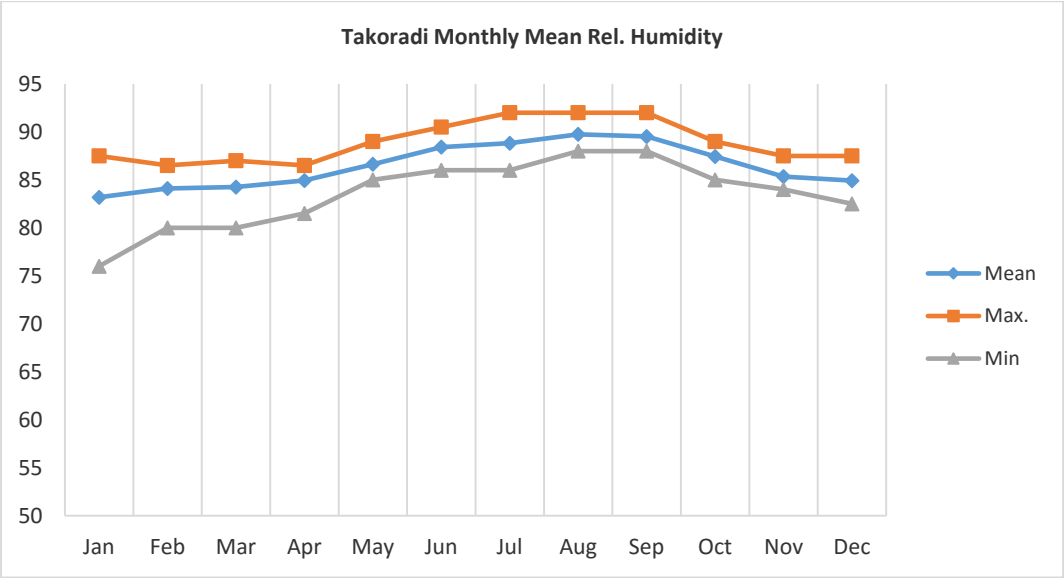


Figure 17: Monthly variation in mean relative humidity at Takoradi Meteorological station (1990 to 2014)

The mean daily duration of bright sunshine is 6 hours. The mean monthly wind speed is 3.7 knots with a mean monthly range from 1.8 to 5.9 knots. Mean monthly wind speeds rarely exceed 4.5 knots (2.3 m/s) as shown in **Figure 18**, resulting in a very stable air regime. September is generally the windiest month and wind direction is south west throughout the year.

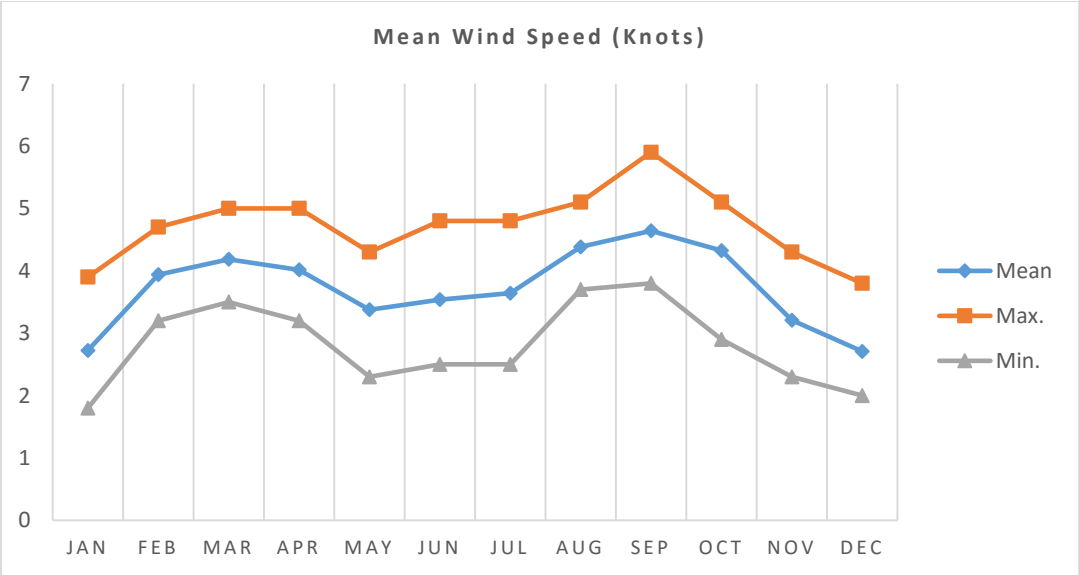


Figure 18: Monthly variation in mean monthly wind speeds at Takoradi Meteorological station (2000 to 2014)

The wind rose analysis demonstrates a predominance of south and south westerly wind directions and wind velocities up to 2.3 m/s. This pattern is consistent with the climatic long

series measured in Takoradi as shown in **Annex 3** for the period 2000-2014. The wind rose from 2009 to 2013 is shown in **Chart 7**.

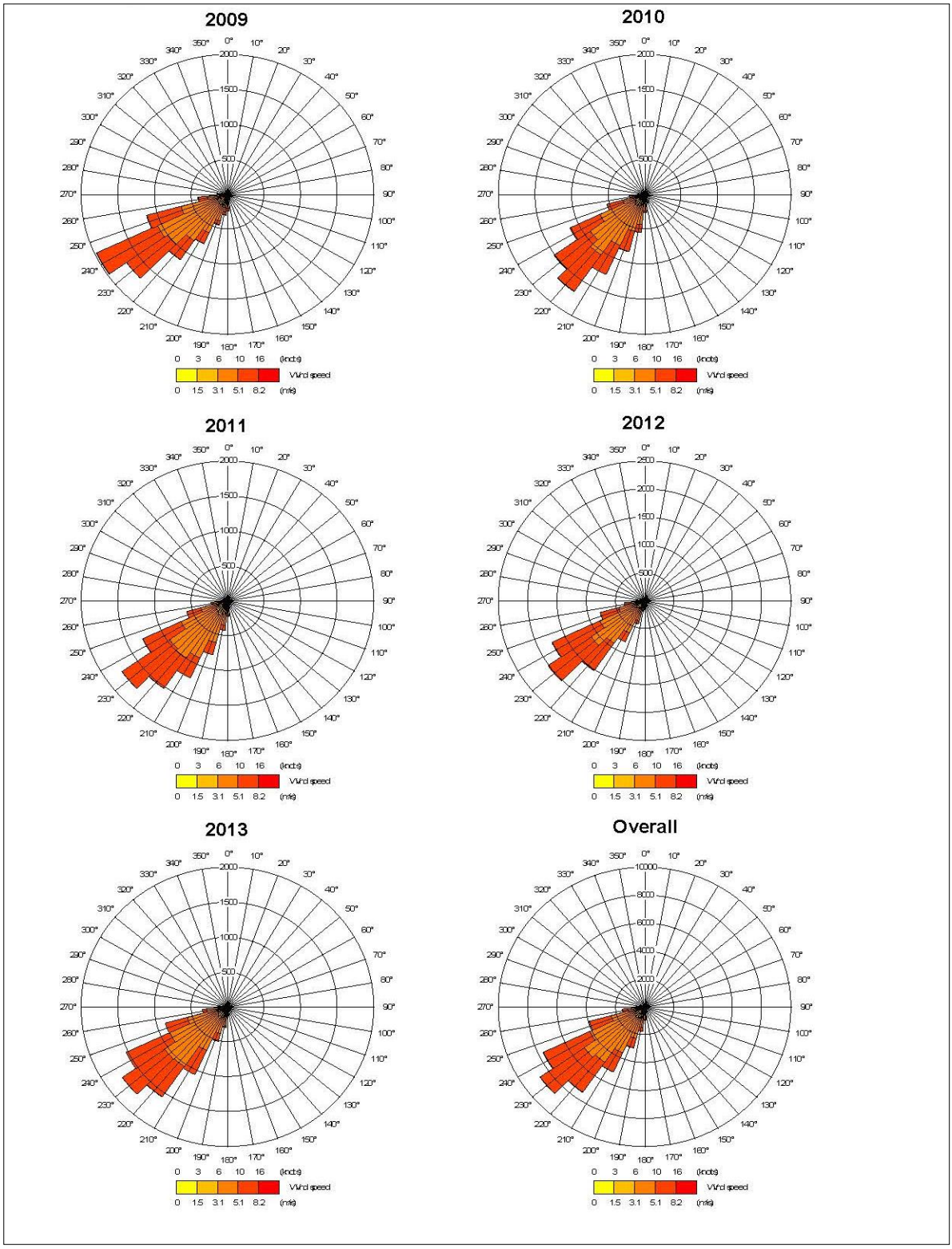


Figure 19: Mean daily wind direction (Source: VRA, 2014)

6.1.6 Water and Sanitation

The availability of potable water and sanitation facilities and services is crucial for a healthy human resource. Considering the fact that malaria continue to top the list of top ten diseases in the project areas, the importance of water and sanitation services cannot be over emphasised.

Ghana Water Company Limited (GWCL) formerly Ghana Water and sewerage Corporation is responsible for the development conservation of potable water in the Metropolis. The scope of service is now limited to towns with population of 10,000 and above while the lower areas are taken up by the Community Water and Sanitation Agency.

The daily demand for industrial, commercial, institutional, domestic, fire control as well as losses stands at 13million gallons a day. (mgd). The present production level by the Ghana water Company Limited (GWCL) is 7.0mgd. The Daboase headwaters, which serve the Takoradi Township generates 5.0mgd, while the Inchaban Head waters service Sekondi at a supply level of 2.0mdg.

The water supply coverage is between 60%-65% and it is mainly in the urban areas of Takoradi, Sekondi and Shama. Supply of water is irregular at most places; however the quality of water has fairly improved and is largely free from dirt and its salty taste. Repair works have been undertaken at the headwater and these accounts for the improved situation.

The production and supply of water in the Metropolis is fraught with constraints, these include encroachment on land reserves for utility services, frequent power interruption, illegal connections, unplanned and uncontrolled housing development, frequent damage to pipes by contractor as well as long service pipeline connections.

The collection, transportation and disposal of solid and liquid waste is the sole responsibility of the Metropolitan Assembly which operates through the Waste Management Departments. The tonnage of waste generated in the Metropolis has been increasing over the years as the population increases.

6.1.7 Population, Ethnicity and Religion

The Sekondi-Takoradi metropolis recorded a population of 559,548 with 273,436 males and 286112 females based on the 2010 Population and Housing Census. This represents 23.5% of the entire region's population of 2,376,021 persons. The household size is 3.7 compared with 4.2 for the region It is noted that other people commute from the neighbouring districts and suburbs into the city for trade and other civic activities. In all, there are four sub metropolitan areas in the metropolis, namely Sekondi, Takoradi, Kwesimintsim and Esikado-Ketan. Only 4.1% of localities in the metropolis is rural and are located in Kwesimintsim and Esikado-Ketan.

The metropolis has its roots from the Ahantas. Fantes, Nzemas, Wassas also have a composition due to proximity to the metropolis. Guans and other tribes are in the minority.

It is estimated that Christianity forms about 86%, while Moslem and traditional religion form about 8% and 1% respectively.

6.1.8 Economy

The Metropolis has a vast revenue base and well established expenditure management system. The passing of the Internal Audit Agency Act and the Financial Administration Systems Act have given a lot of impetus to the financial management system of the Assembly. The Procurement Act has also added to the effective system laid down to ensure transparency and accountability in the use of public fund.

Expenditure in the Assembly is initiated in a Medium Term Development Plan and Annual Budget statement which are all discussed at Sub-Committee and General Assembly meetings before they are passed for payment.

Sekondi - Takoradi is one of the hubs of industrial activity in Ghana. It is the third most industrialized city in the country. The city can boast of some of the big manufacturing industries in the country. However commerce continues to be the dominant sector of the economy. To make the economy more vibrant, various measures are being put in place to attract investment both local and foreign. They include the expansion of the infrastructure base of the city.

Another important area is the development of the Export Processing Zone to promote processing and manufacturing of goods and to encourage the development of commercial activities.

6.1.9 Tourism

The Sekondi-Takoradi is a major tourist destination in Ghana. The tourist attractions include historical preserves and events including festivals.

6.2 Baseline Environmental Conditions of the Port of Takoradi

6.2.1 General Description

The Port of Takoradi is located at a cape, with the western part formed with a rock or reef while the northern coast is sandy beach. The slope of the sea bottom is about 1% judging from about 10m fall in 0.9km distance from the shoreline (JICA/ GPHA, 2002).

The main breakwater is located on the southern side of the Port of Takoradi and extends about 1.5km offshore in the eastwards direction, and extending further in a north-north-east direction to a distance of about 0.7m. **Figure 20** shows the current state of the Port of Takoradi.

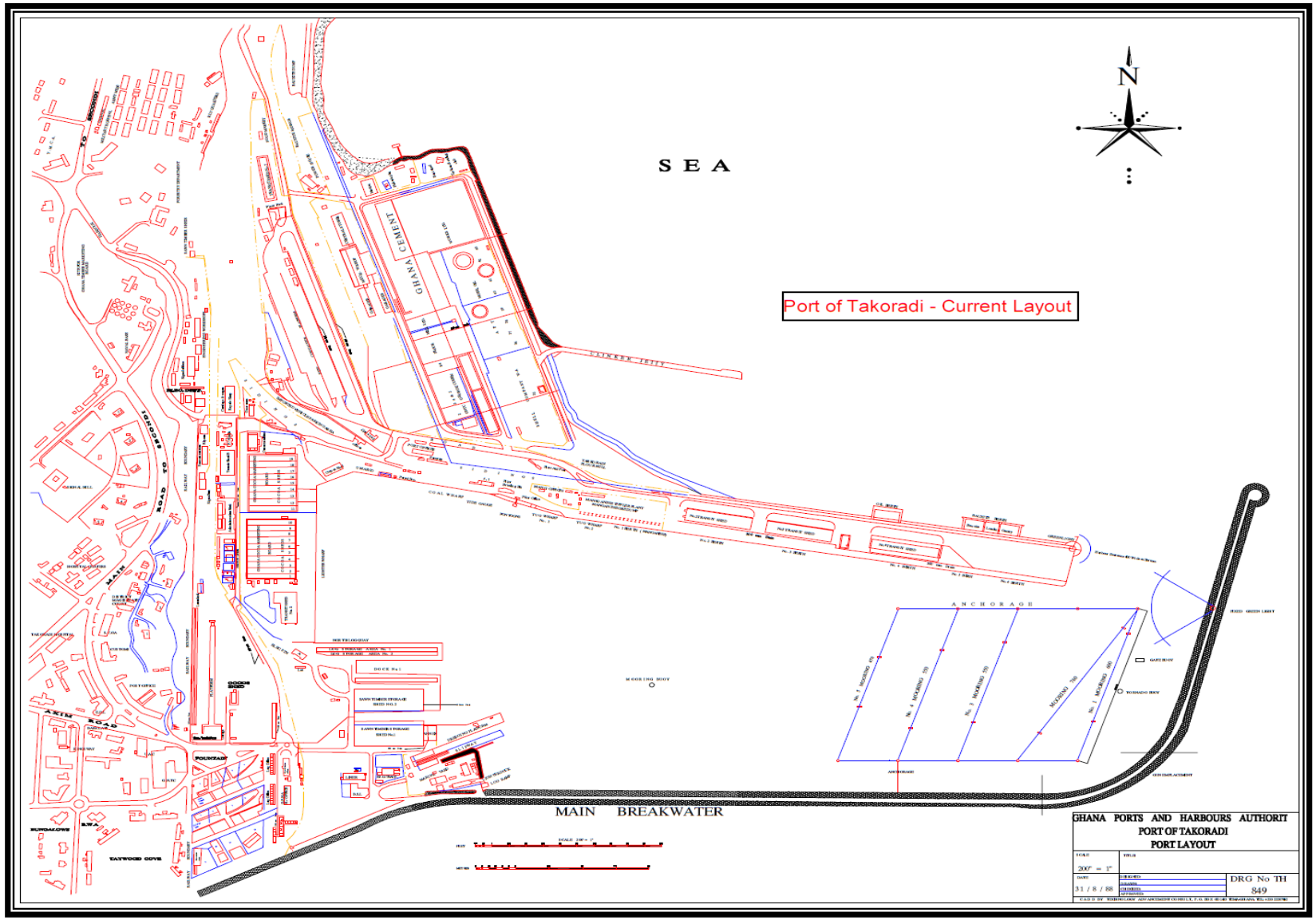


Figure 20: Current Layout of the Port of Takoradi

6.2.2 Marine Conditions

The Port of Takoradi is influenced by the conditions of the Atlantic Ocean and the Monsoon winds.

Currents

The hydrography of the port area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans. The major currents influencing the area include (i) the Canary current from the north which splits into the North Equatorial Current and a coastal current which feeds the Guinea Current, and (ii) the Benguela Current which flows northwards and extends into the Gulf of Guinea as the South Equatorial Current as shown in **Figure 21**.

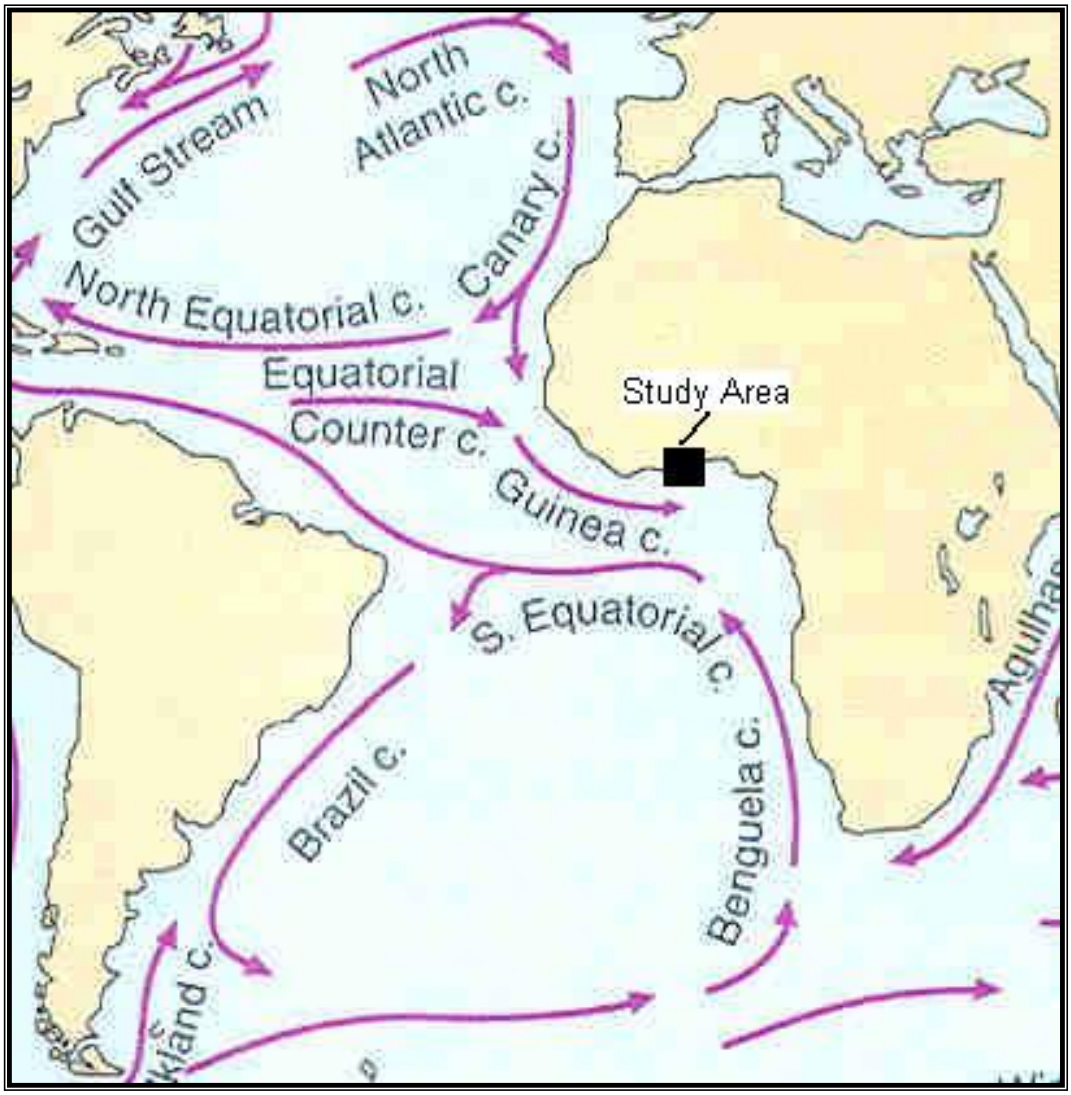


Figure 21: Major current systems influencing the Gulf of Guinea

The Guinea Current which is the main current in the port area flows eastwards throughout the year over its whole length and obtains velocities close to 1.0ms^{-1}. 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. In the Takoradi port itself, due to breakwater, current velocities have been significantly reduced to aid in vessel movements.

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 $1ms^{-1}$, but are responsible for transporting large volumes of littoral sediments and also for rip currents which are more localized in their action, but move appreciable amount of sediments away from the coast.

Tide Levels and Tidal Current

The tide in Ghana has semidiurnal pattern with two high and two low tide levels each day. There is no time difference between the Ports of Takoradi and Tema. The annual tidal predictions are computed and published by GPHA and the highs and lows are as shown in **Table 7**.

Table 7: Tide Level of Port of Takoradi

Tide Level, m			
MHWS	**MHWN**	**MLWS**	**MLWN**
1.5	1.2	0.6	0.2

It is estimated that the velocity of the tidal current is generally less than 0.1m/s but could go up to 0.5m/s.

Waves

The coast is open to south-westerly and south-south-easterly long swells induced by fetches in the South Atlantic Ocean. The coast within the AOI is subject to low wave intensity, dominated by swells with periods of 11-16 seconds. The most common amplitude of waves in the region is 1.0m but annual significant swells could reach 3.3m in some instances. Swells attaining heights of 4.8-6.0 m, however, occur with a 10-20 year periodicity. The peak wave period for the swells generally falls in the range of 7s to 14s. The swell wave direction is almost always south or south-west (**see Figure 22**). Results of statistical analyses as regards wave height exceedance and extreme value analysis are summarized in **Tables 8 and 9** respectively.

Table 8: Offshore Wave Height Exceedance Statistics

Heights (m)	Exceedance (%)
<1.0	82.8
<1.5	23.0
<2.0	3.0
<2.5	0.1
3.0	0.0

Table 9: Extreme Offshore Waves

Return Period (yrs)	Extreme Heights (m)
10	3.0
20	3.2
50	3.4

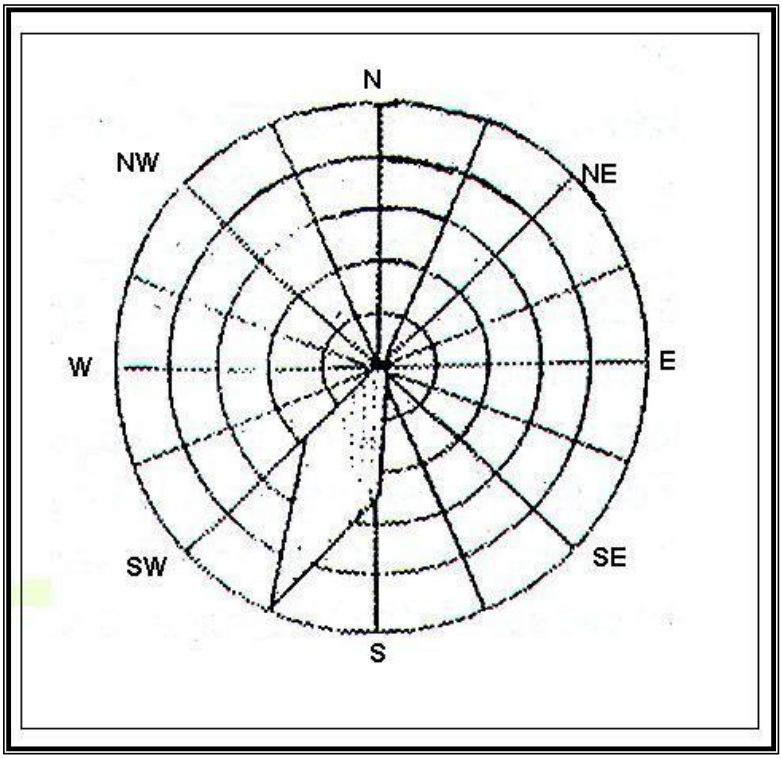


Figure 22: Wave rose indicating predominant swell wave direction

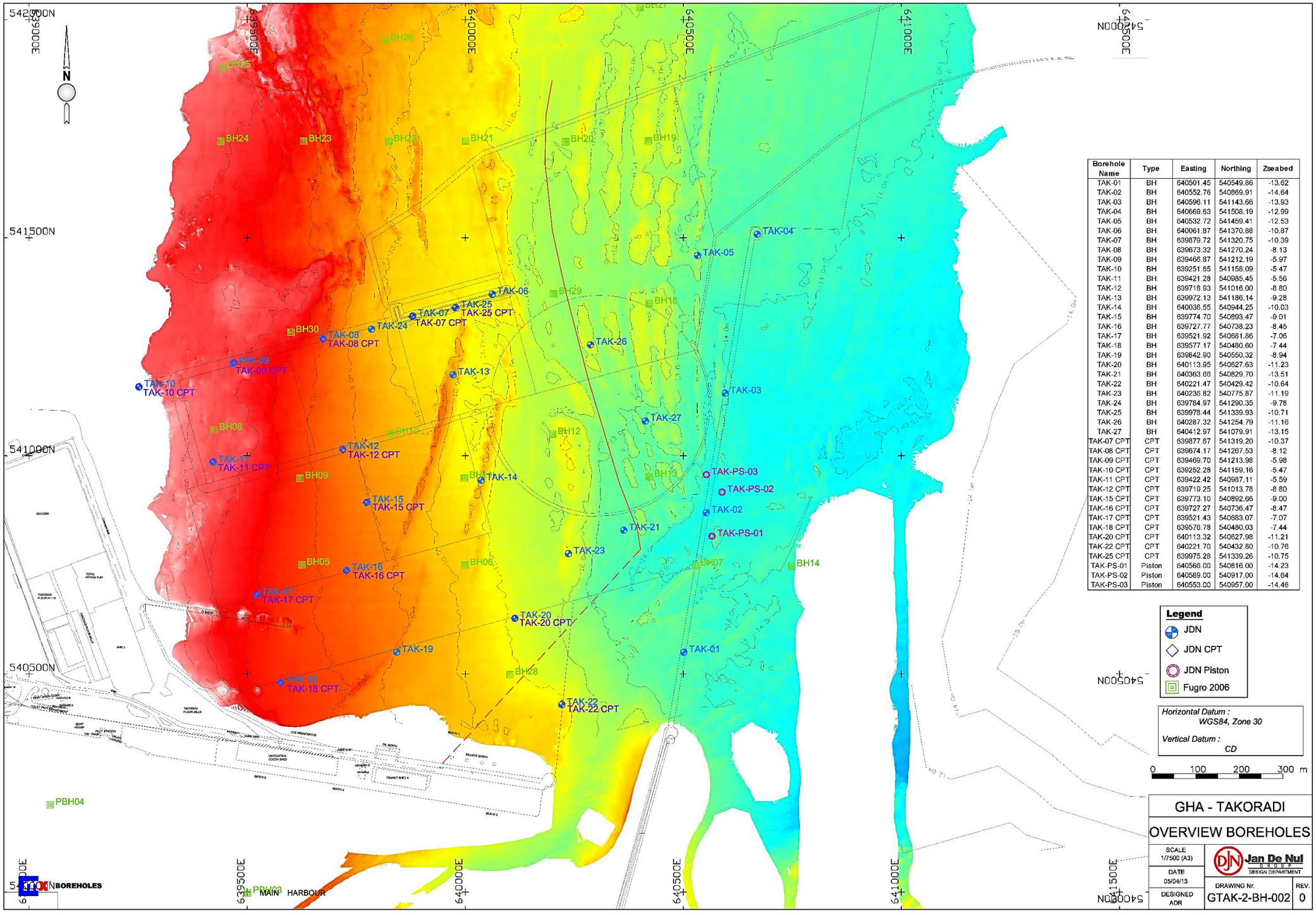
Other observations on the wave climate include a long swell of distant origin and with wavelengths varying between 160m and 220m. This swell has a primary period of 12 seconds and a relatively regular averaged height between 1m and 2m. The swells generally travel from southwest to northeast.

Tidal variations

GPHA publishes annual tidal tables for Takoradi, Tema and other Ghanaian ports. The Takoradi port is the reference port for these tables and is located on Lat 4^0 53' N and Long 1^0 45' W. Normally, there are two high tides and two low tides daily which are an average of six hours apart. Usually the lowest low tide levels in the year occur in February and March. According to the Tide Table 2012 released by GPHA, the low tides this year ranges from 0.10m to 0.91m while the high tides range from 1.15m to 1.91m.

Bathymetric Conditions

The result of the bathymetric survey carried out by Messrs Jan de Nul (JDN) in 2013 is shown in the bathymetric map in **Figure 23**.



Borehole Name	Type	Easting	Northing	Zseabed
TAK-01	BH	640501.45	540549.86	-13.62
TAK-02	BH	640552.76	540869.91	-14.64
TAK-03	BH	640596.11	541143.66	-13.93
TAK-04	BH	640669.63	541508.19	-12.99
TAK-05	BH	640532.72	541459.41	-12.53
TAK-06	BH	640061.87	541370.88	-10.87
TAK-07	BH	639879.72	541320.75	-10.39
TAK-08	BH	639673.32	541270.24	-8.13
TAK-09	BH	639466.87	541212.19	-5.97
TAK-10	BH	639251.65	541158.09	-5.47
TAK-11	BH	639421.28	540985.45	-5.56
TAK-12	BH	639718.93	541016.00	-8.80
TAK-13	BH	639972.13	541186.14	-9.28
TAK-14	BH	640036.55	540944.25	-10.03
TAK-15	BH	639774.70	540893.47	-9.01
TAK-16	BH	639727.77	540738.23	-8.45
TAK-17	BH	639521.92	540681.86	-7.06
TAK-18	BH	639577.17	540480.60	-7.44
TAK-19	BH	639842.90	540550.32	-8.94
TAK-20	BH	640113.95	540627.63	-11.23
TAK-21	BH	640363.66	540829.70	-13.51
TAK-22	BH	640221.47	540429.42	-10.64
TAK-23	BH	640236.82	540775.87	-11.19
TAK-24	BH	639784.97	541290.35	-9.78
TAK-25	BH	639978.44	541339.93	-10.71
TAK-26	BH	640287.32	541254.79	-11.16
TAK-27	BH	640412.97	541079.91	-13.15
TAK-07 CPT	CPT	639877.87	541319.20	-10.37
TAK-08 CPT	CPT	639674.17	541267.53	-8.12
TAK-09 CPT	CPT	639469.70	541213.98	-5.98
TAK-10 CPT	CPT	639252.28	541159.16	-5.47
TAK-11 CPT	CPT	639422.42	540987.11	-5.59
TAK-12 CPT	CPT	639719.25	541013.78	-8.80
TAK-15 CPT	CPT	639773.10	540892.66	-9.00
TAK-16 CPT	CPT	639727.27	540736.47	-8.47
TAK-17 CPT	CPT	639521.43	540683.07	-7.07
TAK-18 CPT	CPT	639576.78	540480.03	-7.44
TAK-20 CPT	CPT	640113.32	540627.98	-11.21
TAK-22 CPT	CPT	640221.70	540432.80	-10.76
TAK-25 CPT	CPT	639975.28	541339.26	-10.75
TAK-PS-01	Piston	640566.00	540816.00	-14.23
TAK-PS-02	Piston	640589.00	540917.00	-14.64
TAK-PS-03	Piston	640553.00	540957.00	-14.46

Figure 23: Bathymetric Conditions in the Port of Takoradi

A few important features can be seen in the new bathymetry:

- For the total area there is a gentle slope from -15 mCD to 0 mCD (coastline)
- Clear set of N-S oriented sandbars in the zone between -11 mCD and -16 mCD
- A number of narrow NW to NE oriented slightly curved ridges in the zone between -11 mCD and -5 mCD.

6.2.3 Geological Condition

Earlier Studies

As part of the planned major rehabilitation and development works of the ports in Ghana, GPHA carried out geotechnical site investigations:

During the planning of this project all previous executed soil investigations were gathered and studied. A list of all available data can be found below.

- 1992 BOSKALIS, geotechnical site investigation, 8 boreholes in the existing port
- 2002 JICA, development study, 2 boreholes in the existing port & seismic survey
- 2006 FUGRO, geotechnical site investigation, 32 boreholes in the new project area and a sandsearch with 21 vibrocores along the coast.

The studies revealed 2 distinct rock types in the port area as follows:

- strongly lithified arkosic sand - (A1) and siltstones (A2) in which weathering and fracturing is not very severe.
- Secondly a carbonate cemented quartz sandstone (B1) that grades into sandy clay.

A1: Dark red micaceous arkosic (rich in feldspar) fine sandstone, sub horizontally layered and poorly bedded. Coarser lenses of medium sandstone are intercalated. Highly compacted and hard. Grains are coated with iron oxide and pores are filled with clay minerals.

A2: Purple-green banded clayey very fine sandstone with quartz concretions, sometimes with reduction spots. Clay content variable. Coarse arcosic sandstone bands of 2-4 cm. Bands with quartz concretional breccia components.

B1: Predominantly pale green & light brown carbonate cemented sub rounded well sorted fine quartz sandstone with foraminifera. Sub horizontally layered. Thin irregular bands of blue – green clay are intercalated. To the top it grades into sandy clay with some amorf SiO2 breccia components.

Rock types A1 and A2 are very lithified, indicating a period of subsurface diagenesis. The process of lithification has produced a hard rock. The clayey part of these rocks is however less resistant. Within these zones shearzones developed, giving the rock a very anisotropic character. After this diagenesis rocktypes A1 and A2 were lifted up to the surface. Quartz sands were deposited in the vicinity of rock types A1 and A2. The field relation of these rocks is not clear. The sand is not significantly compacted but its cohesion is derived from carbonate cementation. This together with the occurrence of marine foraminifera indicates a marine environment

Based on the above information, the conclusion was reached that the seabed material can be dredged using available cutter suction dredgers; some small portion may need to be blasted.

Recent Studies

Further geotechnical studies were carried out by JDN in 2013. Initially 23 boreholes and 8 CPT's were planned. See the original borehole location plan in annex 1. During the execution of the campaign 4 extra boreholes were added. Borehole TAK-02 was cancelled so in total 26 boreholes were drilled (TAK-01 till and TAK-27).

Borehole TAK-02 was cancelled due to a combination of factors. The water depth on location TAK-02 was close to the operational limit of the jack-up. This together with a penetration of the spud legs of more then 1 meter in the seabed made it not safe to perform a borehole on this location. Boreholes TAK-24 and TAK-25 were added on the location of the quay wall, respectively in between TAK-08 / TAK07 and TAK07 / TAK-06. Both boreholes were drilled up to -30 mCD to give extra information from underneath the planned construction. Borehole TAK-23 was moved from its original position to check the boundary between sand and mudstone and to get an idea about the consistency of the ridges in the dredge area. TAK-26 and TAK-27 were added as well to check the location of the sandstone / mudstone boundary.

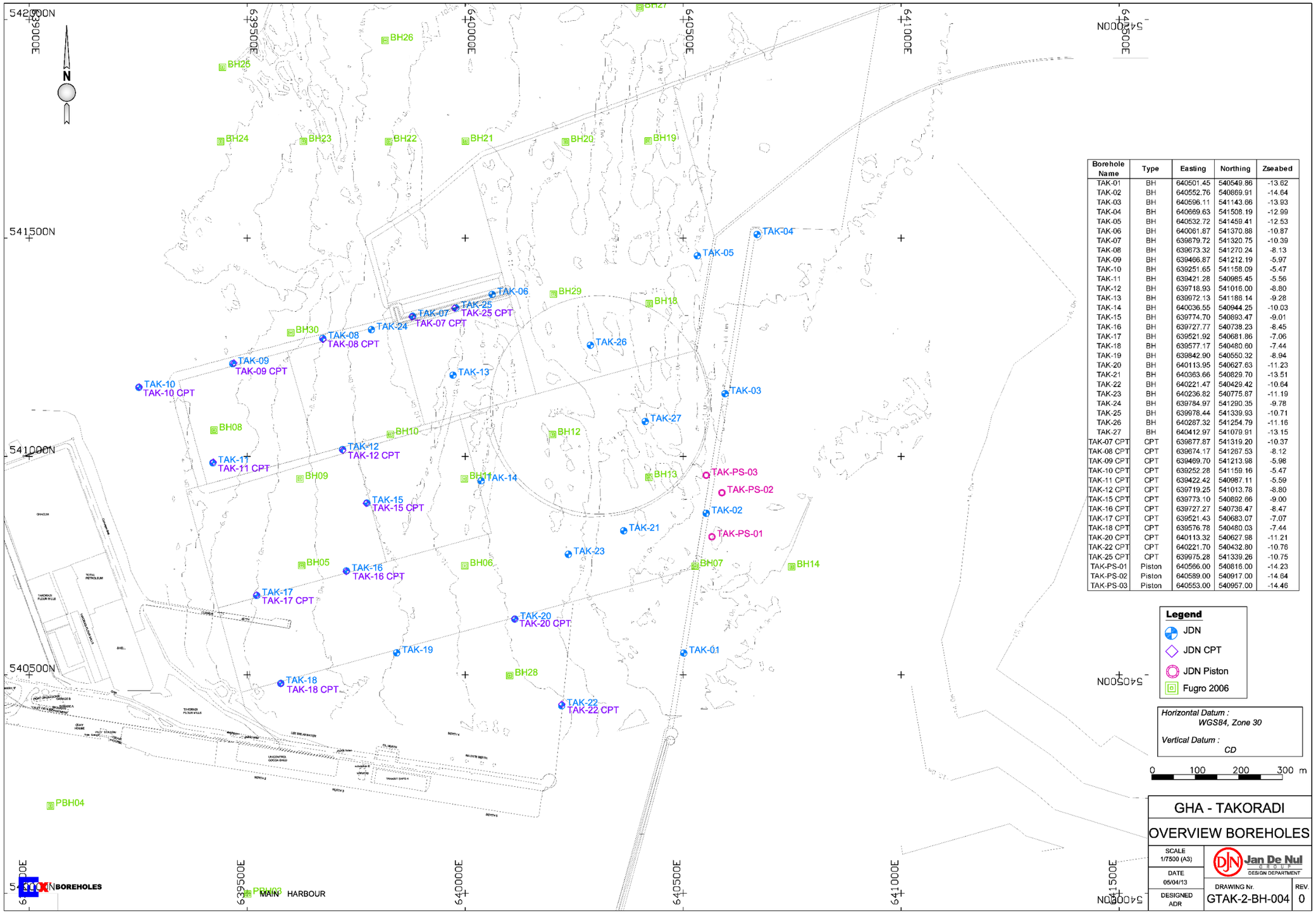
If drilling confirmed the presence of a soft top layer of more than 1 m in thickness a Cone Penetration Test (CPT) was done. In total 13 CPT tests were performed. A map with the as build locations of all boreholes can be found in **Figure 24**.

Results

In general the geology in the project area is build up of sandstone and mudstone / siltstone as realized from the earlier studies. In the eastern part there is a top layer of very soft clay underlain by bedrock consisting of mudstone / siltstone. The transition zone between top layer and bedrock is rather thin. The soft clay gradually changes into stiff clay with gravel (average thickness 1 – 2 m, maximum thickness of 4 m). Sometimes the soft clay also lays directly on top of the bedrock.

In the western part the top layer is less thick or nonexistent and consists of loose to very dense sand to soft silt mixed with gravel. In this part the bedrock consists of sandstone.

The report on the soil investigation by JDN is provided as **Annex 12**.



Borehole Name	Type	Easting	Northing	Zseabed
TAK-01	BH	640501.45	540549.86	-13.62
TAK-02	BH	640552.76	540869.91	-14.64
TAK-03	BH	640596.11	541143.66	-13.93
TAK-04	BH	640669.63	541508.19	-12.99
TAK-05	BH	640532.72	541459.41	-12.53
TAK-06	BH	640061.87	541370.88	-10.87
TAK-07	BH	639879.72	541320.75	-10.39
TAK-08	BH	639673.32	541270.24	-8.13
TAK-09	BH	639466.87	541212.19	-5.97
TAK-10	BH	639251.65	541158.09	-5.47
TAK-11	BH	639421.28	540985.45	-5.56
TAK-12	BH	639718.93	541016.00	-8.80
TAK-13	BH	639972.13	541186.14	-9.28
TAK-14	BH	640036.55	540944.25	-10.03
TAK-15	BH	639774.70	540893.47	-9.01
TAK-16	BH	639727.77	540738.23	-8.45
TAK-17	BH	639521.92	540681.86	-7.06
TAK-18	BH	639577.17	540480.60	-7.44
TAK-19	BH	639842.90	540550.32	-8.94
TAK-20	BH	640113.95	540627.63	-11.23
TAK-21	BH	640363.66	540829.70	-13.51
TAK-22	BH	640221.47	540429.42	-10.64
TAK-23	BH	640236.82	540775.87	-11.19
TAK-24	BH	639784.97	541290.35	-9.78
TAK-25	BH	639978.44	541339.93	-10.71
TAK-26	BH	640287.32	541254.79	-11.16
TAK-27	BH	640412.97	541079.91	-13.15
TAK-07 CPT	CPT	639877.87	541319.20	-10.37
TAK-08 CPT	CPT	639674.17	541267.53	-8.12
TAK-09 CPT	CPT	639469.70	541213.98	-5.98
TAK-10 CPT	CPT	639252.28	541159.16	-5.47
TAK-11 CPT	CPT	639422.42	540987.11	-5.59
TAK-12 CPT	CPT	639719.25	541013.78	-8.80
TAK-15 CPT	CPT	639773.10	540892.66	-9.00
TAK-16 CPT	CPT	639727.27	540736.47	-8.47
TAK-17 CPT	CPT	639521.43	540683.07	-7.07
TAK-18 CPT	CPT	639576.78	540480.03	-7.44
TAK-20 CPT	CPT	640113.32	540627.98	-11.21
TAK-22 CPT	CPT	640221.70	540432.80	-10.76
TAK-25 CPT	CPT	639975.28	541339.26	-10.75
TAK-PS-01	Piston	640566.00	540816.00	-14.23
TAK-PS-02	Piston	640589.00	540917.00	-14.64
TAK-PS-03	Piston	640553.00	540957.00	-14.46

Figure 24: Location of boreholes for soil investigation studies

6.2.4 Water Quality

Water quality studies of the port basin carried out in February 2001 at four different locations revealed moderately polluted conditions but without any significant difference between the sampling locations in the port. The report indicated that oil/grease concentration were in excess of the Assumed Environmental Criteria (AEC) in the absence of a coastal water quality standards for Ghana and that management of oil spill and leakage should take the first priority for water quality management in the Port of Takoradi.

The water quality of the port waters at four (4) different locations was carried out in October 2012. The samples were taken from the following locations using standard sampling techniques:

(i) Fisheries Workshop Area (F),
(ii) Wharf area (W),
(iii) Manganese Berth (M) and
(iv) mini Log Pond (L).

The samples were analysed at the research laboratories of the CSIR- Water Research Institute. Specified methods as laid in "Standard Methods for the Examination of Water and Wastewater" published jointly by the American Water Works Association (AWWA), American Public Health Association (APHA) and the Water Environment Federation (WEF) 20th Edition, 1998 were followed, and the results are as s shown in **Table 10**.

Figure 25 shows the monitoring points for both water quality and air/ noise level assessment.

Figure 25: Water and Ambient Air/ Noise Quality Sampling Locations

Table 10: Water Quality Results- Port of Takoradi, October 2012

Parameter	Unit	F	W	M	L
Turbidity	NTU	12.5	1.50	2.00	3.60
Colour (apparent)	Hz	7.50	2.50	5.00	5.00
pH	pH Units	7.83	7.72	7.76	7.69
Conductivity	µS/cm	52600	52300	52700	52800
Total Suspended Solids (TSS)	mg/l	5.00	1.00	2.00	2.00
Total Dissolved Solids (TDS)	mg/l	28930	28765	28985	29040
Sodium	mg/l	12250	12450	11300	13150
Potassium	mg/l	400	443	400	398
Calcium	mg/l	1202	721	561	2405
Magnesium	mg/l	2599	4568	2332	2379
Total Iron	mg/l	0.477	0.243	0.276	0.308
Ammonium (NH_4-N)	mg/l	<0.001	<0.001	<0.001	<0.001
Chloride	mg/l	17867	16874	21341	19852
Sulphate (SO_4)	mg/l	1428	963	1010	2095
Phosphate (PO_4 - P)	mg/l	0.550	0.326	0.638	0.589
Manganese	mg/l	0.074	0.042	0.048	0.071
Nitrite (NO_2-N)	mg/l	0.032	0.028	0.044	0.033
Nitrate (NO_3-N)	mg/l	0.074	0.043	0.035	0.069
Total Hardness	mg/l	13700	20600	11000	15800
Total Alkalinity	mg/l	133	132	124	131
Calcium Hardness	mg/l	3006	1804	1403	6012
Magnesium Hardness	mg/l	10694	18796	9597	9788
Fluoride	mg/l	0.220	0.176	0.167	0.125
Bicarbonate	mg/l	98.8	116	67.6	97.0
Carbonate	mg/l	34.4	16.4	56.4	34.0
BOD	mg/l	3.40	1.10	1.30	1.20
COD	mg/l	20.9	8.60	9.60	11.4
Oil/ Grease	mg/l	1.25	<1.00	<1.00	<1.00
Zinc (Zn)	mg/l	0.053	0.064	0.066	0.055
Lead (Pb)	mg/l	0.306	0.305	0.312	0.305
Cadmium (Cd)	mg/l	0.095	0.096	0.095	0.096
Copper (Cu)	mg/l	0.095	0.060	0.126	0.105
Total Coliform	cfu/100ml	470	210	180	290
Faecal Coliform	cfu/100ml	66	28	44	59

Source: Laboratory (CSIR- WRI), October 2012

The results showed:

- Typical port water quality regime with excessive anion and cation concentrations;
- Oil/ Grease showed lower concentrations of <1.00mg/l to 1.25mg/l (at the Fisheries Department Workshop area (F) confirming the impact of premix fuel dispensing into the ocean;
- This is also reflected in the COD values with the highest value of 20.9mg/l being recorded at Fisheries Department Workshop area (F);
- Magnesium hardness is rather excessive at the Wharf area (W);
- Zinc, Lead, Cadmium and Copper recorded relatively lower levels without much variations; and
- Coliform levels were also elevated.

6.2.5 Bottom Sediment Quality

The most recent study of marine sediment quality for the Takoradi port was carried out by JICA, on behalf of GPHA, in 2002.

The study confirmed contamination of the bottom sediments in the port basin especially the innermost part which showed severe pollution both in organic matter and heavy metals. The JICA report further indicated that the innermost part of the port showed the most severe pollution both in organic matter and heavy metals, with COD and Lead and Mercury showing levels in excess of the AEC for sediments. The implication is that dredging and consequent disposal of the dredged silt will require careful consideration to prevent contamination.

Sediment Quality of the nearby Albert Bosomtwi Sam Fishing Harbour

JICA also conducted an extensive of sediment quality, as part of the Feasibility Study for the Upgrade and Expansion of the neighboring Albert Bosomtwi Sam Fishing Harbour in 2014. The fishing harbour is located west of the Takoradi Port, and adjacent to the Sekondi Naval Base.

The characteristics of the sediment from the two locations are expected to be similar since they fall within the same marine environment. It must however be noted that the metal concentration represents a conservative, yet relevant, approximation of the Takoradi Port Basin Environment due to higher level of activity and the handling of potentially toxic cargo.

Sample Sites

Seabed load samples were collected from seven locations as shown in **Figure 26** and described in **Table 11**. Samples S-1, S-2 and S-3 were within the port basin, while the remainder were in the nearby environment.

Table 11: Sample sites for sediment quality analysis

Sampling Site	Co-ordinate		Water Depth (m)
	Longitude	Latitude	
S-1	1˚42’25.663”	4 ˚ 56’20.745”	1.4
S-2	1 ˚42’29.110”	4 ˚56’29.92”	3.6
S-3	1 ˚42’21.429”	4 ˚56’29.135”	3.8

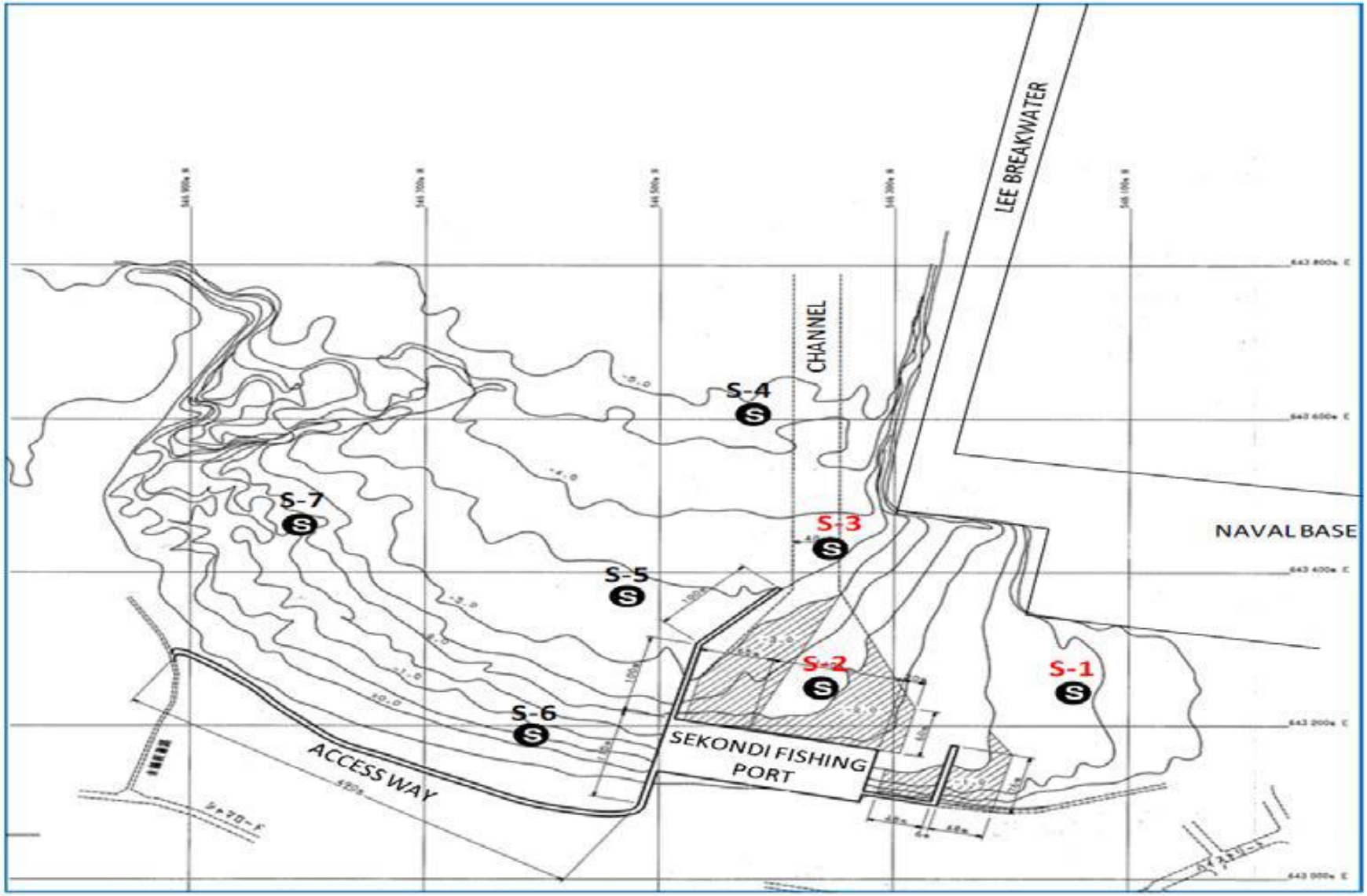


Figure 26: Sampling locations for sediment analysis

Results of Laboratory Analysis

The laboratory results for the heavy metal concentration are shown in **Table 12**.

Table 12: Seabed Material Survey Result (Heavy Metal Contents)

Item	S-1 (Old Beach)	S-2 (In Harbour)	S-3 (Entrance)	Canadian Interim sediment quality guidelines (ISQGs)
Total Nitrogen (mg/kg)	210	135	105	-
Total Phosphorus (mg/kg)	91	20.5	26.5	-
Total Sulphur (g/kg)	127	129	135	200
Arsenic (mg/kg)	2.5	<0.025	<0.025	7.24
Cadmium (mg/kg)	0.75	1.25	0.50	0.70
Chromium (mg/kg)	<0.025	25.0	25.0	52.3
Copper (mg/kg)	5.50	6.75	4.25	18.7
Lead (mg/kg)	15.3	26.5	23.3	30.2
Mercury (mg/kg)	0.25	6.00	3.00	0.13
Nickel (mg/kg)	<0.025	<0.025	<0.025	-
Zinc (mg/kg)	15.5	25.3	16.5	124
DDT (µg/kg)	0.621	0.675	4.054	-

The results indicate that metal concentration within the port basin (at S1, S2 and S3) were within the Canadian Interim sediment quality guidelines (ISQGs) for the parameters measured except mercury and Cadmium.

As stated earlier, this represents a conservative, yet relevant, approximation of the sediment quality within the Takoradi Port Basin.

Dredged materials will therefore need to be treated prior to disposal.

6.2.6 Littoral Drift

In the port area, considerable sand accretion has occurred along the main breakwater. The accreted sand seems to have come from the southern end of the port. 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 $1ms^{-1}$, but are responsible for transporting large volumes of littoral sediments and also for rip currents which are more localized in their action, but move appreciable amount of sediments away from the coast.

6.2.7 Air Quality and Noise

Ambient Air Quality

Previous air quality studies in and around the port in August 2001 showed no major variation from what pertains in the metropolis although the nuisance from dust released from the clinker operations by GHACEM generally pollute the immediate surroundings of that area in

the Port of Takoradi. Similarly, the manganese jetty and cocoa shed area also have excessive dust levels though within the EPA Ambient Air Quality Guideline (AAQG) values.

Similarly, the August 2001 study showed that noise in the port area and surrounding commercial/ industrial area were all below the EPA Ambient Noise Quality Guideline (ANQG) values.

As part of the EIA study, ambient air quality assessment was carried out on 26th September 2012 at three (3) monitoring sites at the port as shown in **Figure 25**.

The monitoring sites are described as A1, A2 and A3 and described as follows:

- A1: Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station;
- A2: Around the Ghana Manganese Company Loading Point away from the Berth; and
- A3: Around the Fisheries Department Workshop Area.

The main objective of the air quality assessment was to determine the baseline ambient air quality levels of Total Suspended Particulate (TSP), Respirable Dust (PM_{10}), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide (CO) to provide a basis for determining the ambient air quality regime at the Port of Takoradi.

Sampling Equipment and Methodology for Particulate Matter

The active principle sampling mechanism was employed in which portable motor-driven SKC Hi-volume dust samplers were installed at each sampling site. The equipment was calibrated in the field prior to use. Background samples were collected for 24 hours on pre-weighed glass fibre filters. These were re-weighed after the sampling in order to determine the weight difference. The flow rate of the sampler was set at 5 $Lmin^{-1}$.

The individual samples were gravimetrically analyzed using the formula given below:

$$TSP/PM_{10}\ (\mu gm^{-3}) = \frac{W_2 - W_1}{Fr \times T} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:
TSP = Total suspended particulate
PM_{10} = Respirable dust
W_1 = Weight of glass fibre filter before sampling
W_2 = Weight of glass fibre filter sampling
Fr = Flow rate (5 $Lmin^{-1}$)
T = Sampling duration in minutes

Sampling Equipment and Methodology for Noxious Gases

The levels of Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide in the ambient air were determined using dragger diffusion tubes, at standard conditions of pressure and temperature (1013kPa, 273K). The concentrations of the gases were obtained using internet conversion software (*www.cdc.gov/niosh/docs/2004-101/calc.htm*) that is also related to the formula:

$[mgm^{-3}]$ = [ppm] x gas density (at standard conditions)……(2)

Result of Air Quality Assessment

The results of the air quality assessment are as shown in **Table 13**.

Table 13: Results of Air Quality Assessment at the Port of Takoradi- September 2012

Sampling Point ID	Sampling Site Description	TSP μgm^{-3}	PM_{10} μgm^{-3}	SO_2 μgm^{-3}	NO_2 μgm^{-3}	CO mgm^{-3}
A1	Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station	200.0	25.0	< 0.0005	N.D*	5.73
A2	Around the Ghana Manganese Company Loading Point away from the Berth	205.0	30.0	< 0.0005	N.D*	4.58
A3	Around the Fisheries Department Workshop Area	220.0	30.0	< 0.0005	N.D*	4.58
EPA Ambient Air Quality Guidelines for Industrial Areas over 24 hours		**230**	**70**	**150**	**150**	**10****

N.D* = Not detected **CO guideline value over 8 hours

The following observations can be made from **Table 13**:

- The TSP for the three sampling sites range from 200.0µgm-3 to 220.0µgm-3 which are within the EPA's maximum permissible level of 230µgm-3 and showed elevated levels of ambient dust around the port;
- The PM10 levels for the sampling site ranged from 25.0µgm-3 to 30.0µgm-3, which is lower than EPA's guideline of 70µgm-3.
- The ambient concentration of SO_2 and CO were all within the maximum permissible levels. NO2 was not detected during the sampling period while SO2 was <0.0005 µgm-3 at all the sampling locations within the port;
- The predominant average wind speed was 0.64 ms-1, blowing from the South Western to the North Eastern direction.

Noise Levels

Noise levels assessment was carried out simultaneously with dust levels at the same sampling sites (see **Figure 25**) using the Quest Integrated Sound Level Meter type 2900 with data logging system. The instrument was positioned at a height of 1.2 meters above ground. The meter was calibrated prior to monitoring and the data logged at 3 seconds interval. The results of the noise level assessment are summarized in the **Table 14**.

Table 14: Results of Noise Level Assessment at the Port of Takoradi- September 2012

Sample ID	Sampling Site	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
A1	Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station	63.0	82.3	48.9	65.4	59.1	54.4
A2	Around the Ghana Manganese Company Loading Point away from the Berth	67.0	82.7	57.8	63.6	60.9	59.9
A3	Around the Fisheries Department Workshop Area	63.0	82.7	57.8	63.6	60.9	59.9
EPA Ambient Noise Level Guideline for a Predominantly Heavy Industrial Area (Day Time)		70	-	-	-	-	-

Legend
Leq - Integrated noise level during the measurement period
Lmax - Maximum noised level
Lmin - Minimum noise level
L_{50} - Average noise level
L_{10} - Nuisance noise level
L_{90} - Background noise level

The integrated noise level during the measurement period ranged from 63.0 dB(A) to 67.0 dB(A) and thus within the EPA permissible noise limit.

6.2.8 Aquatic Biota

There are no significant aquatic species endangered or academically valuable that has been encountered in the port basin. Previous studies show that the continental shelf extends up to 80km broad off the eastern to central part of Ghana from Takoradi and eastwards. Generally, important fishing grounds of gill net fishing and purse seine fishing spread in a coastal zone up to 40km from the coastline including the nearby New Takoradi area to the port.

According to the Fisheries Department of Western Region, there are spawning and fishing grounds for shrimps off Takoradi at water depths between 20m and 50m, and spawning and feeding grounds for the Round *Sardinella* from 30m and outward the shelf (JICA/ GPHA, 2002).

As part of the EIA study an oceanographic study was carried and the report is presented as **Annex 7** of this report.

Macrobenthic fauna

The fauna at the harbour is dominated by rocky intertidal macro-benthic fauna as shown in **Table 15**. The community was visibly dominated by the barnacle, *Chthamalus dentate,* the upper shore littorinid, *Echinolittorina pulchella* and the oyster *Ostrea tulipa.* They are abundant on the sides of the wharf, rocks, breakers, and tyres alongside the wharf. Other taxa represented are gastropods, crustaceans, echinoderms and the cnidaria.

The macroalgae was dominated by the brown alga, *Bachelotia antillarum*. Other phaeophytes recorded are the *Chnoospora minima* and *Ralfsia expansa* as well as a chlorophyte,

Chaetomorpha linum. They are dominant on the rocks and other substratum available for attachment. **Table 15** provides an inventory of the Rocky Shore Fauna and Macroalgae at the Port and their conservation status as per the IUCN Red List of Endangered Species (as at 17 September 2015). The assessment indicates there are no species of conservation value.

Table 15: Inventory of Rocky Shore Fauna and Macroalgae at the Port

Mollusc	Crustacean	Macroalgae
Gastropod	*Chthamalus dentata*	***Chlorophyta (Greens)***
Echinolittorina pulchella (not assessed)		*Chaetomorpha linum*
	Cnidarian	
Thais heamastoma (not assessed)	*Anthopleura* sp.	***Phaeophyta (Browns)***
Nerita atrata (not assessed)		*Chnoospora minima*
Siphonaria pectinate (not assessed)	***Echinoderm***	*Bachelotia antillarum*
	Echinometra lucunter	*Ralfsia expansa*
Bivalvia		
Ostrea tulipa (not assessed)		

Many of these epibenthic fauna are indicators of ecological healthiness and also constitute an important food resource to marine organisms (e.g., fishes) and also humans. The higher the species diversity of these epibenthic organisms is an indication of lack of ecological disturbance (natural and anthropogenic), albeit most ecologist correlate moderate disturbance with higher species diversity. **Table 16** assesses the conservation status of Rocky Shore Fauna and Macroalgae at the Rocky beaches as per the IUCN Red List of Threatened Species (as at 17 September 2015). The assessment indicates there are no species of conservation value.

Table 16: Inventory of Rocky Shore Fauna and Macroalgae Found at Rocky Beaches in the Western Region

Mollusc	Crustacean	Macroalgae
Gastropod	*Grapsus grapsus (not assessed)*	***Chlorophyta (Greens)***
Echinolittorina pulchella (not assessed)	*Cthamalus dentate (not assessed)*	*Bryopsis pennata (not assessed)*
Echinolittorina cingulifera (not assessed)	*Panopeus sp. (not assessed)*	*Chaetomorpha linum (not assessed)*
Echinollitorina granosa (not assessed)		*Chaetomorpha antennina (not assessed)*
Thais nodosa (not assessed)		*Ulva fasciata (not assessed)*
Thais heamastoma (not assessed)	***Echinoderm***	
Cyprae sp. (not assessed)	*Cidaroidea sp. (not assessed)*	***Phaeophyta (Browns)***
Nerita atrata (not assessed)	*Echinometra lucunter (not assessed)*	*Basispora Africana (not assessed)*
Patella safiana (not assessed)		*Chnoospora minima (not assessed)*
Siphonaria pectinate (not assessed)	***Cnidarian***	*Ralfsia expansa (not assessed)*
Nudibranchs sp. (not assessed)	*Sea anemone*	
Clanculus sp. (not assessed)	*Zoanthus sp. (not assessed)*	***Rhodophyta (Reds)***
Arca senilis (not assessed)	*Palythoa sp. (not assessed)*	*Lithothamnia (not assessed)*
Murex sp. (least concerned/lower risk)	*Anthopleura spp. (Least Concern)*	*Botrisia radicans (not assessed)*
Fissurella nubecula (not assessed)		

Bivalvia
Ostrea tulipa (not assessed)
Brachydontes sp. (not assessed)
Perna perna (not assessed)

Commonly encountered fauna on sandy beaches (**see Table 16**) in Ghana are mysids and polychaetes (deGraft-Johnson *et al*., 2010), and the bivalve *Donax pulcherimus*. The littoral benthic organisms include polychaetes, arthropods, bryozoans, and echinoderms. Edmunds (1978) recorded 68 taxonomic families. Some species such as the gastropods *Cymbium* spp. and the spiny lobster *Panulirus* sp. appear to be declining in abundance while the sea star *Astropecten* sp. and other starfishes have completely disappeared (deGraft-Johnson *et al*., 2010).

The inshore and offshore phytoplankton communities of Ghana include diatoms, dinoflagellates, and coccolithophores. The principal species of diatoms in Ghana during the upwelling belong to the genera *Skeletonema, Nitzschia, Chaetoceros, Rhizosolenia,* and *Thalassiosira* (Wiafe, 2002). Other planktonic groups such as chaetognaths are abundant from September to November yearly, thaliaceans, mainly *Thalia democratica*, in December and July, and appendicularians in June and October (Thiriot, 1977). The explosive development of these plankton groups influences the fishery of the nearshore and adjoining coastal water bodies. It has been reported (Mensah, 1966) that maximum occurrence of the zooplankton copepod *Calanoides carinatus* during the upwelling season in Ghana is related to the seasonal abundance of *Sardinella* species in the coastal waters.

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 western Ghana, a phenomenon of major concern to fishermen and other users of the coast. The *Sargassum vulgare* bloom followed soon after the green algae bloom. The sources of these blooms are currently under study by research scientists but nutritional enrichment from many sources has been fingered for blame.

There were reasonably large number of seashore and coastal birds at the port. They were dominated by terns, curlews and plovers. A small number of pied kingfisher were seen within the marine section of the port. These birds feed on the large numbers of worms and other macro-benthic invertebrates exposed at low tides.

Fish and Fisheries

The waters of the port were teeming with large numbers of fish. Fishes of various sizes, both small and large were found in the port waters. Because fishing was officially prohibited in the port, fish had a free hand to feed and grow in the rich waters. A few workers interviewed indicated under anonymity that they fished occasionally with hook and lines catching huge sized quality fishes. The port was serving as a de facto marine protected area for fishes thereby helping to restock the open seas with fish. Serving as a nursery area, fishes migrate to the port for feeding and spawning. A wide range of marine and estuarine species are found in the port.

Adjacent to the port and project vicinity is the Fisheries boatyard locally called 'Fisheries Mpoano'. The boatyard and workshop is under the management of the Fisheries Directorate of the Fisheries Commission. Both inshore vessels and canoes dock here for maintenance. It serves the entire Western region and to some extent the Central region of Ghana. The busiest time of the year for the workshop is in the peak fishing season of June to September. During the peak period between 50 to 100 inshore boats and 10 to 20 canoes could be docked at this location in a typical day. Distressed vessels are towed to this landing beach regularly for attention. Fisheries Technical Assistants stationed at the workshop also collect daily fish catch and effort data as well as sea surface temperature. This data form a critical component of national fish statistics in support of fisheries management.

Adjacent to the workshop is the former State Fisheries Company (SFC) yard which is sold out. Fishers use the yard for mending and construction of fishing gears. Near to the yard is a premix fuel dump serving fishers in the area. Right in front of the yard is a boulder/rocky beach with all the typical rocky shore macro-benthic fauna. On the visit, sea hare (Applysia sp.), sea urchin (Echinometra lucunter), bivalve Perna perna, and littorinid species dominated the fauna at the site.

6.2.9 Road Traffic

There are three (3) access roads to the port, two fairly big roads and a smaller one. Lines of articulated vehicles and trucks parking and waiting for the loading / unloading of goods were often observed on the main access roads, though they occupy an estimated no more than 10% of total traffic volume.

The speed limit within the port is 30km/hr.

6.2.10 Waste Management

<u>Present Situation of Waste Treatment and Sewerage Treatment at Takoradi Port</u>
Toilet sewerage of the Takoradi port is collected into one cesspit at the ports. The cesspit is emptied regularly and transported STMA's designated dumping area at Sofokrom, Garbage/ wastes are also transported and dumped at the STMA's designated dumping site. Private entities have been contracted by GPHA for the collection and disposal of the wastes.

Solid wastes
The solid waste at the port premises is usually garbage generated by calling vessels and port users including visitors. It is estimated that averagely, about 5 tons of solid waste is generated per month (JICA/ GPHA, 2002). The solid waste is currently managed by Zoom Lion Company Limited, a waste management firm for disposal at STMA designated landfill site.

Sewage
Sewage is generated on board vessels and by the port users including visitors. The waste management division of the Port of Takoradi has two sewage disposal tankers for the purposes of siphoning sewage from vessels on request for disposal at STMA designated

disposal sites. These tankers are also responsible for collection of sewage from designated points in the port area.

Hazardous and Oily wastes

Oily wastes generated by calling ships are collected into skips and given to Messrs Zoil, who operates an approved oily waste management facility in the Sekondi-Takoradi Metropolis. Zoil is also able to handle the treatment of oil based mud cuttings from oil & gas drilling operations.

Another thermal desorption plant to also handle the treatment of oil based mud cuttings from oil & gas drilling operations installed by SWACO at the port is yet to be operational.

Zeal Environmental Technologies provides Maritime waste reception services at the Takoradi Port in Ghana in accordance to MARPOL 73/78 Treaty. Managed waste streams could be Hazardous or non-hazardous from Vessels that visit the port. We also provide offshore services to Vessels which cannot berth at the port due to congestion or technical reasons. These services include:

- Classification and safe Disposal of all types of waste from Maritime Operations
- Removal of general and hazardous waste from commercial vessels that visit the port either berthing at the port or Anchoring offshore.
- Inspection of vessel to determine best ways to manage solid waste or Grease or Oily waste before berthing at a port.
- Waste removed from vessel after being classified by Zeal's Environmental team is then removed from port side and then disposed of or recycled at various zeal waste treatment facilities by these disposal or treatment options:
    - Steel Drum Washing, Crashing and Recycling
    - Plastic Drums or Plastic Container Washing, Cutting and Recycling
    - Filter or Grease Canisters and Hazardous Solid Waste Incineration
    - Hazardous Liquid Waste Incineration
    - Waste Water and Chemical Treatment
    - Landfill Disposal Services for Bio Degradable waste
    - Oil recycling and fuels Reclamation
    - Steam and Boiler cleaning
    - Barite and Sludge Management

<u>STMA Dumping Site</u>

Toilet sewerage and garbage/ wastes are transported and dumped at the STMA's designated area by the private entities entrusted by GPHA. The dumping area was constructed by World Bank's assistance and was completed in 2010. The dumping area (Engineer Landfill Site), located at Sofokrom, with approximately 36 ha of surface area and located 7km onward to Accra from the Project site, has a capacity of accommodating all kinds of wastes including industrial hazardous wastes except for the medical wastes up until year 2025. Garbage is sorted by the following three categories at Sofokrom except for the medical wastes.

- Solid wastes (general garbage: both organic wastes and nonorganic wastes): Some private individual come to visit to separate plastics, bins, wooden materials, concrete materials, metals which are worth to sell as recycled materials.

- Liquid wastes mostly toilet sewerage: 6 pools for processing and 2 pools for the final processing are installed.
- Industrial hazardous wastes (oil, contaminated soil with heavy metals): The site is ready to be sealed for several layers by the special plastic protection sheets for each of the waste. This is the place for the sledge of Sekondi port generated by construction activities will be treated.

6.2.11 Oil Spill Management

The Takoradi Commercial Harbour Oil Spill Contingency Plan is being implemented by the Ghana Ports and Harbour Authority to combat oil spills that occur in the port. The port is equipped with one tug at Takoradi fitted with booms, skimmers and tank receptacles for spill management. Other port operators such as Tullow Oil Ghana Limited has equipment which can be utilized by the GPHA in response to spills. Zoil Ghana Limited also has equipment which are the disposal of GPHA to handle any oil spillages.

There has been no major spills in Ghana waters. Only small spills have been reported at the Port of Takoradi

6.3 Baseline Environmental Conditions of the Adjacent Beach (Fisheries 'Mpoano') to New Takoradi Beach

A thorough survey of the Fisheries Department Beach (Fisheries 'Mpoano') to New Takoradi Beach was carried out as part of the EIA study. It is noted that no community will be relocated in this project. What is likely to be relocated is the activity of fisher-folk at the beach (cape adjacent to the current location of the Fisheries Department Workshop) to allow for shoreline reclamation (**see Plate 16**).

At the Takoradi New town fish landing site, we interacted with the fishers about the upcoming project. Fishers were educated about the project as well as solicited their concerns about the project. The dominant fishing gears were Tenge gill net, lobster net, hook and line, encircling gears including purse seine. Fishing effort is very high at this landing site with over 600 canoes operating from here in the peak season. More than half of the number use outboard motor.

A large number of the women processed fish such as smoking for the market. Fishers were already concerned about high sea water swells that threaten landing and launching of boats. The landing site was eroding at a very high rate. Fishers believe the extension of the quay might exacerbate the erosion rate, increase distance to get to their landing site or effectively reduce area for landing of fish. They expect the project to clearly create a space to allow fishing boats to come in to land their catch as well as provide some measures to protect the landing site from further eroding which might end up affecting their livelihoods.

The Regional Fisheries Officer for the Western Region, Mr. Sabah indicated that the workshop was the only natural slipway for servicing inshore boats, canoes and engines. He confirmed that the New Takoradi beach serves as a very important landing site for boats both in the Western and Central Regions. **Plate 17** shows a boat berthed at the slipway near the Fisheries

Department Workshop. He added that the existing heavy wave action at the beach which fishers are coping with could be exacerbated with the implementation of project activities.

Further, Mr. Sabah opined that dredging of the area will adversely affect lower draught vessels such as inshore boats who might find it very difficult to dock. Most importantly, he recommends that a special space should be created in the landing beach to allow distressed vessels to safely land. He indicated his willingness to engage with port authorities and other stakeholders to find solutions to any envisaged problems that might arise from the project.

Plate 16: The Natural Slipway at the Leeside of the Port Close to the Fisheries Department Workshop

Plate 17: Boat Berthed at the Slipway near the Fisheries Department Workshop

7.0 CONSULTATIONS

Consultations have been held with the following 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 meeting (**see Annex 5):**

GPHA- **Proponent**

- GPHA, Head Office – Tema;
- GPHA, Regional Office – Takoradi (**see Plates 18**);

EPA- **Regulator (Environment)**

- EPA Regional Office – Sekondi; and
- EPA, Head Office – Accra.

GMA- **Regulator (Maritime)**

- Ghana Maritime Authority- Sekondi.

GPHA Operators- **Tenants**

- Unicontrol Commodity Ghana Ltd;
- Ghana Manganese Company;
- Burkina Shippers Council;
- Ghana Haulage Truck Drivers Association (GHTDA);
- Panacpine;
- Vikings
- Halliburton;
- Daado Maritime;
- Hull Blyth;
- INTAPRO Ltd;
- Stellar;
- GT. Obiri;
- Tullow oil;
- GHACEM Ltd;
- Docks Consulting;
- Burkina.CCI;
- Gemin;
- MENERGY;
- SLAYYTO;
- Substance;
- Takoradi Flour Mill;
- Macro;
- OMA;
- Zeal Environment Technology;
- Integral Marine;
- Maersk Line;
- Supermaritme;

- Ghana Bauxite Company;
- Niger Shippers Council;
- SCL;
- CMC;
- GDLC;
- Omega Marine;
- Safmarine;
- Coppon Wood;
- A.P.S.;
- Gierre Wood;
- ICS;
- Global Haulage Co.;
- ABIVIAMS;
- Process & Plant;
- Lube Engineering;
- Ghana Rubber Estate Ltd (GREL);
- MSC; and
- IESL.

Government Institutions

- Sekondi-Takoradi Metropolitan Assembly (STMA);
- Ghana Railway Company Ltd (GRCL);
- Ghana Standards Authority (GSA); and
- Ministry of Food and Agriculture (MOFA-PPRSD).

Security Agencies

- National Security;
- NAVY;
- Immigration; and
- CEPS.

Media Practitioners/ Journalists

- Skyy FM;
- Daily Graphic;
- Ghanaian Times;
- TV Africa;
- GBC
- Radio Ghana;
- New Statesman.

Others

- Grace Churce;
- Takoradi Hospital;
- Western Stake Quarry;
- SGSSB Bank; and
- Western Regional Shipper Committee & Shippers Association.

New Takoradi Community

- Opinion Leaders and Representatives of Fisher folks of New Takoradi (**see Plates 19 – 20**).

Concerns raised during the one-on-one consultations are given in **Table 17** while the report of the public consultation meeting is provided in **Annex 5.**

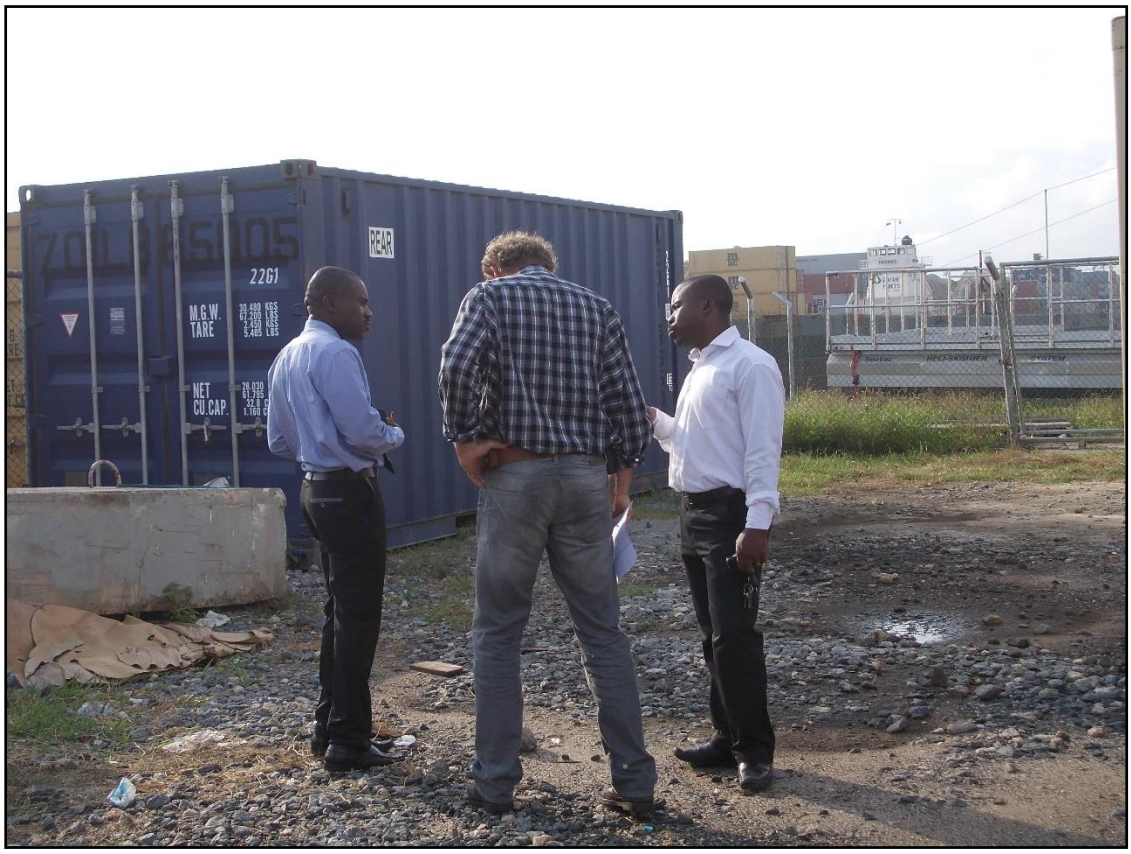


Plate 18: Discussions at a Section of the Port during a Site Tour with officials of the Environment and Estates Department of Takoradi Port

Plate 19: Group Picture of Consultants, GPHA Staff, Opinion Leaders and Representatives of Fisher Folks of New Takoradi Community

Plate 20: A Scene from Informal Discussions with some Fisher Folk at the New Takoradi Landing Beach

Table 17: Summary of Concerns Raised During Stakeholder Consultation

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
Project Implementers					
GPHA, Head Office, Accra					
GPHA, Regional Office, Takoradi	Acting Director of Ports, Mechanical Engineer (Mr Barnes) Senior Estate & Environment Officer (David K.S. Halm) Public Relations Manager, (Mrs Agnes Dennis-Moses)		031 24073 Ext. 4052 0244575090 03123818 020201376	28/06/12	• The Takoradi Port authority organised a meeting with the neighbouring communities in order to discuss the renewing of the Port's strategic plans for 2012-2016 and the proposed project formed part of the discussions; • The fisher folk are a bit concerned about the proposed project, there is therefore the need to educate them more on the proposed project; • The Ghana Railway Development Authority have been involved in the planning of the proposed project, discussions are ongoing and the Government of Ghana will take a decision on the location of office of the Ghana Railway Development Authority;
	Senior Estate & Environment Officer David K.S. Halm		031 24073 Ext. 4052 0244575090	26/06/12	• Information on project scope and port profile; • GPHA, Takoradi liaise with the Sekondi Regional EPA concerning environmental issues at the port
	Fire Safety Manager, Edward Heyman		0244451199	27/06/12	• The Takoradi Port and all the operating oil companies at the port have fire safety policies, GPHA plans to bring all the policies for the various operators together hopefully by the end of the year in order for the Takoradi Port to have one Emergency Preparedness Plan;

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					• Before any dangerous cargoes are brought to the Takoradi Port, the fire safety office is notified and their preparedness to receive such cargoes confirmed; • The Takoradi Port fire safety office has a good relationship with the National Fire Service; and • The fisher folks also corporate with the Port fire officers, the fisher folks are also allowed to park their boats in the port premises.
GPHA, Regional Office, Takoradi	Chief Pilot, Captain Ebenezer Kojo Afadzi		03120 24095/ 25271, 0208181428	27/06/12	• The Habour Master periodically organises exercises with the port operators and they are aware the first point of call when there is an oil spill is the Habour Master, the occasional occurrences of oil spill at the port is from the offshore supply vessels which are quickly contained; • The proposed project will not affect piloting activities in the port.
Takoradi Port Operators					
Unicontrol Commodity Ghana Ltd (UCC)	Country Manager, Kor Ritsema		0312030551/2/3 0244324952	27/06/12	• The Unicontrol Commodity Ghana Ltd are basically involved with the packaging and transferring of cocoa into vessels for export; • Currently their greatest challenge is the lack of space as they have to share space with other operators at the port; the manganese packaging area is close to the cocoa packaging area. The Port Estate & Environment Officer stated that as part of the proposed project,

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					food products operators will be separated from raw material operators; • The proposed project will improve facilities in the port; • Proposes that as part of the project, a proper cleaning facility is purchased; and • The relocation of the cocoa shed will not affect the operations of UCC so long as it is planned properly. Rather in favour of the relocation of the cocoa shed and the provision of more berthing space.
Government Regulatory Agency					
Environmental Protection Agency, Sekondi Regional Office	Chief Program Officer, Shine Fiagome; Senior Program Officer, George K. Diawuoh;	Regulator	0244185270 0245086497	28/06/12	• The Takoradi Port has informed the EPA about the proposed project; • Possible emissions to air and water should be considered in order to stay within the EPA approved limits; • Oil spill waste should be properly disposed; • The EPA should be informed of the source of quarry material for reclamation; • There is the need to carry out an extensive baseline studies due to the short coastal stretch of the proposed project area; • Traffic modelling should be considered as part of baseline studies especially at the inlet of the port through the bunkering area, as traffic could be an

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					issue during haulage of raw materials into the port during construction; • There is also the need to improve facilities to reduce dust emissions from the operations of GHACEM at the port in order to avoid any issues with the New Takoradi Township. The issue of dust emissions from the Takoradi Port should be factored in the design of the proposed project; • The height of the breakwater should be considered as clinker, Manganese, etc are sometimes dumped behind the breakwater; • Security and accessibility to the Port should also be considered as the proposed expansion will bring the Takoradi Port closer to the community; and • GPHA should ensure they provide a good decommissioning plan.
Municipal Assembly					
Sekondi-Takoradi Municipal Assembly	Town and Country Planning, Dadzie Paintsil		02077584281	28/06/12	• The impact of climate change should be considered in the proposed project; • The immediate environs of the proposed project area should also be considered, these should include the coastline of Shama, Jomoro districts etc; • Potential impacts on the existing railway line from the proposed project should be considered; • In order to avoid social tension during resettlement activities, there is the need to ensure that all Project Affected Persons are well informed;

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					• There is also the need to consult with the youth as they would like to know the advantages of the proposed project in the area of employment opportunities; • Training for the PAPs (youth) should also be considered; • Concerning the disposal of waste for the proposed project, GPHA can collaborate with STMA to rehabilitate the STMA dumpsite. GPHA will also have to liaise with the STMA in the disposal of hazardous waste as a landfill site is currently under construction.
Fisher folk, New Takoradi	Chief Fisherman, Kwaw Ackon; Abusuapanyin, Barima Ayeh (Member o Council of elders) Adzikyimunsem (Member of Council of elders); Kojo Busumtwi (Member of Council of elders); John Ewusi (Member of Council of elders);		-	28/06/12	• Appreciate effort of GPHA and the consultants for informing them about the proposed project; • They are happy about the proposed project and looking forward to the commencement of the project as it will bring development to the township; • There is the need to inform the rest of the fisher folks for their opinions before any decisions are taken; and • There is also the need to take into consideration the distance from the new area to be allocated to them to their present location.

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
	Agya Kojo Owusu Antwi (Member of Council of elders); Kwabina Dacosta Vroom (Member of Opinion leaders); Kwame Tawiah (Member of council of elders); Ekow Sackey (member of council of opinion leaders)				

8.0 POTENTIAL ENVIRONMENTAL ISSUES IDENTIFICATION

The nature of the proposed project, field inspections and observations, concerns from stakeholder consultations and issues from relevant literature search formed the basis for the identified potential environmental issues and impacts associated with the project. The Environmental Assessment (EA) broadly covers the following subject areas:

- Dredged materials management;
- Bottom sediment disposal;
- Air emissions;
- General waste reception;
- Wastewater management;
- Solid waste management;
- Hazardous materials and oil management;
- Noise; and
- Biodiversity.

8.1 Project Area of Influence

8.1.1 Geographical Area of Influence

The geographical area covers the Takoradi Harbour Area. The project site, covers the entire port and surrounding areas close to New Takoradi.

8.1.2 Environmental Media of Influence

The main environmental media to be influenced are:

- Soil/land of the project site;
- Spoil and dredge material disposal site;
- Visual landscape;
- Ambient air around the project site; and
- Coastal/ocean environment/waters.

8.1.3 Socio-economic Influence

The project will influence the socio-economy of:

- The Port of Takoradi;
- Sekondi Takoradi Metropolis;
- The Western Region of Ghana; and
- Ghana as a country.

8.2 Project Activities of Environmental/Social Concern

The main project activities that will potentially create environmental/ social and worker health and safety concerns have been grouped under the following:

- Preparatory phase;

- Construction phase activities;
- Operation and maintenance phase activities; and
- Decommissioning phase activities.

8.2.1 Preparatory Phase Activities

Preliminary activities to be carried out prior to the implementation of the proposed projects include:

- Survey works to determine and/or confirm the extent of the reclamation area;
- Identification and enumeration of project affected persons;
- Baseline/feasibility studies and data collection (geotechnical studies etc.);
- Stakeholder consultations;
- Procurement, manufacturing and storage of construction materials and machinery;
- Statutory permitting activities.

8.2.2 Construction Phase Activities

Specific activities will include:

- Ground preparation and earth works;
- Demolition of old structures;
- Disposal of spoil;
- Transport of crushed rock boulders to site;
- Concrete works;
- Paving works;
- Surface markings;
- Drainage improvement works; and
- Erection of buildings and other infrastructure facilities.

8.2.3 Operation and Maintenance Phase Activities

Specific activities will include:

- Rationalisation of like activities in the port;
- Traffic management
- Movement of containers to and from site;
- Storage of containers;
- Maintenance of equipment and machinery;
- Disposal of solid wastes and scraps;
- Disposal of waste oil; and
- Provision of security.

8.2.4 Decommissioning Phase Activities

Specific decommissioning phase activities to potentially impact on the socioeconomic and physical environment is mainly from the replacement of dysfunctional structures or facilities provided under the proposed project. It is not envisaged that the entire port will be decommissioned.

8.3 Categories of Impact Rating

The impact ratings are categorised as follows:

- Minor significance;
- Moderate significance; and
- Major significance.

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.

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. These shall be further addressed by the EIA.

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. These shall be further addressed by the EIA.

8.4 Evaluation of Potential Impacts Associated with Preparatory Phase Activities

Significant environmental issues, which could arise from preparatory phase activities, may include:

- Disturbance and Livelihood issues;
- Anxiety from potentially affected persons; and
- Occupational health & safety issues.

8.4.1 Disturbance and Livelihood Issues

It is noted that no land acquisition will be required and no community will be relocated in this project. Disturbance and livelihood issues are likely to arise from the proposed project activities from the reclamation of the shoreline between Fisheries Department Workshop and New Takoradi Beach. This is a result of restricted access to the beach by fisher-folk, who operate at the cape adjacent to the current location of the Fisheries Department Workshop) and use of beach and the ocean as boatyard.

The location also acts as a natural slipway for servicing inshore boats, canoes and engines. During consultations with the affected fishermen, they requested for the provision of an alternative location for the landing site. The new Takoradi beach and the Albert Bosomtwi-Sam Harbours are possible alternatives.

Appropriate procedures will need to be followed to effectively manage all issues and ensure unhindered execution of the project.

This impact is of major significance.

8.4.2 Anxiety from Potentially Affected Persons

Survey works to establish the project's scope and feasibility as well as initial stakeholder consultations will seek to reduce to the barest minimum the number of affected persons in the project implementation. This may however lead to some level of anxiety from fishermen as a result of the likely interruption of their business.

This impact is of minor significance since information sharing on the scope and extent of the project with the potentially affected persons could allay these fears.

8.4.3 Occupational Health & Safety Issues

The survey works to establish the project's scope and feasibility may pose risk of injury or accident to the personnel involved. However the implementation of standard safety practices by experienced personnel will curb their occurrence. This impact is of minor significance.

8.5 Evaluation of Potential Impacts from Constructional Phase

8.5.1 Potential Positive Impacts

The potential positive impacts from the constructional phase activities include:

- Employment opportunities;
- Improvement in local/national economy;
- Increase in institutional and national revenue; and

<u>Employment Opportunities</u>

GPHA proposes to utilise local labour, both skilled and unskilled, as part of the expected workforce to be engaged for various aspects of the general civil engineering, pavement and construction works. This will provide employment for both skilled and unskilled youth in the area for the duration of the construction. The provision of employment will keep the youth occupied and help focus their attention away from societal vices.

Local construction/consultancy companies will be sub-contracted to carry out various activities in the project such as haulage of construction materials, waste disposal, road design and construction etc. This will create job opportunities for the local firms. The impact is of major significance.

Improvement in Local/National Economy

Raw materials comprising quarry rock aggregates and construction materials such as cement, paving blocks, steel reinforcement, steel frames, timber etc. will be obtained locally for the project and will boost local businesses and manufacturing.

A substantial amount of Ghana Cedis will be pumped into the local economy monthly from payment of workers' wages/ salaries. The purchase of local raw materials and wages/ salaries of construction workers will have a positive impact on the local economy. Income tax from workers' salaries/wages will also add to national revenue. Improvement in port performance during operation will increase corporate revenue/ profit and this will positively impact on the national economy. This impact is of major significance.

Increase in Institutional and National Revenue

Revenue will accrue to the State in the form of tax deductions from wages of workers and Sub-contractor fees. Government agencies like the EPA will charge processing and permit fees for the EIA, which will increase the revenue base of the institution. This is of major significance.

8.5.2 Potential Adverse Impacts

The potential adverse environmental and social impacts associated with constructional phase activities for the proposed project include the following:

- Impacts on visual intrusion;
- Air pollution;
- Noise nuisance;
- Marine pollution and Impacts on aquatic life;
- Impacts from accretion/erosion/tidal/ wave impacts;
- Waste generation and disposal problems;
- Occupational health and safety risks;
- Sanitation challenges;
- Traffic impacts and public safety challenges; and
- General disturbance of port operations.

Impacts on Visual Intrusion

The construction activities will not significantly alter the physical landscape features of the area since it is mainly an expansion of the current operation at the active Harbour. However, waste generated and the presence of heavy machinery near the proposed site for the port development and along the road corridors, as well as the road construction activities, will have temporary impacts on the scenic quality of the project site, if not well planned.

Air Pollution

Impacts on air quality will arise from increase in dust and particulates emissions. Air pollution will result from exhaust/smoke emissions from vehicles and construction equipment as well as dust emission to air during handling of quarry products and cement.

The major recipients of dust, smoke emissions, and noise nuisance are construction workers, workers and commuters in and around the port, as well as pedestrians along the road

corridors. The main harbour area is a restricted area and only authorized persons are allowed inside. Construction workers will have to use appropriate nose masks or respirators.

The local meteorological information indicates that the major wind movement is from the south-west direction and the mean coastal wind speed is about 3.4 knots. This means that during daytime, the wind generally blows from the sea to the land and any serious air pollution episodes will thus affect New Takoradi Township. However, as the distance to the nearest residential area although within 3km, the impact on the community will be insignificant as a result of wind dissipation and dampening over the ocean.

The impact significance is minor.

Noise Nuisance

The construction activities for the breakwater, dredging and other infrastructure will result in elevated noise levels. Noise will be generated from the conveyance of machinery, equipment and construction materials. Concrete mixing and other construction activities including human activities will also generate noise.

The expected increase in noise during construction phase would generally be between 65-75 dBA. Noise levels are not expected to exceed these values during the period. Average noise levels measured around the project area during the day ranged from 63dB(A) -67dB(A).

The major recipients of noise nuisance during construction period will be project workers, workers at nearby wharf in the main harbour area. Workers will be provided with appropriate ear plugs for use. The main harbour area is a restricted area and only authorized people are allowed inside. The impact is expected to be minimal and it will be of minor significance.

Marine Pollution and Impact on Aquatic Life

Construction works within the marine environment such as dredging, construction of additional lay-by berths breakwater and reclamation works are likely to temporarily increase suspended solids in the marine environment. Sediment loading in the harbour waters is also expected as some of the construction debris, sand, stone end up in the waters. There is also the likelihood of re-suspension of chemical contaminants into the water arising from dredging/blasting operations. 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.

Increased turbidity, surface pollution through oil spills will block passage of light and disrupt oxygen dissolution and this can threaten marine life. Dredging activities may also directly impact on benthic fauna.

It is expected that fish and invertebrate populations will be temporarily affected by the construction of facilities will be able to re-populate the area within few months as soon as work is completed. Fisheries, for instance, will relocate from construction areas to safe distances when disturbed.

It is also important to note that dredging activities are proposed in areas that are active portions of the port. Potential impacts of the dredging and on marine life are therefore likely to be localized, and non-persistent. The impact marine pollution and aquatic life is of moderate significance.

Impacts from Accretion/Erosion/Tidal/ Wave Impacts

The dredging, construction of additional lay-by berths breakwater and reclamation works could lead to the release and transport of sediment eastwards (littoral sand drift in the flows eastwards at a rate of 1m/s). This may lead to accretion or sediment deposition to the east.

The impact is of moderate environmental significance.

Waste Generation and Disposal Problems

Dredging will generate mostly slurry/solid waste in the form of dredged spoil consisting mostly of sand, gravels and sea water. All the dredged material will be used for reclamation of portions of the log pond and eastern part of the port for expansion.

The dredged spoil to be transported in a slurry form would not be more than 30% by volume of sediment material. The water component will drain back into the sea from where it originated. Drill spoil disposal is therefore not expected to pose any significant adverse impact. Contaminated sediment will however be disposed of at the STMA designated landfill site at Sofokrom after the necessary analysis have been done to confirm sediment quality. It is expected that over $12x10^6$ m^3 of dredge material will be taken out of the of sea bed based on an estimated area of 2km x 2km and an average depth of 4m. This will be released on-shore in slurry of 70% water and 30 solids. The EPC contractor, Messrs Jan DeNul is responsible for confirming the quality of dredge material and organizing for disposal of any contaminated sediments.

Construction and demolition activities will result in waste generation. Solid wastes such as packaging material used for various inputs such as cement bags, wooden crates, broken concrete blocks and debris from demolition, metal pieces among others will be generated. These wastes would have to be disposed of appropriately by reuse, recycle or at the STMA designated landfill. Demolished concrete works, or existing installations will have to be disposed of in an environmentally sound manner. All scrap generated will be given to a recognised scrap dealer.

This impact is of moderate significance.

Occupational Health and Safety Risks

Workers will be exposed to risks during removal of existing installations such as fenders, bollards, and crane rails as well as during the civil works when excavations, loading, lifting and handling of equipment/machines will be common. Risks to safety and health of workers during construction will arise from operation of construction machinery/ equipment, transportation of construction materials, inhalation of dust and fumes, accidents from falling

objects and fire and explosion risks from welding. Accidents on the dredger could lead to drowning of workers if adequate preventive and safety measures are not taken.

This impact is of moderate significance.

Sanitation Challenges

Sanitation and health problems are anticipated from poorly managed construction site camps. Indiscriminate disposal of wastes such as polythene bags, used water sachet etc. at site will create unsightly conditions at the port area, nearby shore and along the road proposed corridors. Indiscriminate defaecation along the nearby shores by workers will create unsanitary conditions at the shores and may pose health problems, as well as result in conflict with the Tema community beach to the west of the expansion area. Construction workers will be compelled to use existing port sanitation facilities.

This impact is of moderate significance.

Traffic Impacts and Public Safety Challenges

Traffic impacts are anticipated from the road construction activities and the general increase in heavy goods vehicles that are expected to transport constructional material and equipment to the construction sites.

Transport of crushed rocks and quarry dust from local quarry sites will affect traffic and public safety for inhabitants along the affected routes. Dust emissions and 'flying stones' from buckets of moving dump trucks as well as traffic accidents or incidence are likely to arise if appropriate measures are not taken.

Any unattended mechanical breakdown of such haulage trucks on the roads can induce traffic and serious accidents. Traffic control and management plans will minimize the construction period impacts. Construction activities will be managed to avoid stagnant water in uncovered trenches and trenches will be monitored to ensure public safety.

Vehicular and pedestrian movements will be managed to minimize impacts to affected road sections by immediately re- instating them upon completion.

This impact is of major significance.

General Disturbance of Port Operations

The drilling and construction activities will adversely impact on port performance in the short term by disturbing port operations. The dredging of the harbour basin will disrupt ship movements leading to delays to berthing and unberthing of ships and this could mean increased time spent in port for ships.

This impact is of moderate significance.

8.6 Evaluation of Potential Operational Phase Impacts

8.6.1 Positive Impacts

The potential positive impacts from the operational phase activities include the following:

- Improvement in Harbour Performance
- Improvement in Port Environmental Management
- Provision of Employment
- Improvement in Local/National Economy
- Visual/ Landscape Impacts

Improvement in Harbour Performance

The project is expected to impact positively on the port performance during operation leading to improved efficiency and thereby ensuring the port facilities meet the expected increased port traffic. More revenue will accrue to GPHA through improved and realistic levy collection to enable them properly maintain all the port facilities. This impact is of major significance.

Improvement in Port Environmental Management

The re-organisation of the port will facilitate proper housekeeping and thereby improve on operations and create more space for containerised cargo. All like operations e.g. Manganese, Bauxite and Clinker that generate much particulate matter into the atmosphere/ ambient air will be confined to a particular location in the port. This arrangement will afford a more effective approach to management of associated environmental impacts. This impact is of major significance.

Provision of Employment

During the operational phase, the increased cargo volumes would also provide more job opportunities in haulage and related fields. The vast majority of staff is represented by operations staff, followed by maintenance & repair staff and administration staff. Other categories of staff include services that are typically subcontracted to 3rd parties, such as e.g. security staff, canteen service, gardeners etc.

Employment will also be provided to several port related industries as well as truck drivers, shipping agents. Government agencies such as Customs, Immigration etc. will require more staff to attend to increased ship calls and cargo volumes. Indirect employment creation by the private sector will arise from expanded industries, trade, finance etc. in line with the port expansion. The increased industrial activities would result in greater economic activities. Transportation of increased cargoes would also create more jobs and increase economic benefits.

Improvement in Local/National Economy

The planned expansion and reorganization of the port will result in significant boost in local and national economy through the following:

1. Increased capacity and smoother process for movement of goods in and out of the country - this is expected to encourage export through improved efficiency of the port operational processes which will serve to reduce delays at the port markedly. The

importation of goods and equipment, to support local industry and economic activities, will also receive a boost from improved efficiency at the port;

2. A substantial amount of funds will be injected into the local and national economy through payment of workers' wages/salaries as well as workers fulfilling their tax obligations;
3. The purchase of local raw materials and wages/salaries of construction workers will have a positive impact on the local economy;
4. Improvement in port performance during operation will facilitate the collection of revenue. This will increase corporate revenue/ profit and positively impact on the national economy; and
5. The patronage of local commercial activities by the increased port users and truck drivers will result in an increase the income within the STMA area.

This impact is of major significance.

Visual/ Landscape Impacts

The impacts and effects include:

- Changes in landscape; and
- Aesthetics and visual attraction.

The construction of a modern and state of the art infrastructure will enhance the present landscape. The port is expected to be aesthetically pleasing and is expected to attract both local and international visitors to the port area. This impact is positive.

8.6.2 Potential Adverse Impacts

The potential adverse environmental and social impacts associated with operational and maintenance phase activities for the proposed project include the following:

- Contamination of marine environment;
- Introduction of invasive marine pest species;
- Air pollution;
- Noise nuisance;
- Waste generation and disposal challenges;
- Public Health and Safety risks; and
- Power/plant/equipment failure.

Contamination of Marine Environment

There is potential for contamination of the marine environment of the harbour from wastewater generated from port operations including stormwater and sewage from port operations, as well as from discharge of ballast water, bilge water, oily wastes, sewage, garbage and other residues in a vessel.

The port waters and bottom sediment contamination may also result from uncontrolled runoff carrying pollutants such as oil spills, contaminated soils, and garbage from the land based activities. Storm drains leading

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.

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. 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.

When maintenance dredging becomes necessary for the restoration of the depth at the port entrance, this may also result in temporarily increase suspended solids, since soft sediments will be remobilised. The resulting increased turbidity will block access of light and disrupt oxygen dissolution and this can threaten marine life.

This impact is of moderate significance.

Introduction of Invasive Marine Pest Species

Vessels will be arriving at the port from all over the world. Several thousand marine species are thought to be transported globally in ships' ballast water every day (Smith et al. 1996) with many also transported via biofouling (Hayes et al. 2005). Introduction of new invasive species could result in substantial 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).

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).

The IMO through the GloBallast program and MARPOL, and in partnership with the Global Environment Facility and the United Nations Development Program, has developed specific requirements and guidelines to reduce risks associated with marine bioinvasions.

The impact is of major environmental significance.

Impacts from Accretion/Erosion/Tidal/ Wave Impacts

Extension to the breakwaters may lead to potential accumulation of sediment on the updrift side, with progressive advancement of the shoreline and erosion of the coastline on the downdrift region. Periodic dredging and deposition of accumulated sediments will be deposited downdrift to minimize impacts. Any impacts are however expected to be localized to Takoradi and surrounding communities.

The impact is of moderate environmental significance.

Air Pollution

Air pollution occurs from exhaust gas and smoke emissions from ships' engines as well as fumes from engines of motor vehicles and cargo handling machines/ equipment. The handling of clinker, gypsum, wheat, bagged lime, Manganese, Bauxite etc. generate dust. These products arrive or leave the Port as dry bulk cargo and are offloaded/ loaded by grabs and hoppers from vessels unto trucks. The use of conveyor belts and the reorganisation will eliminate such pollution effects.

Volatile organic compounds (VOC) may also be emitted from fuel storage and transfer facilities. Other air pollution sources have to do with dust from other construction activities and from industrial activities within the harbour area. Activities of some industries such as Ghana Cement Company Limited (GHACEM) produce some emissions which pollute the air.

The larger area of the harbour will ensure that the resulting concentrations of noxious gases are not significantly different from the existing conditions. The emissions are likely to be localised and be easily dispersed by air.

The impact is therefore of minor significance.

Noise Nuisance

The National Ambient Noise Level Guidelines and the Factories Inspectorate Division operational noise level guidelines are 70dBA and 85 dB(A) respectively. Port work involves considerable movement of cargo handling equipment, vehicles and human activities and these are generally noisy. Expected average noise levels during operation will range between 60dBA and 85dBA.

Noise level in the harbour area are mainly as a result of the operation of ships, container handling works at the terminals, vehicular movement for the haulage of materials by goods vehicles and power generators.

Although the proposed project will result in increased activity at the harbour as a whole, it is expected that noise levels will not vary significantly due to the larger operational area. The orderliness of the operational terminals at the airport is expected to rather lead to minimum noise levels in the port.

This impact of the proposed project on noise levels is therefore of minor significance.

Waste Generation and Disposal Challenges

Port operations will generate wastes. The common wastes include:

- Solid wastes – packaging wastes (paper, wood, metals, plastics), damaged cargoes, empty sacks, spilled cargoes (rice, sugar, wheat) etc.
- Liquid wastes – mainly from spills and damages to cargoes of oils, paints, chemicals, solvents, beverages etc.
- Emissions to air – these are mainly in the form of fine dust particles arising during discharge and loading of bulk cargoes such as clinker, wheat, corn, wheat bran etc.

These various wastes pose disposal challenges. Inappropriate disposal of the wastes will contaminate the sea water and create sanitation problems within the port environment.

This impact is of moderate significance.

Traffic/Public Health and Safety Risks

Public safety concerns are likely to arise as a result of increased traffic to the port area (mainly goods carrying vehicles) as a result of the port infrastructure upgrade and expansion. The upgrade of the access routes will help mitigate against these impacts.

The impact on public safety is of moderate significance.

Occupational Health and Safety Risks

Inhalation of dust from cement, chemicals, paints and fumes from equipment and machinery is of concern. Accidents from falling objects as well as from climbing and working from heights are likely.

Cargo handling activities result in a variety of accidents, and the common ones being:

- Cargo wire slings parting while lifting or lowering loads;
- Cargo falling overboard;
- Forklifts slipping on ramps, falling into cargo holds;
- Fire, spillage and explosion risks arising from handling of hazardous cargoes and welding activities.

This impact is of major to moderate significance.

Sustainability of the Takoradi Port

Impacts resulting from emergency situations such as power failure, breakdown of equipment as a result of poor maintenance practices are anticipated and will be planned for to minimise its consequences.

This impact is of major significance.

Security Risks

Security is a major issue in port operations as the cargoes handled are prone to theft, pilferage and robbery. The risk of people/ importers attempting to smuggle out illicit drugs and other illegal and banned substances into and out of the port is a concern. Construction/drilling workers could be potential security risks.

This impact is of moderate significance.

8.7 Evaluation of the Potential Decommissioning Phase Impacts

The proposed port infrastructure upgrade and expansion project will not be decommissioned in its entirety. The expansion of the ports will include fixed and mobile structures which are expected to have lifespan of several decades. However, should any of the structures and the

facility become dysfunctional; these are expected to be de-commissioned and replaced. Decommissioning of facilities could result in

- oil spills into the port environment;
- occupational health and safety issues; and
- generation of waste etc.

It is expected that observance of engineering best practices in the decommissioning exercise will significantly mitigate against these impacts. The impact is of moderate environmental significance.

9.0 IMPACT MITIGATION AND MANAGMENT

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 grouped under three major types which comprise:

- Preventive measures, Control measures 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. dust and noise generation from the construction activities. In this case the control essentially involves dust suppression and noise abatement measures to limit the extent of the impact.

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 summarised below.

9.2.1 Preparatory Phase

The significant potential impacts from this phase of the project development arises from disturbance and livelihood issues with respect to the reclamation of the log pond.

9.2.2 Constructional Phase

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

- Marine pollution and Impacts on aquatic life;
- Occupational health and safety risks;
- Air pollution;
- Noise nuisance;
- Waste generation and disposal problems;
- Sanitation challenges;
- Traffic impacts and public safety challenges; and

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:

- Contamination of marine environment;
- Introduction of invasive marine pest species;
- Impacts from Accretion/Erosion/Tidal/ Wave Impacts;
- Air pollution;
- Waste generation and disposal challenges;
- Occupational health and safety;
- Traffic Impacts and Public Safety Challenges;
- Emergency situations; and
- Security risks.

9.2.4 Decommissioning Phase Impacts

The potential impacts from this phase of the project development was rated as minor. The potential impacts to be generated from this magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. Best Operation Practices will tend to minimise these.

9.3 Recommended Mitigation Measures

Table 18 provides a summary of the significant impacts, as per the evaluation, the impact receptors and the recommended mitigation measure for each impact.

9.3.1 Mitigation Measures for Potential Preparatory Phase Impacts

Table 18: Proposed Mitigation Measures for Potential Preparatory Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Preparatory Phase Impacts
Disturbance and Livelihood Isues	Local Community	GPHA will put in place measures in collaboration with the Ghana Maritime Authority (GMA) to facilitate the compensation proceedings to ensure that all affected parties especially the fisher folk at New Takoradi are promptly compensated/ resettled by provision of alternative landing site off the bauxite sidings. No community will be resettled but only their activities and berthing area around the fisheries department workshop will be reclaimed for port operations and this will affect their livelihoods. It is noted that the reclamation of the coastline will be tackled during the latter stages of the proposed project and will therefore afford GPHA and the EPC contractor adequate time to fashion out resettlement options for the fisheries department workshop and the boat berthing area. The available options under consideration include relocating the existing workshop and berthing area to Albert Bosumtwi-Sam Fishing Harbour in Sekondi or building a new landing site with berthing facility for bigger vessels at New Takoradi beach. A framework Resettlement/ Compensation Plan is provided as **Annex 8.**

9.3.2 Mitigation Measures for Potential Constructional Phase Impacts

Table 19: Proposed Mitigation Measures for Potential Constructional Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Construction Phase Impacts
Marine Pollution and Impact on Aquatic Life	Marne environment	"Best management practices" (BMPs) will be required in order to contain and minimize any impacts. Messrs Jan De Nul, will bring to bear their vast experience with dredging to ensure the BMPs are abided by. Sediment loading in the harbour waters during construction of breakwater and quay walls, as well as dredging/blasting activates, may have temporary impacts, but use of BMPs will ensure that any impacts are minimized to the extent practical. • Dredging and placement of rock materials for the breakwater will be done within a short space of time and 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. (Annex 11 provides a detailed Dredging Management Plan). • Well maintained pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area. Any observed or detected leaks will be repaired as soon as practicable. Pumping will stop if a major rupture is identified (within the operational constraints of the equipment). • The operation of the dewatering process within the existing reclamation area (e.g. internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment. On observation • GPHA will require the contractors, Messrs Jan de Nul, to prepare a spill prevention and control plan 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. • Messrs Jan De Nul will be required to implement suspended sediment control if turbidity levels 150m from the construction area exceed above background levels significantly i.e. 10 NTUs. Measures such as reducing dredger delivery rate or ceasing operation, where necessary will be employed when turbidity is detected to exceed the limits. • Messrs Jan De Nul will also carry out detail geotechnical assessment of the port basin including sediment analysis before actual construction commences. Contaminated sediment will be scooped and appropriately disposed of at the approved disposal site of the STMA at Sofokrom. • In addition, shore protection measures such as carefully placed groins and rivets should be erected to protect the nearby shores from expected increased erosion.
Impacts from Accretion/Erosion/Tidal/ Wave Impacts	Eastern Coast/marine environment	
Occupational health and safety hazards/ Public and Traffic safety	Workers/ Local communities and road users	<u>Adoption of Health and Safety Policies</u> It is the policy of GPHA and for that matter the Port of Takoradi to establish and maintain high standards of occupational health, safety and environmental protection at work, so as to prevent personal injury or illness, property damage, fires, security losses and environmental pollution.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		The health, safety and environmental protection at the workplace objectives defined in this policy statement have equal status with all other primary business objectives. The responsibility for implementing this policy lies directly and personally with management through to employees. This is summarized in the Port's Occupational Health and Safety Policy (October 2005) objectives *viz* to: • 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; • establish regulatory and organizational framework for the efficient and effective management of occupational health, safety and environment issues in the Ports; • maintain safe plant, machinery and equipment in the Ports; • maintain safe and healthy work place for all Port workers and Port users • maintain incident and injury-free working environment in the Ports; • prevent occupational related diseases/ illness among Port workers; and • promote and maintain a clean, healthy and hygienic environment in the Ports of Ghana. (**see Annex 9 for the Occupational Health and Safety Policy Document**) GPHA 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 Environment and Estates Manager will ensure compliance with the Health and Safety Policy. GPHA will operate has a hospital outside the Port for use by workers. First aid centers will be set up at the construction areas manned by trained first aiders to treat minor ailments and cuts. However, major cases will be referred to the Port Hospital, which is within 2km of the port for treatment or referral to Effia Nkwanta Hospital. <u>Use of Experienced Personnel</u> GPHA will ensure that well-trained workers are engaged to operate any heavy machine or equipment. Only drivers with the requisite licenses will be allowed to handle vehicles and earth-moving equipment into the port. Initial training and testing in

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		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. GPHA will ensure that regular defensive driving training sessions are organized for the drivers to ensure their safety and the safety of the general public. <u>Provision of Personal Protective Equipment (PPE)</u> GPHA will ensure that workers are provided with the appropriate personal protective equipment such as safety boots, rain-coats, hand gloves, earplugs and nose masks. Supervisors will be mandated to ensure the use of these protective devices and to implement sanctions when necessary. <u>Phasing out of Material Movements/ Scheduling Material Movements</u> 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 port at any given time to reduce the risk of accidents. GPHA intends to carefully plan materials movement to minimise these impacts. Materials and equipment will be transported to the sites during daylight, from 6am to 6pm. <u>Use of Road Worthy Vehicles</u> Good conditioned cargo vehicles will be used to avoid any breakdown along the roads. Regular and scheduled maintenance will be done on such vehicles to reduce noise nuisance and smoke emissions, which could otherwise affect public health and safety. <u>Transport of Some Boulders on Barges</u> It is expected to reduce traffic in the Sekondi Takoradi Metropolis by sourcing boulders from the Shai Hills area about 30km from the Port of Tema for onward transport on barges to Takoradi for the breakwater construction
Air Pollution	Workers/ Local communities and road users	• Dust, emissions, will be controlled and minimized by the use of designated truck routes in order to minimize impacts to residents, construction workers, port workers/users and institutions along the RoW . • The proposed road construction and road upgrade works will be done using mitigation and control techniques, such as standard dust suppression measures through dampening of unpaved surfaces. • Speed of vehicles over any unpaved landscape will be controlled to minimise dust generation. Materials dumping will be regulated to reduce dust emissions.
Noise Nuisance	Workers/ Local communities and road users	GPHA will employ standard noise abatement measures and engineering best practices to ensure that the impact of these issues minimized and reduced to acceptable limits.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• GPHA will ensure that earthworks and other construction activities will be phased out or controlled to reduce noise generation during construction. • New equipment will be used and properly maintained to reduce noise generation. • Ear muffs will be provided for workers where necessary.
Waste generation and disposal problems	Workers	As per the IFC General EHS Guidelines, waste materials generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, will be treated and disposed of at permitted facilities specially designed to receive the waste, in order to avoid potential impacts to human health and the environment. In line with this, any unsuitable dredge material/ settled sediment/ mud which has been characterized to be low in heavy metals and PAHs/ BTEX concentration, will therefore be disposed of at the STMA approved engineered landfill site at Sofokrom. The Sofokrom landfill has approximately 36 ha of surface area and is located 9km onward to Accra from the Project site. It has the capacity of accommodating all types of wastes, including industrial hazardous wastes, except for the medical wastes, up until year 2025. The landfill operates in line with the IFC EHS Guidelines for Waste Management Facilities, e.g. garbage is presorted by three categories - solid wastes, liquid wastes and industrial hazardous wastes. <u>General Waste (non-construction waste)</u> Adequate waste bins will be provided at the temporary work-camps to minimise littering of the sites. The collected refuse will then be transferred to the GPHA and STMA approved disposal site at Sofokrom. Management has entrusted with the management of waste within port to private entities who collect and transport the waste on daily basis. GPHA will continue with this arrangement during the construction period. Management will supervise the process. <u>Construction Waste</u> • All scraps or other solid wastes will be collected and disposed of at the approved disposal site of the STMA. • Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction and also for reclamation if found to be suitable. • Contaminated soil/spoil will be considered as waste material and disposed of accordingly at the STMA approved disposal site. • All metal scraps will be sold out to third party agents for use by metal companies. Paint containers will be given out to paint manufacturers to be reused. <u>Dredging</u>

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• The dredged spoil which will come in a form of slurry would not be more than 30% by volume of sediment material. The water will be drained back to the ocean where it originated and the spoil used for reclamation of portions of the log pond and the northeastern coast of the port between the fisheries department workshop and New Takoradi Beach. • Contaminated settled sediment/ mud will however be disposed at the STMA Sofokrom landfill site after investigating the metal composition to ascertain their concentrations (see Annex 11 for Dredging Management Plan).
Sanitation and hygiene	Workers	• Adequate waste bins will be provided at the temporary work-camps at the construction site to minimize littering. GPHA will ensure that waste generated is disposed of at the STMA landfill site. • Toilet and washroom facilities will be provided for workers in general to discourage "free-range" defecation and its attendant health problems. Workers will also be educated to use the waste collection and washroom facilities to be provided on site.
Traffic Impacts and Public Safety Challenges	Workers/Public	<u>Restriction of Access</u> GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area. <u>Use of warning signs</u> Uncovered trenches or deep excavations will be protected using indicator linings or picture 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. <u>Scheduling of Work</u> The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods. <u>Announcement and Notification of Work</u> The STMA 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. GPHA 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. <u>Transport of Equipment and Materials</u> Traffic impacts resulting from carting of equipment and materials (e.g. quarry materials) to the port expansion site from local quarry sites will be limited to only selected port bound roads. In consultation with the Police Motor Transport and Traffic Unit

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		(MTTU), 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: • All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and MTTU; • Haulage of materials including quarry products to the port area will be limited to off-peak hours; • Trucks transporting quarry products and other friable materials to the port will be covered; • All trucks conveying materials to the port will carry appropriate warning signals such as red flag and rotating amber lights; • Road worthy dump trucks will be used; • Very experienced drivers will be engaged; • Traffic wardens will monitor dump truck movements and ensure public and traffic safety; and • Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks. • In an unfortunate incident of any truck failure, such trucks will be towed within 24 hours.
General Disturbance of Port Operations	Port users	• GPHA will elicit the assistance of the GMA and representative bodies of the port users to provide adequate warning to port users on the schedule of work to be carried out to ensure their operations are not unduly disturbed.

9.3.3 Mitigation Measures for Potential Operational Phase Impacts

Table 20: Proposed Mitigation Measures for Potential Operational Phase Impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Operational Phase Impacts
Contamination of Marine Environment	Marine environment	• GPHA will ensure that the likelihood of oil spills are reduced to the barest minimum through regular monitoring and audits of vessels being used. • storm drainage will constructed such that they do not discharge directly into port waters, using containment basins in areas with a high risk of accidental releases of oil or hazardous materials (e.g. fueling or fuel transfer locations), and oil / grit or oil /water separators in all runoff collection areas. Oil / water separators and trapping catch basins should be maintained regularly to keep them operational. • GPHA will ensure that the waste reception facilities for the collection, storage, treatment and transfer of waste at the port are utlisied by vessels arriving at the port. The Captains will be adequately informed of this. • Where necessary, Installing filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the port water • The GPHA 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, • Maintenance dredging will be controlled to reduce turbidity to the minimum possible. • GPHA will utilize will continuously conduct education campaigns for other port users to ensure the proper maintenance of vessels to prevent leakage, as well as indiscriminate disposal of waste in the port waters. • GPHA has establishment 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. • Punitive measures will be enforced for all persons observed to throw waste into the port waters. • 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
Introduction of Invasive Marine Pest Species	Marine water	<u>Ballast water</u> GPHA to 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. These strategies include • Treating ballast to remove or render inert any harmful organisms. • Exchanging coastally sourced ballast mid-ocean or in deep water and where required • Minimising uptake of organisms into ballast tanks • Routine maintenance of ballast tanks to remove sediments

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• Avoiding unnecessary ballast discharge, particularly when in port; using discharge to the waste reception facility at the port for treatment and disposal <u>Biofouling</u> 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: • Using anti-fouling systems appropriate to a ship hull and activity • Applying appropriate operational management practices to reduce the development of biofouling (e.g. maintaining seawater intake system cleaning) • 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 • 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 • 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 inwater 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 • GPHA to ensure effective dissemination of information of relevance to biofouling management to ensure appropriate biofouling management systems are implemented by all vessels
Impacts from Accretion/Erosion/Tidal/ Wave Impacts	Marine/ Shoreline	GPHA will liaise with the Ministry of Water Resources, Works and Housing to provide some coastal protection structures at the New Takoradi Beach and at Nkontompo to eliminate any potential erosion of the coastline. While accretion would occur along the breakwater. Threatened fish landing site at New Takoradi should be protected with coastal protection structures.
Air Pollution	Workers/ Port users	• Measures to be implemented to reduce air pollution will include the use of sysems such as mechanized cargo handling system, closed conveyor systems, covered or regular dampening of dusty cargo storage yards, closed silos, closed evacuation of dusty cargo from the ship to storage silo, direct loading of dusty cargo from the silo through electronic chute in the truck, dust suppression system, closed truck or covered truck etc. • GPHA will ensure the necessary institutional arrangements with port users for air quality monitoring within the port are in place to ensure the ambient air quality is within the maximum permissible limits of the NAAQG.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• The export & import of the cargo will generally be handled by a number of exporters, importers and local transporters. The port managers will ensure the necessary safeguards are put in place during the cargo handling and transportation to reduce air emissions. • Develop a regular maintenance programme of the system to ensure that ambient levels of particulate emissions are within permissible level • Install appropriate valves, flanges, fittings, seals etc to reduce fugitive emissions from fuel installations
Waste Generation and Disposal Challenges	Workers/Port user	Education campaigns • GPHA will utilize the Port community network to continuously conduct education campaigns for all port users to ensure the proper disposal of waste. Waste Collection and Disposal • GPHA will provide and enforce the use of waste collection bins throughout the port area to reduce the incidence of indiscriminate disposal of waste in the port area. The collected wastes shall be transferred to the Port Waste Reception and Treatment Facilities • Picture/symbolic signage will be provided throughout the port area to alert and encourage port users to utilize waste collection bins provided. • Private entities will continue to be contracted to ensure the efficient final disposal of waste at designated dumping site of the STMA.
Occupational health and safety	Workers	Training in chemical handling GPHA will 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. Provision of appropriate PPEs GPHA 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. Emergency Provisions • GPHA will develop and implement an emergency response plan to handle all emergency situations 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• Emergency shower and fire hoses will be installed and maintained, especially at the berths handling Crude Oil and Petroleum Products, Naphtha and Chemicals, fertilizer etc.. • A comprehensive maintenance programme will be put in place to avert any serious breakdowns or failures. The required maintenance for the systems will include among others: o Environmental incident/accident investigation; o Carry out mock oil spill response drills o Routine equipment maintenance/inspection schedule; o Annual equipment inspection and maintenance record; o Procedure for pre-arranged repair service; o Procedure for preventive maintenance; o Procedures for handling materials; and o Regular calibration of equipment. • Management will ensure a minimum harbour water depth is controlled and periodically measured to ensure the safety of fishing vessels using the harbour. <u>Housekeeping</u> 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.
Traffic Impacts and Public Safety Challenges	Workers/Public	• Traffic signal lights will be located at the junctions of access roads to the Port and the existing trunk roads. Speed limit signs and directional signs will be located at vantage points along these roads to guide road users. • GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the port area. • Trucks transporting friable materials to the port will be covered; • Speed limits of between 20-30 km/hour will be allowed along the route to the fishing harbour area for all trucks. • The necessary linkages with rail will be created to enable its utilisation when the rail system is improved.
Emergency situations	Workers/ Local communities	• GPHA will develop and implement an emergency response plan to handle all emergency situations including fire, and oil spills that will arise from all its operations to minimize any hazards to humans and the environment. Management will ensure regular review of the plan.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• GPHA will ensure that the likelihood of oil spills and fire outbreaks are reduced to the barest minimum through regular monitoring and audits of third party facilities and equipment. Procedures will be specified to detect and contain any leak if it did occur and define methods for clean up and disposal.
Security Risk	Port Users	• GPHA superintends over the Ghana Maritime Security Act and the Shipping Act. The Takoradi Port has a security plan in place as mandated by SOLAS and the ISPS code,to deal with maritime security threats. The plans are based on the current infrastructure, and will be updated to incorporate the master plan, as per the Maritime Security Act. • As per the plan, GPHA shall provide security to passengers, crews, and personnel in port through measures such as access control

10.0 ENVIRONMENTAL MONITORING

Management of GPHA is committed to ensuring effective protection of the environment, property, workers and the general public within the port area. The objective of the monitoring programme is to:

- Ensure that all mitigation and control measures are operating efficiently and with designed effect;
- Provide information to develop improved practices and procedures for environmental protection and worker safety;
- Detect changes in the receiving environment and enable analysis of their causes; and
- Enable effective liaison with stakeholders including addressing complaints and concerns.

10.1 Environmental Issues to be Monitored

Monitoring programmes would be instituted and carried out and relevant records would be kept to ensure compliance with sound environmental practices.

10.1.1 Preparatory Phase

The major environmental issues on which monitoring will be focused during the preparatory phase i.e. prior to the commencement of construction activities include:

- Noise levels;
- Air quality;
- Water quality;
- Sediment quality; and
- Public complaints.

10.1.2 Constructional Phase

The major environmental issues on which monitoring will be focused during the construction phase include:

- Noise levels;
- Air quality;
- Water quality;
- Sediment quality;
- Invertebrate biota;
- Rate of shore recession at down-drift areas and material accretion upstream;
- Use of personal protective equipment (PPE);
- Waste generation and disposal;
- Accidents, worker injury and health;
- Traffic and public safety; and
- Public complaints.

10.1.3 Operational Phase

- The major environmental issues on which monitoring will be focused during the operational phase include:
- Noise levels;
- Air quality;
- Water quality;
- Sediment quality;
- Invertebrate biota;
- Rate of shore recession at down-drift areas and material accretion upstream;
- Use of personal protective equipment (PPE);
- Waste generation and disposal;
- Accidents, worker injury and health;
- Traffic and public safety; and
- Public complaints.

10.2 Summary of Environmental Monitoring Programme

The environmental monitoring programme is set out in **Table 21**. About GH¢291,000.00 will be spent on monitoring activities annually from the implementation of the project. The following personnel will be responsible for the various environmental monitoring activities and they shall report directly to the Director of Port, Takoradi:

- The Estate and Environmental Manager (EEM);
- Fire and Safety Manager (FSM);
- The Harbour Master (HM);
- The Head of Medical Services (HMS); and
- Port Security Manager (PSM).

Table 21: Environmental Monitoring Programme- Construction and Operation

Environmental component	Parameters to be monitored	Monitoring Sites	Methodology/ standards	Frequency/ Responsibility	Estimated cost/ annum (GH¢)
Noise Levels	Sound levels in dBA	Takoradi Port at Established Sampling Points	Noise Level Data Logger /EPA guidelines	Quarterly /EEM	12,000.00
Air quality	NOx, Cox, Sox, PM_{10} and TSP	Takoradi Port at Established Sampling Points	HiVol Sampler and DraeggerTubes/ EPA guidelines	Quarterly/ EEM	32,000.00
Water quality	-General physicochemical parameters including: temperature, conductivity, dissolved oxygen, pH, turbidity, TSS, -Trace metals (V, Cu, Zn, Pb, Mn, Fe and Cd) -PAHs -Total and faecal coliforms	Harbour basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/EEM and HM	24,000.00
Sediment quality	Heavy metals (V, Cu, Zn, Pb, Mn, Fe and Cd) PAHs	Harbour basin at Established Sampling Points in the entire area of influence	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/EEM and HM	40,000.00
Invertebrate biota	Mollusc and crustacean	Harbour area at specified locations	field work and laboratory analysis	Quarterly/EEM and HM	16,000.00
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	around the port	Physical inspections and reporting	Biannually/ EEM	8,000.00
Use of Personal protective gears	Life jackets, Safety boots, gloves, earplug/ear muffs, Helmet etc.	Harbour area	Inspections and Audits/ Safety Policy of GPHA	Daily/PSM &FSM	40,000.00
Waste generation and disposal	-Metallic wastes -Garbage	Harbour area	Record quantity and type of waste generated. Inspect quantity and	Weekly /EEM	32,000.00

	-Waste oil -Hazardous waste		condition of waste bins. Keep records of time and place of final disposal /KPIs of GPHA		
Accidents, injuries and worker health	Type and frequency of injuries /accidents Number of record of occupational accidents and diseases dangerous occurrences and accidents	Harbour area	Observation, audits, complaint/ incident records/ Safety Policy of GPHA	-Daily-FSM -Quarterly-HMS	33,000.00
Traffic and public safety	Human and vehicular traffic	Harbour area	Observations and complaints/incidents records/ Safety Policy of GPHA	-Daily -PSM	36,000.00
Public complaints	No. of complaints resolved Type and nature of complaints and concerns No. of complaints resolved	Takoradi Port	Complaint records, Stakeholder meetings	Daily –EEM/PSM/ FSM	18,000.00
TOTAL					**291,000.00**

11.0 PRELIMINARY ENVIRONMENTAL MANAGEMENT PLAN (PEMP)

A Provisional Environmental Management Plan (PEMP) for the project is in accordance with the Environmental Assessment Regulations of 1999, LI 1652, the IFC's 2012 Performance Standards (PS) and Environmental, Health, and Safety (EHS) General Guidelines and EHS Guidelines for Ports and Harbors. The aim of the provisional EMP is to act as a guiding manual with respect to the mitigation and monitoring of adverse impacts as well as baseline parameters during construction and operation.

The PEMP allocates appropriate resources for items discussed under mitigation and monitoring and is to ensure sound environmental practice during construction and operation. An estimated environmental budget for the PEMP is provided, which includes the cost of the environmental monitoring.

It is the policy of the Port of Takoradi to establish and maintain high standards of occupational health, safety and environmental protection at work, so as to prevent personal injury or illness, property damage, fires, security losses and environmental pollution.

11.1 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 Takoradi 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 fulfill 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 Takoradi 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.

Every employee, port operator, tenant and user has an obligation to comply with all applicable environmental regulations and GPHA requirements.

11.2 Occupational Health and Safety Policy

At the Port of Takoradi, the Authority's policy on Occupational Health and Safety Administration shall be applied (**see Annex 9**). Thus, the Port of Takoradi 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 Takoradi 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.

To achieve the dynamic morale and team spirit based on mutual confidence without which a business cannot be successful, people have to be cared for during their working lives and in retirement. In recognition of this fact, the Port of Takoradi places the highest priority on promoting and preserving the health and safety of its employees. Employees, for their part, have a clear duty to take every reasonable precaution to avoid injury to themselves, their colleagues and members of the public.

11.3 Programme to meet Requirement

The programme to meet requirements provides an environmental and social management system, as per the IFC performance standards to implement the mitigation measures proposed for the identified impacts. It takes into consideration the existing systems in place for the management of the port operations.

11.3.1 Responsibility/ Policy Implementers

The Director-General shall have overall responsibility for the formulation, implementation, monitoring and evaluation of Health, Safety and Environmental Issues of the Port of Takoradi. This responsibility may be delegated to other Directors and Managers of the port and these include:

- The Director of Port;
- The Harbour Master;
- The Head of Medical Services;
- The Fire/Safety Manager;
- The Stevedore Manager;
- Port Operations Co-ordinator;
- The Traffic Manager (Plant);
- The Port Mechanical Engineer;
- The Port Civil Engineer;
- The Port Electrical Engineer;
- The Estate and Environmental Manager;
- Port Security Manager;
- The Training Manager; and
- Port workers.

Table 22 indicates the main responsibilities of the above named key players in the implementation of the policy on environment, health and safety of GPHA.

Table 22 Responsibilities of Key Players

No	Key Players	Responsibility
1	The Director of Port	Shall be responsible for the implementation of the Health, Safety and Environmental Policy in the Portof Takoradi.
2	The Harbour Master	Shall be responsible for all matters regarding Marine Safety, Pollution and related Environmental issues in the port.
3	The Head of Medical Services	Shall be responsible for the management of all Occupational Health related matters. He/She shall undertake regular medical examination of all employees to detect the incidence of occupationally related health and safety diseases. In collaboration with the Training Manager, he/she shall also organise educational fora to educate employees and port users on occupational health and safety issues.
4	The Fire/ Safety Manager	Shall be responsible for planning, coordinating, monitoring, advising and reporting all matters relating to Occupational Health and Safety including accidents and Fire-related incidents in the port
5	The Stevedore Manager	Shall be responsible for the safe conduct of the port's stevedoring business
6	Port Operations Co-ordinator	Shall be responsible for ensuring that license port operators and customers undertake their activities in compliance with the requirements of the Health, Safety and Environmental Policy

7	The Traffic Manager (Plant)	Shall be responsible for allocating only safe operable equipment and competent operators in all terminal operations and ensuring safe plant/equipment operating practices
8	The Port Mechanical Engineer	Shall be responsible for the maintenance of all Plant, Equipment and Vehicles. He shall release to the plant only equipment that do not leak oil, emit excessive smoke and fumes or pollute the environment
9	The Port Civil Engineer	Shall be responsible for all aspects of civil infrastructure to ensure roads, access ways, sheds and terminals are well maintained for movement of persons and mobile equipment
10	The Port Electrical Engineer	Shall be responsible for all matters concerning electricity connections, supply, distribution, and usage within the port environment. He/She shall ensure that all workplaces – terminals, offices and workshops are well lit.
11	The Estate and Environmental Manager	Shall be responsible for planning, implementing, monitoring, evaluating and reporting on all environmental matters in the Port and ensuring that Sheds and other Port properties are in good repair.
12	Port Security Manager	Shall be responsible for the effective control of movement of both human and vehicular traffic to designated areas within the port. He/She shall protect life and property against assault, damage and sabotage within the port. He/She shall ensure that only vehicles and equipment that meet the Authority's safety and environmental standards enter the port. He/She shall enforce safe code of driving and no smoking regulations in the port.
13	The Training Manager	Shall be responsible for co-ordinating with all Departmental Heads including the Estate/Environmental Manager to ensure training programmes are developed for all employees and other port users towards higher safety, health and environmental standards in the port.
14	The Public Relations Manager	Shall be responsible for co-ordinating with all Departmental Heads to ensure that all public complaints are properly received, discussed and addressed. He/ She will manage any public consultations programme during project implementation in the port
15	Port workers and Visitors	All port workers shall co-operate with the Authority and its officers in all matters relating to occupational health, safety and environment. They are to take reasonable care of their own health and safety and report all occupational health and safety as well as environmental concerns to the appropriate officers.

11.3.2 Establishment of Environmental Management Committee

An Environmental Management Committee (EMC) shall be formed and shall comprise of the Director of Port as the Chairman, the Estates and Environment Manager (EEM) as the Environmental Champion (EC), and other Directors/Managers enumerated above and will work closely with the Safety/Environment Coordinators of the sections and departments as well as the Contractors to ensure effective execution of the project.

This high profile Committee reflects the importance with which the Port of Takoradi attaches to environmental issues. The work of the Environmental Management Committee will be co-ordinated by the EEM, and the reporting line as it relates to this project and within the Port of Takoradi Management structure is shown in **Figure 27.**

Functions of the Environmental Champion (EC)

The functions of the EC include:

- responsibility for implementing the environmental policies of the port;
- liaising with the port's Public Relations Manager to interact with government agencies and the general public on all such matters of environmental concern affecting the port including complaints;
- working closely with other personnel in the Engineering Section, the Fire Safety Section and the and Security Personnel to co-ordinate all activities with bearing on the environment, security and safety of the Port of Takoradi;
- processing and management of environmental data that will be generated with time to be presented in an appropriate way to ensure easy consumption and appreciation by Management and the general public;
- to contribute to the port expansion activities to ensure that environmental concerns are included in the planning stage for execution;
- consultations with Management in deciding which environmental concerns could be handled in-house and which ones should be handled by consultants; and
- liaising with the EPA and obtaining approvals for environmental issues during projects.

In addition, he will also ensure that all contractors comply with the relevant legislation by providing copies of their Environmental Management Plans/ Certificates before commencement of works, and also ensure compliance with the yet to be adopted World Bank's General Environmental Management Conditions for Construction Contracts as shown in **Annex 10.**

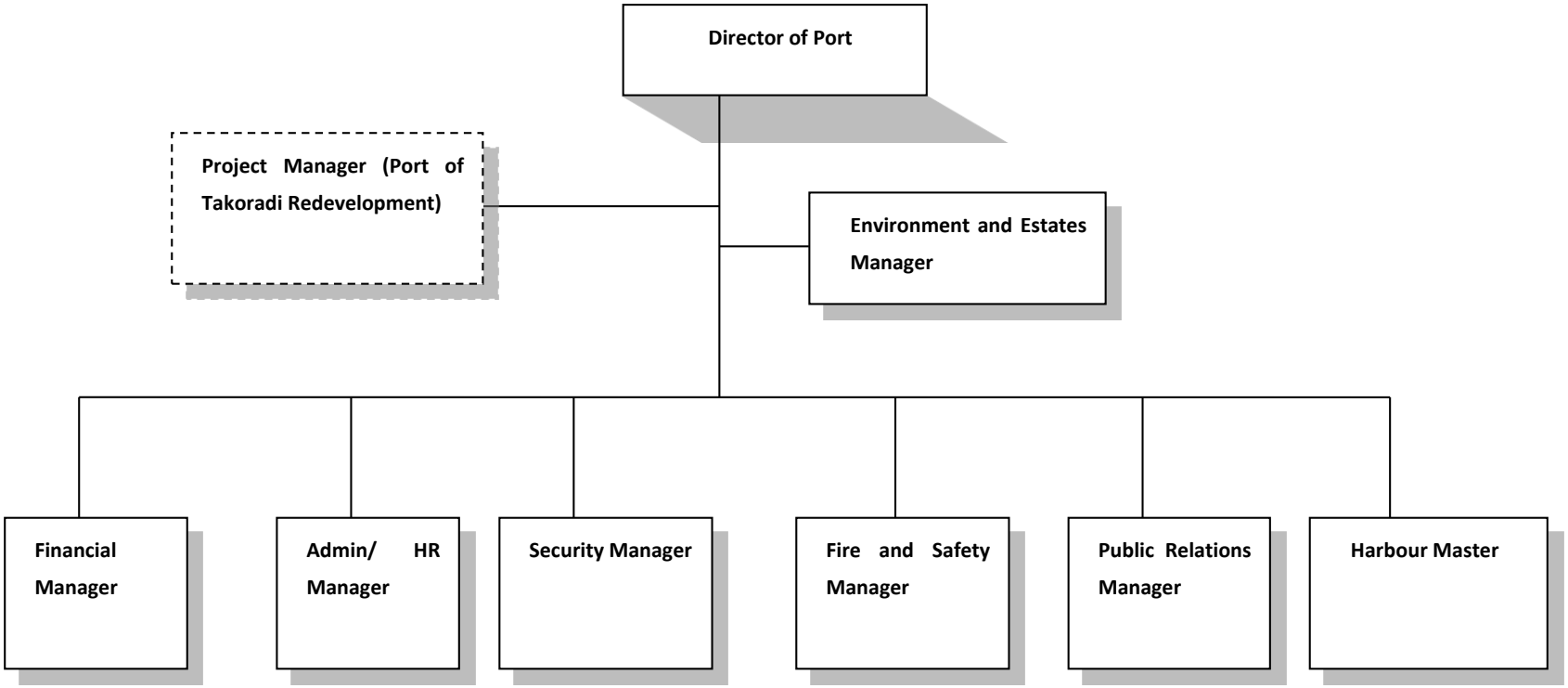


Figure 27: Environmentally Based Organisational Structure of the Port of Takoradi

11.3.3 Establishment of Unit Safety/Environment Committee (USEC)

All departments of the Port of Takoradi and all port operators whose functions carry major risks shall form Unit Safety/ Environment Committees. The following departments of the Port of Takoradi shall each form Unit Safety/Environment Committees:

(i) Civil Engineering;
(ii) Mechanical Engineering;
(iii) Electrical Engineering;
(iv) Marine Engineering and Marine Operations;
(v) Fire and Safety;
(vi) Container Depot;
(vii) Container Freight Station;
(viii) Stevedoring Section;
(ix) Security;
(x) Medical (Hospital/ Clinic); and
(xi) Materials Management.

Licensed port operators who provide the following services in the port shall also be required to establish Unit Safety/ Environment Committees:

(i) Stevedoring; and
(ii) Container Terminal Operations.

A Unit Safety/ Environment Committee shall consist of appointed Senior and Junior Officers. It shall consist of a minimum of three (3) members including representatives from the Unions.

The Committee shall be chaired by the Head of Department/ Sections who will provide the necessary direction in the implementation of the port's Safety/ Environment Policy at the functional level.

Membership to the committee shall where possible, be rotated among the staff so that in the long run every employee will appreciate the role of Safety/ Environment. This shall help reinforce their personal commitment to safety and environment.

11.3.4 Engagement of Environmental Consultants

As part of measures to implement environmental actions, the Port of Takoradi will engage the services of competent Environmental Consultants to provide technical support to the Environmental Management Committee. The consultants among others would:

- advise on all environmental concerns;
- assist with training and awareness creation on all aspects of environmental and safety issues for all levels of staff;
- sample the environmental media and provide results on monthly/ quarterly basis for quality assessment;
- undertake annual environmental management and safety audits; and
- perform the services of Environmental Attorneys to the Port of Takoradi.

11.3.5 Technical Co-operation

The Port of Takoradi 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.

11.3.6 Staff Information and Training

Environmental Awareness Creation

The Port of Takoradi will intensify its plans to educate all workers from the Director to the port workers on environmental issues. This will be done through series of properly planned and scheduled meetings and seminars.

Environmental Information Dissemination

The Port of Takoradi will use the following means to disseminate environmental and safety information to staff and workers:

- Staff and workers meetings;
- Local area network and the internet;
- Annual bulletins on GPHA operations; and
- Inter-departmental competitions.

11.3.7 Public Participation

It is the desire of Management that the public will appreciate the on-going environmental changes in the port and would be able to adjust accordingly. Management will consider suggestions and advice from all stakeholders, its contractors and subcontractors, visitors and the general public, which will help improve its operations in order to minimise impact on the environment, the public and worker health and safety. The offices of the Director of Port and the Public Relations Manager are open to the general public for complaints reporting and suggestions.

11.3.8 Monitoring

In addition to the environmental monitoring programme outlined in this report for this project, Management will develop a holistic monitoring programme for all Port of Takoradi activities and will implement the programme accordingly. The monitoring programme will include among other things environmental media quality and resource utilization in line with the EPA Act 1994 (Act 490) (Sec. 27 & 2 (d & 1). The monitoring programme will assist in evaluating management options. The monitoring work will ensure self-compliance with the port's own programme as well as satisfying statutory requirements.

11.3.9 Annual Audits and Reviews

The Port of Takoradi will liaise with the local environmental consultants to be engaged to carry out annual environmental and safety audits for the Port facility. The findings and recommendations of the audits will assist in correcting any lapses detected.

11.3.10 Oil Spill Contingency Plan

The National Oil Spill Contingency Plan provides a three-tiered responses are based on the following spill scenarios:

Tier 1 - up to 10 tonnes – a small spill requiring a local response: The Combat Agency will generally be able to respond to and clean up a spill utilising its own resources.

Tier 2 - between 10 and 1000 tonnes – a medium spill requiring regional and/or national assistance: The resources of the Combat Agency will need to be supplemented by other resources from adjacent region, or from adjacent industry operators under mutual aid arrangements.

Tier 3 - above 1000 tonnes – a large spill requiring national assistance: The Combat Agency will require local, regional, national and possibly international assistance. National and international resources will be facilitated by the EPA.

Response Policy

The National Plan gives containment and recovery as the preferred policy options for oil spill response. Dispersant use, however, is listed as being both feasible and desirable in some cases. Any clean-up would involve manual shoreline cleaning due to the predominantly onshore winds for much of the year. Disposal options include landfill, burning, recycling recovered oil at a refinery or reusing in industry.

Spill Notification

For any release within the harbour area, the Harbour Master shall be notified immediately in person or via phone. The Ghana Ports and Harbour Authority (GPHA), as the appointed Combat Agency, is responsible for any further notifications regarding responses to this incident with the pertinent agencies.

Spill Response Arrangements

Under the National Oil Spill Contingency Plan, the Ghana Port and Harbour Authority (GPHA) is the designated Statutory Agency for Oil Spill Response within the Takoradi Harbour jurisdiction for Tier 1 and 2 spills.

The Takoradi Commercial Harbour Oil Spill Contingency Plan has been prepared by the Ghana Ports and Harbour Authority to combat oil spills that occur in the port.

For any spill originating from assets of private operators such as Tullow Ghana Limited, the private operator will take all measures required to first control the source of the spill and activate its OSCP. The Harbour Master shall be notified as soon as practicable of the incident and will take overall command of the response as the Combat Agency's On Scene Commander.

The private operator will continue to respond to the incident under the overall direction of the Harbour Master until the response is complete.

The relevant Statutory Agency will provide management, operational, technical and environmental advice and support to the Combat Agency as required. This may include support for the management of the response.

Tier 3 Response

The EPA, as the National Statutory Agency and Head of the National Oil Spill Response Centre, has overall responsibility for formulating the response strategies used to combat a Tier 3 incident. The Director of Operations of the Ghana Navy shall act as the National On-Scene Commander. Responsibilities include:

- The deployment of the required resources.
- The co-ordination of all activities on-scene with regard to the response including the direction and the deployment of needed resources for prevention of pollution, containment clean up and disposal of any pollutants and restoration of the site.
- Providing a focal point of information at the spill site for all parties concerned.
- Responsible to the Harbour OSC for the operational aspects of the response.

Equipment

The port is equipped with one tug at Takoradi fitted with booms, skimmers and tank receptacles for spill management. Other port operators such as Tullow Oil Ghana Limited has equipment which can be utilized by the GPHA in response to spills. Zoil Ghana Limited also has equipment which are the disposal of GPHA to handle any oil spillages.

Previous Spill Experience

There has been no major spills in Ghana waters. Only small spills have been reported at the Port of Takoradi

11.3.11 Hazardous Materials Management

As per the IFC EHS General Guidelines, the main objectives hazardous materials management are the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities.

Management measures to be employed by GPHA, in conjunction with the operators of terminals handling hazardous materials, include the following:

- Spill Prevention
    - Regular examination of storage facilities for leak detection
    - Hazardous materials storage and handling facilities should be constructed away from active traffic and protect storage areas from vehicle accidents.
- Spill Control Planning
    - Identifies areas within the port that are sensitive to spills and releases of hazardous materials and locations of any water
    - Implement the oil spill control measures outlined in the OSCP

- Dangerous Goods Handling
  - Materials safety data sheet for materials will be made available for all users
  - Training for all staff handling hazardous materials as per MSDS and best practice
  - Establishment of segregated and access-controlled storage areas with the means to collect or contain accidental releases;
  - Requesting Dangerous Goods Manifests for hazardous materials whether in transit, loading or unloading to and from ships, including proper shipping (technical) name, hazard class, United Nations number, and packing group;
  - Training staff in relevant aspects of dangerous goods management including screening and acceptance of dangerous goods at the port; · Emergency response procedures specific to dangerous goods.

11.3.12 Environmental Reporting

In order to comply with statutory as well as internal review, periodic reporting will be done. Reports to be prepared to serve as sources of environmental and safety information for stakeholders will include:

- Annual Environmental Reports – statutory requirement to EPA;
- Quarterly Environmental Monitoring Returns – statutory requirement to EPA; and
- Annual Environmental Audit Report – for in-house reporting.

11.4 Provisional Environmental Management Budget

The environmental management and monitoring programmes earmarked for implementation require detailed cost analysis to determine the actual budget needed. Certain costs elements may form part of the operational cost of the Port of Takoradi and the contractor. Provisional cost estimates are provided in **Table 23.**

Tentatively, about **GH¢1,011,000.00** will be needed in the first year for environmental as well as occupational health and safety management actions.

Table 23: Provisional Environmental Management Budget

NO	ISSUE	COST (GH¢)/ YEAR
1	Environmental Monitoring Plan	291,000.00
2	Provision of personal protective/ safety clothes and equipment	500,000.00
3	Staff Training and Education and Seminars	120,000.00
4	Annual Environmental and Safety Auditing	24,000.00
5	Annual Environmental Reporting	16,000.00
6	Preparation of EMP	60,000.00
Total		**1,011,000**

12.0 DECOMMISSIONING

12.1 Work Camp Facilities

Temporary work camp facilities to be constructed 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 the STMA designated sanitary landfill site at Sofokrom.

12.2 Other Port Facilities

The various facilities to be installed at various locations in the port will remain so long as the port is operational and functional. The Port of Takoradi will not require decommissioning in the medium to long term. The facilities will be rehabilitated as the need arises due to depreciation, worn out, damage or becomes dysfunctional.

Any major rehabilitation work at the port 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.

13.0 CONCLUSION

GPHA as part of the planned expansion of facilities at the Port of Takoradi will undertake this project in accordance with Ghanaian as well as International standards governing development projects of this nature. The dredging and reconstruction activities and operation of the facilities to be provided will satisfy the relevant local environmental protection laws and international conventions.

The major environmental, safety issues 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.

The recommended mitigation measures will be implemented to help minimise any significant adverse effects. An environmental monitoring programme to be carried out during project implementation will help maintain environmental quality within acceptable guidelines, while a general environmental management conditions for construction contracts developed by the World Bank has been provided as part of the EIS.

The dredged materials will be used to reclaim portions of the coastline for other phases of the project involving construction of container terminals and other on shore facilities. The provision of employment to the youth, revenue generation to the government, improvement in shipping traffic for bulk and cargo vessels drawing up to 14.0m draft at the port will go a long way to improve the status and image of the Port of Takoradi and impact positively on the socio-economy of the country. This will also assist and propel the country to achieving its oil and gas development strategies.

14.0 REFERENCES

1. Ghana Ports and Harbours Authority: Summary of Phases: Takoradi Port Development July 2012.

2. Ghana Ports and Harbours Authority: Strategic Environmental Assessment Report (SEA) for the Port of Tema, June 2008 by AY&A Consult Limited.

3. 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)

4. 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

5. Ghana Statistical Service: 2010 Population and Housing Census, Summary Report of Final Results, May 2012.

6. 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.

7. Internet Sources

ANNEXES

Annex 1: EPA Response to Project Registration

Annex 2: Copy of Scoping Notice

Annex 3: EPA Response to Scoping Report

Annex 4: EPA Response to Draft EIS

Annex 5: Report of Public Consultation Meeting

Annex 6: Climatic Data

Annex 7: Oceanographic Study Report

Annex 8: Resettlement/ Compensation Framework

Annex 9: GPHA Occupational Health and Safety Policy Document

Annex 10: World Bank's General Environmental Management Conditions for Construction Contracts

Annex 11: Dredging Management Plan

Annex 1: EPA Response to Project Registration

Tel: (0302) 664697 / 664698,
662465 / 667524
Fax: 233 (0302) 662690

Email: support@epaghana.org

Environmental Protection Agency
P. O. Box M 326
Ministries Post Office
Accra, Ghana

Our Ref: CI: 2050/01/02

June 20, 2012

The Ag. Director General
Ghana Ports and Harbours Authority
P. O. Box 150
Tema, Ghana

Attn: Mr. Richard A. Y. Anamoo

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED DEVELOPMENT OF PORT INFRASTRUCTURE AND DREDGING AT TAKORADI HARBOUR, TAKORADI

We acknowledge receipt of the completed Environmental Assessment Registration Form (EA2) submitted to the Agency on the above proposal in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

The proposal falls in the category of undertakings (Regulation 3) for which Environmental Impact Assessment (EIA) is required to help understand the likely implications of the proposal, the relevant alternatives and mitigations to consider in order to ensure, sound decision-making and sustainable development of the projects.

In line with Regulations 11 of LI 1652 however, you are advised to carry out a scoping exercise to generate the relevant terms of reference (TOR) to guide satisfactory EIA study of the proposal.

Please note that scoping is meant to focus the EIA on the key issues, concerns and decision areas and solicit input and guidance of all relevant stakeholders on the TOR. Scoping notices must be served as appropriate to facilitate stakeholder involvement (see attached sample). Ten (10) hard copies of the scoping report must be submitted for study and agreement on the TOR, prior to the EIA studies.

It is important that the scoping report and Environmental Impact Statement contains information on the consultants who prepared the reports. This should include the names, address, email, telephone experience and their specific contribution to the study. Failure to provide this information would render the submission in complete.

Do not hesitate to consult with the EPA Head Office (Room 305) and the EPA Western Regional Office, Sekondi for further guidance.

Yours faithfully,

Audrey Quarcoo (Mrs.)
PPO/EAA Dept
For: Ag. Executive Director

cc: The Regional Director, EPA, Western Region, Sekondi

Annex 2: Copy of Scoping Notice

SALE OF INDUSTRIAL PLOT WITH WAREHOUSE

0.80 acre land with warehouse and residential property for sale at the North Industrial Area, Accra. (Adjacent to Polyprint and Piccadily Factory). Interested purchasers should call the owner on **Tel. # 0302-780169 / 785763.**

No Agents Please.

SCOPING NOTICE

The Ghana Ports and Harbours Authority (GPHA) proposes to undertake a Port Infrastructure Development Project including Dredging, at Takoradi Port in the Sekondi Takoradi Metropolis of the Western Region of Ghana.

Notice of the proposed Port Infrastructure Development Project is hereby served for public information as required under the procedure for the conduct of EIA in accordance with regulation 15(1) of (LI 1652).

Any person(s) who has an interest, concern or special knowledge relating to potential environmental effects of the proposed undertaking, may contact or send such concerns, etc to:

The Acting Director General
Ghana Ports and Harbours Authority (GPHA),
P. O. Box 150,
Tema.
Tel: 0303 202631-9
Fax: 0303-202812
Email: dg@ghanaports.net
hsuleiman@ghanaports.net
projects_hq@ghanaports.net

and

The Executive Director
Environmental Protection Agency
P. O. Box M326
Accra
Tel: 0302 664 697/8, 0302 708175-9
Fax: 0302 662 690
support@epaghana.org

Annex 3: EPA Response to Scoping Report

Tel: (0302) 664697 / 664698,
662465 / 667524
Fax: 233 (0302) 662690

Email: support@epaghana.org

Ref.: CI: 2050/01/05

Environmental Protection Agency
P. O. Box M 326
Ministries Post Office
Accra, Ghana

October 17, 2012

The Ag. Director General
Ghana Ports and Harbours Authority
P. O. Box 150
Tema Ghana

Dear Sir

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED DEVELOPMENT OF PORT INFRASTRUCTURE AND DREDGING AT TAKORADI HARBOUR, TAKORADI

We refer to the Scoping Report on the above proposal submitted to the Agency, in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

The report has been reviewed and found to be generally satisfactory. You are therefore advised to proceed with the EIA study and submit a draft Environmental Impact Statement taking into consideration the comments below;

- Provide details of how dredge spoil will be disposed
- Conduct soil analysis for heavy metal concentration in the Dredge spoil before disposal
- Provide details of disposal site for Dredge spoil

You are required to submit **eight (8) hard copies** of the draft Environmental Impact Statement document in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

You are also requested to pay a non-refundable **Processing Fee of Seven Thousand, Seven Hundred and Ninety Ghana Cedis (GH¢7790.00) by bankers draft** in accordance with the Fees and Charges (Amendment) Instrument, 2011 (LI 1986).

Do not hesitate to contact the EPA Head Office (Room 305) for any assistance or guidance you may require.

Yours faithfully

Andrey Quarcoo
PPO/EAA Dept
For: Ag. Executive Director

Cc: The Regional Director EPA, Western Region, Sekondi

Annex 4a: EPA Response to Draft EIS

Tel: (0302) 664697 / 664698,
662465 / 667524
Fax: 233 (0302) 662690

Email: support@epaghana.org

Environmental Protection Agency
P. O. Box M 326
Ministries Post Office
Accra, Ghana

Our Ref: CI: 2050/01/09

November 22, 2012

The Ag. Director General
Ghana Ports and Habours Authority
P. O. Box 150
Tema, Ghana

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED DEVELOPMENT OF PORT INFRASTRUCTURE INCLUDING DREDGING AT THE TAKORADI HARBOUR, TAKORADI

We refer to the draft EIS report on the above proposal submitted to the Agency, in accordance with the Environmental Assessment Regulations 1999, (LI 1652).

The report has been duly reviewed and the attached areas/issues have been identified for consideration and inclusion in a revised Environmental Impact Statement (EIS).

You are therefore required to revise the report taking into account the attached issues and submit (5) hard copies of the Environmental Impact Statement (EIS) to the Agency.

Do not hesitate to consult with the Agency for any further guidance and clarification you may require.

Yours faithfully,

Audrey Quarcoo (Mrs)
PPO/EAA Dept.
For: Ag. Executive Director

CC: The Consultant, SAL Consult, P.O Box GP20200, Accra

REVIEW COMMENTS

Ghana Ports and Harbours Authority

Legal Framework

- Key legislations that have to do with port development and administration have been mentioned, however, further details should be given on what the instrument requires and how it will influence the proposed development and its operations.
- Legal enactments and legislative instruments should be cited fully.
- Reference is made of Ministry of Harbours and Railways to formulate policies under the Maritime Authority Act, 2002. This Ministry does not exist. The ports operations are regulated under the ministry of Transport.

Project Description

- A brief introduction of the project should be provided.
- The size of the topo map provided should be enlarged, possibly on A3 sheet to allow for details to be observed.
- Alternatives considered include construction of new port facility, relocation of some services to other ports and no development option. It is difficult to visualize how 'a no development option' is an option for the proposed project.
- Provide details of Quarry site to supply boulders and an estimate of the volume required for the project.
- Give an estimate of the number of haulage trucks to be used in carting boulders
- No evidence of consultation with the International Oil Companies operating at the Port
- No evidence of consultation with Ghana Highway Authority (Haulage of boulders on the roads demands a consultation with GHA)
- Pg.7: 2.2 Relevant International Conventions
- UN Convention on the Law of the Sea (UNCLOS)
- Basel Convention on shipment of Trans boundary Waste
- ISPS Code
- Exclusive Economic Zone

Baseline Conditions

- The account on safety and security of cargoes and vehicles should have included some information on records of previous accidents and security breaches that would inform the current study.
- The fishing communities that would be affected and for which possible relocation is intended have not been identified in the report. More details is required on this including demographic information and the intended place of relocation.
- While the project includes dredging, it is not stated how much dredged materials and sediment will be removed. The site of reclamation has been vaguely mentioned as 'towards New Takoradi'. It is necessary to be very specific here as shore/beach reclamations though generally desirable, have considerable implications, specifying this will assist the evaluation of the potential impacts of the

measure. It is also necessary to provide some details on the type of reclamation, whether it is just beach nourishment or would include some shoreline stabilization measures.

- Generally, the description of the baseline environment has been done without establishing the appropriate linkages with the proposed project, for example, how the description of geology and soil or seismicity relates to the stability of port structures and risk elements. How does sea level rise apply to the design of breakwater structures etc?
- It is not clear as to which area is referred in Section 6.1.4 as 'the Regional capital.'
- The description of seismicity is rather on a sub regional and national level. It will be rather useful to narrow down to the situation with respect to Takoradi.
- It is not stated how much solid and liquid wastes are generated currently at the port and how the project will affect the waste situation
- Reference is made of sediment quality but no data is provided to support statements.
- Information provided on littoral drift is scanty.
- Breakwater development has implications for material accretion and erosion and therefore volume of sediment transport and the implications to the project and on areas outside the immediate confines of the port are serious issues and should be treated as such.
- Aquatic Biota – The information provided does not help the assessment of the potential impacts of the project on marine biota. At least some baseline information could have been provided for marine invertebrates within the existing port environment including breakwater structures and what pertains at the intended project site.
- There are significant issues with the dredged materials as the report indicates the presence of heavy metals such as mercury and lead and therefore requires close attention. Quantities and qualities are of interest.
- Pg.26: 4.2.5 Reclamation of Log Pond and Northern Side of the Port towards New Takoradi
- Explain/clarify the statement on the use of dredge material. Has there been any sediment analysis? Provide details of results.
- Pg. 45: 6.2.5 Bottom Sediment Quality

Consultation

- Consultations do not appear to be exhaustive. The GMA has not been consulted. The operators of the service infrastructures to be relocated and the fishing community.
- Apart from the EPA, no evidence is provided for consultations carried out with specified institutions in respect of the issues raised by these institutions.

Mitigation

- Key impacts seem to have been identified, however the potential for shoreline erosion at the lee side of the port and accretion of materials at the mouth of the breakwater structures as well as at the western side of the port should be considered.
- The significance of all the identified impacts was not assessed. This is considered a key component of the report which will enable mitigation measures to be focused on impacts that are of significance.
- It is necessary to consider mitigation for the social impacts on fishing community to be relocated

- PEMP has been provided and covered the issues raised. Responsibilities have also been identified, however, the scope may change when an assessment of the significance of the identified impacts are assessed and the new issues of erosion, accretion, resettlement are considered.
- Last Bullet – Provide a detailed Resettlement Plan (RAP) outlining any compensation payments
- Pg. 68: Provide HSE Policy and Management Systems of GPHA

Monitoing

- Monitoring should include rate of shore recession at the down-drift areas and material accretion upstream. Also invertebrate biota, sediment quality should be included.
- How does this section relates to section 4.2.5 on Pg. 26

Annex 4b: Comments of the OPIC on Final EIS

Comments of 25th August

No.	Key Issue Raised	Section addressed
1.	EIS to address IFC's Performance Standards 1 through 8, Environmental, Health and Safety (EHS) Guidelines for Ports and Harbors and General EHS Guidelines	Sections 8 and 9 updated
2.	Dredging impacts on the marine environment and mitigation measures to be elaborated	Sections 8 and 9
3.	Provision of a dredging management plan	See Annex 12
4.	Sediment quality data has to include monitoring locations	Addressed in the monitoring plan (Table 21)
5.	Disposal site of dredged materials	Dredged materials to be used for reclamation. (See Annex 12 and Table 13). It must be noted that Phase 1 of the dredging has been carried out at this stage. All the dredged materials were used for reclamation.
6.	Livelihood restoration activities should use current data and not 2012 data which is probably obsoleted by now	The data is still applicable
7.	infrastructure impacts should be comprehensively addressed with current data	Se Section 8
8.	PAHs and other toxics should be included in the parameters monitored and if not detected, the Tables should indicate so	Addressed in the monitoring plan (Table 21)
9.	The EIA should include all Appendices with current information. Appendices 7b, 8, 9, and 10 are missing	Updated. Climate data updated to 2014
10.	Disposal of dredged material and other wastes in STMA Sofokrom landfill and other sites needs to be elaborated especially how such disposal complies with attached IFC's General EHS Guidelines and EHS Guidelines for landfills/waste management	See Section 9 (Table 19 and 18), Section 6.2.10
11.	Land acquisition/compensation including impacts on livelihoods on fishermen need to be elaborated upon to demonstrate compliance with IFC's Performance Standard 5	See Annex 11
12.	Impacts on infrastructure such as road construction/upgrading, etc. need to be elaborated	See Section 8

Comments of 16th September 2015

Comment	Section addressed
1. The ESIA should include a commitment to comply with the requirements of the IFC's 2012 Performance Standards (PS) and Environmental, Health, and Safety (EHS) General Guidelines and EHS Guidelines for Ports and Harbors.	See Sections 2.0, 2.1 and 2.2
2. The ESIA should summarize what is being done to address environmental, safety, and social issues under the Master Plan and the Master Plan attached as an Appendix.	See Chapter 8,9,10 and 11. Summary of Master Plan added as Annex 13
3. The ESIA should include a discussion on how the Project has been assessed using IFC's 2012 Performance Standards especially PS1 and should include details on the Sponsor's environmental and social management system, organizational capacity, training, community and stakeholder engagement, monitoring, and reporting. Some, but not all, of this information may be present in Chapter 11.	See Chapter 11.
4. The ESIA should indicate the threatened status of all species that may potentially be present in the Project area including flora and fauna. The ESIA should also present how impacts on these will be mitigated to ensure compliance with the IFC's EHS Guidelines for Ports and Harbors and IFC's PS 6.	See Section 6.2.8 (Tables 15 and 16)

Comment	Section addressed
5. The ESIA should provide additional details on dredging management (with a summary of the dredging management plan) and should include the following:	See Sections 4.2.3 and 4.2.4
(a) The sediment quality (in an earlier conference call, it was indicated that dredging is undertaken regularly and therefore, recent data on sediment quality is available) including concentration levels on the major pollutants such as toxic metals, organics including PAHs, PCBs, etc.	See Section 6.2.5. The sediment quality analysis has been proposed in the monitoring plan
(b) Dredging techniques (bucket or hopper excavators, etc.)	See Sections 4.2.3 and 4.2.4
(c) Turbidity levels of water in the proposed dredging area.	See Table 10.
(d) Dredging impact mitigation measures such as the use of silt curtains etc.	See Sections 4.2.3 and 4.2.4 and Section 9
(e) Pumping rate of water to evacuate the dredging area.	Information on pumping rate not available
6. Disposal of the dredged material (including alternatives assessment) should be such that it does not release toxics (including metals and organics) into the environment. The disposal practice currently indicated does not mitigate the risk of release of toxics to the environment.	Mitigation measures provided in Chapter 9.
7. The management of sewage and wastewaters and wastes generated both during construction and operations phases need to be comprehensively presented (may be in accordance with existing port management practices).	Se section 8.6.2 "Contamination of Marine Environment". Existing Port Waste Reception and Treatment Facilities to be utilised
8. Impact mitigation measures should be comprehensively discussed in Chapter 9 and should address all significant impacts. It should also include information on how the mitigation measures will reduce the impacts to acceptable levels with documentation of how they will comply with the IFC's EHS Guidelines both General and for Ports and Harbors. Some of this information may be available in Tables 16 and 17 in Chapter 11.	All significant impacts addressed under Chapter 9
9. The economic impact mitigation measures should provide a comprehensive compensation framework with a budget, the number of people affected and that need to be compensated, and the Sponsor's commitment to comply with the requirements of IFC's PS 5.	There will be no compensation payment. Fishermen agreed from the consultations to be provided an alternative landing site ant the Fishing harbour or new Takoradi
10. The ESIA should include details on infrastructure impacts, on the access roads, and other port operations.	Incorporated under air quality, noise nuisance, occupational health and safety, public health/safety issues
11. The erosion and accretion impacts needed to be addressed both for the construction and operations phases.	See Section 8.5.2
12. The impact on ship movement (use of tug boats etc.) and an increase in the number of ships servicing the port (some of the information from the Master Plan) needs to be comprehensively presented to demonstrate that the increase in traffic will not increase in more accidents etc.	Section 4.2
13. Wastes and wastewaters from ships (including ballast water and sewage) need to be comprehensively presented along with the commitment to comply with the MARPOL convention etc.	Se section 8.6.2 "Contamination of Marine Environment"
14. Impacts from the construction phase and their mitigation measures need to be presented in a separate section from the impacts during operations phase.	Construction phase impacts in Section 8.5, Operational Phase Impacts on Section 8.6

Comment	Section addressed
15. The EMP needs to address the both the construction and operations impacts and cover all the impacts discussed in Chapter 8 (including dredging and disposal of dredged materials, compensation of fishermen, grievance mechanism to address concerns from stakeholders, etc.), their mitigation measures, document what indicators from the IFC's EHS Guidelines for both General and Ports and Harbors will be complied with, etc.	Mitigation measures are covered under Chapter 9. The PEMP provides the management systems to ensure the proposed mitigation measures are implemented.
16. The monitoring plan (Table 17) needs to include all the major parameters (toxic metals, organics including PAHs, turbidity, accretion and erosion, compensation paid, grievances expressed and other indicators of social issues, etc.) that need to be monitored. The budgets for these items should be reasonable.	Monitoring plan updated to reflect preparatory, construction and operational phase
Measures to controlling oil spill including the response equipment that will be kept to ensure effective and timely response to a spill with some description of the size and nature of oil spills that are possible. During the discussion, I was told that the Project will not handle oil but the ESIA has several references that it will support oil services. Please note that the ESIA does not demonstrate capabilities to handle large oil spills and references to managing oil should clarify what exactly are the services that the Project will provide.	The GPHA has prepared and is implementing the *Takoradi Commercial Harbour Oil Spill Contingency Plan.* See Section 11.3.10 The master plan involves the creation of an oil services berth.
Management of hazardous materials in compliance with Section 1.5 of IFC's General EHS Guidelines.	See Section 11.3.11
The monitoring should include biota monitoring too in addition to turbidity, toxic metals, and any other toxics that may potentially be released either during construction (dredging or disposal of dredged materials) or operations.	Biota monitoring included

Annex 5: Report of Public Consultation Meeting

Republic of Ghana

MINISTRY OF TRANSPORT

GHANA PORTS AND HARBOURS AUTHORITY

REPORT OF

STAKEHOLDER ENGAGEMENT MEETING

Environmental and Social Impact Assessment (ESIA) Studies on Port Infrastructure Development, including Dredging, at Takoradi Port, Western Region

SAL Consult Limited, P O Box GP20200, Accra, Ghana
in association with Royal Haskoning DHV, Nijmegen, Netherlands

November 2012

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1.0 INTRODUCTION

1.1 Background

The Ghana Ports and Harbours Authority (GPHA) is the national authority which manages the ports of Tema and Takoradi as well as the fishing harbours. It was established as a statutory corporation in 1986 under the PNDC Law 160 to succeed the then Ghana Cargo Handling Company (GCHC), Takoradi Lighterage Company (TLC), and Ghana Ports Authority (GPA). The GPHA is therefore responsible for the operation, management, and administration of the ports of Ghana and has ambitions to make the ports the maritime hub of the West African sub-region.

The law established the GPHA as a statutory government corporation and defines the Boards and function of the GPHA, the assets made available to it, the staff and its personnel and the financial arrangements of the GPHA. The GPHA falls under the auspices of the Ministry of Transport (MoT), which has the delegated responsibility to ensure that a good transport system plays the needed crucial role in the socio-economic development of Ghana.

In a 2002 report on The Development Study of Ghana Sea Ports in the Republic of Ghana prepared by the Overseas Coastal Area Development Institute (OCDI) of Japan and Nippon Koei Co Ltd sponsored by the Japan International Cooperation Agency (JICA) for GPHA, the following development principles were adduced for the Port of Takoradi viz. to:

- function as the main export port of commodities produced in Western Ghana such as manganese, bauxite, cocoa and timber;
- function as an import port of commodities consumed in western Ghana such as foodstuffs and consumer goods; and
- support industrial development and agriculture by providing necessary facilities for import of materials and export of manufactured goods and crops.

With the emergence of oil and gas industry in the Western Region of Ghana, it has become even more urgent to upgrade the Takoradi Port infrastructure to meet the demands of the emerging cluster of port businesses.

The GPHA is therefore proposing to develop the infrastructure at the Port of Takoradi which will include dredging of the port basin. The improved infrastructure at the port will also enhance Public Private Partnership (PPP) ventures at the Port of Takoradi. The PPP concept, which is a key government economic reform agenda and strategy to increase private sector involvement in infrastructure and public services delivery reflects the desire of Government of Ghana (GoG) to improve the quality, cost effectiveness, and timely provision of public infrastructure and services in Ghana.

In recognition of the environmental implications of the proposed Port of Takoradi infrastructure development and in compliance with the the Environmental Protection Agency Act 1994, Act 490 and Environmental Assessment Regulations 1999, LI 1652, the GPHA has contracted Messrs SAL Consult Ltd of Ghana and Royal Haskoning of the

Netherlands to conduct an Environmental Impact Assessment (EIA) study of the proposed project to ensure that the developments are environmentally sustainable and socially responsible, and also meet international best practices. The inception report presented by the consultants on the assignment recognized the need for an engagement meeting with stakeholders to sensitise and solicit concerns on environmental issues at the port.

A stakeholder engagement meeting was therefore organized for a selected number of stakeholders on 1st November 2012 and the report on the exercise is hereby issued (see **Annex 1** for notification of the meeting published in the Ghanaian Time Newspaper).

1.2 The EIA Process

EIA is a planning and a decision making tool, applied in Ghana to proposed "undertakings" (ie any activity, project, structure, investment, plan, programme, etc., the implementation or development of which may have a significant impact).

The process involves:

- Registration of the project with EPA;
- Screening by EPA and Response to Application;
- Publication of Scoping Notice & Reporting;
- Review and Comment by EPA;
- Preparation of Draft ESIA Report;
- Publication/ Disclosure of EIS by EPA;
- Review and Comment by EPA;
- Preparation of Final ESIA Report; and
- Acquisition of Environmental Permit.

The ESIA involves the gathering and analysis of all relevant information on a proposed undertaking to determine the likely consequences of implementing the undertaking in a given area; and provision of appropriate mitigation measures for adverse impacts and enhancement of the positive impacts. Alternatives/ options are considered in an EIA study in order to ensure environmentally sound and sustainable implementation of the proposed project.

The output is a report that outlines the environmental impacts, and mitigation measures as well as offering alternatives and guidelines for development.

1.3 Theme and Objective of the Meeting

The objective of the public consultation meeting was to bring together in a forum the stakeholders and the general public to solicit their inputs and concerns on the proposed Port of Takoradi redevelopment including dredging to assure sustainable operations of the port.

It was also to create awareness of the proposed project among stakeholders.

2.0 THE STAKEHOLDER MEETING PROCEEDINGS

The stakeholder engagement workshop was held at the GPHA Club House in Takoradi for one day between 0900hrs and 1400hrs on 1st November 2012. The workshop programme is attached as **Annex 2. Table 1** summarises the activities carried out and the responsible official(s) for each activity shown.

Table 1: Summary of Activities and Responsible Official(s)

Activity	Performed by
Opening Prayer	Mr Paul Ansah, Head of Strategic Management Team-GPHA, Takoradi
Welcome Address	Ing. Huseini Suleiman, Project Engineer
Presentation on Project Scope	Ing. Huseini Suleiman, Project Engineer
Presentation on Draft EIS	Mr Richmond Yeboah Amoako, Senior Consultant, SAL Consult Ltd
Questions and Answers Session	All Participants coordinated by Mr Paul Ansah, Head of Strategic Management Team-GPHA, Takoradi
Closing Remarks	Capt Owusu-Koranteng, Acting Director of Ports. Takoradi
Vote of thanks	Mr Paul Ansah, Head of Strategic Management Team-GPHA, Takoradi

2.1 Organisers of the Meeting

The workshop was organised by the GPHA in collaboration with the Environmental Consultants carrying out the EIA study viz., SAL Consult Ltd of Accra, Ghana and Royal Haskoning DHV of The Netherlands.

2.2 Participation

A total of one hundred and twenty three (123no) participants excluding the Resource Persons (The Consultants) attended the workshop. These comprised officials from industries operating at the port, governmental agencies and security agencies. **Annex 3** presents the list of the participants.

2.3 Opening Statement

The opening statement was given by Ing. Huseini Suleiman, Project Engineer. This was preceded by an opening prayer by Mr Paul Ansah, Head of Strategic Management Team.

The Project Engineer gave a brief on the purpose of the gathering which is to present the findings of the ESIA studies to the public and to seek their comments and concerns. He also stated that the meeting was a follow up to a similar meeting held previously on the same proposed project.

2.4 Presentations

There were two presentations, one each by GPHA and the Consultants (SAL Consult Ltd/ Royal Haskoning DHV) as follows:

- Presentation on Project Scope of Works by Ing. Huseini Suleiman (GPHA) see **Plate 1**; and
- Presentation on Draft EIS by Mr Richmond Yeboah Amoako (SAL Consult Ltd/ Royal Haskoning DHV), see **Plate 2**.

Plate 1: GPHA Project Engineer making his Presentation

Plate 2: Environmental Consultant making his Presentation

The highlights of the two presentations are shown below.

Presentation on Project Scope of Works

The Project Engineer presented the various phases of the proposed redevelopment project. The salient points of his presentation included the following while the full text is attached as **Annex 4:**

- The vision of GPHA to upgrade the Takoradi Port infrastructure to meet the demands of the cluster of port businesses;
- The various phases of the project; and
- Brief introduction of the consultant undertaking the EIA study.

Presentation on EIS

The presentation on the Draft EIS touched on:

- EIA procedure in Ghana;
- Highlight of project activities;
- Stakeholders identified and contacted;
- Concerns of stakeholders;
- Findings and observations from baseline and desktop studies;
- Environmental and Social Impact identification including Potential hazards and risks; and
- Mitigation measures proposed.

The presentation on the Draft EIS is attached as **Annex 5**.

2.5 Questions and Answers Session

The participants were given the forum to ask questions and also express their concerns over the proposed Takoradi Port Redevelopment project. The session was coordinated by Mr Paul Ansah of GPHA. The questions and the corresponding answers have been attached as **Annex 6**.

2.6 Closing Statement

The Acting Director of Ports, Mr Koranteng informed the gathering that the much awaited project is a reality now and also encouraged the public to give GPHA their full support so they can serve them better (see **Plate 3**).

The vote of thanks was also given by the Head of Strategic Management team for the Port of Takoradi, he thanked all the participants for making it to the meeting. He also emphasized on the need and the importance of operating a fund for future developments at the ports.

Plate 3: The Director of Ports addressing the Participants

3.0 STAKEHOLDER MEETING OUTPUT AND RECOMMENDATION

3.1 Stakeholder Meeting Output

The workshop provided a good forum for all stakeholders to appreciate and understand the EIA process in line with the vision of GPHA as well as the requirements for internationally recognised environmental management practices at the port.

The participation of the stakeholders has helped to strengthen the already existing relationship with the GPHA, which will go a long way to project the good corporate image of the Takoradi Port and for that matter the GPHA.

At the end of the workshop, participants had:

- Acquired sufficient information to enable them contribute towards the successful implementation of the EIA for the Redevelopment of the Port of Takoradi;
- Developed an appreciation of, and understood the integration of the Environmental factor in the efficient and effective management of GPHA;
- Understood and appreciated the relevance of good occupational health, safety and security measures for the Port of Takoradi; and
- Identified and appreciated the critical role of each individual and organisation in the management of the Takoradi Port Environment.

3.2 Recommendation

The following general recommendations were deduced from the questions and answers session:

- Stakeholder engagement process should be extended beyond the Takoradi port area; and
- The provision of alternative sites for relocation of New Takoradi fisher folks landing site/ boatyard.

ANNEX 1 NOTIFICATION OF MEETING IN GHANA TIMES NEWSPAPER

Guinness Ghana Breweries Ltd - results for the three months to 30th September 2012

GUINNESS GHANA BREWERIES LIMITED

GGBL's net turnover grew by 17% for the first 3 months of F13. Despite being below volume against last year, we grew our top line through price increase as well as a favorable volume mix.
Cost of sales also grew by 16% compared to the first three months of F12. This growth was mainly driven by price inflation and forex losses (GH$1.2m) on imported raw materials which constitute a substantial percentage of our production inputs. The company has invested GH$8m in various capital projects during the 3 months to September 2012. Advertising and Promotion cost has remained flat against LY. The business will continue to invest behind all our brands in our portfolio to reinforce brand positioning and drive volume performance as well as gain market share. Some of the key activations planned for Q2 F13 are the Guinness Football Challenge, the Malta Guinness Street dance and the Star NCP.

General & Administrative expenses grew by 29% against same period last year. This has been due to the increased headcount as well as general price inflation.
Operating profit increased by 15% compared to the same period last year. Profit before tax however increased by 93% due to a 69% decline in financial charges as a result of the reduction in our debt stock which commenced in F12.

Looking Forward
In Q2 we expect to build on the positive start in Q1 with investment in our brands and route to market. We will also continue to manage cost especially in a high inflationary environment driven mostly by a weaker currency.

UNAUDITED STATEMENT OF COMPREHENSIVE INCOME FOR THE THREE MONTHS ENDED 30th SEPTEMBER, 2012

	2013 GH¢'000	2012 GH¢'000
Net Turnover	67,273	57,522
Cost of Goods Sold	(46,357)	(39,326)
Gross Profit	20,916	18,196
Selling, General & Administrative Expenses	(13,900)	(12,082)
Operating Profit	7,016	6,114
Financial Charges	(901)	(2,951)
Profit /(Loss) Before Taxation	6,115	3,163
Taxation	(1,426)	(158)
Profit/(Loss) For the Period	4,690	3,005
Other Comprehensive Income	-	-
Total Comprehensive Income	4,690	3,005
Earning Per Share (GHc per share)	0.022	0.014
Diluted Earnings Per Share (GHc per share)	0.022	0.014

UNAUDITED STATEMENT OF CHANGES IN EQUITY FOR THE THREE MONTHS ENDED 31st SEPTEMBER 2012

	Share Capital GH¢'000	Retained Earnings GH¢'000	Total GH¢'000
Balance at 1 July 2012	96,252	42,705	138,957
Comprehensive income for the period		4,690	4,690
Total Comprehensive Income for the period	96,252	47,395	143,647
Dividend to Shareholders	-	-	-
Balance at 30 September 2012	96,252	47,395	143,647

UNAUDITED STATEMENT OF FINANCIAL POSITION AT 30th SEPTEMBER 2012

	2013 GH¢'000	2012 GH¢'000
ASSETS		
Non Current Assets		
Property, Plant and Equipment	163,545	156,434
Intagible Assets	3,499	5,031
	167,045	161,465
Current Assets		
Inventories	45,113	32,843
Trade and other receivables	13,323	3,712
Amounts due from related companies	1,068	4,754
Income Tax Asset	1,554	1,482
Cash and cash equivalents	30,885	8,162
	91,943	50,753
Total Assets	258,987	212,218
EQUITY AND LIABILITIES		
Share Capital	96,252	28,252
Retained Earnings	47,395	22,449
Total Equity	143,647	48,701
Non-Current Liabilities		
Medium term loans	7,583	20,438
Obligation under Finance lease	3,282	-
Employee benefit obligations	1,903	760
Deferred Tax Liabilities	13,619	7,772
Total non-current liabilities	26,387	28,970
Current Liabilities		
Bank Overdraft	177	14,808
Short term loans	7,750	25,483
Trade and other payables	58,624	35,669
Amounts due to related companies	22,402	56,176
Dividend Liability	-	2,411
Total Current Liabilities	88,953	134,547
Total Liabilities	115,340	163,517
Total Liabilities and Equity	258,987	212,218

Peter Ndegwa, Managing Director
Charles Mwangi, Finance Director

UNAUDITED STATEMENT OF CASH FLOW FOR THE THREE MONTHS ENDED 30th SEPTEMBER 2012

	2013 GH¢'000	2012 GH¢'000
Cash Flows from operating activities		
Profit/(Loss) before taxation	6,115	3,164
Adjustement for Depreciation charges	5,915	5,728
Loss on sale of property plant & Equipment	(10)	0
Net interest expense	901	2,951
	12,922	11,842
Changes in Inventories	(11,576)	(4,707)
Changes in Trade and other receivables	(4,272)	1,924
Changes in trade and other payables	9,546	(1,474)
Changes in Related company balances	1,819	2,552
Changes in employee benefits	475	135
Cash Flow From Operations	8,914	10,272
Interest Paid	(901)	(2,951)
Income Tax Paid	(2,056)	4
Net Cash Outflow from Operating Activities	5,957	7,325
Cash Flow from Investing Activities		
Additions to Property, Plant and Equipment	(8,056)	(5,155)
Net Cash Outflow from Investing Activities	(8,056)	(5,155)
Cash Flow from Financing Activities		
Net movement in loan balances	(2,583)	(6,457)
Net Cash flow from Financing Activities	(2,583)	(6,457)
Increase (Decrease) in cash and cash equivalents	(4,682)	(4,287)
Analysis of changes in cash & cash equivalents end of period		
Balance as at 1st July	35,390	(2,359)
Net Cash flow	(4,682)	(4,286)
Balance at 31 March	30,708	(6,646)
Analysis of Cash and Cash Equivanlents in the Statement of Financial Position		
Bank and Cash Balances	30,885	8,162
Bank Overdraft	(177)	(14,808)
Balance at 31 March	30,708	(6,646)

The Most Vibrant and Iconic Business in Ghana

MINISTRY OF TRANSPORT
GHANA PORTS AND HARBOURS AUTHORITY

PUBLIC PARTICIPATION NOTICE

Environmental and Social Impact Assessment (ESIA) Proposed Port Infrastructure Development, including Dredging, at Takoradi Port

The Ghana Ports and Harbours Authority (GPHA) as part of the Ghana Environmental Assessment (EA) Procedures has prepared and submitted a draft Environmental and Social Impact Assessment (ESIA) report to the Environmental Protection Agency on the above-proposed project.

As part of the project implementation strategies and in line with the EA Procedures, the GPHA is holding a "Public Participation" meeting on the proposed Project in order to present the proposed project and the draft ESIA Report to the public, and to elicit concerns if any.

THE GENERAL PUBLIC AND ALL STAKEHOLDERS ARE HEREBY CORDIALLY INVITED TO ATTEND THE PUBLIC HEARING.

Date: Thursday, 1st November 2012
Venue: GPHA Club House, Port of Takoradi
Time: 10:00 am Prompt

THANK YOU.

GHANA PORTS AND HARBOURS AUTHORITY

OUR VISION:
TO BE THE REGIONAL HUB IN WEST AFRICA

ANNEX 2 PROGRAMME

Public Presentation Meeting

Date: 1st November, 2012

Venue: GPHA Club House, Takoradi

PROGRAMME

PROGRAMME OF ACTIVITIES

9:30am – 10:45am:	**Registration**
10:45am – 11:00am	**Opening Remarks and Scope of the Proposed Project (GPHA)**
11:00am – 11:45am	**Presentation by ESIA Consultants (SAL Consult)**
11:45am – 12:45pm	**Q & A Session, Issues/ Concerns etc**
12:45pm--13:00pm	**Closing Remarks**
13:00pm – 13:30pm	**Refreshment**

ANNEX 3 LIST OF PARTICIPANTS

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	Seth Larmie	SAL Consult Ltd	Consultant	0244378265	slarmie@salconsultgh.com seth.larmie@yahoo.co.uk
2	Richmond Yeboah Amoako	"	"	0244724603	ryeboah@amoako@salconsultgh.org amoako@chemist.com
3	Heidi N.A Maclean	"	"	0244995245	hmaclean@salconsultgh.com
4	JOSEPH ANMLEY YANKEY	GHANA BAUXITE Co	OPS SUPT.	0244330344	joe.yankey@boscughana.com
5	MARY OCRAN	GHANA BAUXITE	SECRETARY	0233811388	ocran_mary@yahoo.com
6	GARRY HOWITT	HALLIBURTON	SERVICE CO-ORDINATOR	+233549553961	GARRY HOWITT2@HALLIBURTON.com
7	Osei Daniel	MAT. SEC.	EXDO	0208194935	–
8	John Alorsor	SSA	OFFICER	0205087214	alormanu@yahoo.com
9	Thomas Addaquay	UNICONTROL	SITE MANAGER	0244639073	addaquay@gmail.com
10	DAMBRANDIA BACHIR	NIGER SHIPPERS COUNCIL	REPRESENTATIVE	0242947760	dambrandia@yahoo.fr
11	Danso Okai Koi	National Security	Representative	0244974051	cyclous2007@yahoo.com
12	Collins O. Asante	SCL	Terminal Manager	0244847888	coasante@safeboard.com.gh.
13	Anita Anto	SCL	Claims/Doc. Manager	0205814316	aanto@yahoo.co.uk
14	Alex Oberg Sakyi	CMC (GH) Ltd	HR personel	0243238362	alex.obergsakyi@yahoo.com
15	J. V. Sackey	GDLC	OFFICER	0208201447	jvsackey@yahoo.com

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	THIERRY LOUPIAC	TAKORADI FLOUR MILLS	GENERAL MAN	0264311889	
2	PERCY BOSCHWAY	✓	PRO	0264311879	
3	Jacob Nsiah	Macro	Coordinator	020-8419488	Jacob@macro.com.gh.
4	Emmanuel Nkrumah	FDB	SRO	0244254315	emmlnkrumah@hotmail.com
5	Kwaming Wilson	OMA	Branch Mgr	0202224404	wilsonk@omaghana.com
6	Elijah Amoo-Frimpong	Tadi Hosp.	Internal Auditor	0244054467	amoofrimpong@yahoo.com
7	Robert Yartel	Zeal Envt. Tech.	Operations Manager	0244174364	r.yartel@zealenvironmental.com.
8	John K A. Amoah	GRCL	Dy Chief Engr	0244865599	quesiamoa@gmail.com
9	BEN AMOFAH	GRCL	DMD (E)	0244469160	benamofah@gmail.com
10	Joseph Sankah	GRCL	DMD Ap	0244235355	joesankah@yahoo.com
11	SIMPKE SAISIG	INTEGRAL MARINE	B/OPM.	0201205393	operations-tdid@korolute
12	Norbert F. Kevi	Maersk Line	Operations	0244326933	norbert.fornyikpor-kevi@maersk.com
13	ISAAC APPIAH	SUPERMARITIME	Operations Asst	0243315874	bopiah@yahoo.com.
14	FELIX MATE-KODJO	CUSTOMS	OPERATIONS	0208110672	fmatekodjo@yahoo.co
15	Eric Gyabah	SKH	0266231213	0207606660	Ericgyabah1977@yahoo

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	KOZMSON CHRIS	GT. OB.R.I	ADMIN. SEC.	0203160101	nanakumi2000@yahoo
2	ROBERT BROWN	TULLOW	MARINE SUPT.	0244 342674	Marine Superintendent @ Tullowoil.com
3	JACOB LARTEY	GHA. Imm. Ser.	ASI	024401214L	—
4	Faustina Nkrumah	Gh. Imm. Ser	Recruitoffice	0244967129	Faugelf @ yahoo.com
5	Capt. WILLIAM THOMPSON	G. M. A.	BRANCH MANAGER	0201599499	WILLYTOM@REDIFFMAIL.COM
6	BAYOR SEIDU	GHACEM LTD	PROD. MGR	0244358247	seidu.bayor@ghacem.com
7	FRANCIS B. OWU	DOCKS CONSULTANT	MARINE SURVEYOR	0279645854	f_owu@yahoo.com
8	Yodu Seydou	BURKINA.CCI	BRANCH TAKORADI	0266019194	yamba.24@yahoo.com
9	Joe. EKEM	GEMIN.	BRANCH MAN	0277808454	—
10	JOSHUA BENFUL	MENERGY	MANAGER	0208401919	jbenful@menergyinternational.com
11	Col KAKU KORSAH	NATIONAL SECURITY	REGIONAL Co-ORDINATOR	0204636363	kakucolonel@yahoo.com
12	Zunch Tieboo	GPHA	Financial Mgr.	0208207439	tzunch@yahoo.com
13	E. Eo. HAYMAHAI	GPHA	FIZ/CARGO	0244871199	addymarine@yahoo.com
14	Active Hyde Anlei	Maytro	Operation Man.	0243250368	—
15	Ebenezer Abban	Subsistence	Operation Ass.	0243355176	[illegible]

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	JAMES ATOH	GMC	PORT OPERATIONS CO-ORDINATOR	0543141714	jatoh@ghanaemp.net
2	David Kyelem	Burkina Shippers' Council.	REP.	0243861049	Ouragone@yahoo.fr
3	Afrijie K. Anthony	GPHA	PMAME	0208125079	afrijieak@yahoo.com
4	DAVID APAU	GHIDA	VICE CHAIRMA	0244772081	
5	Apostle Ekow Sackey	Grace Church	Apostle	0244847395	—
6	BEN KLU	GPHA	PRIN MECH ENGR	0202017342	klubenk@hotmail.com
7	Seth Bokor	Panalpina	Branch Manager	0277771033	Seth.bokor@panalpina.com
8	Victor DOE	Panalpina	Ops Officer	0277771042	"
9	A. E. Kwapie	Vikings	Optns Mgr	0261230650	
10	J. J. Parker	Halliburton	Project mgr	0200553258	
11	Yakubu Issifu	Sando Maritime	Branch Head	0277435213	
12	Samuel Kofi Armah	Hull Blyth	Ops Mngr	0277325686	
13	JAME ADAIR	✓ ✓	Branch Manager	0544311531	
14	Stephen Bondoh	Intaspo Ltd	Inspector	0207478288	
15	Ajuru Sunule	Stallar	Shipping Mgr	0244330657	

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	E-Isaac Quarmyne	Global Haulage Co	Manager	0243 40 4000	
2	Paul Ansah	Takoradi Renewable TREL	Logistic	0544342686	pba@trel-ghana.com
3	Daniel K. Obobu	Westrock Quarries	Quarry Manager	0244676864	dan.obobu@westrock quarries.com
4	Michael Ofori	"	Acc. Manager	0208718846	mcoclay2004@yahoo.com
5	Eugene Donkoh	E.P.A.	Service Person	0272350084	eugenedkd@yahoo.com
6	Kwadwo Opoku-Mensah	EPA	Asst Prog. Officer	0242938893	jazzimoo@yahoo.co.uk
7	Henry Tumbabia	Global Haulage Co. Ltd	Architect	0244454220	tumbabiahe@yahoo.com
8	Henry J. Ocansey	Chamber of Commerce & Ind.	Credit Union manager	0242517855	dettehocansey@gmail.com
9	Richard Sackey	GDL Co	Director	0276604984	
10	A.K. Senzah	A.S.C.	Ops. Mgr.	0244164604	
11	Sarah Zaato	Shippers Au		0244445723	Sarahzaato@yahoo.com
12	Ben A. Kwamoh	APS	Ops Officer	0242701419	
13	P.K. Apaggyei	Regional Office	Commander	0287319735	
14	Kezis A Mensah	Process & Plant	Sales & Credit Admin	0242285216	Kmensah@ppsghana.com
15	Reece O. Donkor	Lubes Engineering	Manager	0276790330	manfuah20@gmail

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	David Essiam	A.P.S.	Estate Officer	0244480010	davidessiam@yahoo.com
2	ALBERTO ADOWOH	GIPF	EXECUTIVE	0208490175	aadowoh3@yahoo.com
3	LT (GN) SB AKIEDU	NAVY	DEPUTY OPERATIONS OFFICER	0244890862	Kwakuboateng09@yahoo.com
4	ISAAC G. ANNAN	WESTERN STARE QUARRY LTD	CHIEF EXEC	0208117750	weststateq@yahoo.com
5	Lovelace Abusah	SG-SSB	Relationship Manager	0247269403	lovelace.abusah@socgen.com
6	K. C. OPPON	GIERRE WOOD	EXP MANAGER	0205081114	—
7	Jayne Plange Dula	ICS	BRANCH HEAD	0208640185	magnulady@yahoo.com
8	LOVESTONE DONKPASH	GPHA SECU.	SECURITY INTELLIGENCE	0244943097	
9	PROSPER S. BEDIAKO	G.P.H.A. SEC	SECURITY INFO	0249887077	prosperseniobediako@yahoo.com
10	Wilson Amo Affo	GPHA	Security officer	0244405887	Wilson amoaffo@yahoo.com
11	George Gavchie	ABIVAMS	P/Manager	0244701954	AB contiems.
12	Wisdom Agbanyo	GPHA	Techn Supr	0208510200	wisdomanyo@yahoo.com
13	Daniel Annor	✓	Prin Civil Eng	0244813457	danannor2001@yahoo.com
14	David Acquaah	✓	Technician Dry Dock	0244945415	DKAcquaah@yahoo.com
15	Kwame MAC DORMELO	MOFA-PPRSD	REG HEAD	0246035566	macdormelo@yahoo.com

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	E. [illegible]	Steelcon	HR M	0202015441	[illegible] Africa.com
2					
3	Francis Woode	TIDD-FC	MANAGER	0244521063	kofwoode@yahoo.com
4	Orthillous Lamboq	TIDD-FC	MANAGER	0208241767	LAMPA412@yahoo.com
5	Kweku Kulson	SICCI	Service Personnel	0205058410	nanakuukw@gmail.com
6	Felix K. NTIBREY	NG. OFFICE	SUR OFFICER	0243183030	[illegible]
7	Fred [illegible]	Graphic			
8	Asiedu Manfo	Graphic	Reg. Editor		
9	Robert Gyeti	Omegar marine	B. MANAGER	0204353008	r.gyeti@omegarmarine.com
10	JUSTICE DAMOAH	TV. AFRICA	CAMERAMAN	0242540171	justicedamoah@gmail.com
11	Clement Adzei Boye	Ghanaian Times	TIMES	0243247786	tracypaasha65@gmail.
12	Kwabena Ayim	TV. Africa	Reg. Correspondent	0246513224	ayimjoel@yahoo.com
13	Lawrence Adigbo	Safmarine	Branch Manager	0244330824	ladigbo@safmarine.com
14	John Dadson	COTTON WOOD	Shipping Manager	0208157449	CoKTKali@Yahoo.com
15	EDWARD OFOSUHENE	GHANA STANDARDS AUTHORITY	OFFICER IN-CHARGE	0244265623	ofosuchief@yahoo.co.uk

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	GEORGE G. YANISON	GBC	EDITOR - MEDIA	0246710675	
2	G. M. ASHALEY	GBC	MEDIA PRACTIONER	0244177766	
3	R. NYEMEKYE	GBC	- DO -	0208143399	
4	F. ACQUAFIO	GMOL	Com MGR	0208255077	felicity@gmelgh.com
5	Boffour-Ida Joseph	GREL	Logistics Off	0244361232	boffour@gmelgh.com
6	Justice Kwamena Addison	WESTERN REGIONAL SHIPPER COMMITTEE	CHAIRMAN	0244547319	
7	Ato-Djan	Radio Ghana	Reporter	0246582658	atodjan@yahoo.com
8	Yaaba Mamud	Star Times	Reg Edit	0244[illegible]	[illegible]
9	Paul Ayamba	MSC	Ops manager	0244344417	Pgyamba@msc.gh.mscgva.ch
10	LEONARD AITSU	IESL	BASE MANAGER	0244851584	leonard@iesghana.com
11					
12					
13					
14					
15					

REGISTRATION FORM

NO	NAME	ORGANISATION	POSITION	TELEPHONE	E-MAIL
1	Samuel K. Armah	Hull Blyth	OPRS Manager	0277325686	Samuel.Armah@hb-gh.com
2	James Adjair	" "	Branch Manager	0544311531	James.Adjair@hb-gh.com..
3					
4					
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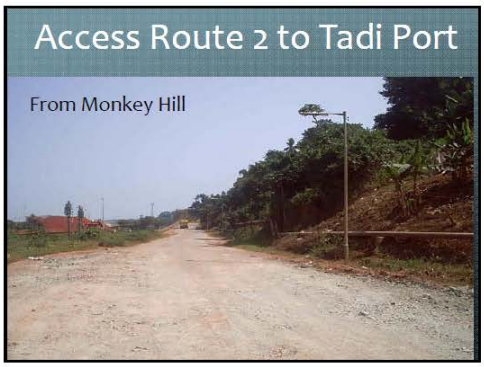
ANNEX 4 PRESENTATION ON PROJECT SCOPE

05-Dec-12

Ministry of Transport
Ghana Ports & Harbours Authority
Embracing the Future to provide the Most Efficient Maritime Services within the West African Sub-region


Access Route 2 to Tadi Port
From Monkey Hill

Takoradi Port Layout
The way forward

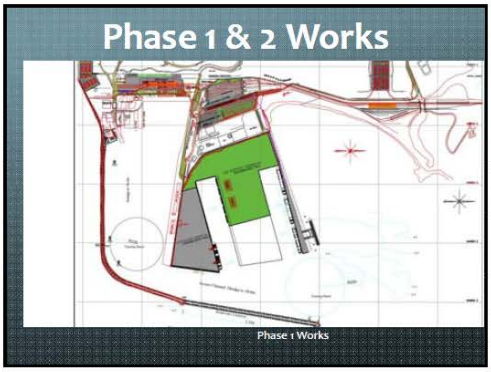
Upcoming Projects
Contract with CHEC for the development of 11 coastal fishing ports and fish landing sites with related on-land facilities in the Western, Central and Greater Accra Regions.
US$200m
Contract with CHEC for redevelopment of Tadi Port:
US$150m
Another Agreement was signed on 20th September, 2012 between GPHA/Jan De Nul/KBC Bank for the expansion works at Takoradi Port. Works include extension of breakwater, dredging, reclamation, construction of bulk ore handling.
€197m
Both Works are expected to complete in 36months.

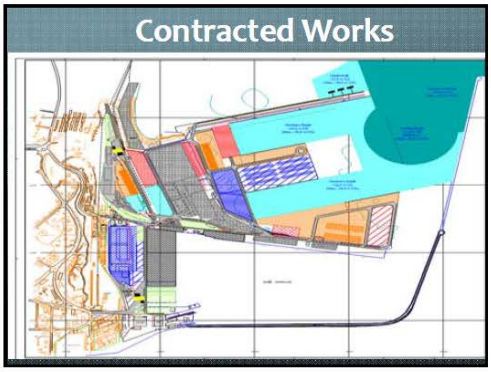
1

05-Dec-12

Essential Utilities: Access Roads

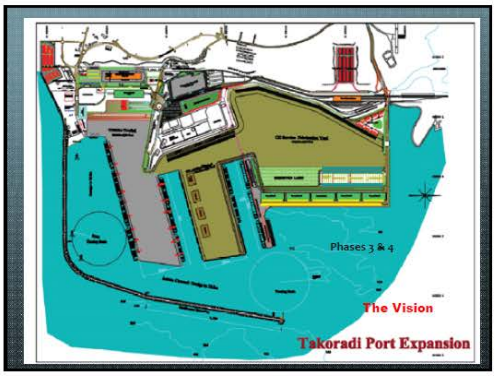
Reconstruct Access Roads

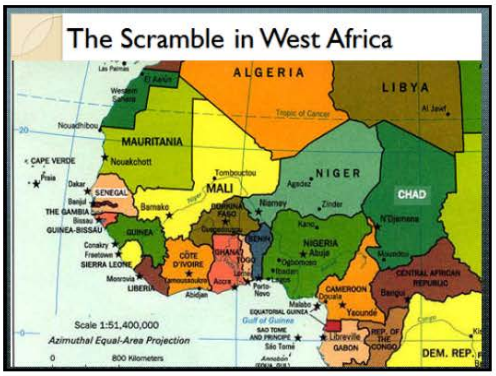

Phase 1 & 2 Works
Phase 1 Works


Contracted Works

2

05-Dec-12


Phases 3 & 4
The Vision
Takoradi Port Expansion


The Scramble in West Africa
ALGERIA
LIBYA
MAURITANIA
NIGER
MALI
CHAD
NIGERIA
Scale 1:51,400,000
Azimuthal Equal-Area Projection

Rig Repairs : Over 35 Rigs Now in West Coast
Drilling Contractors must undertake long trips to Canary Islands or South Africa to repair their Rigs.
Ghana is perfectly located in West Africa to cut such travel time.

Businesses in need of space for fabrication and repairs for the Oil and gas industry.
Shipping Lines in need of deeper water and faster loading.
Container vessels in need of deeper water and faster handling rates

3

05-Dec-12

Facilities for Rig Repair is not a Luxury!
Transocean Marianas entering Tema Port, Dawn of 18th August 2011:
Half of Port cleared to bring her in.

Marianas about to berth for 25 days in Tema Port
She displaces almost 3 vessels for her stay
in the Port. The Port stood still.

Implementation Plan: Existing Ports
Phased Works: Takortadi Port
Mineral Jetty
Extended Breakwater
Dredging Works, & Reclamation
Access Roads, Rail access, & Sekondi Terminals, Power distribution, etc.
CDB + Belgium + Others = US $550m+
Phased Works: Tema Port
New Breakwaters & Dredging
Quay Wall & Reclamation works
Pavement & Access Roads, Rail Terminal
External Funding: US750m+
Project Funding & GoG.

4

ANNEX 5 PRESENTATION ON DRAFT ESIA

05-Dec-12

Republic of Ghana
Ministry of Transport

Ghana Ports and Harbours Authority (GPHA)

PUBLIC CONSULTATION MEETING

Environmental and Social Impact Assessment (ESIA) Study
Port Infrastructure Development, including Dredging, at Takoradi Port

SAL Consult Limited/ Royal Haskoning DHV
P O Box GP 20200
Accra, Ghana
October, 2012

THE PRESENTATION OUTLINE

- The Takoradi Port project
- EIA procedure in Ghana
- Highlight of project activities
- Stakeholders identified and contacted
- Concerns of stakeholders
- Findings and observations from baseline and desktop studies
- Environmental and Social Impact identification including Potential hazards and risks
- Mitigation measures proposed
- Conclusion

2

THE TAKORADI PORT PROJECT

3

THE TAKORADI PORT PROJECT

- Provision of a dedicated bulk ore and oil services terminals;
- Construction of breakwater;
- Dredging and reclamation;
- Construction of quay walls, and where appropriate, strengthening of the existing quay walls in the port;
- Cargo handling and berthing furniture at all the respective berths;
- Bulk ore storage areas;
- Relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the port;
- Upgrading of port access roads, entry and exits; and
- Coastal reclamations and the possible resettlement of, where affected, local fishing community and/ their practices and businesses.

4

THE TAKORADI PORT PROJECT

5

THE TAKORADI PORT PROJECT

6

1

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ESIA PROCEDURE IN GHANA

- Registration of the project with EPA
- Screening by EPA and Response to Application
- Publication of Scoping Notice & Reporting
- Review and Comment by EPA
- Preparation of Draft ESIA Report
- Publication/ Disclosure of EIS by EPA
- Review and Comment by EPA
- Preparation of Final ESIA Report
- Acquisition of Environmental Permit

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PURPOSE OF THE ESIA

- The ESIA is to address possible direct and indirect significant environmental and social impacts of the project during the construction and operation phase of the project.
- Provide Mitigation Measures for adverse impacts and enhancement of the positive impacts.
- It is also to provide guidance to GPHA, the Construction Contractors/ Consultants, Operators on the measures and actions to be taken during implementation of the project.

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HIGHLIGHTS OF THE PROPOSED PROJECT ACTIVITIES

- Demolition of Old Structures
- Construction of Infrastructure including Extension of the Breakwater
- Dredging of the Port Basin
- Relocation and Reorganisation of Port Structures and Operations
- Reclamation of Log Pond and Northern side of the Port towards New Takoradi

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SCENES FROM THE PORT

10

STAKEHOLDERS IDENTIFIED- INSTITUTIONS

- EPA, Head Office & Regional Office - Accra & Sekondi
- Ghana Maritime Authority (GMA)- Head Office & Takoradi
- GPHA, Head Office & Port of Takoradi - Accra and Takoradi
- Ghana Railway Development Authority (GRDA)/ Ghana Railway Company (GRC)- Accra
- Sekondi-Takoradi Metropolitan Assembly (STMA)
- Department of Fisheries, Fisheries Commission- Sekondi Takoradi

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STAKEHOLDERS IDENTIFIED - OPERATORS/ TENANTS

- Unicontrol Comodity Ghana Ltd, Port of Takoradi;
- Ghana National Manganese Corporation
- Ghana Bauxite Company
- Ghana Cement (Ghacem)
- Takoradi Flour Mills
- Shell
- Stevedoring Companies
- Transporters

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STAKEHOLDERS IDENTIFIED- COMMUNITY

- Opinion Leaders
- Fisher Folk of New Takoradi

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PURPOSE OF STAKEHOLDER CONSULTATION

- provide information about the project and its potential impacts to those interested in or to be affected by the project, and solicit their opinion
- provide opportunities to stakeholders to discuss their opinions and concerns
- manage expectations and any misconceptions regarding the project
- verify the significance of environmental and social impacts identified
- inform the process of developing appropriate mitigation, monitoring and emergency preparedness measures

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SOME STAKEHOLDER CONCERNS- EPA

- Dredge Material Disposal
- Emissions air and water should be considered
- Waste oils disposal
- Extensive baseline required
- Traffic management & public safety
- Security
- Decommission plan to be provided

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SOME STAKEHOLDER CONCERNS- STMA

- Implication for climate change
- Study of the entire coastline eg Shama to Jomoro
- Impacts on existing railway line
- PAPs to be properly informed and trained
- Involve/ consult the youth
- Collaboration to develop/ improve landfill site

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SOME STAKEHOLDER CONCERNS- COMMUNITY/ FISHERIES DEPARTMENT

COMMUNITY

- Look forward to project implementation
- Further consultation/ meeting with Fisher folk/ opinion leaders required
- Prefer not to relocate outside New Takoradi

FISHERIES DEPARTMENT

- Strategically positioned workshop- natural slipway

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SOME STAKEHOLDER CONCERNS- GPHA/ TENANTS

Tenants eg Unicontrol Commodity

- Project to create adequate space for various operations
- Facilities should be properly planned

GPHA

- Addressing concerns of fisher folk
- Harnessing individual OHS Policies into one composite policy/ Emergency Preparedness Plan
- Position of GRDA on old railway station

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BASELINE STUDIES

- climate
- Water Quality Assessment
- Ambient Air Quality
- Ambient Noise Levels
- Oceanographic Studies
- Socio-economic

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FINDINGS AND OBSERVATIONS

Demolition of Old Structures

- Solid waste
- Hazardous materials
- Air quality
- Noise
- Biodiversity

Construction of Infrastructure including Extension of the Breakwater

- Dredged materials
- Air quality & Noise
- Conflict- port operations
- Biodiversity
- Importation of quarry material
- Traffic safety

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FINDINGS AND OBSERVATIONS

Dredging of the Port Basin

- Dredged material management
- Hazardous materials
- Air Quality
- Noise
- Biodiversity

Relocation and Reorganisation of Port Structures and Operations

- Disruption in operations eg GNMC, maintenace workshop
- Conflicts-

22

FINDINGS AND OBSERVATIONS

Reclamation of Log Pond and Northern side of the Port towards New Takoradi

- Land take
- Relocation of berthing area for vessels and fisheries department workshop
- Conflicts- fisher folk

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CATEGORIES OF IMPACTS

- A 'minor impact' - an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards.
- A 'moderate impact' - an effect will be within accepted limits and standards.
- A 'major impact' - an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/ sensitive resource/ receptor.

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POSITIVE IMPACTS

- Employment generation
- Improvement in Port infrastructure & performance
- Improvement in port environment\
- Improvement in local and national economy
- Improvement in coastline- reclamation of coastline towards New Takoradi

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MAJOR CONSTRUCTIONAL PHASE POTENTIAL ADVERSE IMPACTS

Dredging/ Other Construction Activities

- Air pollution
- Noise nuisance
- Marine water pollution & impact on aquatic life
- Changes in landscape
- OHS Risks
- Waste generation & sanitation challenges
- Traffic and public safety challenges
- Disturbance of Port operations
- Security risk

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MAJOR CONSTRUCTIONAL PHASE POTENTIAL IMPACTS

Construction of Breakwater

- Air pollution
- Noise nuisance
- Marine water pollution & impact on aquatic life
- Changes in landscape
- OHS Risks
- Sanitation challenges
- Traffic and public safety challenges- haul of quarry materials

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MAJOR OPERATIONAL PHASE POTENTIAL IMPACTS

- Water pollution
- Air pollution
- Noise Nuisance
- Waste generation and disposal
- Occupational health and safety & Emergency situations
- Erosion/ Accretion due to Extension of Breakwater
- General Security

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MITIGATION MEASURES- CONSTRUCTION PHASE

Potential Impact

- Land Take

Receptor

- Local Community

Proposed Mitigation Measure

- Properly compensated
- Alternative landing/ berthing site required

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MITIGATION MEASURES- CONSTRUCTION PHASE

Potential Impact

- OHS hazards
- Public and traffic safety

Receptor

- Workers, Local Community, public

Proposed Mitigation Measure

- Adoption of health and safety policy/ education
- Use of experienced personel
- Provision of PPE
- Use of road worthy vehicles
- Scheduling materials movement

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MITIGATION MEASURES- CONSTRUCTION PHASE

Potential Impact
- Dredge Material Disposal

Receptor
- Marine Environment

Proposed Mitigation Measure
- Drain back water to ocean
- Spoil to be used as reclamation material
- Mud/ sediment to be disposed at STMA landfill after confirming quality

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MITIGATION MEASURES- OPERATION PHASE

Potential Impact
- Erosion/ Accretion due to extension of breakwater

Receptor
- Marine/ shoreline

Proposed Mitigation Measure
- Need to provide coastal protection structures at New Takoradi including landing site
- Accretion to occur along breakwater

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MITIGATION MEASURES- OPERATION PHASE

Potential Impact
- Emergencies

Receptor
- Worker/ port community

Proposed Mitigation Measure
- Takoradi Port to develop emergency response plan
- Ensure potential for emergency occurrences are eliminated

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MONITORING PLANS

- Shoreline
- Ambient air and noise levels
- Water quality
- Sediment quality
- Waste generation and disposal
- Use of PPE
- Accidents, worker injury and health
- Traffic and public safety
- Public and community complaints

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CONCLUSION

- Potential Environmental and Social Impacts Identified
- Mitigation Measures to cater for the Social Impacts Provided
- Environmental Management and Monitoring Plan Provided
- Contractors to Provide their Environmental Management Plans

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Thank You

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ANNEX 6 QUESTIONS AND ANSWERS

Contributor			Question/Comment	Response
No.	Name	Community/Organisation		
Comments on Scope of Proposed Project Presentation				
1.	James Attoh	Ghana Manganese Company	• Propose that a deeper manganese berth is created as part of the project, as the proposed 11m depth is not enough considering the future plans of Ghana Manganese to bring in larger vessels; and • The transportation activities of Ghana Manganese are about 60% by railway and 40% by road.	The current design for the proposed project is based on the funds available.
2.	Chris Koomson	University of Cape Coast	• Does the whole project centre on Phase 1 and 2; and • Would it not have been more prudent to build a separate oil service?	There are plans underway to build a new port around Pumpuni in the Western Region. In any case there is a difference between oil service terminal and base terminal the two cannot be put together. Feasibility studies by Royal Haskoning, Nederland are currently ongoing to identify an area for the third port. The Takoradi Port is the first port in Ghana and also serves as a source of livelihood for the people of Takoradi.
3.	Joseph Sankah	Ghana Railway Company Limited (GRCL)	• GRCL is located in Takoradi and not Accra; • The Company is yet to be consulted by the environmental consultants; • There are plans underway for the construction of standard gauge there is therefore the need to make provision for direct access to the quay for a rail way line to cater for future large cargoes	• Location of GRCL noted and forum is part of the stakeholder consultation process which is still ongoing; and • Provisions have been made for the GRCL in the proposed project design but this will be effected when GRCL has acquired a standard gauge.

Contributor			Question/Comment	Response
No.	Name	Community/Organisation		
4.	Joe Yankey	GRCL	What are the various time schedules for the different phases of the project?	The proposed project is about to begin but first there is the need to obtain an environmental permit from the Environmental Protection Agency (EPA). Currently feasibility studies are ongoing.
5.	Samuel K. Armah	Hull Blyth	• Suggest that the proposed draft depth of 12.5m is adjusted to 13.5m to cater for bigger vessels; • Currently, there is a problem with IOA, what is going to be done about this? • Information on conveyor belt. What provision has been put in place for the conveyance of quicklime?	• Currently, with the funds available for the proposed project, GPHA can only develop the main infrastructure and encourage private partnership for future developments in the port; • With the proposed project design, vessels that will draw up to about 14m depth should be able to draw easily, it is envisaged that the access channel will go up to 16m depth. GPHA do not want to undermine the port structure especially the quay walls; and • Conveyance of cargoes will be made easier with the construction of the barge; and • Bauxite will not be relocated, only manganese will be moved, this will bring their dumpsite closer to the railway line and easy transportation into vessels.
6.	Felix Ntibrey	National Disaster Management Office	What provisions have been put in place for the New Takoradi township as they would not like to be relocated?	The proposed project will not affect the Takoradi township therefore there will not be the need for relocation; rather the canoe landing site might be affected. There are plans underway to fix a new area for the Takoradi fisher folks.
7.	Henry Tumbabia	Global Haulage Company Limited (GHCL)	The Company has constructed a structure for the storage of cocoa pod, what is their fate as tenant within the port with the proposed Port expansion project	• GHCL will not be affected by the proposed project; • Operations at the Port will not be affected; the extension of the breakwater might delay cargo delivery.
8.	Henry Ocansey	Chamber of Commerce & Law	How will businessmen be affected by the proposed project?	-

Contributor			Question/Comment	Response
No.	Name	Community/Organisation		
9.	Richard Sackey	Ghana Dock Company Limited	Will there be towing services at the port considering current traffic issues?	• Currently GPHA, Takoradi has engaged the services of a tow truck, eventually, they will have their own towing truck through Public Private Partnership investment; • Traffic will be managed properly at the construction stage and an EMP to be developed will be followed during the operational phase of the project.
10.	Jacob Nutor	Macro	• How will the operations of the supply vessels be affected; and • How many vessels can berth at a time with the proposed project considering current competition?	• The operations of the supply vessels will be improved as part of the proposed project; • About four (4) vessels will be able to berth; this will include one (1) for oil services and three (3) for bulk supplies (manganese, bauxite etc.).
11.	Ben Amofa	Ghana Railway Company Limited	Request for clarification on the number of projects	-
12.	Justice Kwamena Addison	Ghana Shippers Committee (GSC)	• The Committee has been looking forward to the commencement of the proposed project; • The Committee also has a complaint centre and hope GPHA, Takoradi will compliment this office	Forum is part of consultation process and Stakeholder consultation is still ongoing. GPHA will also have a complaint desk
13.	Thomas Addoquaye	Unicontrol Commodity	Was the provision of additional space factored into the proposed project?	-
14.	Ophillons Cambog	Forestry Commission TiDA	Bulk transportation of timber was not mentioned in the presentation, will the proposed project affect timber shed?	Provisions have been made for the timber shed and the concerns taken into consideration

15.	Norbert Kevi	Maersk Line	• Lonrho Services will build an oil service port and have signed a contract with GoG to this effect; and • Will Lonrho compete with the Naval basin as most supply vessels prefer the naval basin?	• The Naval basin zone is not for the public as it is a security zone. All private vessels are to dock at the main Takoradi Port for their own security; and • GPHA is the only authority designated to manage and operate port in Ghana.
Comments on ESIA study Presentation				
17.	Colonel Korsah	Security Cordinator	Is the existing landfill site, adequate for the disposal of waste, what alternative sites have been considered (areas)	• Most of the dredged materials from construction will be reused in the port; and • For solid waste disposal, there is a well engineered landfill site at Sofokrom to cater for this. It has also been confirmed that the landfill can receive hazardous waste.
18.	Paul Ansah	Takoradi Renewable Energy Limited	• It appears most of the potential impacts identified in the ESIA studies centres around the Takoradi area. What plans have been put in place in terms of traffic management? and • The picture presented might not reflect the situation on the ground as Ghanaians are known for 'lots of talk'.	• Potential impacts on the Metropolis were also considered and this has been captured in the EIS. Issues of traffic will be looked at. Appropriate time schedules will be designated for transportation .e.g. waste material; and • The project will certainly be a reality as feasibility studies are currently ongoing.
19.	Kofi Abban	Stellar Logistics	• Currently, the medical facilities are overused, what provisions have been put in place to cater for the health and safety of the workers	The use of Personal Protective Equipments (PPEs) will be emphasised. A monitoring plan will also be developed.

Annex 6: Climatic Data

Takoradi Monthly Mean Rainfall (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	0.0	5.9	33.8	82.2	73.7	245.8	26.1	6.6	9.6	105	81.5	62
1991	13.3	44	44.3	195.4	317.8	161	158.8	98.8	7.8	128.4	29.2	0.0
1992	0.0	0.0	4.7	114.5	231	240.9	73.8	2.9	44.2	192.1	60.5	46.3
1993	0.5	70.3	46.6	169.1	145.6	353.3	9.1	37.5	102.4	94.4	157.8	1.5
1994	39.2	39.7	47.5	56.5	190.7	258.8	56.1	34	136.4	223.7	77.2	0.0
1995	13.1	26.2	111.9	158.2	108.5	351	170.2	83.1	108.4	26.5	33.4	2.2
1996	14.1	15.7	49.6	96.4	435	506.5	131.8	139.1	20.9	18.5	67.6	9.7
1997	10.3	0	157.1	76.7	208.8	319.8	444	3.6	11.4	185.3	68.7	37.4
1998	12.5	7.6	27.7	134.6	101.5	107.7	345	10	5.5	324.4	23.4	41.8
1999	55.4	255	58.2	218.1	112.4	192	195.1	103.1	15.4	58.7	89.4	20.5
2000	27.2	0.0	68	145.1	195.1	296.3	24.7	34.1	33.3	42.1	30.2	152.2
2001	0.0	40	21.6	174.9	271.9	206.4	190	19.9	11.9	106.5	50.4	3
2002	13.7	35.8	17.3	181.9	181.5	307.6	247.6	67.4	5.2	88.8	67.2	6.8
2003	37.3	40	76.1	192.2	182.2	79.2	6.5	18.6	11.3	234.8	30.1	9.6
2004	59.3	77.2	96.2	14	189.4	132.3	98.9	15.2	135.8	251.2	24.5	13.2
2005	2.3	55.4	136.7	50.4	269.7	103	3.3	4.8	37	190.9	41.3	26.2
2006	4.3	6.8	11.2	22.6	360.4	228	132.2	30.9	23.9	85.4	22.8	4.6
2007	0.2	7.9	83.2	102.9	125	197.2	255	60.7	161.9	210.6	33.1	11.9
2008	28.7	1.5	41.9	104	220	352	107.7	103.8	54.8	58.6	102.9	52.3
2009	12.6	5.5	23.0	104.7	201.4	408.3	175.1	29.7	10.3	78.6	19.4	42.4
2010	27.6		44.1	169.7	296.8	320.1	44.1					
2011	13.9	16.2	7.4	97.1	102.5	310.4	130.8	63.8	48.3	126.0	45.8	12.0
2012	6.0	61.3	10.7	23.5	295.6	395.4	55.3	20.5	12.0	127.0	122.9	55.2
2013		6.3	18.6	24.7	147.5	303.3	50.1	4.5	94.3	64.5	52.8	28.1
2014	86.2	19.9	69.8	131.4	156.7	283.6		10.0	130.7		105.4	29.3
Mean	**19.9**	**34.9**	**52.3**	**113.6**	**204.8**	**266.4**	**130.5**	**41.8**	**51.4**	**131.4**	**59.9**	**27.8**
Max.	**86.2**	**255.0**	**157.1**	**218.1**	**435.0**	**506.5**	**444.0**	**139.1**	**161.9**	**324.4**	**157.8**	**152.2**
Min.	**0**	**0**	**4.7**	**14**	**73.7**	**79.2**	**3.3**	**2.9**	**5.2**	**18.5**	**19.4**	**0**

Mean Daytime Temperature

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	31.3	31.8	32.5	31.8	31.3	29.8	27.6	27.4	28.6	30	31.1	31.0
1991	31.6	31.6	31.9	30.8	30.8	30.1	28.5	27.2	28.5	28.6	30.1	30.7
1992	31.4	32.4	31.7	31.8	30.7	28.7	27.2	27.4	27.8	29.3	30.3	31
1993	31.1	31.3	31.2	31.7	31.1	29.1	27.7	27.4	28.9	30.5	31.4	31.4
1994	31.1	31.9	32.2	32.2	31	29.3	27.7	27.9	27.9	29.4	31.3	31.8
1995	31.7	32.3	31.7	32.5	31.8	30	28.7	28.1	28.6	29.9	31.2	31.7
1996	31.3	32	32	32.1	31	29	28.3	27.2	27.4	29.2	30.8	30.3
1997	30.7	31.9	30.9	30.6	30.6	28.6	27.8	27.6	28.6	30.1	30.8	31.2
1998	31.6	32.7	33	32.7	31.5	30.1	28.6	28	28.6	29.8	31.8	31.6
1999	31.1	31.7	31.8	31.4	31.1	30.2	28.5	27.7	27.9	28.9	30.7	31.5
2000	30.5	31.7	31.7	31.1	31.1	29	27.9	27.3	27.9	29.7	31.2	30.7
2001	30.5	31.7	31.7	31.5	31.5	29.2	27.8	27	27.6	29.9	31	31.2
2002	31.4	32.1	31.7	31.6	31.6	29.2	27.6	27.4	28.2	29.7	31.1	31.7
2003	31.2	31.9	32.4	31.5	31.5	29.4	29	27.9	28.7	30	31.5	31.7
2004	31.2	31.8	32.3	31.4	31.4	28.5	27.7	27.2	28.5	29.8	31	31.2
2005	31.4	31.8	31.9	32.1	32.1	28.8	27.8	27.3	28.6	30.1	31.3	31.7
2006	31.2	31.9	32	32.7	32.7	29.9	28.5	27.8	28.6	29.8	31.1	31.6
2007	31.6	31.8	31.8	31.7	31.7	29.3	28.8	28.2	28.3	28.7	30.9	31.5
2008	31.3	32.1	32.1	31.8	31.8	30.1	29.9	28.6	29	30.5	31.2	31.8
2009	31.5	32.0	32.3	31.7	31.3	29.7	28.5	27.7	28.6	29.5	31.3	31.8
2010	32.2		32.8	32.5	31.4	29.7	28.8					
2011	31.7	31.8	32.5	32.2	31.2	29.8	28.3	27.4	28.5	29.9	31.3	31.5
2012	31.4	31.0	31.9	31.8	30.6	29.2		27.1				31.5
2013		32.0	32.8	32.0	31.4	29.2	27.7	27.3	28.2	29.8	31.0	31.1
2014	31.5	31.5										
Mean	**31.3**	**31.9**	**32.0**	**31.8**	**31.3**	**29.4**	**28.2**	**27.6**	**28.3**	**29.7**	**31.1**	**31.4**
Max.	**32.2**	**32.7**	**33**	**32.7**	**32.7**	**30.2**	**29.9**	**28.6**	**29**	**30.5**	**31.8**	**31.8**
Min.	**30.5**	**31**	**30.9**	**30.6**	**30.6**	**28.5**	**27.2**	**27**	**27.4**	**28.6**	**30.1**	**30.3**

Mean Night time Temperature

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	23.2	22.8	24.9	24.2	24	24.0	22.2	22.0	22.9	23.2	23.5	22.8
1991	23.3	24.0	24.3	23.6	23.8	23.9	22.5	22.0	23.1	22.1	22.9	23.1
1992	21.5	23.9	24.6	24.7	22.9	23.2	21.4	21.5	22.4	22.3	22.9	23.0
1993	21.7	24.0	23.6	23.9	24.5	23.5	22.0	21.6	22.6	23.0	23.1	23.7
1994	22.6	24.2	23.7	24.0	23.6	23.3	22.0	22.4	22.2	22.5	22.9	22.6
1995	22.1	24.0	23.5	24.2	24.1	23.5	22.8	22.7	22.4	22.6	23.2	23.2
1996	23.2	24.0	24.1	24.2	23.9	23.5	22.9	22.5	22.2	22.6	23.3	23.3
1997	23.3	23.7	24.1	23.7	23.8	23.7	22.9	22.8	23.0	23.7	23.7	23.8
1998	23.6	25.7	26	25.9	23.8	23.6	22.8	22.6	22.9	23.6	24.1	23.8
1999	23.8	23.2	24.1	24.3	24.5	23.6	23.0	21.9	22.5	22.7	23.3	23.8
2000	23.4	23.3	24.8	24.0	24.0	23.4	21.9	21.9	22.4	22.9	23.6	23.5
2001	23.2	23.9	24	23.9	24.3	23.4	22.9	22.1	22.4	23.5	23.9	24.1
2002	23.5	24.4	24.8	24.6	24.6	23.5	23.2	22.1	22.6	23.5	23.5	22.7
2003	23.7	24.5	24.7	24.3	24.4	23.5	22.5	22.3	23.5	24.0	23.9	23.8
2004	24.0	24.5	24.8	25.0	24.3	23.4	22.6	22.5	23.4	23.7	24.1	24.3
2005	22.3	25.1	24.9	25.5	24.4	24.3	22.7	22.0	23.4	23.7	24.2	23.9
2006	24.2	24.0	24.3	25.3	24.1	23.5	23.4	22.9	23.2	22.6	23.9	23.8
2007	22.4	24.7	24.9	24.7	24.6	23.9	23.1	22.6	23	22.9	23.4	23.7
2008	21.1	24.3	24.3	24.5	24.1	23.8	23.3	22.6	23.1	23.8	24.0	24.0
2009	22.5	24.3	24.5	24.5	24.3	23.5	23.3	22.9	22.8	23.5	23.9	24.2
2010	24.5			25.6	25.1	24.7	23.3					
2011	23.9	24.0	24.8	24.9	25.0	24.3	23.4	22.8	23.2	23.7	24.1	24.0
2012	23.3	24.0	25.1	24.9	24.1	23.6		22.0				24.3
2013		25.2	25.4	25.1	24.7	23.7	22.9	21.7	22.9	23.3	23.9	23.5
2014	24.1	23.9										
Mean	**23.1**	**24.2**	**24.5**	**24.6**	**24.2**	**23.7**	**22.8**	**22.3**	**22.8**	**23.2**	**23.6**	**23.6**
Max.	**24.5**	**25.7**	**26**	**25.9**	**25.1**	**24.7**	**23.4**	**22.9**	**23.5**	**24**	**24.2**	**24.3**
Min.	**21.1**	**22.8**	**23.5**	**23.6**	**22.9**	**23.2**	**21.4**	**21.5**	**22.2**	**22.1**	**22.9**	**22.6**

Takoradi Mean relative humidity

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	84.0	83.0	84.0	85.5	86.0	86.0	88.5	89.5	89.0	88.0	85.5	84.0
1991	82.0	86.5	85.5	86.5	89.0	87.5	89.0	92.0	89.5	89.0	87.5	85.5
1992	77.0	84.5	86.5	85.5	89.0	90.5	92.0	89.0	90.0	88.0	86.0	86.5
1993	80.5	86.0	84.0	84.5	87.5	89.0	89.0	90.5	90.0	87.0	85.0	84.5
1994	83.5	84.5	84.5	84.5	87.5	88.5	89.5	90	91.5	88.0	84.5	82.5
1995	82.5	84.5	84.5	84.5	86.0	87.0	87.5	90.5	88.5	87.0	85.0	84.5
1996	86.5	85.0	83.0	83.5	85.5	88.5	88.5	91.5	90.5	87.5	84.0	87.5
1997	87.0	82.0	87.0	86.0	87.5	88.5	89.0	88.5	88.0	87.0	86.5	86.5
1998	81.5	84.0	84.0	84.5	87.0	89.5	89.5	88.5	88.0	87.5	85.0	85.0
1999	86.5	82.5	84.5	85.5	85.5	88.0	89.5	88.5	89.5	87.5	85.0	83.5
2000	85.0	80.0	82.5	85.5	86.0	88.0	88.5	89.5	89.0	87.5	84.0	84.5
2001	86.5	82.5	84.0	84.0	86.0	88.5	89.0	90.0	89.0	85.0	85.0	86.0
2002	82.0	83.0	84.5	84.5	85.0	87.5	90.5	90.0	88.5	87.0	85.0	83.5
2003	85.0	86.0	85.0	86.0	86.0	88.5	86.0	88.5	88.0	87.0	84.0	83.5
2004	85.5	82.5	80.0	86.0	85.5	89.5	90.0	90.5	90.0	87.5	86.0	85.5
2005	80.0	85.5	84.5	85.5	88.0	88.0	89.0	88.5	88.5	86.0	84.5	85.0
2006	87.5	85.5	83.5	81.5	86.5	89.5	89.0	89.0	90.0	89.0	85.5	86.0
2007	76.0	85.0	84.5	86.0	85.5	89.0	88.5	89.5	92.0	88.0	86.0	84.5
2008	81.0	84.0	84.0	85.0	86.0	86.5	86.5	88.0	89.5	86.5	86.0	85.5
2009	82.0	86.0	86.0	85.0	87.0	90.0	88.0	91.0	89.0	88.0	86.0	86.0
2010	86.0		83.0	85.0	86.0	88.0	88.0	90.0	90.0	88.0	87.0	85.0
2011	81.0	84.0	84.0	84.0	87.0	88.0	90.0	92.0	91.0	87.0	85.0	83.0
2012	83.0	83.0	85	85	88	89.0		90.0				85.0
2013		84.0	84.0	85.0	86.0	89.0	88.0	89.0	90.0	88.0	85.0	85.0
2014	85.0	85.0										
Mean	83.2	84.1	84.3	84.9	86.6	88.4	88.8	89.8	89.5	87.4	85.3	84.9
Max.	87.5	86.5	87	86.5	89	90.5	92	92	92	89	87.5	87.5
Min.	76	80	80	81.5	85	86	86	88	88	85	84	82.5

Mean Wind Speed(Knots)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	2.5	3.2	3.5	3.2	3.1	2.9	3.1	3.7	4.5	2.9	4.3	2.3
2001	2.5	3.2	4.3	3.7	3	3.3	2.5	4.5	5.3	5.1	3.3	2.8
2002	2.3	4.7	4.6	4	3.9	3.7	3.4	4.5	5.3	5.1	3.3	2.8
2003	3.3	4.4	3.7	4.9	3.8	3.1	4.8	5.1	5.9	3.8	3.5	2.9
2004	2.3	3.6	4	3.7	4.3	3.9	3.3	4.7	5.1	4.8	3.5	3.8
2005	3.9	4.3	4.4	4.6	3.1	4.8	4.2	4.6	4.1	4.4	2.8	2.5
2006	3.2	4.7	4.4	4.6	3.3	3.5	3.9	4.5	4.4	4	2.5	2.5
2007	2	4.2	4.2	4.1	3.1	2.5	4	4	3.8	4.1	2.3	2.1
2008	1.8	3.3	3.7	3.4	3	3.3	3.6	4.1	3.8	4.1	2.9	2.8
2009	2.5	3.6	4.1	3.6	2.3	3.2	3.2	3.9	4.5	4.6	3.1	2.7
2010	3.1		3.5	3.4	3.0	3.8	3.7					
2011									4.0	4.0	3.0	2.0
2012	3.0	4.0	5.0	5.0	4.0	4.0		5.0				3.0
2013		4.0	5.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	4.0	3.0
2014	3.0	4.0										
Mean	**2.7**	**3.9**	**4.2**	**4.0**	**3.4**	**3.5**	**3.6**	**4.4**	**4.6**	**4.3**	**3.2**	**2.7**
Max.	**3.9**	**4.7**	**5**	**5**	**4.3**	**4.8**	**4.8**	**5.1**	**5.9**	**5.1**	**4.3**	**3.8**
Min.	**1.8**	**3.2**	**3.5**	**3.2**	**2.3**	**2.5**	**2.5**	**3.7**	**3.8**	**2.9**	**2.3**	**2**

Annex 7: Oceanographic Study Report

REPORT ON

OCEANOGRAPHIC STUDIES
FOR PROPOSED
TAKORADI PORT REDEVELOPMENT AND EXPANSION PROJECT

Prepared for:

SAL CONSULT LTD.

By

Dr. F. K. E. Nunoo
Dept. of Marine & Fisheries Sciences
University of Ghana, Legon.

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1.0 INTRODUCTION

This study forms part of an Environmental & Social Impact Assessment (ESIA) for the Takoradi Port Redevelopment and Expansion Project, which the Ghana Ports & Harbours Authority (GPHA) plans to implement. The ESIA is to meet the standards and requirements of Ghana's Environmental Protection Agency (EPA) and international best practice.

All planned project activities will be phased and include dredging, sea reclamation through pushing quay seawards, building quay for bulk terminal, extension of breakwater, demolishing of buildings and other structures, and road construction. Dredge spoils will be used for land reclamation.

This report covers the oceanography of the Takoradi port. Emphasis is laid on tidal variations and other coastal hydrological characteristics, marine fauna and flora with attention to species of ecological concern and a discussion of ecological and social consequences of alteration of the existing project site.

1.1 OBJECTIVES

These oceanographic study aims to provide baseline information on the local dynamics of the ocean, flora and fauna in the project area. 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.

2.0 Methodology

2.1 Study design

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 New Takoradi community and other workers in the port area including the regional Fisheries Officer, Mr. Alex Sarbah (from 25th – 27th September 2012) was followed by data analysis and subsequent report writing.

2.2 Field Observations

2.2.1 Study sites

The Takoradi harbour has a high vessel traffic. Records from the Harbour Master's office indicate that for the month of September 2012, the average daily vessel traffic was 13; with a

range of 10 to 16 vessels daily. The most visited berth was the Dredging wharf, followed by Wharf numbers 6 and 3.

Data collection was made at the following stations in and around the Takoradi port:

- Marine section
- Wharf
- Manganese dumping area
- Bauxite area
- Oil berth
- Fisheries workshop ('Fisheries Mpoano')
- New Takoradi fish landing beach

2.2.1.1 Flora and fauna survey

To help assess the overall biological integrity of the marine ecosystem in the project area, a qualitative approach was adopted for all data collection. Observations including aquatic flora and fauna identification and abundance estimation as per standard methods at all stations were carried out. All species were identified using standard identification guides supported by experience of experts.

Because thorough sampling could not be done due to security sensitivity of project, some residents/patrons of the port were interviewed to provide information on vertebrates and other flora/fauna encountered in the area. The interviews were conducted on a one-on-one basis so as to obtain independent views of the interviewees on potential importance of existing biodiversity. Other relevant observations were noted and results analysed to help with predictions and mitigation of significant impacts.

For plants, aquatic macrophytes including flora and overhanging flowering plants were assessed. The fauna groups assessed were zooplankton, benthos, nekton including fishes and crustaceans, awfwuchs, and aquatic birds. Some fishermen were identified to fish at the stations where possible and all catch was examined. Representative fishers and residents found in the area were interviewed using picture fish identification guide (Schneider, 1990) to provide information on dynamics of fish biodiversity and exploitation.

3.0 RESULTS AND DISCUSSION

3.1 Oceanographic conditions

Currents

The hydrography of the study area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans. The major currents influencing the area include (i) the Canary current from the north which splits into the North Equatorial Current and a coastal current which feeds the Guinea Current, and (ii) the Benguela Current which flows northwards and extends into the Gulf of Guinea as the South Equatorial Current.

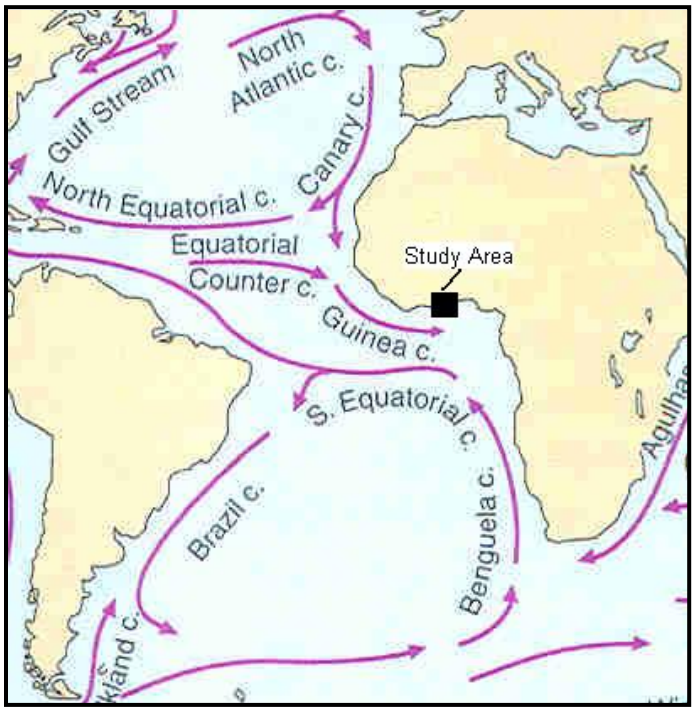

Figure 1 Major current systems influencing the Gulf of Guinea

The Guinea Current which is the main current in the study area flows eastwards throughout the year over its whole length and obtains velocities close to 100 cm s-1. 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. In the Takoradi port itself, due to breakwater, current velocities have been significantly reduced to aid in vessel movements.

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 ms^{-1}, but are responsible for transporting large volumes of littoral sediments and also for rip currents which are more localized in their action, but move appreciable amount of sediments away from the coast.

Waves

The coast is open to south-westerly and south-south-easterly long swells induced by fetches in the South Atlantic Ocean. The coast within the AOI is subject to low wave intensity, dominated by swells with periods of 11-16 seconds. The most common amplitude of waves in the region is 1.0 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 (Figure 3). Results of statistical analyses as regards wave height exceedance and extreme value analysis are summarized in Tables 1 and 2 respectively.

Table 1 Offshore Wave Height Exceedance Statistics

Heights (m)	Exceedance (%)
<1.0	82.8
<1.5	23.0
<2.0	3.0
<2.5	0.1
3.0	0.0

Table 2 Extreme Offshore Waves

Return Period (yrs)	Extreme Heights (m)
10	3.0
20	3.2
50	3.4

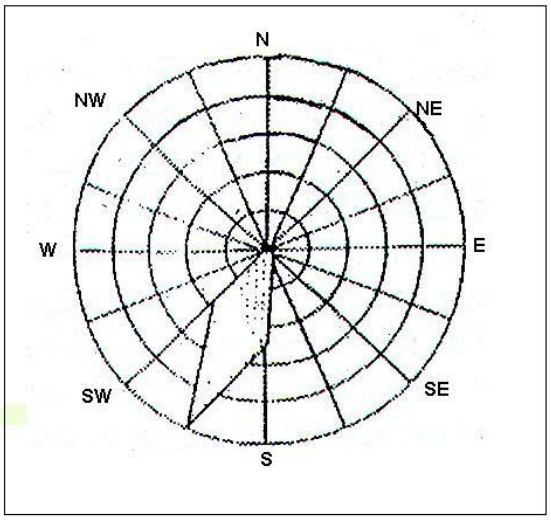

Figure 2. Wave rose indicating predominant swell wave direction

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 and 2 m. The swells generally travel from southwest to northeast.

Tidal variations

The Ghana Ports and Harbours Authority (GPHA) publishes annual tidal tables for Takoradi, Tema and other Ghanaian ports. The Takoradi port is the reference port for these tables and is located Lat 4^0 53' N and Long 1^0 45' W. Normally, there are two high tides and two low tides daily which are an average of six hours apart. Usually the lowest low tide levels in the year occur in February and March. According to the Tide Table 2012 released by GPHA, the low tides this year ranges from 0.10 to 0.91 m while the high tides range from 1.15 to 1.91 m.

3.2 Fauna and flora survey

There are areas of rocky shore fauna as well as small distances of sandy shore around the port area. Detailed below are fauna and flora found on such shores in the Takoradi port and the Western region.

Macrobenthic fauna

The fauna at the harbor is dominated by rocky intertidal macro-benthic fauna (Table 1). The community was visibly dominated by the barnacle, *Chthamalus dentate,* the upper shore littorinid, *Echinolittorina pulchella* and the oyster *Ostrea tulipa.* They are abundant on the sides of the wharf, rocks, breakers, and tyres alongside the wharf. Other taxa represented are gastropods, crustaceans, echinoderms and the cnidaria.

The macroalgae was dominated by the brown alga, *Bachelotia antillarum*. Other phaeophytes recorded are the *Chnoospora minima* and *Ralfsia expansa* as well as a chlorophyte, *Chaetomorpha linum*. They are dominant on the rocks and other substratum available for attachment.

Table 1 Inventory of rocky shore fauna and macroalgae at the port

Mollusc	Crustacean	Macroalgae
Gastropod	*Chthamalus dentata*	***Chlorophyta (Greens)***
Echinolittorina pulchella		*Chaetomorpha linum*
	Cnidarian	
Thais heamastoma	*Anthopleura* sp.	***Phaeophyta (Browns)***
Nerita atrata		Chnoospora minima
	Echinoderm	
Siphonaria pectinata	*Echinometra lucunter*	*Bachelotia antillarum*
		Ralfsia expansa
Bivalvia		
Ostrea tulipa		

Many of these epibenthic fauna are indicators of ecological healthiness and also constitute an important food resource to marine organisms (e.g., fishes) and also humans. The higher the species diversity of these epibenthic organisms is an indication of lack of ecological disturbance (natural and anthropogenic), albeit most ecologist correlate moderate disturbance with higher species diversity.

Table 2 Inventory of rocky shore fauna and macroalgae found at rocky beaches in the Western region

Mollusc	Crustacean	Macroalgae
Gastropod	*Grapsus grapsus*	***Chlorophyta (Greens)***
Echinolittorina pulchella	*Cthamalus dentata*	*Bryopsis pennata*
Echinolittorina cingulifera	*Panopeus* sp.	*Chaetomorpha linum*
Echinollitorina granosa	*Pagurus* sp.	*Chaetomorpha antennina*
Thais nodosa		*Ulva fasciata*
Thais heamastoma	**Echinoderm**	
Cyprae sp.	*Cidaroidea* sp.	***Phaeophyta (Browns)***
Nerita atrata	*Echinometra lucunter*	*Basispora africana*
Patella safiana		*Chnoospora minima*
Siphonaria pectinata	**Cnidarian**	*Ralfsia expansa*
Nudibranchs sp.	*Sea anemone*	
Clanculus sp.	*Zoanthus* sp.	***Rhodophyta (Reds)***
Arca senilis	*Palythoa* sp.	Lithothamnia
Murex sp.	*Anthopleura* spp.	*Botrisia radicans*
Fissurella nubecula		

Bivalvia *Ostea tulipa* *Brachydontes sp.* *Perna perna*		

Commonly encountered fauna on sandy beaches in Ghana are mysids and polychaetes (deGraft-Johnson *et al*., 2010), and the bivalve *Donax pulcherimus*. The littoral benthic organisms include polychaetes, arthropods, bryozoans, and echinoderms. Edmunds (1978) recorded 68 taxonomic families. Some species such as the gastropods *Cymbium* spp. and the spiny lobster *Panulirus* sp. appear to be declining in abundance while the sea star *Astropecten* sp. and other starfishes have completely disappeared (deGraft-Johnson *et al*., 2010).

The inshore and offshore phytoplankton communities of Ghana include diatoms, dinoflagellates, and coccolithophores. The principal species of diatoms in Ghana during the upwelling belong to the genera *Skeletonema, Nitzschia, Chaetoceros, Rhizosolenia,* and *Thalassiosira* (Wiafe, 2002). Other planktonic groups such as chaetognaths are abundant from September to November yearly, thaliaceans, mainly *Thalia democratica*, in December and July, and appendicularians in June and October (Thiriot, 1977). The explosive development of these plankton groups influences the fishery of the nearshore and adjoining coastal water bodies. It has been reported (Mensah, 1966) that maximum occurrence of the zooplankton copepod *Calanoides carinatus* during the upwelling season in Ghana is related to the seasonal abundance of *Sardinella* species in the coastal waters.

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 western Ghana, a phenomenon of major concern to fishermen and other users of the coast. The *Sargassum vulgare* bloom followed soon after the green algae bloom. The sources of these blooms are currently under study by research scientists but nutritional enrichment from many sources has been fingered for blame.

There were reasonably large number of seashore and coastal birds at the port. They were dominated by terns, curlews and plovers. A small number of pied kingfisher were seen within the marine section of the port. These birds feed on the large numbers of worms and other macro-benthic invertebrates exposed at low tides.

Fish and fisheries

The waters of the port was teeming with large numbers of fish. Fishes of various sizes, both small and large were found in the port waters. Because fishing was officially prohibited in the port, fish had a free hand to feed and grow in the rich waters. A few workers interviewed indicated under anonymity that they fished occasionally with hook and lines catching huge sized

quality fishes. The port was serving as a de facto marine protected area for fishes thereby helping to restock the open seas with fish. Serving as a nursery area, fishes migrate here for feeding and spawning. A wide range of marine and estuarine species are found in the port.

Adjacent to the port and project vicinity is the Fisheries boatyard locally called 'Fisheries Mpoano'. The boatyard and workshop is under the management of the Fisheries Directorate of the Fisheries Commission. Both inshore vessels and canoes dock here for maintenance. It serves the entire Western region and to some extent the Central region of Ghana. The busiest time of the year for the workshop is in the peak fishing season of June to September. During the peak period between 50 to 100 inshore boats and 10 to 20 canoes could be docked at this location in a typical day. Distressed vessels are towed to this landing beach regularly for attention. Fisheries Technical Assistants stationed at the workshop also daily collect fish catch and effort data as well as sea surface temperature. This data form a critical component of national fish statistics in support of fisheries management.

Adjacent to the workshop is the former State Fisheries Company (SFC) yard which is sold out. Fishers use the yard for mending and construction of fishing gears. Near to the yard is a premix fuel dump serving fishers in the area. Right in front of the yard is a boulder/rocky beach with all the typical rocky shore macro-benthic fauna. On the visit, sea hare (*Applysia* sp.), sea urchin (*Echinometra lucunter*), bivalve *Perna perna*, and littorinid species dominated the fauna at the site.

At the Takoradi New town fish landing site, we interacted with the fishers about the upcoming project. Fishers were educated about the project as well as solicited their concerns about the project. The dominant fishing gears were Tenge gill net, lobster net, hook and line, encircling gears including purse seine. Fishing effort is very high at this landing site with over 600 canoes operating from here in the peak season. More than half of the number use outboard motor. A large number of the women processed fish such as smoking for the market. Fishers were already concerned about high sea water swells that threaten landing and launching of boats. The landing site was eroding at a very high rate. Fishers believe the extension of the quay might exacerbate the erosion rate, increase distance to get to their landing site or effectively reduce area for landing of fish. They expect the project to clearly create a space to allow fishing boats to come in to land their catch as well as provide some measures to protect the landing site from further eroding which might end up affecting their livelihoods.

The Regional Fisheries Officer for the Western Region, Mr. Sabah indicated that the workshop was the only natural slipway for servicing inshore boats, canoes and engines. He confirmed that the New Takoradi beach serves as a very important landing site for boats both in the Western and Central Regions. He added that the existing heavy wave action at the beach which fishers are coping with could be exacerbated with the implementation of project activities. Further, Mr.

Sabah opined that dredging of the area will adversely affect lower draught vessels such as inshore boats who might find it very difficult to dock. Most importantly, he recommends that a special space should be created in the landing beach to allow distressed vessels to safely land. He indicated his willingness to engage with port authorities and other stakeholders to find solutions to any envisaged problems that might arise from the project.

4.0 Potential significant impacts

The greatest threat to the survival of the fauna and flora may come from improper disposal of dredge spoils. Such dredge waste could be washed back into the seas if not properly contained and disposed off far away from project site. Entrainment of fine sand and silt in the water will adversely affect feeding and breathing of sessile organisms that dominate the fauna of the rocky and platform substratum of the port. Noise and other disturbance in the water would temporarily scare out fishes whose normal feeding and spawning forays would be hampered. However, there are no threatened species using the project site worthy of serious attention.

A major concern is the expected erosion resulting from changes in wave and current action due to extension of quay. Swells from wave action could hamper fishing activities as already alluded to by fishers. However, of utmost concern is erosion could happen to nearby shores like New Takoradi as well as in areas further from this site which might escape the eyes of project implementers. Monitoring and mitigative measures should be carefully planned to forestall such adverse impacts.

5.0 Mitigation

All disturbed habitats should be restored to its pre-construction status using a remedial plan that includes monitoring till all vegetation re-grows or rocky shore fauna are re-established.

Further, dredging should be done very quickly within a short space of time. Dredging should be done within small sized enclosed areas at a time protected with fine meshed films to shut out spread of fine sand/silt to large areas.

A dedicated route should be provided for fishers of New Takoradi to move in and out of the landing site. In addition, shore protection measures such as carefully placed groins and rivets should be erected to protect the nearby shores from expected increased erosion.

A very comprehensive environmental management plan (EMP) supported by a working environmental management system (EMS) will be established for the project within months of commencement of operation.

Finally, a very close liaison with all stakeholders and communities in the project area should be maintained throughout project life.

6.0 Conclusion

The project will have temporary short term minor negative impact on fisher livelihoods and biodiversity if measures are taken as outlined above to manage identified impacts. It will however have a long term positive economic and social impact on Ghanaians.

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Annex 8: Resettlement/ Compensation Framework

1.0 Project Background

The preparation of a complete Resettlement Action Plan (RAP) for the proposed Port of Takoradi Redevelopment, including Dredging is premature at the present time when the design of the coastline to be reclaimed is still ongoing. Project-Affected-Persons (PAPs) /structures identified at this stage include the Fisheries Department Workshop and the Boatyard referred to as Fisheries "Mpoano".. However, the number of boats using the boatyard is undefined since they are not permanently stationed there. Nonetheless, this framework to be adopted for the purposes of resettlement or paying compensation to affected persons is hereby developed based on issues identified during the ESIA study.

2.0 Resettlement Action Plan

RAP is an information-gathering and analytical process that helps to design development project that results in involuntary resettlement on affected communities. Its objectives are to evaluate all physical or economic impacts, displacement, temporary or permanent loss of assets or facilities that may be experienced by project-affected communities. It thus identifies people affected by the project, the nature and degree of the impacts, measures taken to minimise the effects and compensation with other assistance to be delivered to affected people for unavoidable impacts. The RAP framework has been developed to meet the requirements set out by the Government of Ghana which is in conformity with the World Bank operational Policy on Involuntary Resettlement OP 4.12 for projects of this nature in relation to resettlement and compensation.

3.0 Project Impacts on Assets and Livelihoods

It is expected that the project will have limited impacts on assets or properties. What will be affected is the restriction to the use of the natural resource, the ocean by the community for the livelihood. Issues of land acquisition will not be a major issue here since land required for the port expansion is towards the sea.

Possible impacts on assets expected from the project are presented in **Table 1.**

Table 1: Project Impacts on Assets/Properties

Project Activity	Potential Impacts on Assets/ Properties			
	Land	Crops	Structures (	Livelihoods included
Shoreline Reclamation between Fisheries Department Workshop and New Takoradi Beach	Restriction to use of beach and the ocean as boatyard	-	Relocation of Fisheries Department Workshop	Livelihoods of boat owners/ operators

3.1 Project Affected Persons

There will be the need to resettle/ compensate the people who may be directly or indirectly affected by the project when designs are completed, and the number of people/ boats to be potentially affected has been identified and enumerated. Design works for the project is still ongoing by the EPC contractor thus a list of Project Affetted Persons (PAPs) will be premature at this stage.

4.0 Proposed Project Compensation Policy

The driving principles of the project compensation policy include:

- Any impact of the project on land and/or people shall be addressed in compliance with the Constitution of Ghana and other Ghanaian regulations. If inhabited dwellings are potentially affected by a component of a sub-project, wherever practicable, the sub-project shall be redesigned (facility relocation, re-routing) to avoid any impact on such dwellings and to avoid displacement/relocation accordingly.
- Compensation shall be paid prior to displacement.
- Compensation will be at full replacement value. This will include the establishment of a resettlement working group and a negotiated entitlement framework.
- Information and consultation will take place before the process leading to displacement is launched in each particular location by a sub-project.
- Vulnerable people will be specifically taken care of.
- A dedicated grievance registration and processing mechanism will be put in place, in addition to usual judicial processes.

5.0 Legal and Institutional Background

The relevant legal and institutional background for land acquisition and resettlement in Ghana is complex. Since this project relates to the maritime environment, They will comprise:

- The 1992 Constitution of Ghana, which establishes the right of any Ghanaian displaced by a project of public interest to be resettled by the State, and
- The Ghana Maritime Authority Act 2002, Act 630.

6.0 Eligibility

In line with this resettlement/ compensation framework the following two categories of affected people will be eligible to project resettlement/ compensation assistance:

a) those who have formal legal rights to structure/property (including customary and traditional rights recognised under the laws of the country); and
b) those who do not have formal legal rights to structure/property but have a claim to such assets—provided such claims are recognised under the laws of Ghana.

Persons in category (b) above will be provided compensation for loss of livelihood etc.

7.0 Compensation

Compensation principles to be adopted will include:

- Compensation will be paid prior to commencement of the project activities at the beach; and
- Compensation will be at full replacement value or reinstatement cost.

8.0 Entitlements

Entitlement matrix for compensation issues for the proposed project is presented in the **Table 2**.

Table 2: Entitlement Matrix

Property	Type of Impact	Entitled units	Eligibility criteria	Entitlement
Land/ Ocean	Loss of land/property or restriction to access	Land owner (s)/ Designated persons using resource	Evidence of ownership (legal/customary)	Cash compensation or relocation package
Structures	Destruction of permanent immoveable structures	Owner of property	Evidence of ownership of affected structure	Cash compensation at full replacement value of structures Reinstatement of pavements, concrete floors/platforms etc
	Temporary displacement of moveable structures	Owner	-	GPHA to bear cost of relocation of

9.0 Valuation and Compensation Rates

Methods used by the Land Valuation Division (LVD) to calculate rates cannot be disclosed and are kept confidential. Structures to be demolished will be assessed by professional valuers, either from the LVD or from private valuers certified by the Ghana Institution of Surveyors (GIS).

10.0 Resources available for Compensation

10.1 Human Resources

GPHA has human resources available to deal with compensation issues. The Estate and Environment Department will handle the assignment. GPHA will seek relevant cooperation from competent agencies at regional level, such as the regional offices of the LVD where necessary.

10.2 Funds for Compensation

The initial budget estimate for resettlement/ compensation of affected structures/ livelihoods is not known because final designs and extent of land take is not fully known. Any budget proposed will however need refinement when valuation of affected properties is completed. Compensation cost will be funded by GPHA.

11.0 Procedure for Compensation Payment

Each eligible affected person will sign a resettlement/ compensation certificate together with GPHA authorised representative and the relevant Chief Fisherman/ Opinion Leader/ Assemblyman for the area. The compensation certificate will clarify mutual commitments as follows:

- on the project side: commitment to pay the agreed compensation; and
- on the affected person's side: commitment to vacate the structure/land by the agreed date.

The format of payment certificates will be developed in order to be as easily understandable as possible to affected people. Compensation will be paid prior to the affected person vacating the structure/land. Actual vacation will be monitored by GPHA in cooperation with the Sekondi Takoradi Metropolitan Assembly (STMA).

12.0 Grievance Management and Redress Mechanisms

During such compensation and resettlement operations, it often appears that many grievances derive from misunderstandings of the project policy, or result from neighbour conflicts, which can usually be solved through adequate mediation using customary rules. Most grievances can be settled with additional explanation efforts and some mediation. This is why a first instance of dispute handling will be set up with the aim of settling disputes amicably. Aggrieved people would however remain free to open a Court case without having registered their grievance with this first-tier mechanism.

13.0 Monitoring and Evaluation

The project will be monitored to ensure that its implementation is in compliance with objectives and methods set out in this Resettlement Framework. Evaluation of the mid- and long-term impacts of the RAP on affected households' livelihood, environment, local capacities, on economic development and settlement will also be carried out.

14.0 Consultation and Disclosure

Two steps of information and consultation proposed to be implemented involves initial provision of basic information to potentially affected people on the project and resettlement/

compensation principles as they are outlined in this framework; and at least a public meeting for each subproject.

15.0 Implementation Responsibilities

The main institutions to be involved with the implementation of the resettlement plan include:

- GPHA;
- Fisheries Directorate of Fisheries Commission;
- Environmental Protection Agency (EPA) (resource personnel); and
- Land Valuation Division (LVB) (resource personnel).

16.0 RAP Management Committee

A RAP management team is being proposed to oversee the implementation of the RAP. The team shall consist of Local Assemblyman, local Chief / Chief Fisherman or their representatives, Opinion Leader, and representatives of Fisheries Department, GPHA and LVD. The implementation of the RAP activities shall be done in consultation with the Site or Supervising Engineer. The composition of the team shall be approved by GPHA as well as the roles and responsibilities associated with the RAP properly defined and added after the formation of the RAP Management Committee.

Annex 9: GPHA Occupational Health and Safety Policy Document

GHANA PORTS AND HARBOURS AUTHORITY

OCCUPATIONAL HEALTH AND SAFETY POLICY

OCTOBER 2005

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DEFINITIONS

For the purposes of this Policy:

1. Authority means Ghana Ports and Harbours Authority.

2. Contractors include cleaning companies and others employed to execute projects for the Authority.

3. Dangerous Goods shall mean:

   (a) Any good that from time to time the Authority may by regulation list or describe as such.

   (b) Any of the cargoes, whether packaged, carried in bulk, or listed in the International Maritime Dangerous Goods Code.

   (c) Empty receptacles having previously been used for carriage of dangerous goods unless they have been rendered safe.

4. Hot Work Permit means a permit issued by the Authority authorising the conduct of hot works in the Port

5. Hot works means the use of naked fires and flames, power tools or hot rivets, grindings, soldering, burning, cutting, welding or any other repair work involving heat or creating sparks which may lead to a fire hazard.

6. Licensed Port Operators include Stevedoring, Receipt and Delivery Service Provider, Container Terminal Operators and others licensed to handle cargo in any of the Authority's ports under PNDC Law 160.

7. Port users include shipping companies, clearing agents and freight forwarders, trucking companies, inspection companies, consignees and exporters.

8. Port worker is any person employed by a licensed port operator or any employer in operating in the Port, including employees of Government Agencies like Ghana Immigration Service, Customs Excise and Preventive Service.

LIST OF ABBREVIATIONS

CEPS	Customs Excise and Preventive Service
GDLC	Ghana Dock Labour Company Limited
GPHA	Ghana Ports and Harbours Authority
PNDC	Provisional National Defence Council
PPE	Personal Protective Equipment
IMDG	International Maritime Dangerous Goods Code
RIDDO	Reporting of Injuries, Diseases and Dangerous Occurrences

SAFETY CHARTER

In a question of Convenience versus Safety

SAFETY FIRST

In a question of Comfort versus Safety

SAFETY FIRST

In a question of Tonnage versus Safety

SAFETY FIRST

Safety of Life

Safety of Equipment

Safety of Cargo

ALWAYS, SAFETY FIRST

GHANA PORTS AND HARBOURS AND AUTHORITY
OCCUPATIONAL HEALTH AND SAFETY POLICY STATEMENT

The Ghana Ports and Harbours Authority (GPHA), hereinafter referred to as the Authority, is mandated by Law to plan, build, develop, manage, maintain, operate, regulate and control seaports in Ghana. We shall ensure that health, safety and environmental considerations are at the heart of everything we do as part of our statutory functions. We recognise our responsibility to provide and promote high occupational health, safety and environmental standards in all our ports; and to ensure compliance by our employees, licensed port operators, contractors, suppliers and visitors with our standards.

To this end, the Authority shall, so far as is reasonably practicable, ensure that:

a. Safe and healthy working conditions are provided and maintained for all employees, Port operators and users.

b. No person working in the Port shall be exposed to a significant health risk in the performance of his or her normal activities.

c. Safety devices and Personal Protective Equipment shall be provided and maintained to a serviceable standard for all conditions where and when they are required.

d. Information, training, instruction and supervision are provided, as deemed necessary to enable employees, licensed port operators and port users perform their respective work safely and efficiently and without significant risk to health.

e. Every port worker, licensed port operators and port user adhere to stated safety practices and departmental notices and comply with all relevant health and safety regulations.

f. All accidents, incidents and work-related illness shall be investigated, in order to identify and put right any defects in the occupational health and safety management system of the Authority.

f. The responsibility of health and safety is inseparable from other activities of the Authority. Implementation shall involve all employees who have responsibilities for the actions of other employees, Port operators, Port users and visitors.

g. The Board and Management recognizes its ultimate responsibility for ensuring compliance with the Safety Policy and have delegated both authority and responsibility for its implementation through the Management/Supervisory structure; each manager shall be responsible for health, safety and environment issues in his/her area of responsibility.

h. The Director-General shall have the overall responsibility for occupational health and safety policy formulation, implementation, monitoring and evaluation.

i. All port workers, licensed port operators and port users shall comply with all relevant health and safety legislation and regulations of the Ports.

j. This Policy shall apply to all ports managed, operated and controlled by the Authority. The Policy shall be regularly monitored to ensure that its goals and objectives are achieved. It shall be reviewed every two years in the light of technological, operational, legislative or organizational changes in the work environment.

DATE.....

.....
BEN OWUSU MENSAH
(DIRECTOR - GENERAL

1.0 GENERAL POLICY FRAMEWORK AND GUIDELINES

1.1 GENERAL OBJECTIVES

The objectives of this policy are:

i. To conduct activities in the Ports in accordance with relevant national and international laws and regulations on occupational health and safety. This includes the Labour Act, (Act 651 - 2003), the Factory, Offices and Shops Act (Act 328 1970), the Fire Service Act (Act 537- 1997) Building Regulations (LI 1724, 2003), MARPOL Convention 73/78, ILO Conventions 152,155 and160.

ii. To establish a regulatory and organisational framework for the efficient and effective management of occupational health, safety and environmental issues in the Ports

iii. To maintain safe plant, machinery and equipment in the Ports

iv. To maintain a safe and healthy work place for all port workers and port users

v. To maintain incident and injury-free working environment in the Ports

vi. To prevent occupational related diseases/illness among port workers

vii. To promote and maintain a clean, healthy and hygienic environment in the Ports of Ghana

1.2 GENERAL GUIDELINES

These general policy guidelines cover issues relating to fire and safety, alcohol and drug, environment, health administration, licensed port operators, vessel owners and operators, road transport owners and truck drivers, contractors and visitors to the Ports.

1.2.1 *Fire and Safety Policy*

The Authority shall endeavour to protect all persons and property from the damage of fire and explosion within the Port environment. It shall discharge its corporate responsibility as far as is practicable within strict compliance with all relevant national legislation, in particular, LI 1724 - 2003, PNDC Law 160 (1986), Fire

Service Act (Act 537 - 1997), the Port Regulations - 1964 and its amendments. The Authority shall also institute the following measures:

i. Declare its offices and the entire port estate, delineated by the port perimeter security fence, a "NO SMOKING" area to all persons, including port workers and customers.

ii. Control the use of fires and light in the port areas by strict application of regulations with respect to fires, lights and prevention of accidents by fire.

iii. Require all port workers, licensed port operators and port users to observe all bye-laws, fire procedures and codes of procedure issued on fire prevention from time to time.

iv. Provide portable fire extinguishers and other equipment as necessary, to further safeguard personnel and property from the dangers and hazards of fire and explosion.

v. Provide information, training and education in basic fire prevention, fire protection and fire fighting to all port workers, licensed port operators and port users.

vi. Require all licensed port operators to observe all regulations regarding fire prevention. They shall also be required to provide training in basic fire prevention, fire protection and fire fighting to all their employees working in the Port.

vii. Require that handling, storage and transportation of all dangerous goods shall be in strict compliance with the provisions of the International Maritime Dangerous Goods (IMDG) Code and regulations of the Authority.

viii. Require that all hot works undertaken in the ports shall be covered by a "Hot Work Permit" issued by the Authority.

1.2.2 *Alcohol and Drug Policy*

The Ghana Ports and Harbours Authority recognises that the misuse of alcohol and drugs may affect the health, safety performance, and relationships at work and at home. The Authority shall institute appropriate actions programmes to:

i. Promote the health and well being of port workers and to minimise problems at work arising from the effects of alcohol or drugs.

ii. Prevent persons who are under the influence of alcohol or drugs from entering the Port to work. Such workers, if they are employed by any of the licensed port operators shall be sanctioned.

iii. Undertake periodic and unannounced alcohol and drug test on port workers. Any port worker found to be under the influence of alcohol or drugs, beyond the permissible legal limits shall be sanctioned.

vii. Sanction anyone port worker who reports to work under the influence of alcohol or drugs. Such port workers shall not be permitted to work. In cases of dispute an Alco test may be conducted on the port worker.

1.2.3 *Environmental Policy*

The Authority recognises that its operations have the potential to adversely impact the physical environment. It is therefore committed to engaging in environmentally conscious practices in the development and operation of its Ports. The Authority shall, as much as possible, comply with all relevant conventions and legislations on the use and protection of the environment aimed at achieving sustainable port development and environmentally safe port operations. The Authority shall therefore ensure that:

i. Every effort is made to reduce waste generated from port operations.

ii. All wastes generated are collected and disposed of in an environmentally responsible manner and in compliance with appropriate national legislations.

iii. Facilities are available in the Ports for the reception and treatment of ship waste and other wastes generated from its operations.

iv. All licensed port operators and contractors working in the Ports undertake their operations in full compliance with appropriate national legislation on the protection and sustainable use of the environment.

v. Good housekeeping practices are observed by all port workers, licensed port operators, port users on its facilities; and that all workplaces to minimise spillages of substances that are hazardous to the environment.

vi. No form of waste or pollutant is disposed of into the harbour basin.

vii. 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.

viii. The emission of dust and hazardous chemical into the atmosphere are monitored and controlled to prevent any environmental emergencies.

ix. 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 terminals and 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.

x. Licensed port operators and contractors practice responsible and environmentally port operations.

xi. Industries located in the precincts of the Port adopt and practice sound environmental management practices.

1.2.4 *Occupational Health Administration Policy*

The Authority will lead the drive for improvement in the occupational health of all persons employed to work in the ports, whether or not they are employees of the Authority. 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 Authority shall institute appropriate measures to:

i. Mobilize port workers for active involvement and participation in occupational health education programmes and activities.

ii. Reduce or eliminate occupational related diseases and personal accidents through education, training, enforcement of rules and regulations.

iii. Conduct medical examination on every one of its own employees at the time of entry into employment to determine their medical condition and fitness.

iv. Conduct routine and curative medical examinations on every one of its own employees during employment to monitor their medical condition and fitness.

v. Conduct medical examinations on every employee at the time of exit to ascertain their medical condition and fitness for post-service care.

vi. Educate all port workers on the risks and dangers of HIV/AIDS. As part of this, the Authority shall set up a Peer Education Programme Unit to be responsible for HIV/AIDS education and counselling for port workers infected and affected by HIV/AIDS.

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

1.2.5 *Licensed Port Operators Policy*

All licensed port operators, and other persons whose employees work in the port on a regular basis, shall be required to observe and comply with the provisions of this Policy. Failure to observe the provision of the Policy may result in the suspension or revocation of the operating licence issued to the licensed port operator. In particular, licensed port operators shall:

i. Employ only persons who have undergone training in Basic Health and Safety in Ports. Such safety training shall be provided by competent institutions and shall not be less than five days and shall meet minimum requirements for safe working in the Port.

ii. Provide all persons employed in cargo and related work prescribed personal protective equipment (PPE). It would be an offence to employ any person not properly clothed in PPE in the Ports.

iii. Use appropriate gears and equipment in cargo handling operations. All gears and equipment used in cargo operations shall be inspected and certified by a competent Inspection Agency each year. It would be an offence to use gears and equipment that have not been certified.

iv. Maintain all gears, plant and equipment used in cargo handling operations in top performance condition.

v. Appoint a Safety Liaison Officer to be responsible for all safety matters during all cargo handling operations.

vi. Institute adequate precautionary measures whenever dangerous goods, heavy lifts and cargoes which require special attention are being handled.

vii. Fix safety nets under tackles and between the quay and the ship when working conventional and dry bulk cargoes.

viii. Fix safety tarpaulins under tackles and between the quay and the ship when working dry bulk cargoes.

ix. Report all accidents, near miss accidents and dangerous occurrences to the Fire and Safety Manager within 24 hours of their occurrence; and to fully co-operate during investigation of such accidents.

x. Take adequate steps to reduce oil spillage and discharge of other pollutants into the environment at their workshops, gear stores and other areas of operations.

xi. Avoid the use of cargo handling equipment and vehicles that leak oils or emit heavy smoke and fumes in the Ports.

xii. Clean and remove all wastes generated from their operations at the close of every shift. Receipt-Delivery Services Providers shall be responsible for the environmental cleanliness and hygiene of the facilities leased to them.

1.2.6 Vessel Owners and Operators

These guidelines shall apply to all vessel owners and operators whose vessels call at the Ports whether or not they carry cargo for reward.

i. All vessels calling at the Ports shall comply with the provisions and requirements of the Port Regulation, MARPOL Convention 1973/78, SOLAS 1974, and the ISPS Code 2004.

ii. All vessels requesting the services of a pilot shall be equipped with a pilot ladder in accordance with the requirements of SOLAS 1974.

iii. All movements of vessels of 10 gross tonnes and above within the port sheltered area shall be with the assistance of a pilot and a tug boat.

iv. All vessels above 1000 gross tonnes shall require the assistance of at least two tug boats.

v. If an outbreak of fire occurs on board a vessel within the Ports, the Master of the vessels shall:

a. take immediate action by means of the ship's fore fire fighting equipment to put out the fire;

b. report the fire to the Harbour Master through the Signal Station; and

c. give warning by prolonged blasts of the vessel's horn.

vi. The Master of a vessel (other than a vessel of less than 10 gross tonnes) berthed alongside a quay or lying at buoys shall provide and maintain safe, sufficient and proper gangway, with safety nets for access and egress of all persons having lawful business on the vessels; and shall during the hours of darkness provide sufficient lighting to illuminate the whole length of the gangway.

vii. All vessels calling to work cargo in the Ports shall have their cargo handling gear in safe and good working conditions. The cargo handling gears shall be covered by appropriate inspection certificates issued by a recognised Inspection Agency.

viii. All vessels working cargo in the Ports shall provide adequate lighting to illuminate the holds and decks where cargo is being worked.

ix. The Master of a vessel working in the Port shall ensure that all cargo work are conducted in a safe manner to protect life and property.

x. No vessel in Port shall discharge oil, garbage, sewage or other pollutants into the water.

xi. All dangerous goods under IMDG Classes 1, 2 and 7 shall be removed from the Port on arrival, i.e. delivered ex-ship.

xii. All documentation and declarations of dangerous goods shall, among others, indicate the scientific name of the substance (not the brand name), the IMDG Class, the UN number and EMS number.

1.2.7 Road Transport Vehicle Owners and Truck Drivers Policy

The following policy guidelines shall apply to all Road Transport Vehicle Owners and Truck Drivers operating in the Ports, whether or not for reward.

i. Vehicle owners and drivers shall be responsible for the safety and security of their vehicles and the cargoes carried by their vehicles while they are on the premises of the Authority. They shall be required to observe all Port Regulations and Rules regarding the physical and mechanical condition of vehicles, dimension of vehicles, driving and parking of vehicles in the Port.

ii. Vehicles that emit excessive smoke and fumes, or leak oil and lubricants, or those that are mechanically and physically unsuitable to carry their loads may be denied access to the Port.

iii. Vehicle owners and drivers shall be responsible for the cost of cleaning of oil leakage from their vehicles.

iv. Vehicles owners and drivers shall ensure that their vehicles are roadworthy and in good working condition before entering the Port. Vehicle owners and drivers shall be held liable for the breakdown of their vehicles in the Port and for obstructing traffic and interfering with other port activities.

v. Owners and Drivers of vehicles carrying bulk cargoes to/from the Ports shall take adequate steps to prevent the leakage/spillage of their cargoes in the Ports and its environs.

vi. Owners and Drivers of vehicles carrying cargoes to/from the Ports shall ensure that their vehicles do not exceed weight and height requirements; and that cargoes are properly secured with securing devices like twist locks and other lashing materials.

1.2.8 Contractors and Suppliers Policy

The Authority has a responsibility for ensuring the safety of person(s) contracted to carry out works for, or on behalf of the Authority and its licensed operators.

i. Contractors and sub-contractors performing duties on the premises of the Authority shall be expected to give, as a condition of their contract, an undertaking that they will comply with this policy and any other relevant codes

of practice and recommended guidelines applicable to the work being carried out.

ii. A contractor may be asked to supply detailed method statement, details of relevant training, qualifications and experience of those to be employed on the contract, and details of equipment, procedures and other provisions related to safety that will be available for that contract.

iii. The Authority reserves the right to terminate the contract of a contractor or sub-contractor if the contractor or sub-contractor fails to comply with the provisions of the Ghana Ports Harbours Authority's Safety Code for contractors and sub-contractors. The Authority further reserves the right to ask for the removal from site any employee of a contractor or sub-contractor whose actions or conduct is found to be repugnant to the tenets of the Ghana Ports Harbours Authority's Safety Code for contractors and sub-contractors.

1.2.9 Visitors Policy

The Authority recognizes that it has a responsibility for ensuring the safety of visitors. It is therefore that person(s) visiting the Port premises:

i. Comply with all safety rules, procedures and regulations.

ii. Be accompanied as far as reasonably practicable to and from that area safely

iii. Be provided restricted access to very hazardous and operational areas shall be restricted to visitors.

iv. Be provided appropriate PPE and other attire or marks that would help identify them as such.

2.0. OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

The Authority shall put adequate measures in place in order to keep the port area free of occupational health and safety risks. The use of personal protective equipment on the port premises shall be stringently enforced. Activities in the port shall be closely monitored to ensure that the port community is not exposed to significant occupational hazards. Other regulatory and reactive measures like care for the physical and marine environment, limiting working hours of port workers, issue of permits to work, institution of safe code of practice for the handling, storage and transportation of dangerous goods, operation of plant and equipment; and accident reporting shall be enforced. Conscious and continuing training shall feature prominently in the Authority's Occupational Health and Safety Management Programmes.

2.1 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Safety and Health of port workers i.e. employees of the Authority and those of licensed port operators - are of paramount importance to the Authority. All port workers shall be supplied appropriate personal protective equipment by their employers as a protection against injury, accidents and occupational hazards. Employers shall provide PPE at no cost to the employee.

i. All Licensed Port Operators including Ghana Dock Labour Company Limited shall provide basic PPE to their employees.

ii. All port workers engaged in cargo operations, workshops, construction work, etc. shall be supplied a set of basis PPE by the employer. This includes a pair of steel toed boots, a helmet and a pair of gloves. Additional PPE shall be provided depending on the conditions at the workplace.

iii. Employers shall be required to provide PPE to workers employed in port activities or places where:

   a. Excessive fumes/dust is present.
   b. It is wet, cold or exposed to dangerous elements.
   c. There is bodily contact with accumulation of oil, grease corrosives, etc.
   d. Hot particles exit.
   e. The environment is noisy
   f. The environment is unhygienic.
   g. It is not possible to enclose or isolate the work process from the Worker.
   h. It is not possible to provide adequate ventilation.

i. There are slips, trips and falling hazards.
j. Where conditions require an employee to appear neat and hygienic

iv. PPE supplied to Authority's own workers shall remain the property of the Authority. These shall be returned by employees in exchange for new ones when required; and on cessation of employment. Specialised PPE supplied for specific assignments shall be returned at the end of such assignments.

v. All Authority's employees issued with PPE shall be held accountable for any misuse, abuse, non-use or waste of such equipment and shall be liable to disciplinary action.

vi. All managers and supervisors of the Authority shall ensure that their subordinates working in the Port use appropriate PPE at all times.

vii. Port workers who do not use the appropriate PPE may be turned away from the job and sanctioned.

viii. Licensed Port operators and other employers in the Port who employ persons who are not clothed in the appropriate PPE shall be sanctioned.

ix. Authority's own employees who misplace any PPE issued to them shall be surcharged with the cost of the item misplaced.

x. Authority's Managers viz. Heads of Departments and Sections and their immediate supervisors shall ensure that PPE supplied to non-permanent employees including National Service Personnel are returned at the end of their tenure. Heads of Department, Sectional Heads and Supervisors who do not comply shall be surcharged with the cost of such items.

xi. When any PPE issued to Authority's workers become defective or unserviceable through prolonged usage, manufacturing defect or accident, it shall be returned to the Fire/Safety Section through the Heads of Department or Section.

xii. All PPE, upon the expiration of their useful life, shall be retrieved and replaced by the employer. No defective or expired PPE shall be allowed for use at work in the Port.

xiii. The selection of any type of PPE shall be the responsibility of the Fire/Safety Section and Materials Department in consultation with the user Department/Section.

2.2 OCCUPATIONAL HEALTH AND HYGIENE

The Authority shall take adequate steps to control the conditions that govern work, and which if not properly controlled, could adversely affect the health of the people exposed to them. In this regard, the Authority shall:

i. Maintain surveillance of the work environment, including toilets, canteens, and housing to identify factors that may affect workers' health.

ii. Take every step reasonably practicable to reduce noise at source to the lowest level at all work places. All port workers who are constantly or regularly exposed to high noise levels shall be required to wear some form of ear protection equipment. This shall be supplied freely to workers who require them.

iii. Take all reasonable steps to eliminate or reduce dust and fumes to acceptable limits by installing appropriate procedures, methods and/or efficient control systems such as extraction and ventilation. Where such systems may be insufficient, the Authority shall provide suitable and sufficient personal respiratory devices or equipment as is necessary to safeguard the health of the individual employee.

iv. Control exposure of port workers to substances hazardous to health.

v. Provide adequate lighting at all work places, taking into consideration the acceptable luminance levels required for various tasks and jobs.

vi. Register of all persons who prepare and sell food on the premises of the Authority, including the Food Markets, and other food vending points located on its property.

vii. Authorise its Medical personnel to conduct periodic medical examination of all persons who prepare and sell food on the premises of the Authority to ensure that food vendors and their workers do not carry communicable diseases.

viii. Prohibit the selling of alcohol on the premises of the Port, including the Food Markets.

ix. All persons working in environments where noise levels are in excess of 80 dba shall be provided ear protectors as part of the basic PPE.

x. All persons working at noisy environments shall be required to undergo annual and periodic audiometric tests.

2.3 WORKING HOURS

The Authority recognises that fatigue is a major cause of accidents. Consequently, no person employed in cargo operations viz. stevedore gangs, shore gangs, crane drivers and winchmen, plant operators, etc. shall work for more than 12 hours during any particular shift.

All persons employed to operate quay and yard gantry cranes in the Port shall take a mandatory fifteen minutes break for every two continuously hours at any particular time.

All persons employed to operate Reach Stackers and other heavy duty cargo handling equipment above 40 tonnes shall be required to take a mandatory fifteen minutes rest after four hours of continues operations.

2.4 PERMIT –TO- WORK

Any organisation seeking to perform any work in the Port shall obtain Permit-to-work prior to the execution. The following activities shall require permit-to-work:

i. Civil and Electrical works
ii. General Engineering works
iii. Hot works
iv. Chipping
v. Diving and salvage
vi. Bunkering

2.5 HANDLING, STORAGE AND TRANSPORT OF DANGEROUS GOODS

All handling, transportation and storage of dangerous goods shall be in accordance with the provisions of the IMDG Code and the Port Regulations and administrative directives that may be issued from time to time.

2.6 PLANT AND EQUIPMENT OPERATORS

All persons employed to operate powered industrial trucks e.g. Fork lift trucks, mobile cranes, quayside cranes, Ro-ro tractors and trailers etc shall be required to undergo appropriate training and be licensed by a competent authority.

All equipment operators shall be required to undergo mandatory eye test every year as part of the requirements for the renewal of their licenses or certificate of competence.

2.7 ACCIDENTS

i. All accidents shall be reported to Director of Port and the Fire and Safety Manager within twenty-four hours of their occurrence. All accidents shall be investigated by the Fire and Safety Department.

ii. It shall be an offence to fail to report an accident that leads to injury, death or damage to Port property

iii. Any accident involving injury and causing death to any personnel (employee or customer) must be reported to the Fire/Safety Department for onward notification of the Port Police within 24 hours of its occurrence.

iv. Road traffic accident (including those not resulting from personal injury) on Port roads and in other areas within the Port shall be reported to the Police. Accidents occurring within the Port security perimeter shall be reported to the Fire and Safety Department as well as the Security within 24 hours of its occurrence.

v. In the event of a very serious accident which may or may not require immediate medical treatment, the accident scene should be left undisturbed until a preliminary investigation has been conducted. Near miss accidents and dangerous occurrences must also be reported.

vi. The Fire/Safety Department shall have the responsibility to investigate all accidents, including marine accidents. All employees and licensed port operators, port users, and other person(s) concerned shall be required to assist in the investigation of accidents.

vii. In order that the conditions of the reporting of injuries, diseases and dangerous occurrences (RIDDO) can be complied with, it is necessary that accident report forms are forwarded to the Safety Office within 48 hours of the accident.

Under RIDDO procedures, any injury which is likely to cause absence or a change of job for three days or more must be reported to the Welfare Office within seven (7) days. Therefore irrespective of the report form all such accidents and dangerous occurrences must be reported to the Fire/Safety Department at the earliest opportunity by whatever means available.

viii. It is an offense not to report all injuries and property damage accident to responsible authorities.

2.8 HEALTH AND SAFETY TRAINING

The Authority shall set standards for training, certification and registration of port workers.

The Authority shall promote occupational health and safety training among licensed port operators and port workers. Occupational health and safety training shall be continuous and aimed at achieving accident and incident-free working environment and eradicating occupationally related illnesses.

All persons registered or employed as a port worker and are intended to be employed in cargo work or associated activities in the Port shall undergo appropriate occupational health and safety training mandated and certified by the Authority.

All persons employed to work in the Port might have undergone appropriate occupational health and safety training mandated and certified by the Authority.

3.0 POLICY IMPLEMENTATION AND MONITORING

The responsibility of health and safety is inseparable from other activities of the Authority. The Director-General shall have overall responsibility for the formulation, implementation, monitoring and evaluation of Health, Safety and Environmental Issues of the Ghana Ports and Harbours Authority. This responsibility may be delegated to the Directors of the Ports.

3.1 THE DIRECTOR OF PORT

The Director of Port shall be responsible for the implementation of the Health, Safety and Environmental Policy in the Port.

3.2 THE HARBOUR MASTER

The person shall be responsible for all matters regarding Marine Safety, Pollution and related Environmental issues in the Port.

3.3 THE HEAD OF MEDICAL SERVICES

Shall be responsible for the management of all occupational Health related matters. He shall undertake regular medical examination of all employees to detect the incidence of occupationally related health and safety diseases. In collaboration with the Training Manager, he shall also organize educational fora to educate employees and Port users on occupational health and safety issues.

3.4 THE FIRE/SAFETY MANAGER

He shall be responsible for planning, coordinating, monitoring, advising and reporting all matters relating to Occupational Health and Safety including accidents and Fire-related incidents in the Port.

3.5 THE STEVEDORE MANAGER

The Stevedore Manager shall be responsible for the safe conduct of the Authority's stevedoring business.

3.6 PORT OPERATIONS CO-ORDINATOR

Shall be responsible for ensuring that license Port operators and customers undertake their activities in compliance with the requirements of the Health, Safety and Environmental Policy.

3.7 THE TRAFFIC MANAGER (PLANT)

Shall be responsible for allocating only safe operable equipment and competent operators in all terminal operations and ensuring safe plant/equipment operating practices.

3.8 THE PORT MECHANICAL ENGINEER

Shall be responsible for the maintenance of all Plant, Equipment and Vehicles. He shall release to the plant pool only equipment that do not leak oil, emit excessive smoke and fumes or pollute the environment.

3.9 THE PORT CIVIL ENGINEER

Shall be responsible for all aspects of civil infrastructure to ensure roads, access ways, sheds and terminals are well maintained for movement of persons and mobile equipment.

3.10 THE PORT ELECTRICAL ENGINEER

Shall be responsible for all matters concerning electricity connections, supply, distribution, and usage within the Port Estate. He shall ensure that all workplaces - terminals, offices and workshops are well lit.

3.11 THE ESTATE AND ENVIRONMENT MANAGER

Shall be responsible for planning, implementing, monitoring evaluating and reporting on all environmental matters in the Port and ensuring that Sheds and other Port properties are in good repair.

3.12 PORT SECURITY MANAGER

Shall be responsible for the effective control of movement of both human and vehicular traffic to designated areas within the Port. He shall protect life and property against assault, damage and sabotage within the Port. He shall ensure that only

vehicles and equipment that meet the Authority's safety and environmental standards enter the Port. He shall enforce safe code of driving and no smoking regulations in the Port.

3.13 THE TRAINING MANAGER

Shall be responsible for co-ordinating with all Departmental Heads to ensure training programmes are developed for all employees and other port users towards higher safety and health standards in the Port.

3.14 PORT WORKERS

All port workers shall co-operate with the Authority and its officers in all matters relating to occupational health, safety and environment. They are to take reasonable care of their own health and safety and report all occupational health and safety concerns to the appropriate officers detailed in this policy document.

4.0 PORT SAFETY COUNCIL AND COMMITTEES

The Authority recognizes that the views and active involvement of employees, port operators and port users are paramount in the successful implementation of the Health, Safety and Environmental Policy. To this end, there shall be instituted a Port Safety Council, Port Safety Steering Committee and Unit Safety Committees. Membership and function of these bodies shall be as follows:

4.1 PORT SAFETY COUNCIL

4.1.1 Membership of the Port Safety Council

i.	Director-General	-	Chairman
ii.	The Director of Port – Tema	-	Member
iii.	The Director of Port – Takoradi	-	Member
iv.	The General Manager – Tema Fishing Harbour	-	Member
v.	The General Manager – Engineering	-	Member
vi.	The General Manager – Legal	-	Member
vii.	The Corporate Estate and Environment Manager	-	Member
viii.	The General Manager (Admin)	-	Secretary
ix.	The Managing Director of Tema Oil Refinery	-	Member
x.	The Managing Director of GHACEM	-	Member
xi.	Representative of Licensed Port Operators	-	Member
xii.	Representative of Shipping Companies./Agents	-	Member
xiii.	Representatives of Freight Forwarders	-	Member

4.1.2 Functions of the Port Safety Council

The Port Safety Council shall meet quarterly and shall be responsible for:

i. The development of strategies and plans for the implementation of the Health, Safety and Environment Policy.

ii. The setting up of Health, Safety and Environment objectives for the Port, Port Operators/users.

iii. Cause an audit of the health, safety and environment management system of the Ports.

iv. Undertake periodic unannounced inspection of the Port estate to acquaint itself of health and safety procedures and arrangements.

v. Evaluate the policies, strategies and programmes of Health, Safety and Environment management system for improvement.

4.2 PORT SAFETY STEERING COMMITTEES

4.2.1 Membership of the Port Safety Steering Committee

The following shall form the membership of the Steering Committees for their respective stations of operation:

i.	Director of Port	- Chairman
ii.	Harbour Master	- Technical. Advisor
iii.	Head of Medical Services	- Medical. Advisor
iv.	Port Operations Co-ordinator	- Operations Advisor
v.	Fire/Safety Manager	- Member/Secretary
vi.	Port Estate and Environ. Manager	- Member/Dep. Secretary
vii.	Port Personnel and Administrative Manager	- Member
viii.	A representative of the Senior Staff Union	- Members
ix.	A Representative of Junior Staff Union	- Member
x.	Port Electrical Engineer	- Member
xi.	Port Mechanical Engineer	- Member
xii.	Port Marine Engineer	- Member
xiii.	Port Civil Engineer	- Member
xiv.	Port Security Manager	- Member
xv.	A Representative of Freight Forwarders	- Member
xvi.	A Representative of Stevedoring Companies	- Member
xvii.	M.D of Safe Bond Company Limited	- Member
xviii.	Representatives of Road Transport Operators	- Member
xix.	M.D. of Meridian Port Servicesl (Tema)	- Member, Tema Port
xx.	District Commander-Railway & Ports Police (Tema)	- Member, Tema Port
xxi.	District Commander – Railway & Port Police (Tkdi)	- Member, Tkdi Port
xxii.	M.D, Ghana Manganese Co. (Tkdi)	- Member, Tkdi Port
xxiii.	M.D, Unicontrol Commodities (Tkdi)	- Member, Tkdi Port
xxiv.	Sector Commander - CEPS (Tema)	- Member, Tema Port
xxv.	Sector Commander - CEPS (Tkdi)	- Member, Tkdi Port
xxvi.	Executive Director – GDLC (Tema)	- Member, Tema Port
xxvii.	Manager – GDLC (Tkdi)	- Member, Tkdi Port

4.2.2 Functions of the Port Safety Steering Committee

The Safety Steering Committee shall perform the following functions:

i. Implement decisions of the Port Safety Council

ii. Review Port Health, Safety and Environmental Plans

iii. Set targets for continuous improvement in health and safety performance, making sure resources are available to help us deliver those targets and reporting to the Port Safety Council on progress at least once a year.

iv. Undertake periodic inspection of activities at terminals, workshops and other work locations to determine compliance with safety regulations, procedures and practices.

v. Disseminate information on health, safety and environment issues in the Port.

vi. Prescribe appropriate safety equipment

vii. Prescribe sanctions for infringement of safety regulations, rules and procedures.

4.3 PORT SAFETY UNIT COMMITTEES

All departments of the Authority and all Port operators whose functions carry major risks shall form Unit Safety Committees. The following departments of the Authority shall each form Unit Safety Committees.

i. Civil Engineering
ii. Mechanical Engineering
iii. Electrical Engineering
iv. Marine Engineering
v. Marine Operations
vi. Fire and Safety
vii. Container Depot
viii. Container Freight Station
ix. Stevedoring Section
x. Security
xi. Hospitals and Clinics
xii. Materials Management

License Port Operators who provide the following services in the Port shall be required to establish Unit Safety Committees:

i. Stevedoring

ii. Receipt Delivery
iii. Container Terminal Operations

4.3.1 Membership of the Unit Safety Committees

a. A Unit Safety Committee shall consist of appointed Senior and Junior Officers. It shall consist of a minimum of three (3) members including representatives from the Unions.

b. The Committee shall be chaired by the Head of Department/Sections who will provide the necessary direction in the implementation of the Authority's Safety Policy at the functional level.

c. Membership to the committee shall where possible, be rotated among the staff so that in the long run every employee will appreciate the role of Safety. This shall help reinforces their personal commitment to Safety.

d. Appointed members should, where possible, serve a two-year period.

4.3.2 Functions of the Unit Safety Committees

The Unit Safety Committee shall meet once every month to discuss matters relating to industrial safety, health and environment in the Department/Section. A copy of the minutes of meetings shall be sent to the Fire/Safety Manager within seven (7) days. The Committee shall undertake the following functions.

i. Carry out and implement the decisions of the Port Safety Steering Committee and work closely with the Fire and Safety Department on matters relating to industrial safety, health and environment.

ii. Conduct inspections of the workplace to identify safety, health and environmental hazards and make appropriate recommendations.

iii. Carry out regular inspection of the work environment to identify infraction of safety regulations, procedures and standards and take corrective action.

iv. Undertake inspections of the workplace immediately an accident /incident is reported to establish causes and circumstances and institute preventive measures.

v. Maintain statistics on accidents.

vi. Review and update work systems, practices, safety guidelines, safety rules and safety checklists, to ensure their relevance and applicability to changing working conditions and circumstances.

vii. Submit quarterly reports highlighting the activities and programmes of the Committee to the Fire and Safety Manager. The Reports should be submitted by the close of the month following the relevant quarter.

4.4 PORT SAFETY LAISON OFFICERS

Departments and licensed port operators e.g. Administration, Cleaning Companies etc whose functions carry less safety risks, need not set up Unit Safety Committees. This group shall appoint a Safety Liaison Officer who must be a Senior Officer, to be responsible for safety matters. The Safety Liaison Officer shall:

i. Monitor and identify health, safety and environmental hazards at the workplace.

ii. Educate the Staff and ensure that all lights and electrical/electronic appliances at workplace are put off after close of work.

iii. Inspect and ensure that all emergency exits are kept clear of all obstructions and are functioning properly.

iv. Submit monthly reports on his activities and programmes to the Fire and Safety Manager.

Annex 10: World Bank's General Environmental Management Conditions for Construction Contracts

General Environmental Management Conditions for Construction Contracts

General

1. In addition to these general conditions, the Contractor shall comply with any specific Environmental Management Plan (EMP) or Environmental and Social Management Plan (ESMP) for the works he is responsible for. The Contractor shall inform himself about such an EMP. and prepare his work strategy and plan to fully take into account relevant provisions of that EMP. If the Contractor fails to implement the approved EMP after written instruction by the Supervising Engineer (SE) to fulfil his obligation within the requested tune, the Owner reserves the right to arrange through the SE for execution of the missing action by a third party on account of the Contractor
2. Notwithstanding the Contractor's obligation under the above clause, the Contractor shall implement all measures necessary to avoid undesirable adverse environmental and social impacts wherever possible, restore work sites to acceptable standards, and abide by any environmental performance requirements specified in an EMP. In general these measures shall include but not be limited to.
   a) Minimize the effect of dust on the surrounding environment resulting from earth mixing sites, vibration equipment, temporary access roads, etc.to ensure safety, health and the protection of workers and communities living within the vicinity dust producing activities.
   b) Ensure that noise levels emanating from machinery, vehicles and noisy construction activities (e g. excavation, blasting) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities.
   c) Ensure that existing water flow regimes in rivers, streams and other natural or irrigation channels is maintained and or re-established where they are disrupted due to works being carried out.
   d) Prevent oils, lubricants and waste water used or produced during the execution of works from entering into rivers, streams, irrigation channels and other natural water bodies reservoirs, and also ensure that stagnant water in uncovered borrow pits is treated to the best way to avoid creating possible breeding grounds for mosquitoes.
   e) Prevent and minimize the impacts of quarrying, earth borrowing, piling and building of temporary construction camps and access roads on the biophysical environment including protected areas and arable lands; local communities and their settlements. In as much as possible restore /rehabilitate all sites to acceptable standards.
   f) Upon discovery of ancient heritage, relics or anything that might or believed to be of archaeological or historical importance during the execution of works, immediately report such findings to the SE so that the appropriate authorities may be expeditiously contacted for fulfilment of the measures aimed at protecting such historical or archaeological resources.
   g) Discourage construction workers from engaging in the exploitation of natural resources such as hunting; fishing, and collection of forest products **or** *any* other activity that might have a negative impact on the social and economic welfare of the local communities
   h) Implement soil erosion control measures in order to avoid surface run off and prevents siltation, etc.
   i) Ensure that garbage, sanitation abd drinking water facilities are provided in construction workers camp**.**
   j) Ensure that, in as much as possible, local materials are used to avoid importation of foreign material and long distance transportation.
   k) Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents,
3. The Contractor shall indicate the period within which he/ she shall maintain status on site after completion of civil works to ensure that significant adverse impacts arising from such works have been appropriately addressed.
4. The Contractor shall adhere to the proposed activity implementation schedule and the monitoring plan/ strategy to ensure effective feedback of monitoring information to project management so that impact management can be implemented properly, and if necessary, adapt to changing and unforeseen conditions.
5. Besides the regular inspection of the sites by the SE for adherence to the contract conditions and specifications, the Owner may appoint an Inspector to oversee the compliance with these environmental conditions and any proposed mitigation measures. State environmental authorities may carry out similar inspection duties. In all cases, as directed by the SE. the Contractor shall comply with directives from such inspectors to implement measures required to ensure the adequacy rehabilitation measures carried out on the bio-physical environment and compensation for socio-economic disruption resulting from implementation of any works.

Worksite/Campsite Waste Management

6 All vessels (drums, containers, bags, etc.) containing oil/ fuel/ construction materials and other hazardous chemicals shall be bunded in order to contain spillage. All waste containers, litter and any other waste generated during the construction shall be collected and disposed off at designated disposal sites in line with applicable government waste management regulations.

7 All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.

8 Used Oil from maintenance shall be collected and disposed-off appropriately at designated sites or be re-used or sold for re-use locally.

9. Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.

10. Construction waste shall not be left in stockpiles along the load, but removed and reused or disposed of on a daily basis.

11. If disposal sites for clean spoil are necessary, they shall be located in areas, approved by the SE. of low land use value and where they will not result in material being easily washed into drainage channels. Whenever possible, spoil materials should be placed in low-lying areas and should be compacted and planted with species, indigenous to the locality.

Material Excavation and Deposit

12. The Contractor shall obtain appropriate license/ permits from relevant authorities to operate quarries or borrow areas.

13. The location of quarries and borrow areas shall be subject to approval by relevant local and national authorities, including traditional authorities if the land on which the quarry or borrow areas fall in traditional laud

14. New extraction sites:

a) Shall not be located in the vicinity of settlement areas, cultural sites, wetlands or any other valued ecosystem component, or on high or steep ground or in areas of high scenic value, and shall not be located less than 1km from such areas.

b) shall not be located adjacent to stream channels wherever possible to avoid siltation of river channels where they are located near water sources, borrow pits and perimeter drains stall surround quarry sites.

c) shall ret be located In archaeological areas, Excavations in the vicinity of such areas shall proceed with great care and shall be done in the presence of government authorities having a mandate for their protection.

d) shall not be located in forest reserves, However, where there are no other alternatives, permission shall be obtained from the appropriate authorities and an environmental impact study shall be conducted.

e) shall be easily rehabilitated, Areas with minimal vegetation cover such as flat and bare ground, or areas covered with grass only or covered with shrubs less than 1.5m in height; are preferred.

f) shall have clearly demarcated and marked boundaries to minimize vegetation clearing.

15. Vegetation clearing shall be restricted to the area required for safe operation of construction work. Vegetation clearing shall not be done more than two months in advance of operations.

16. Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exits from workings.

17. The Contractor shall deposit any excess material in accordance with the principles of these general conditions, and any applicable EMP, in areas approved by local authorities and or the SE

18. Areas for depositing hazardous materials such as contaminated liquid and solid materials shall be approved by the SE and appropriate local and/or national authorities before the commencement of work. Use of existing, approved sites shall be preferred over the establishment of new sites.

Rehabilitation and soil Erosion Prevention

19, To the extent practicable, the Contractor shall rehabilitate the site progressively so that the rate of rehabilitation is similar to the rate of construction.

20, Always remove and retain topsoil for subsequent rehabilitation. Soils shall not be stripped when they are wet as this can lead to soil compaction and loss of structure.

21, 21. Topsoil shall not be stored us large heaps. Low mounds of no more than 1 to 2m high are recommended.

22, Re-vegetate stockpiles to protect the soil from erosion, discourage weeds and maintain an active population of

beneficial soil microbes.

23, Locate stockpiles where they will not be disturbed by future construction activities.

24, To the extent practicable, reinstate natural drainage patterns where they have been altered or impaired.

25, Remove toxic materials and dispose of them in designated sites. Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.

26, Identify potentially toxic overburden and screen with suitable material to prevent mobilization of toxins.

27, Ensure reshaped land is formed so as to be inherently stable, adequately drained and suitable for the desired long-term laud use. and allow natural regeneration of vegetation.

28, Minimize the long-term visual impact by creating landforms that are compatible with the adjacent landscape.

29, Minimize erosion by wind and water both during and after the process of reinstatement.

30, Compacted surfaces shall be deep ripped to relieve compaction unless subsurface conditions dictate otherwise.

31, Re-vegetate with plant species that will control erosion, provide vegetative diversity and. Through succession, contribute to a resilient ecosystem. The choice of plant species for rehabilitation shall be done in consultation with local research institutions, forest department and the local people.

Water Resources Management

32, The Contractor shall at all costs avoid conflicting with water demands of local communities.

33, Abstraction of both surface and underground water shall only be done with the consultation of the local community and after obtaining a permit from the relevant Water Authority.

34, Abstraction of water from wetlands shall be avoided. Where necessary, authority has to be obtained from relevant authorities.

35, Temporary damming of streams and rivers shall be done in such a way to avoid disrupting water supplies to communities downstream and maintains the ecological balance of the river system.

36, No construction water containing spoils or site effluent, especially cement and oil, shall be allowed to flow into natural water drainage courses.

37, Wash water from washing out of equipment shall not be discharged into water courses or road drains.

38, Site spoils and temporary stockpiles shall be located away from the drainage system, and surface runoff shall be directed away from stockpiles to prevent erosion.

Traffic Management

39, Location of access roads/ detours shall be done in consultation with the local community especially in important or sensitive environments. Access roads shall not traverse wetland areas.

40, Upon the completion of civil works, all access roads shall be ripped and rehabilitated.

41, Access roads shall be sprinkled with water at least five times a day in settled areas, and three times in unsettled areas, to suppress dust emissions.

Blasting

42, Blasting activities shall not take place less than 2km from settlement areas, cultural sites, or wetlands without the permission of the SE.

43, Blasting activities shall be done during working hours, and local communities shall be consulted on the proposed blasting times

44, Noise levels reaching the communities from blasting activities shall not exceed 90 decibels.

Disposal o1 Unusable Elements

45 Unusable materials and construction elements such as electro-mechanical equipment, pipes, accessories and demolished structures will be disposed of in a manner approved by the SE. The Contractor has to agree with the SE which elements are to be surrendered to the Client's premises, which will be recycled or reused, and which will be disposed of at approved landfill sites.

46. As far as possible, abandoned pipelines shall remain in place. Where for any reason no alternative alignment for the new pipeline is possible, the old pipes shall be safely removed and stored at a safe place to be agreed upon with the SE and the local authorities concerned.

47 AC-pipes as well as broken parts thereof have to be treated as hazardous material and disposed of as specified above.

48. Unsuitable and demolished elements shall be dismantled to a size fitting on ordinary trucks for transport.

Hearth and Safety

49. In advance of the construction work, the Contractor shall mount an awareness and hygiene campaign Workers and local residents shall be sensitized on health risks particularly of AIDS.

50. Adequate road signs to warn pedestrians and motorists of construction activities, diversions, etc. shall be provided at appropriate points.
51. Construction vehicles shall not exceed maximum speed limit of 40km per hour.

Repair of Private Property

52. Should the Contractor, deliberately or accidentally, damage private property, he shall repair the property to the owner's satisfaction and at his own cost. For each repair, the Contractor shall obtain from the owner a certificate that the damage has been made good satisfactorily in order to indemnify the Client from subsequent claims.

53 In cases where compensation for inconveniences, damage of assets etc. are claimed by the owner, the Client has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the Client before signing the Contract. In unforeseeable cases, the respective administrative entities of the Client will take care of compensation.

Contractor's Health, safety and Environment Management Plan (HSE-MP)

54 Within 6 weeks of signing the contract, the Contractor shall prepare an EHS-MP to ensure the adequate management of the health, safety environmental and social aspects of the works, including implementation of the requirements of these general conditions and any specific requirements of an EMP for the works The Contractor's EHS-MP will serve two

- For the Contractor, for internal purposes, to ensure that all measures are in place for adequate HSE management, and as an operational manual for his staff.
- For the client support where necessary by a SE, to ensure that the contractor is fully prepared for the adequate management of the HSE aspects of lie project, and as, a basis for monitoring of the contractor's HSE performance.

55 The contractor’s EHS-MP shall provide at least:

- a description of procedures and methods for complying with these general environmental management conditions, and any specific conditions specified in an EMP;
- a description of specific mitigation measures that will be implemented in order to minimize adverse impacts,
- a description of all planned monitoring activities (e g. sediment discharges from borrow areas) and the reporting thereof; and
- the internal organisational management and reporting mechanisms put in place for such.

56 The Contractor's EHS-MP will be reviewed and approved by the Client before start of the works. This, review should demonstrate if the Contractor's EHS-MP covers all of the identified impacts, and has defined appropriate measures to counteract any potential impacts.

HSE Reporting

57 The Contractor shall prepare bi-weekly progress reports to the SE on compliance with these general conditions, the project EMP if any and his own EHS-MP. An example format for a Contractor HSE report is given below. It is expected that the Contractor's reports will include information on:

- HSE management actions/measures taken, including approvals sought from local or national authorities;
- Problems encountered in relation to HSE aspects {incidents, including delays, cost consequences etc. as a result thereof),
- Lack of compliance with contract requirements on the part of the Contractor.
- Changes of assumptions, conditions, measures, designs and actual works in relation to HSE aspects; and
- Observations, concerns raised and/or decisions taken with regard to HSE management during site meetings

58. It is advisable that reporting of significant HSE incidents be done "as soon as practicable". Such incident reporting shall therefore be done individually. Also, it is advisable that the Contractor keeps his own records on health, safety and welfare of persons, and damage to property. It is advisable to include such records, as well as copies of incident reports, as appendixes to the bi-weekly reports Example formats for an incident notification and detailed report are given below. Details of HSE performance will be reported to the Client through the SE's reports to the Client.

Training of Contractor's Personnel

59. The Contractor shall provide sufficient training to his own personnel to ensure that they are all aware of the relevant aspects of these general conditions, any project EMP, and his own EHS-MP and .are able to fulfil their expected roles and functions. Specific training should be provided to those employees that have particular responsibilities associated with the implementation of the EHS-MP.
    General topics should be:
    - HSE in general (working procedures),
    - emergency procedures, and
    - social and cultural aspects (awareness raising on social issues)

Cost of Compliance

60. It is expected that compliance with these conditions is already part of standard good workmanship and state of art as generally required under this Contract. The item "Compliance with Environmental Management Conditions" in the Bill of Quantities covers these costs. No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable HSE impact.

Example Format HSE Report

Contract:
Period of reporting:
HSE management actions/measures:
Summarize HSE management actions/measures taken during period of reporting, including planning and management activities (e.g. risk and impact assessments), HSE training, specific design and work measures taken, etc.

HSE incidents:
Report on any problems encountered in relation to HSE aspects, including its consequences (delays, costs) and corrective measures taken. Include relevant incident reports.
HSE compliance:
Report on compliance with Contract HSE conditions, including any cases of non-compliance.

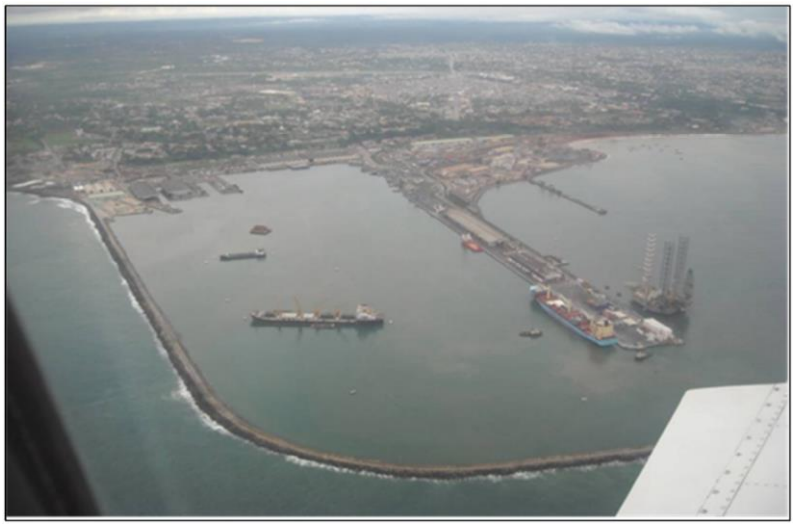
Changes:
Report on any changes of assumptions, conditions, measures, designs and actual works in relation to HSE aspects.
Concerns and observations:
Report on any observations, concerns raised and/or decisions taken with regard to HSE management during site meetings and visits
Signature (Name, Title Date):
Contractor Representative
Example Format: HSE incident Notification
Provide within 24 hrs to the Supervising Engineer
Originators Reference No:
Date of incident: **Time:**
Location of incident:
Name of Person(s) involved:
Employing Company. Type of incident:
Description of Incident:
Where, when, what, how, who, operation in progress at the time (only factual)
Immediate Action:
Immediate remedial action and actions taken to prevent reoccurrence or escalation
Signature (Name, Tittle, Date):
Contractor Representative

Annex 11: Dredging Management Plan

Republic of Ghana

MINISTRY OF TRANSPORT

GHANA PORTS AND HARBOURS AUTHORITY



DREDGING MANAGEMENT PLAN

ANNEX 11

Environmental and Social Impact Assessment (ESIA) Studies on Port Infrastructure Development, including Dredging, at Takoradi Port, Western Region

SAL Consult Limited, P O Box GP20200, Accra, Ghana
in association with Royal Haskoning DHV, Nijmegen, Netherlands

September 2015

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1.0 INTRODUCTION

1.1 Background

The GPHA is proposing to develop the infrastructure at the Port of Takoradi which will include dredging of the port basin. The improved infrastructure at the port will enhance Public Private Partnership (PPP) ventures at the Port of Takoradi. The PPP concept, which is a key government economic reform agenda and strategy to increase private sector involvement in infrastructure and public services delivery reflects the desire of Government of Ghana (GoG) to improve the quality, cost effectiveness, and timely provision of public infrastructure and services in Ghana.

The key priority areas identified for development and improvement include:

- Provision of a dedicated bulk ore and oil services terminals;
- Construction of breakwaters;
- Dredging and reclamation;
- Construction of quay walls, and where appropriate, strengthening of the existing quay walls in the port;
- Cargo handling and berthing furniture at all the respective berths;
- Bulk ore storage areas;
- Relocation of affected port operations and maintenance engineering workshops and offices to newly designated points within the ports;
- Upgrading of ports' access roads, entry and exits; and
- Coastal reclamations and the possible resettlement of, where affected, local fishing communities and/ their practices and businesses.

The purpose of the project is to improve the infrastructure base at the Port of Takoradi in order to:

- eliminate the current draft restrictions that lead to time consuming barge operations;
- enable the port improve on the efficiency of handling dry bulk cargo- export of manganese and bauxite and import of clinker; and
- enable the port provide the required space and services to the oil and gas industry.

In keeping with statutory regulations of the country and in line with the Ghana Environmental Assessment (EA) procedures, GPHA has carried out an Environmental and Social Impact Assessment for the proposed project and obtained an environmental permit from the Ghana EPA.

The final EIS was reviewed by the Overseas Private Investment Corporation (OPIC), who requested for the preparation of a Dredging Management Plan to guide the dredging activities to be carried out.

1.2 Objectives

The purpose of this Dredging Management Plan is to provide details on the environmental management aspects of the dredging and spoil disposal activities to be undertaken as part of the Takoradi Port Infrastructure Development Project. It details the environmental management and monitoring that will be implemented throughout the dredging and spoil disposal program to be undertaken by Messrs Jan De Nul, contracted by the GPHA, as part of the Infrastructure Development Project.

The specific objectives of Company's Dredging Management Plan are to:

1. Reduce impacts of dredging on the marine life and water quality;
2. Reduce sediment (turbid plume) mobilisation during dredging; and
3. Propose appropriate disposal methods for dredge material.

1.3 Proposed Construction Activities (including Dredging)

The Master Plan being prepared by Messrs Sellhorn and HPC indicates that the completion of the projects up to the Phase 3 activities, which is expected to be completed/ operational in 2018 will cover the following activities:

- Extension of the main breakwater by 1,150m;
- Deepening of the access channel to -14.5m CD;
- Dredging of a new 500m turning basin;
- Construction of two harbour basins in the north of the existing main pier;
- Construction of
    - a deep water pier with 780m of berths for dry bulk and 260 m for liquid bulk
    - a total of 1,050m of container and multipurpose berths
- Reclamation of 48 ha of terminal area at the new harbour basins;
- Building of a state-of-the art container terminal including a 7.5ha devanning area;
- Relocation of the mechanical workshop, storage yard for imported vehicles, and the manganese yard;
- Construction of 3.2 ha of new sheds;
- Preparation of 6.5 ha storage and working area for the oil and gas service industry;
- Improvements of access roads, internal roads and gates; and
- Relocation and rehabilitation of railway tracks.

Upon completion of the projects, the traffic flows through the new port arrangement separate container and non-container traffic. The proposed traffic management thus avoids crossings between railroad and truck traffic.

The outlook is further illustrated in **Figure 1**.

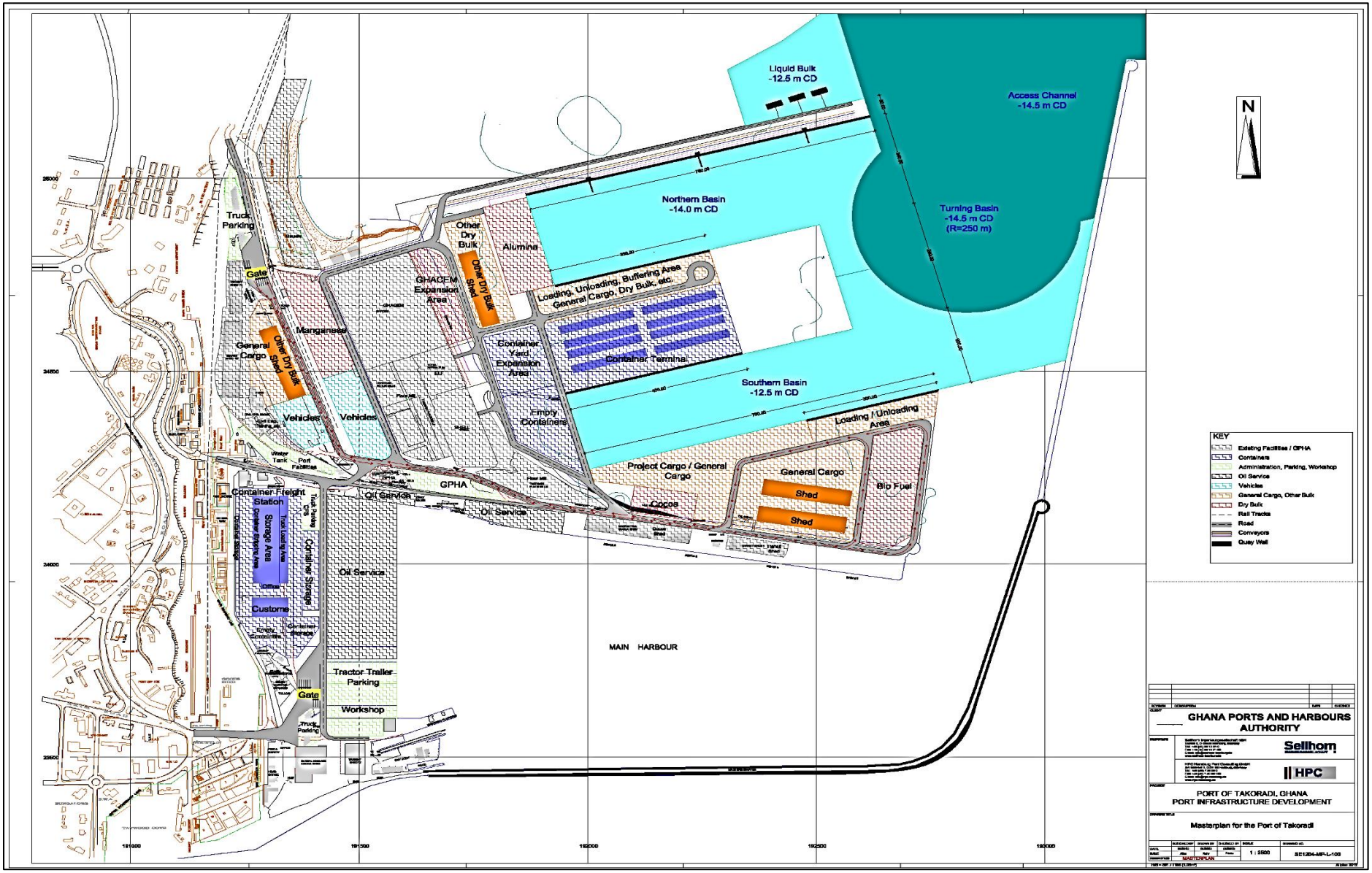


Figure 1: Outlook of the Port of Takoradi Development as of 2018 (Phases 1, 2 and 3)

2.0 DESCRIPTION DREDGING AND DISPOSAL METHODS

2.1 Location

The proposed site for the dredging activity site is located in Ghana at the gulf of Guinea immediately north of the port of Takoradi. The existing port, constructed by the British in the 1920's, is situated 180 km south west of Accra and 150 km east of the border with Ivory Coast. The total project covers an area of 4 km^2 (2x2 km). The actual water depth in the project area varies between -3m and -14m CD.

The dredging will also result in a new turning basin with a diameter of about 500m and a depth of 14.5m to allow safe turning of vessels with a maximum Length over all (LOA) of 250m with tugboat assistance.

2.2 Dredging Methodology and Equipment

It is proposed to dredge the port basin to a draft of between -14m and -16m CD to ensure that the water depths in the harbour basin and at the berths become generally sufficient for safe manoeuvering. Based on various studies carried and the design considerations, it is proposed to dredge the entrance channel of the port to -14.5m CD.

It is proposed the dredging will be carried out by means of a cutter suction dredger (CSD). The operation of the CSD is illustrated in Figure 2.

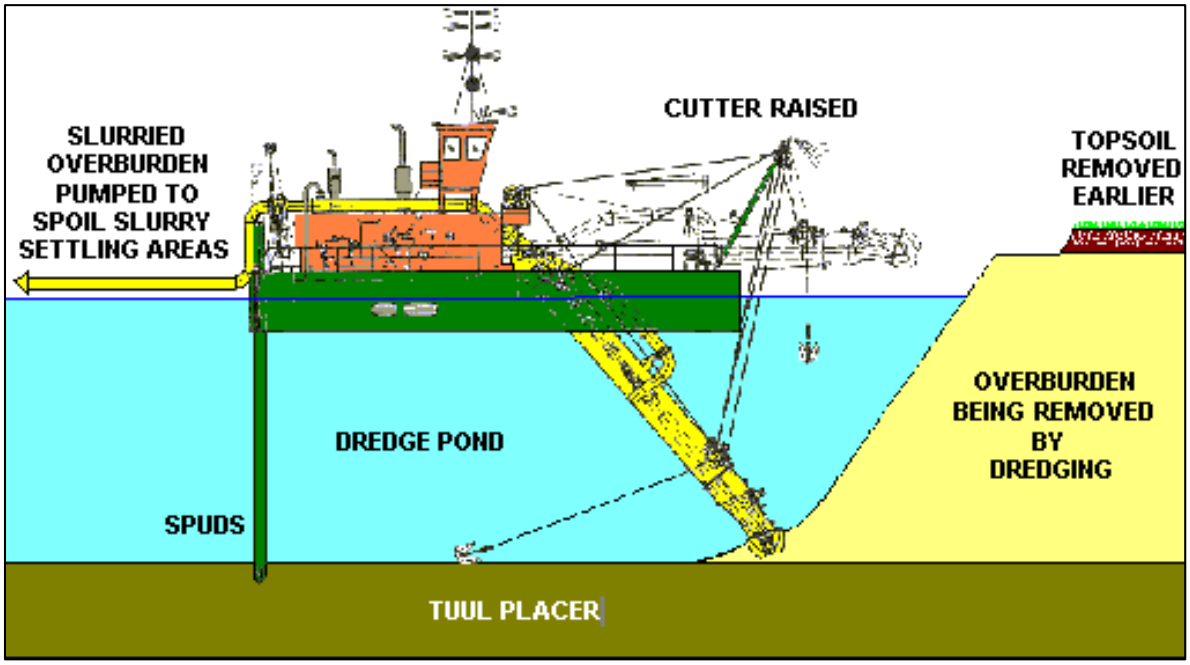


Figure 2: Schematic diagram of the operation of the CSD (Source: MISFITS' ARCHITECTURE)

The CSD is equipped with a rotating cutter head, which is able to cut hard soil or rock into fragments. The cutter head is a rotating mechanical device, mounted in front of the suction head and rotating

along the axis of the suction pipe. The cut soil is then sucked in by dredge pumps. CSDs cut the soil according to a pre-set profile. The dredged material is then pumped ashore using pumps and a floating pipeline or loaded into a split hopper barge moored alongside, which in turn can then offload the dredged sediment at the designated location. The cutting action of a CSD is powerful and, combined with the suction action, the material can be 'cut' into suitably sized pieces. These pieces are then sucked into the suction pipe as a solid/water slurry (70% water and 30% solids) and pumped to the surface using pumps mounted on a structural device which extends towards the seabed known as 'the ladder'.

2.3 Disposal / Reclamation Management

Overall, it is expected that over $12x10^6$ m^3 of dredge material (solid/water slurry) will be taken out of the of sea bed based on an estimated area of 2km x 2km and an average depth of 4m.

Direct dredging by CSD is expected 3,227,000 m^3 of solid material. Blasting, drilling and dredging is also expected to yield 410,500 m^3 of solid material. It is expected that the dredged material would be good enough as reclamation material, and would therefore not be "cut to spoil" but to be reused for reclamation purposes. Land reclamation works will require about 4,370,000 m^3 of fill material. The dredge materials therefore falls short of the reclamation requirements by 1,143,000 m^3. Additional fill materials will therefore be obtained from quarry sites to supplement the dredge materials to be obtained.

2.3.1 Disposal of Dredge Material

A major activity under this project will be the reclamation of the log pond and the northern side of the port to extend to the current location of the Fisheries Department Workshop. It is expected to use the whole dredge material to reclaim the area adjacent to the Fisheries Department Workshop and midway between the workshop and the New Takoradi landing beach.

The dredge material will be devoid of any heavy metal contaminants since the sediments will be scooped for disposal at STMA designated landfill site before dredge materials will be used.

Measures outlined in Table 11 will be implemented to ensure the marine environment is not contaminated as a result of dredging and reclamation activities.

It is noted that the reclamation of the coastline will be tackled during the latter stages of the proposed project and will therefore afford GPHA and the EPC contractor adequate time to fashion out relocation options for the fisheries department workshop and the boat berthing area. The available options under consideration include relocating the existing workshop and berthing area to Albert Bosumtwi-Sam Fishing Harbour in Sekondi or building a new landing site with berthing facility for bigger vessels at New Takoradi beach.

3.0 EXISTING MARINE ENVIRONMENT

3.1 General Description

The Port of Takoradi is located at a cape, with the western part formed with a rock or reef while the northern coast is sandy beach. The slope of the sea bottom is about 1% judging from about 10m fall in 0.9km distance from the shoreline (JICA/ GPHA, 2002).

The main breakwater is located on the southern side of the Port of Takoradi and extends about 1.5km offshore in the eastwards direction, and extending further in a north-north-east direction to a distance of about 0.7m. **Figure 3** shows the current state of the Port of Takoradi.

3.2 Marine Conditions

The Port of Takoradi is influenced by the conditions of the Atlantic Ocean and the Monsoon winds.

3.2.1 Currents

The hydrography of the port area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans. The major currents influencing the area include (i) the Canary current from the north which splits into the North Equatorial Current and a coastal current which feeds the Guinea Current, and (ii) the Benguela Current which flows northwards and extends into the Gulf of Guinea as the South Equatorial Current as shown in **Figure 4**.

The Guinea Current which is the main current in the port area flows eastwards throughout the year over its whole length and obtains velocities close to $1.0ms^{-1}$. 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. In the Takoradi port itself, due to breakwater, current velocities have been significantly reduced to aid in vessel movements.

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 $1ms^{-1}$, but are responsible for transporting large volumes of littoral sediments and also for rip currents which are more localized in their action, but move appreciable amount of sediments away from the coast.

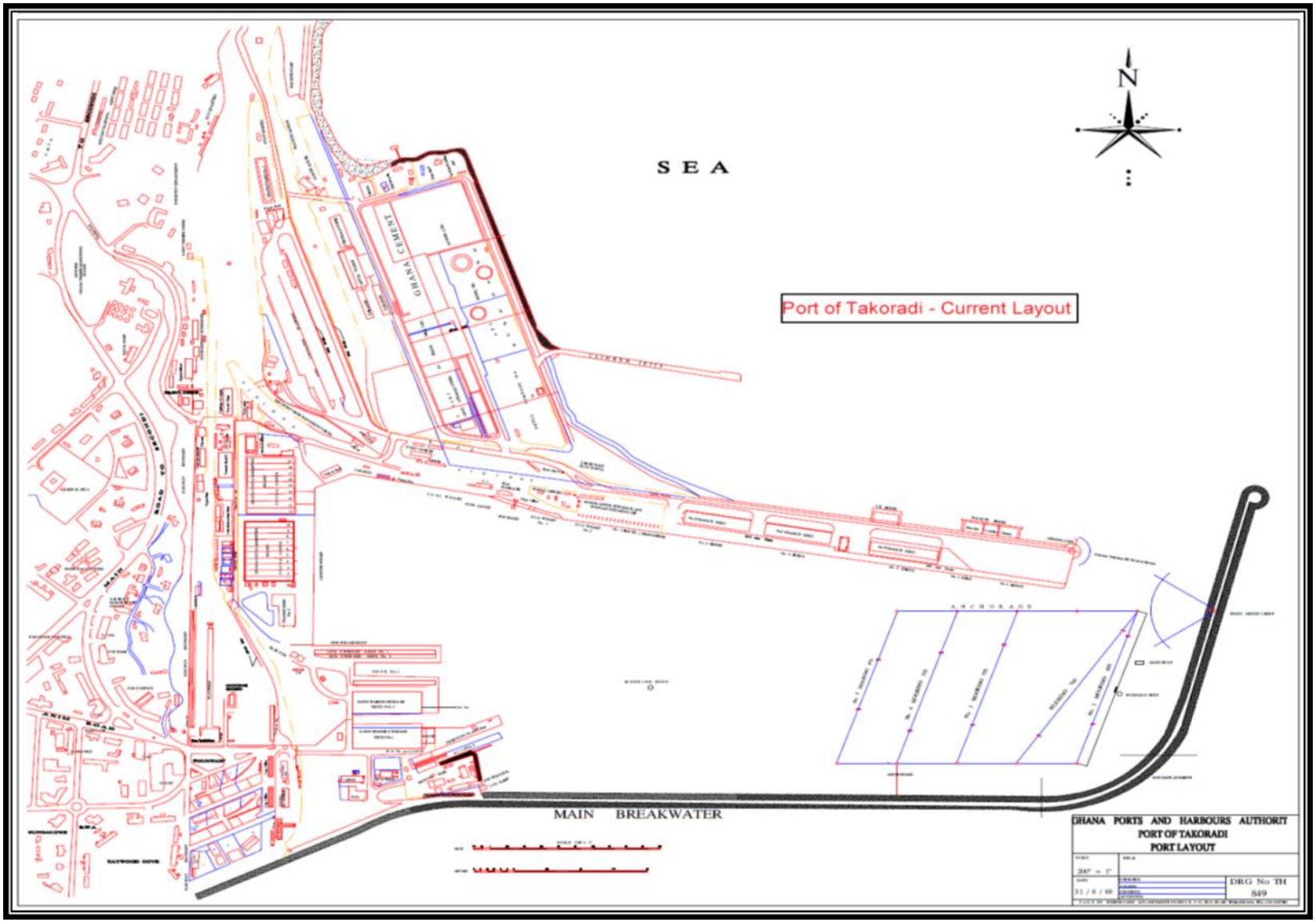


Figure 3: Current Layout of the Port of Takoradi

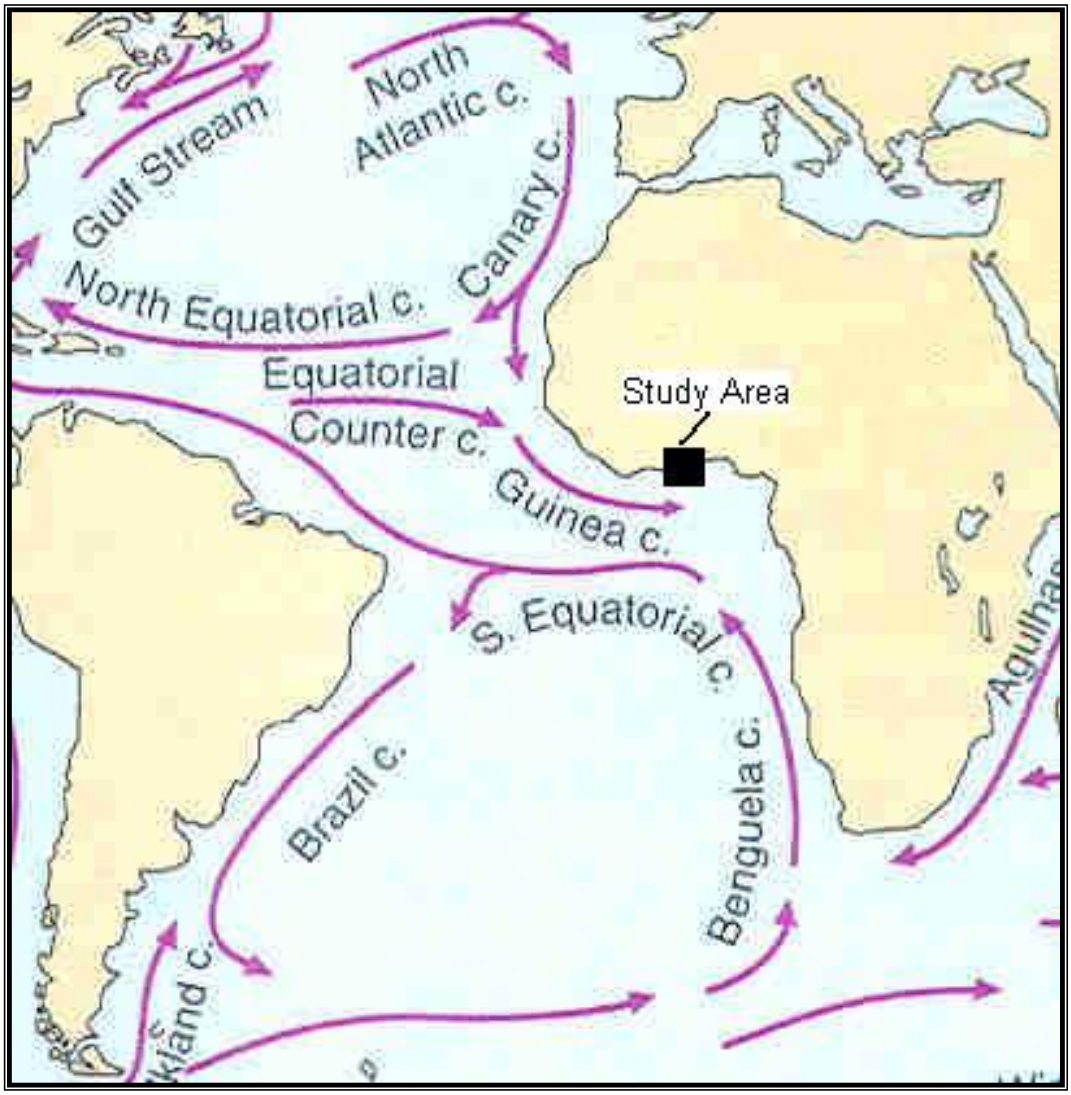


Figure 4: Major current systems influencing the Gulf of Guinea

3.2.2 Tide Levels and Tidal Current

The tide in Ghana has semidiurnal pattern with two high and two low tide levels each day. There is no time difference between the Ports of Takoradi and Tema. The annual tidal predictions are computed and published by GPHA and the highs and lows are as shown in **Table 1**.

Table 1: Tide Level of Port of Takoradi

Tide Level, m			
MHWS	**MHWN**	**MLWS**	**MLWN**
1.5	1.2	0.6	0.2

It is estimated that the velocity of the tidal current is generally less than 0.1m/s but could go up to 0.5m/s.

Waves

The coast is open to south-westerly and south-south-easterly long swells induced by fetches in the South Atlantic Ocean. The coast within the AOI is subject to low wave intensity, dominated by swells with periods of 11-16 seconds. The most common amplitude of waves in the region is 1.0m but annual significant swells could reach 3.3m in some instances. Swells attaining heights of 4.8-6.0 m, however, occur with a 10-20 year periodicity. The peak wave period for the swells generally falls in the range of 7s to 14s. The swell wave direction is almost always south or south-west (**see Figure 5**). Results of statistical analyses as regards wave height exceedance and extreme value analysis are summarized in **Tables 2 and 3** respectively.

Table 2: Offshore Wave Height Exceedance Statistics

Heights (m)	Exceedance (%)
<1.0	82.8
<1.5	23.0
<2.0	3.0
<2.5	0.1
3.0	0.0

Table 3: Extreme Offshore Waves

Return Period (yrs)	Extreme Heights (m)
10	3.0
20	3.2
50	3.4

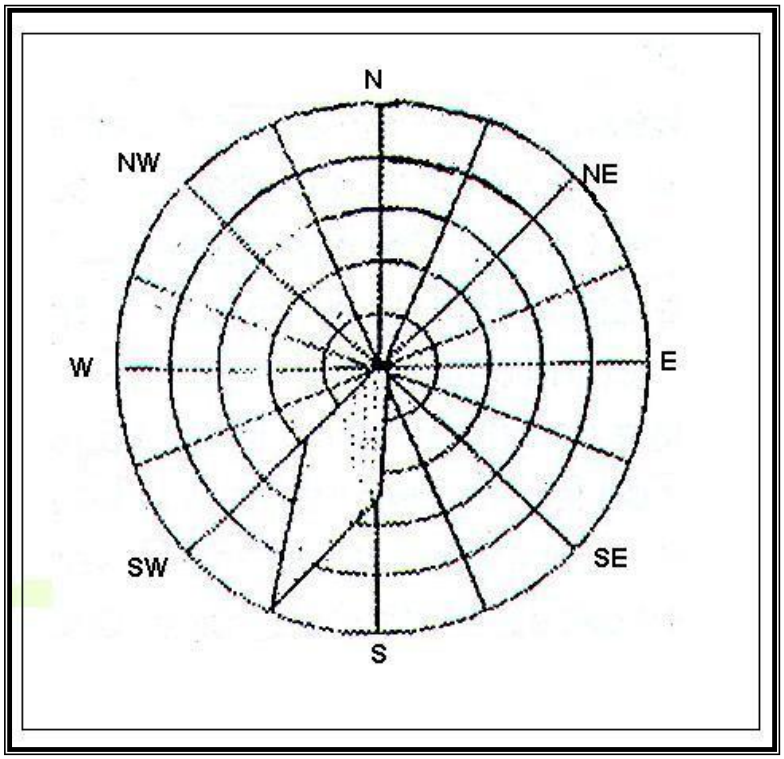


Figure 5: Wave rose indicating predominant swell wave direction

Other observations on the wave climate include a long swell of distant origin and with wavelengths varying between 160m and 220m. This swell has a primary period of 12 seconds and a relatively regular averaged height between 1m and 2m. The swells generally travel from southwest to northeast.

3.2.3 Tidal variations

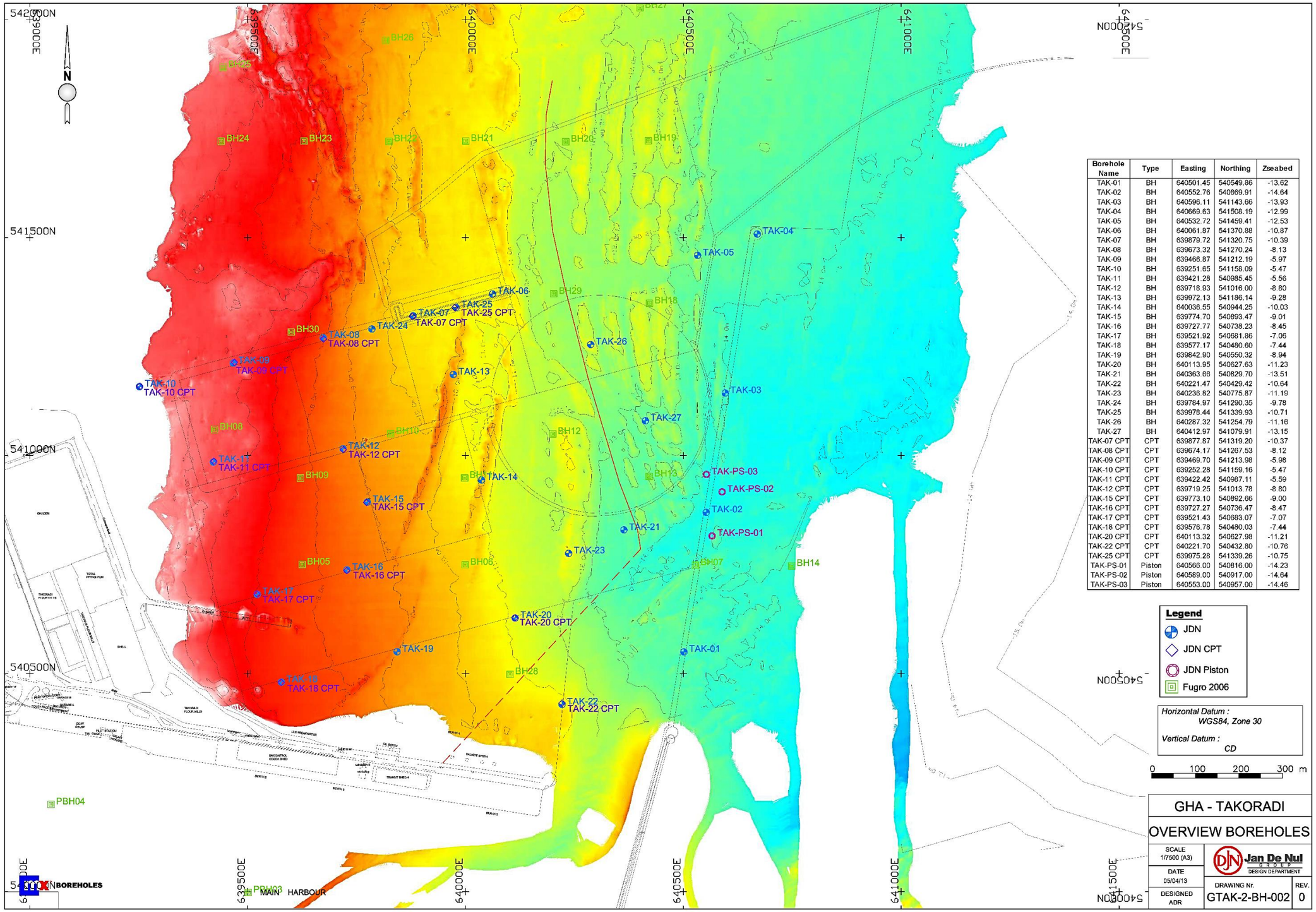
GPHA publishes annual tidal tables for Takoradi, Tema and other Ghanaian ports. The Takoradi port is the reference port for these tables and is located on Lat 4^0 53' N and Long 1^0 45' W. Normally, there are two high tides and two low tides daily which are an average of six hours apart. Usually the lowest low tide levels in the year occur in February and March. According to the Tide Table 2012 released by GPHA, the low tides this year ranges from 0.10m to 0.91m while the high tides range from 1.15m to 1.91m.

3.2.4 Bathymetric Conditions

The result of the bathymetric survey carried out by Messrs Jan de Nul (JDN) in 2013 is shown in the bathymetric map in **Figure 6**.

A few important features can be seen in the new bathymetry:

- For the total area there is a gentle slope from -15 mCD to 0 mCD (coastline)
- Clear set of N-S oriented sandbars in the zone between -11 mCD and -16 mCD
- A number of narrow NW to NE oriented slightly curved ridges in the zone between -11 mCD and -5 mCD.



Borehole Name	Type	Easting	Northing	Zseabed
TAK-01	BH	640501.45	540549.86	-13.62
TAK-02	BH	640552.76	540869.91	-14.64
TAK-03	BH	640596.11	541143.66	-13.93
TAK-04	BH	640669.63	541508.19	-12.99
TAK-05	BH	640532.72	541459.41	-12.53
TAK-06	BH	640061.87	541370.88	-10.87
TAK-07	BH	639879.72	541320.75	-10.39
TAK-08	BH	639673.32	541270.24	-8.13
TAK-09	BH	639466.87	541212.19	-5.97
TAK-10	BH	639251.65	541158.09	-5.47
TAK-11	BH	639421.28	540985.45	-5.56
TAK-12	BH	639718.93	541016.00	-8.80
TAK-13	BH	639972.13	541186.14	-9.28
TAK-14	BH	640036.55	540944.25	-10.03
TAK-15	BH	639774.70	540893.47	-9.01
TAK-16	BH	639727.77	540738.23	-8.45
TAK-17	BH	639521.92	540681.86	-7.06
TAK-18	BH	639577.17	540480.60	-7.44
TAK-19	BH	639842.90	540550.32	-8.94
TAK-20	BH	640113.95	540627.63	-11.23
TAK-21	BH	640363.66	540829.70	-13.51
TAK-22	BH	640221.47	540429.42	-10.64
TAK-23	BH	640236.82	540775.87	-11.19
TAK-24	BH	639784.97	541290.35	-9.78
TAK-25	BH	639978.44	541339.93	-10.71
TAK-26	BH	640287.32	541254.79	-11.16
TAK-27	BH	640412.97	541079.91	-13.15
TAK-07 CPT	CPT	639877.87	541319.20	-10.37
TAK-08 CPT	CPT	639674.17	541267.53	-8.12
TAK-09 CPT	CPT	639469.70	541213.98	-5.98
TAK-10 CPT	CPT	639252.28	541159.16	-5.47
TAK-11 CPT	CPT	639422.42	540987.11	-5.59
TAK-12 CPT	CPT	639719.25	541013.78	-8.80
TAK-15 CPT	CPT	639773.10	540892.66	-9.00
TAK-16 CPT	CPT	639727.27	540736.47	-8.47
TAK-17 CPT	CPT	639521.43	540683.07	-7.07
TAK-18 CPT	CPT	639576.78	540480.03	-7.44
TAK-20 CPT	CPT	640113.32	540627.98	-11.21
TAK-22 CPT	CPT	640221.70	540432.80	-10.76
TAK-25 CPT	CPT	639975.28	541339.26	-10.75
TAK-PS-01	Piston	640566.00	540816.00	-14.23
TAK-PS-02	Piston	640589.00	540917.00	-14.64
TAK-PS-03	Piston	640553.00	540957.00	-14.46

Figure 6: Bathymetric Conditions in the Port of Takoradi

3.3 Geological Condition

3.3.1 Earlier Studies

As part of the planned major rehabilitation and development works of the ports in Ghana, GPHA carried out geotechnical site investigations:
During the planning of this project all previous executed soil investigations were gathered and studied. A list of all available data can be found below.

- 1992 BOSKALIS, geotechnical site investigation, 8 boreholes in the existing port
- 2002 JICA, development study, 2 boreholes in the existing port & seismic survey
- 2006 FUGRO, geotechnical site investigation, 32 boreholes in the new project area and a sandsearch with 21 vibrocores along the coast.

The studies revealed 2 distinct rock types in the port area as follows:

- strongly lithified arkosic sand - (A1) and siltstones (A2) in which weathering and fracturing is not very severe.
- Secondly a carbonate cemented quartz sandstone (B1) that grades into sandy clay.

A1: Dark red micaceous arkosic (rich in feldspar) fine sandstone, sub horizontally layered and poorly bedded. Coarser lenses of medium sandstone are intercalated. Highly compacted and hard. Grains are coated with iron oxide and pores are filled with clay minerals.

A2: Purple-green banded clayey very fine sandstone with quartz concretions, sometimes with reduction spots. Clay content variable. Coarse arcosic sandstone bands of 2-4 cm. Bands with quartz concretional breccia components.

B1: Predominantly pale green & light brown carbonate cemented sub rounded well sorted fine quartz sandstone with foraminifera. Sub horizontally layered. Thin irregular bands of blue – green clay are intercalated. To the top it grades into sandy clay with some amorf SiO2 breccia components.

Rock types A1 and A2 are very lithified, indicating a period of subsurface diagenesis. The process of lithification has produced a hard rock. The clayey part of these rocks is however less resistant. Within these zones shearzones developed, giving the rock a very anisotropic character. After this diagenesis rocktypes A1 and A2 were lifted up to the surface. Quartz sands were deposited in the vicinity of rock types A1 and A2. The field relation of these rocks is not clear. The sand is not significantly compacted but its cohesion is derived from carbonate cementation. This together with the occurrence of marine foraminifera indicates a marine environment

Based on the above information, the conclusion was reached that the seabed material can be dredged using available cutter suction dredgers; some small portion may need to be blasted.

3.3.2 Recent Studies

Further geotechnical studies were carried out by JDN in 2013. Initially 23 boreholes and 8 CPT's were planned. See the original borehole location plan in annex 1. During the execution of the campaign 4 extra boreholes were added. Borehole TAK-02 was cancelled so in total 26 boreholes were drilled

(TAK-01 till and TAK-27).

Borehole TAK-02 was cancelled due to a combination of factors. The water depth on location TAK-02 was close to the operational limit of the jack-up. This together with a penetration of the spud legs of more then 1 meter in the seabed made it not safe to perform a borehole on this location. Boreholes TAK-24 and TAK-25 were added on the location of the quay wall, respectively in between TAK-08 / TAK07 and TAK07 / TAK-06. Both boreholes were drilled up to -30 mCD to give extra information from underneath the planned construction. Borehole TAK-23 was moved from its original position to check the boundary between sand and mudstone and to get an idea about the consistency of the ridges in the dredge area. TAK-26 and TAK-27 were added as well to check the location of the sandstone / mudstone boundary.

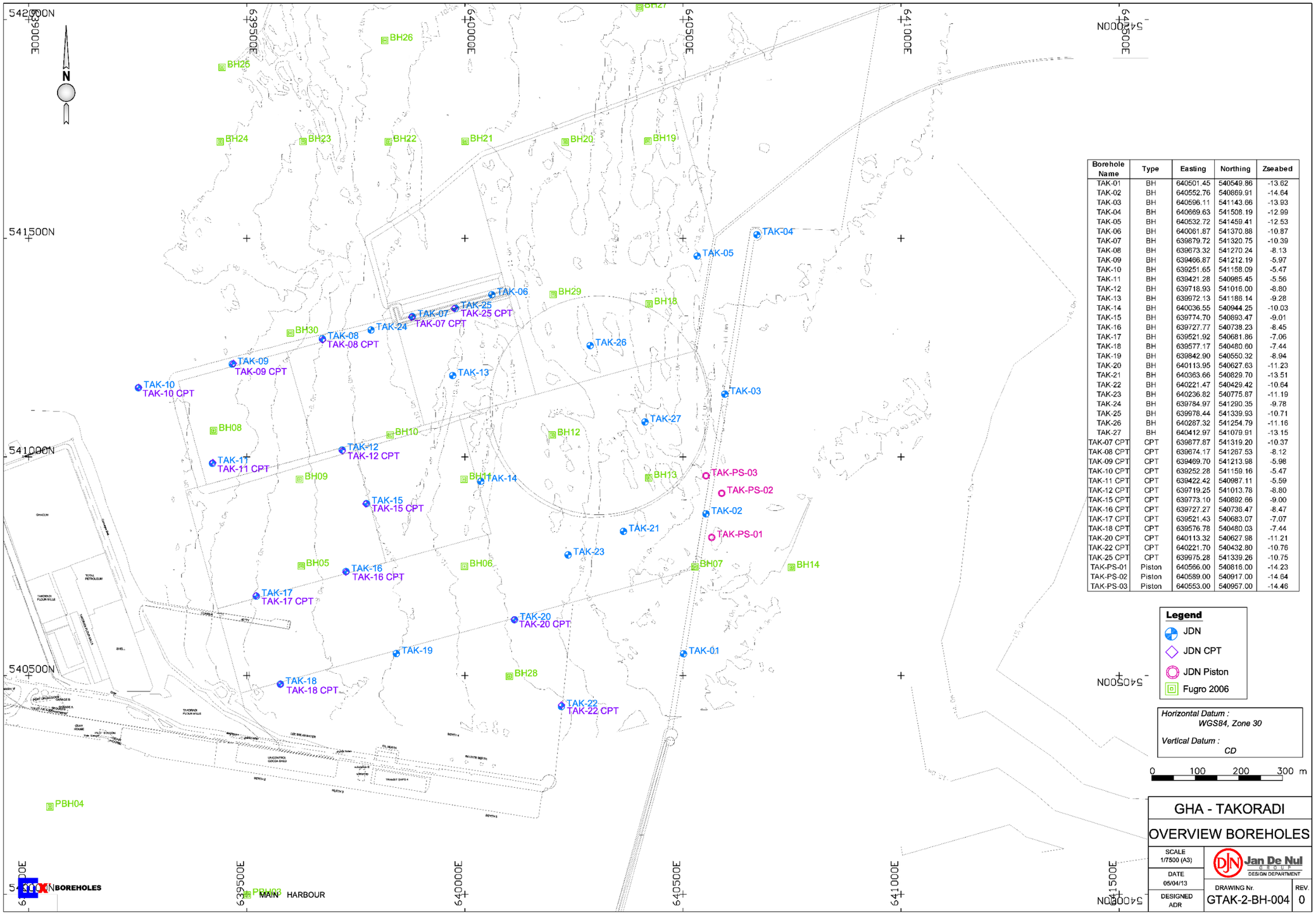
If drilling confirmed the presence of a soft top layer of more than 1 m in thickness a Cone Penetration Test (CPT) was done. In total 13 CPT tests were performed. A map with the as build locations of all boreholes can be found in **Figure 7**.

Results

In general the geology in the project area is build up of sandstone and mudstone / siltstone as realized from the earlier studies. In the eastern part there is a top layer of very soft clay underlain by bedrock consisting of mudstone / siltstone. The transition zone between top layer and bedrock is rather thin. The soft clay gradually changes into stiff clay with gravel (average thickness 1 – 2 m, maximum thickness of 4 m). Sometimes the soft clay also lays directly on top of the bedrock.

In the western part the top layer is less thick or nonexistent and consists of loose to very dense sand to soft silt mixed with gravel. In this part the bedrock consists of sandstone.

The report on the soil investigation by JDN is provided as **Annex 12** of the EIS.



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TAK-18 CPT	CPT	639576.78	540480.03	-7.44
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TAK-PS-02	Piston	640589.00	540917.00	-14.64
TAK-PS-03	Piston	640553.00	540957.00	-14.46

Figure 7: Location of boreholes for soil investigation studies

3.4 Water Quality

Water quality studies of the port basin carried out in February 2001 at four different locations revealed moderately polluted conditions but without any significant difference between the sampling locations in the port. The report indicated that oil/grease concentration were in excess of the Assumed Environmental Criteria (AEC) in the absence of a coastal water quality standards for Ghana and that management of oil spill and leakage should take the first priority for water quality management in the Port of Takoradi.

The water quality of the port waters at four (4) different locations was carried out in October 2012. The samples were taken from the following locations using standard sampling techniques:

(i) Fisheries Workshop Area (F),
(ii) Wharf area (W),
(iii) Manganese Berth (M) and
(iv) mini Log Pond (L).

The samples were analysed at the research laboratories of the CSIR- Water Research Institute. Specified methods as laid in "Standard Methods for the Examination of Water and Wastewater" published jointly by the American Water Works Association (AWWA), American Public Health Association (APHA) and the Water Environment Federation (WEF) 20th Edition, 1998 were followed, and the results are as s shown in **Table 4**.

Figure 8 shows the monitoring points for both water quality and air/ noise level assessment.

Figure 8: Water and Ambient Air/ Noise Quality Sampling Locations

Table 4: Water Quality Results- Port of Takoradi, October 2012

Parameter	Unit	F	W	M	L
Turbidity	NTU	12.5	1.50	2.00	3.60
Colour (apparent)	Hz	7.50	2.50	5.00	5.00
pH	pH Units	7.83	7.72	7.76	7.69
Conductivity	µS/cm	52600	52300	52700	52800
Total Suspended Solids (TSS)	mg/l	5.00	1.00	2.00	2.00
Total Dissolved Solids (TDS)	mg/l	28930	28765	28985	29040
Sodium	mg/l	12250	12450	11300	13150
Potassium	mg/l	400	443	400	398
Calcium	mg/l	1202	721	561	2405
Magnesium	mg/l	2599	4568	2332	2379
Total Iron	mg/l	0.477	0.243	0.276	0.308
Ammonium (NH_4-N)	mg/l	<0.001	<0.001	<0.001	<0.001
Chloride	mg/l	17867	16874	21341	19852
Sulphate (SO_4)	mg/l	1428	963	1010	2095
Phosphate (PO_4 - P)	mg/l	0.550	0.326	0.638	0.589
Manganese	mg/l	0.074	0.042	0.048	0.071
Nitrite (NO_2-N)	mg/l	0.032	0.028	0.044	0.033
Nitrate (NO_3-N)	mg/l	0.074	0.043	0.035	0.069
Total Hardness	mg/l	13700	20600	11000	15800
Total Alkalinity	mg/l	133	132	124	131
Calcium Hardness	mg/l	3006	1804	1403	6012
Magnesium Hardness	mg/l	10694	18796	9597	9788
Fluoride	mg/l	0.220	0.176	0.167	0.125
Bicarbonate	mg/l	98.8	116	67.6	97.0
Carbonate	mg/l	34.4	16.4	56.4	34.0
BOD	mg/l	3.40	1.10	1.30	1.20
COD	mg/l	20.9	8.60	9.60	11.4
Oil/ Grease	mg/l	1.25	<1.00	<1.00	<1.00
Zinc (Zn)	mg/l	0.053	0.064	0.066	0.055
Lead (Pb)	mg/l	0.306	0.305	0.312	0.305
Cadmium (Cd)	mg/l	0.095	0.096	0.095	0.096
Copper (Cu)	mg/l	0.095	0.060	0.126	0.105
Total Coliform	cfu/100ml	470	210	180	290
Faecal Coliform	cfu/100ml	66	28	44	59

Source: Laboratory (CSIR- WRI), October 2012

The results showed:

- Typical port water quality regime with excessive anion and cation concentrations;
- Oil/ Grease showed lower concentrations of <1.00mg/l to 1.25mg/l (at the Fisheries Department Workshop area (F) confirming the impact of premix fuel dispensing into the ocean;
- This is also reflected in the COD values with the highest value of 20.9mg/l being recorded at Fisheries Department Workshop area (F);
- Magnesium hardness is rather excessive at the Wharf area (W);
- Zinc, Lead, Cadmium and Copper recorded relatively lower levels without much variations; and
- Coliform levels were also elevated.

3.5 Bottom Sediment Quality

The most recent study of marine sediment quality for the Takoradi port was carried out by JICA, on behalf of GPHA, in 2002.

The study confirmed contamination of the bottom sediments in the port basin especially the innermost part which showed severe pollution both in organic matter and heavy metals. The JICA report further indicated that the innermost part of the port showed the most severe pollution both in organic matter and heavy metals, with COD and Lead and Mercury showing levels in excess of the AEC for sediments. The implication is that dredging and consequent disposal of the dredged silt will require careful consideration to prevent contamination.

Sediment Quality of the nearby Albert Bosomtwi Sam Fishing Harbour

JICA also conducted an extensive of sediment quality at the nearby Albert Bosomtwi Sam Fishing Harbour in 2014. The Harbour is approximately 20 km west of the Takoradi Port, and adjacent to the Sekondi Naval Base.

The characteristics of the sediment from the two locations are expected to be similar since they fall within the same marine environment. It must however be noted that the metal concentration represent a conservative, yet relevant, approximation of the Takoradi Port Basin Environment due to higher level of activity and the handling of potentially toxic cargo.

Sample Sites

Seabed load samples were collected from seven locations as shown in **Figure 9** and described in **Table 5**. Samples S-1, S-2 and S-3 were within the port basin, while the remainder were in the nearby environment.

Table 5: Sample sites for sediment quality analysis

Sampling Site	Co-ordinate		Water Depth (m)
	Longitude	Latitude	
S-1	1˚42’25.663”	4 ˚ 56’20.745”	1.4
S-2	1 ˚42’29.110”	4 ˚56’29.92”	3.6
S-3	1 ˚42’21.429”	4 ˚56’29.135”	3.8

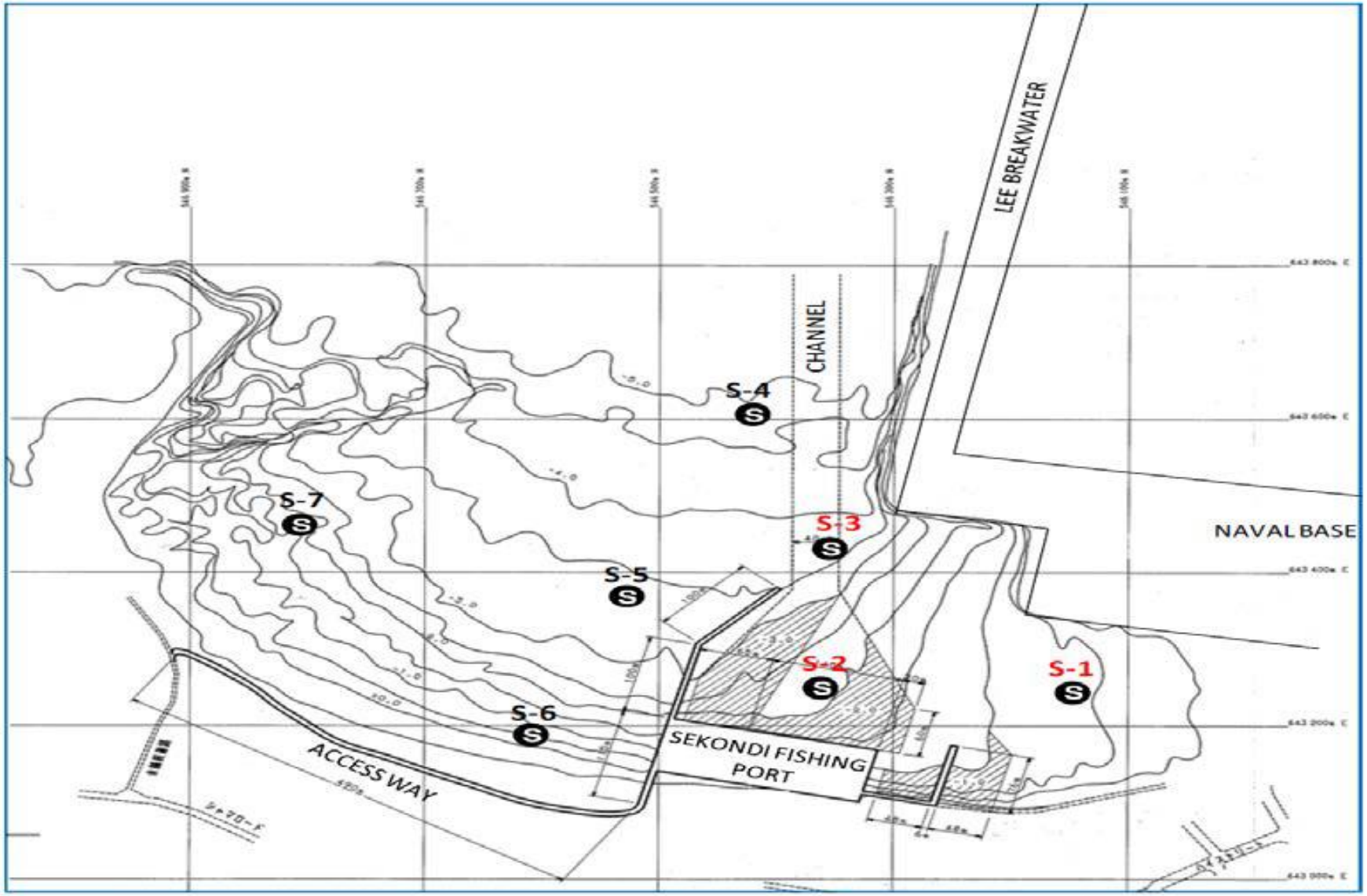

Figure 9: Sampling locations for sediment analysis

Results of Laboratory Analysis

The laboratory results for the heavy metal concentration are shown in **Table 13**.

Table 6: Seabed Material Survey Result (Heavy Metal Contents)

Item	S-1 (Old Beach)	S-2 (In Harbour)	S-3 (Entrance)	Canadian Interim sediment quality guidelines (ISQGs)
Total Nitrogen (mg/kg)	210	135	105	-
Total Phosphorus (mg/kg)	91	20.5	26.5	-
Total Sulphur (g/kg)	127	129	135	200
Arsenic (mg/kg)	2.5	<0.025	<0.025	7.24
Cadmium (mg/kg)	0.75	1.25	0.50	0.70
Chromium (mg/kg)	<0.025	25.0	25.0	52.3
Copper (mg/kg)	5.50	6.75	4.25	18.7
Lead (mg/kg)	15.3	26.5	23.3	30.2
Mercury (mg/kg)	0.25	6.00	3.00	0.13
Nickel (mg/kg)	<0.025	<0.025	<0.025	-
Zinc (mg/kg)	15.5	25.3	16.5	124
DDT (µg/kg)	0.621	0.675	4.054	-

The results indicate that metal concentration within the port basin (at S1, S2 and S3) were within the Canadian Interim sediment quality guidelines (ISQGs) for the parameters measured except mercury and Cadmium.

As stated earlier, this represents a conservative, yet relevant, approximation of the sediment quality within the Takoradi Port Basin.

Dredged materials will therefore need to be treated prior to disposal.

3.6 Littoral Drift

In the port area, considerable sand accretion has occurred along the main breakwater. The accreted sand seems to have come from the southern end of the port. 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 $1ms^{-1}$, but are responsible for transporting large volumes of littoral sediments and also for rip currents which are more localized in their action, but move appreciable amount of sediments away from the coast.

3.7 Air Quality and Noise

3.7.1 Ambient Air Quality

Previous air quality studies in and around the port in August 2001 showed no major variation from what pertains in the metropolis although the nuisance from dust released from the clinker operations by GHACEM generally pollute the immediate surroundings of that area in the Port of Takoradi. Similarly, the manganese jetty and cocoa shed area also have excessive dust levels though within the

EPA Ambient Air Quality Guideline (AAQG) values.

Similarly, the August 2001 study showed that noise in the port area and surrounding commercial/ industrial area were all below the EPA Ambient Noise Quality Guideline (ANQG) values.

As part of the EIA study, ambient air quality assessment was carried out on 26th September 2012 at three (3) monitoring sites at the port as shown in **Figure 8**.

The monitoring sites are described as A1, A2 and A3 and described as follows:

- A1: Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station;
- A2: Around the Ghana Manganese Company Loading Point away from the Berth; and
- A3: Around the Fisheries Department Workshop Area.

The main objective of the air quality assessment was to determine the baseline ambient air quality levels of Total Suspended Particulate (TSP), Respirable Dust (PM_{10}), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide (CO) to provide a basis for determining the ambient air quality regime at the Port of Takoradi.

Sampling Equipment and Methodology for Particulate Matter

The active principle sampling mechanism was employed in which portable motor-driven SKC Hi-volume dust samplers were installed at each sampling site. The equipment was calibrated in the field prior to use. Background samples were collected for 24 hours on pre-weighed glass fibre filters. These were re-weighed after the sampling in order to determine the weight difference. The flow rate of the sampler was set at 5 $Lmin^{-1}$.

The individual samples were gravimetrically analyzed using the formula given below:

$$TSP/PM_{10}\ (\mu gm^{-3}) = \frac{W_2 - W_1}{Fr \times T} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:
TSP = Total suspended particulate
PM_{10} = Respirable dust
W_1 = Weight of glass fibre filter before sampling
W_2 = Weight of glass fibre filter sampling
Fr = Flow rate (5 $Lmin^{-1}$)
T = Sampling duration in minutes

Sampling Equipment and Methodology for Noxious Gases

The levels of Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide in the ambient air were determined using dragger diffusion tubes, at standard conditions of pressure and temperature (1013kPa, 273K). The concentrations of the gases were obtained using internet conversion software (*www.cdc.gov/niosh/docs/2004-101/calc.htm*) that is also related to the formula:

$[mgm^{-3}]$ = [ppm] x gas density (at standard conditions)……(2)

Result of Air Quality Assessment

The results of the air quality assessment are as shown in **Table 5**.

Table 7: Results of Air Quality Assessment at the Port of Takoradi- September 2012

Sampling Point ID	Sampling Site Description	TSP μgm^{-3}	PM_{10} μgm^{-3}	SO_2 μgm^{-3}	NO_2 μgm^{-3}	CO mgm^{-3}
A1	Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station	200.0	25.0	< 0.0005	N.D*	5.73
A2	Around the Ghana Manganese Company Loading Point away from the Berth	205.0	30.0	< 0.0005	N.D*	4.58
A3	Around the Fisheries Department Workshop Area	220.0	30.0	< 0.0005	N.D*	4.58
EPA Ambient Air Quality Guidelines for Industrial Areas over 24 hours		**230**	**70**	**150**	**150**	**10****

N.D* = Not detected **CO guideline value over 8 hours

The following observations can be made from **Table 11**:

- The TSP for the three sampling sites range from 200.0µgm-3 to 220.0µgm-3 which are within the EPA's maximum permissible level of 230µgm-3 and showed elevated levels of ambient dust around the port;
- The PM10 levels for the sampling site ranged from 25.0µgm-3 to 30.0µgm-3, which is lower than EPA's guideline of 70µgm-3.
- The ambient concentration of SO_2 and CO were all within the maximum permissible levels. NO2 was not detected during the sampling period while SO2 was <0.0005 µgm-3 at all the sampling locations within the port;
- The predominant average wind speed was 0.64 ms-1, blowing from the South Western to the North Eastern direction.

3.7.2 Noise Levels

Noise levels assessment was carried out simultaneously with dust levels at the same sampling sites (see **Figure 8**) using the Quest Integrated Sound Level Meter type 2900 with data logging system. The instrument was positioned at a height of 1.2 meters above ground. The meter was calibrated prior to monitoring and the data logged at 3 seconds interval. The results of the noise level assessment are summarized in the **Table 6**.

Table 8: Results of Noise Level Assessment at the Port of Takoradi- September 2012

Sample ID	Sampling Site	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
A1	Cargo Truck Parking Area between the roundabout leading to the GPHA Office Building and the Railway Station	63.0	82.3	48.9	65.4	59.1	54.4
A2	Around the Ghana Manganese Company Loading Point away from the Berth	67.0	82.7	57.8	63.6	60.9	59.9
A3	Around the Fisheries Department Workshop Area	63.0	82.7	57.8	63.6	60.9	59.9
EPA Ambient Noise Level Guideline for a Predominantly Heavy Industrial Area (Day Time)		70	-	-	-	-	-

Legend
Leq - Integrated noise level during the measurement period
Lmax - Maximum noised level
Lmin - Minimum noise level
L_{50} - Average noise level
L_{10} - Nuisance noise level
L_{90} - Background noise level

The integrated noise level during the measurement period ranged from 63.0 dB(A) to 67.0 dB(A) and thus within the EPA permissible noise limit.

3.8 Aquatic Biota

There are no significant aquatic species endangered or academically valuable that has been encountered in the port basin. Previous studies show that the continental shelf extends up to 80km broad off the eastern to central part of Ghana from Takoradi and eastwards. Generally, important fishing grounds of gill net fishing and purse seine fishing spread in a coastal zone up to 40km from the coastline including the nearby New Takoradi area to the port.

According to the Fisheries Department of Western Region, there are spawning and fishing grounds for shrimps off Takoradi at water depths between 20m and 50m, and spawning and feeding grounds for the Round *Sardinella* from 30m and outward the shelf (JICA/ GPHA, 2002).

As part of the EIA study an oceanographic study was carried and the report is presented as **Annex 7** of the EIS.

3.8.1 Macrobenthic fauna

The fauna at the harbour is dominated by rocky intertidal macro-benthic fauna as shown in **Table 7**. The community was visibly dominated by the barnacle, *Chthamalus dentate,* the upper shore littorinid, *Echinolittorina pulchella* and the oyster *Ostrea tulipa.* They are abundant on the sides of the wharf, rocks, breakers, and tyres alongside the wharf. Other taxa represented are gastropods, crustaceans, echinoderms and the cnidaria.

The macroalgae was dominated by the brown alga, *Bachelotia antillarum*. Other phaeophytes recorded are the *Chnoospora minima* and *Ralfsia expansa* as well as a chlorophyte, *Chaetomorpha*

linum. They are dominant on the rocks and other substratum avialble for attachment.

Table 9: Inventory of Rocky Shore Fauna and Macroalgae at the Port

Mollusc	Crustacean	Macroalgae
Gastropod	*Chthamalus dentata*	***Chlorophyta (Greens)***
Echinolittorina pulchella		*Chaetomorpha linum*
	Cnidarian	
Thais heamastoma	*Anthopleura* sp.	***Phaeophyta (Browns)***
Nerita atrata		Chnoospora minima
	Echinoderm	
Siphonaria pectinata	*Echinometra lucunter*	*Bachelotia antillarum*
		Ralfsia expansa
Bivalvia		
Ostrea tulipa		

Many of these epibenthic fauna are indicators of ecological healthiness and also constitute an important food resource to marine organisms (e.g., fishes) and also humans. The higher the species diversity of these epibenthic organisms is an indication of lack of ecological disturbance (natural and anthropogenic), albeit most ecologist correlate moderate disturbance with higher species diversity.

Table 10: Inventory of Rocky Shore Fauna and Macroalgae Found at Rocky Beaches in the Western Region

Mollusc	Crustacean	Macroalgae
Gastropod	*Grapsus grapsus*	***Chlorophyta (Greens)***
Echinolittorina pulchella	*Cthamalus dentata*	*Bryopsis pennata*
Echinolittorina cingulifera	*Panopeus* sp.	*Chaetomorpha linum*
Echinollitorina granosa	*Pagurus* sp.	*Chaetomorpha antennina*
Thais nodosa		*Ulva fasciata*
Thais heamastoma	**Echinoderm**	
Cyprae sp.	*Cidaroidea* sp.	***Phaeophyta (Browns)***
Nerita atrata	*Echinometra lucunter*	*Basispora africana*
Patella safiana		*Chnoospora minima*
Siphonaria pectinata	**Cnidarian**	*Ralfsia expansa*
Nudibranchs sp.	*Sea anemone*	
Clanculus sp.	*Zoanthus* sp.	***Rhodophyta (Reds)***
Arca senilis	*Palythoa* sp.	Lithothamnia
Murex sp.	*Anthopleura* spp.	*Botrisia radicans*
Fissurella nubecula		
Bivalvia		
Ostea tulipa		
Brachydontes sp.		
Perna perna		

Commonly encountered fauna on sandy beaches (**see Table 8**) in Ghana are mysids and polychaetes (deGraft-Johnson *et al*., 2010), and the bivalve *Donax pulcherimus*. The littoral benthic organisms include polychaetes, arthropods, bryozoans, and echinoderms. Edmunds (1978) recorded 68

taxonomic families. Some species such as the gastropods *Cymbium* spp. and the spiny lobster *Panulirus* sp. appear to be declining in abundance while the sea star *Astropecten* sp. and other starfishes have completely disappeared (deGraft-Johnson *et al*., 2010).

The inshore and offshore phytoplankton communities of Ghana include diatoms, dinoflagellates, and coccolithophores. The principal species of diatoms in Ghana during the upwelling belong to the genera *Skeletonema, Nitzschia, Chaetoceros, Rhizosolenia,* and *Thalassiosira* (Wiafe, 2002). Other planktonic groups such as chaetognaths are abundant from September to November yearly, thaliaceans, mainly *Thalia democratica*, in December and July, and appendicularians in June and October (Thiriot, 1977). The explosive development of these plankton groups influences the fishery of the nearshore and adjoining coastal water bodies. It has been reported (Mensah, 1966) that maximum occurrence of the zooplankton copepod *Calanoides carinatus* during the upwelling season in Ghana is related to the seasonal abundance of *Sardinella* species in the coastal waters.

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 western Ghana, a phenomenon of major concern to fishermen and other users of the coast. The *Sargassum vulgare* bloom followed soon after the green algae bloom. The sources of these blooms are currently under study by research scientists but nutritional enrichment from many sources has been fingered for blame.

There were reasonably large number of seashore and coastal birds at the port. They were dominated by terns, curlews and plovers. A small number of pied kingfisher were seen within the marine section of the port. These birds feed on the large numbers of worms and other macro-benthic invertebrates exposed at low tides.

Fish and Fisheries

The waters of the port were teeming with large numbers of fish. Fishes of various sizes, both small and large were found in the port waters. Because fishing was officially prohibited in the port, fish had a free hand to feed and grow in the rich waters. A few workers interviewed indicated under anonymity that they fished occasionally with hook and lines catching huge sized quality fishes. The port was serving as a de facto marine protected area for fishes thereby helping to restock the open seas with fish. Serving as a nursery area, fishes migrate to the port for feeding and spawning. A wide range of marine and estuarine species are found in the port.

Adjacent to the port and project vicinity is the Fisheries boatyard locally called ‘Fisheries Mpoano’. The boatyard and workshop is under the management of the Fisheries Directorate of the Fisheries Commission. Both inshore vessels and canoes dock here for maintenance. It serves the entire Western region and to some extent the Central region of Ghana. The busiest time of the year for the workshop is in the peak fishing season of June to September. During the peak period between 50 to 100 inshore boats and 10 to 20 canoes could be docked at this location in a typical day. Distressed vessels are towed to this landing beach regularly for attention. Fisheries Technical Assistants stationed at the workshop also collect daily fish catch and effort data as well as sea surface temperature. This data form a critical component of national fish statistics in support of fisheries management.

Adjacent to the workshop is the former State Fisheries Company (SFC) yard which is sold out. Fishers use the yard for mending and construction of fishing gears. Near to the yard is a premix fuel dump serving fishers in the area. Right in front of the yard is a boulder/rocky beach with all the typical rocky shore macro-benthic fauna. On the visit, sea hare (Applysia sp.), sea urchin (Echinometra lucunter), bivalve Perna perna, and littorinid species dominated the fauna at the site.

4.0 ANALYSIS OF POTENTIAL IMPACTS FROM DREDGING/RECLAMATION ACTIVITIES

The potential environmental and social impacts associated with the dredging activities as presented in the Revised Final EIS for the Port Infrastructure Development, including Dredging at the Takoradi Port are as follows:

Preparatory Phase

- Land acquisition and compensation issues

Construction Phase

- Marine pollution and impact on aquatic life;
- Waste generation and disposal problems;
- Occupational health and safety risks ;
- General disturbance of port operations; and
- Noise nuisance.

4.1 Land Acquisition and Compensation Issues

Compensation issues comprising; disturbance and livelihood issues; are likely to arise from the proposed project activities. Appropriate procedures will need to be followed to effectively manage all issues on compensation for Project-Affected-Persons (PAPs) to avoid conflicts and ensure unhindered execution of the project.

It is noted that no land acquisition will be required and no community will be relocated in this project. Reclamation of the shoreline between Fisheries Department Workshop and New Takoradi Beach may however restrict access to the beach by fisher-folk, who operate at the cape adjacent to the current location of the Fisheries Department Workshop) and use of beach and the ocean as boatyard. The location also acts as a natural slipway for servicing inshore boats, canoes and engines. During consultations with the affected fishermen, they requested for the provision of an alternative location for the landing site.

This impact is of major significance.

4.2 Marine Pollution and Impact on Aquatic Life

Dredging works within the marine environment and reclamation works are likely to temporarily increase suspended solids in the marine environment. Sediment loading in the harbour waters is also expected as some of the construction debris, sand, stone end up in the waters. There is also the likelihood of re-suspension of chemical contaminants into the water arising from dredging/blasting operations. 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.

Increased turbidity, surface pollution through oil spills will block passage of light and disrupt oxygen dissolution and this can threaten marine life. Dredging activities may also directly impact on benthic

fauna.

It is expected that fish and invertebrate populations will be temporarily affected by the construction of facilities will be able to re-populate the area within few months as soon as work is completed. Fisheries, for instance, will relocate from construction areas to safe distances when disturbed.

It is also important to note that dredging activities are proposed in areas that are active portions of the port. Potential impacts of the dredging and on marine life are therefore likely to be localized, and non-persistent. The impact marine pollution and aquatic life is of moderate significance.

4.3 Introduction of Invasive Marine Pest Species

Dredger vessels arriving at the port may inadvertently transport marine pest species through ballast water or biofouling. Introduction of new invasive species could result in substantial 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).

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).

The IMO through the GloBallast program and MARPOL, and in partnership with the Global Environment Facility and the United Nations Development Program, has developed specific requirements and guidelines to reduce risks associated with marine bioinvasions.

The impact is of major environmental significance.

4.4 Waste Generation and Disposal Problems

Dredging will generate mostly slurry/solid waste in the form of dredged spoil consisting mostly of sand, gravels and sea water. All the dredged material will be used for reclamation of portions of the log pond and eastern part of the port for expansion.

The dredged spoil to be transported in a slurry form would not be more than 30% by volume of sediment material. The water component will drain back into the sea from where it originated. Drill spoil disposal is therefore not expected to pose any significant adverse impact. Contaminated sediment will however be disposed of at the STMA designated landfill site at Sofokrom after the necessary analysis have been done to confirm sediment quality. It is expected that over $12x10^6$ m^3 of dredge material will be taken out of the of sea bed based on an estimated area of 2km x 2km and an average depth of 4m. This will be released on-shore in slurry of 70% water and 30 solids. The EPC contractor, Messrs Jan DeNul is responsible for confirming the quality of dredge material and organizing for disposal of any contaminated sediments.

Construction and demolition activities will result in waste generation. Solid wastes such as packaging material used for various inputs such as cement bags, wooden crates, broken concrete blocks and debris from demolition, metal pieces among others will be generated. These wastes would have to be disposed of appropriately by reuse, recycle or at the STMA designated landfill. Demolished concrete works, or existing installations will have to be disposed of in an environmentally sound manner. All scrap generated will be given to a recognised scrap dealer.

This impact is of moderate significance.

4.5 Occupational Health and Safety Risks

Workers will be exposed to risks during removal of existing installations such as fenders, bollards, and crane rails as well as during the civil works when excavations, loading, lifting and handling of equipment/machines will be common. Risks to safety and health of workers during construction will arise from operation of construction machinery/ equipment, transportation of construction materials, inhalation of dust and fumes, accidents from falling objects and fire and explosion risks from welding. Accidents on the dredger could lead to drowning of workers if adequate preventive and safety measures are not taken.

This impact is of moderate significance.

4.6 General Disturbance of Port Operations

The dredging and blasting activities will adversely impact on port performance in the short term by disturbing port operations. The dredging of the harbour basin will disrupt ship movements leading to delays to berthing and unberthing of ships and this could mean increased time spent in port for ships.

This impact is of moderate significance.

4.7 Noise Nuisance

The dredging/blasting activities will result in elevated noise levels. Noise will be generated from the conveyance of machinery, equipment and construction materials. Concrete mixing and other construction activities including human activities will also generate noise.

The expected increase in noise during construction phase would generally be between 65-75 dBA. Noise levels are not expected to exceed these values during the period. Average noise levels measured around the project area during the day ranged from 63dB(A) -67dB(A).

The major recipients of noise nuisance during construction period will be project workers, workers at nearby wharf in the main harbour area. Workers will be provided with appropriate ear plugs for use. The main harbour area is a restricted area and only authorized people are allowed inside. The impact is expected to be minimal and it will be of minor significance.

4.8 Sanitation Challenges

Sanitation and health problems are anticipated from poorly managed construction site camps. Indiscriminate disposal of wastes such as polythene bags, used water sachet etc. at site will create unsightly conditions at the port area, nearby shore and along the road proposed corridors. Indiscriminate defaecation along the nearby shores by workers will create unsanitary conditions at the shores and may pose health problems, as well as result in conflict with the Tema community beach to the west of the expansion area. Construction workers will be compelled to use existing port sanitation facilities. This impact is of moderate significance.

5.0 MANAGEMENT AND MONITORING

5.1 Mitigation Measures for Identified Impacts

Table 9 presents a summary of the potential impacts related to dredging and disposal of contaminated sediments together with mitigation and management measures to avoid or reduce these impacts.

Contractor shall adapt this plan to prepare a Site-Specific Dredging Management Plan, which will as a minimum incorporate the measures described in **Table 9** but shall not be limited to these measures.

5.2 Environmental Monitoring

Management of GPHA is committed to ensuring effective protection of the environment, property, workers and the general public within the port area. The objective of the monitoring programme is to:

- Ensure that all mitigation and control measures are operating efficiently and with designed effect;
- Provide information to develop improved practices and procedures for environmental protection and worker safety;
- Detect changes in the receiving environment and enable analysis of their causes; and
- Enable effective liaison with stakeholders including addressing complaints and concerns.

5.3 Environmental Issues to be Monitored

Monitoring programmes would be instituted and carried out and relevant records would be kept to ensure compliance with sound environmental practices. The major environmental issues on which monitoring will be focused include:

- Noise levels;
- Water quality;
- Sediment quality;
- Invertebrate biota;
- Rate of shore recession at down-drift areas and material accretion upstream;
- Use of personal protective equipment (PPE);
- Waste generation and disposal;
- Accidents, worker injury and health; and
- Public complaints.

The environmental monitoring programme is set out in **Table 10**. About **GH¢194,000.00** will be spent on monitoring activities annually from the implementation of the project.

Table 11: Proposed mitigation measures

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Preparatory Phase Impacts
Land Acquisition and Compensation Issues (Involuntary Resettlement)	Local Community	GPHA will put in place measures in collaboration with the Ghana Maritime Authority (GMA) to facilitate the compensation proceedings to ensure that all affected parties especially the fisher folk at New Takoradi are promptly compensated/ resettled by provision of alternative landing site off the bauxite sidings. No community will be resettled but only their activities and berthing area around the fisheries department workshop will be reclaimed for port operations and this will affect their livelihoods. It is noted that the reclamation of the coastline will be tackled during the latter stages of the proposed project and will therefore afford GPHA and the EPC contractor adequate time to fashion out resettlement options for the fisheries department workshop and the boat berthing area. The available options under consideration include relocating the existing workshop and berthing area to Albert Bosumtwi-Sam Fishing Harbour in Sekondi or building a new landing site with berthing facility for bigger vessels at New Takoradi beach.
		Dredging/Blasting/ Reclamation Impacts
Marine Pollution and Impact on Aquatic Life	Marne environment	"Best management practices" (BMPs) will be required in order to contain and minimize any impacts. Messrs Jan De Nul, will bring to bear their vast experience with dredging to ensure the BMPs are abided by. Sediment loading in the harbour waters during construction of breakwater and quay walls, as well as dredging/blasting activates, may have temporary impacts, but use of BMPs will ensure that any impacts are minimized to the extent practical. • Dredging and placement of rock materials for the breakwater will be done within a short space of time and 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. (Annex 11 provides a detailed Dredging Management Plan). • Well maintained pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area. Any observed or detected leaks will be repaired as soon as practicable. Pumping will stop if a major rupture is identified (within the operational constraints of the equipment). • The operation of the dewatering process within the existing reclamation area (e.g. internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment. On observation • GPHA will require the contractors, Messrs Jan de Nul, to prepare a spill prevention and control plan 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. • Messrs Jan De Nul will be required to implement suspended sediment control if turbidity levels 150m from the construction area exceed above background levels significantly i.e. 10 NTUs. Measures such as reducing dredger delivery rate or ceasing operation, where necessary will be employed when turbidity is detected to exceed the limits.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• Messrs Jan De Nul will also carry out detail geotechnical assessment of the port basin including sediment analysis before actual construction commences. Contaminated sediment will be scooped and appropriately disposed of at the approved disposal site of the STMA at Sofokrom. • In addition, shore protection measures such as carefully placed groins and rivets should be erected to protect the nearby shores from expected increased erosion.
Solid Waste Management	Workers	As per the IFC General EHS Guidelines, waste materials generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, will be treated and disposed of at permitted facilities specially designed to receive the waste, in order to avoid potential impacts to human health and the environment. In line with this, any unsuitable dredge material/ settled sediment/ mud which has been characterized to be low in heavy metals and PAHs/ BTEX concentration, will therefore be disposed of at the STMA approved engineered landfill site at Sofokrom. The landfill site was constructed with World Bank's assistance and was completed in 2010. The Sofokrom landfill has approximately 36 ha of surface area and is located 9km onward to Accra from the Project site. It has the capacity of accommodating all types of wastes, including industrial hazardous wastes, except for the medical wastes, up until year 2025. The landfill operates in line with the IFC EHS Guidelines for Waste Management Facilities, e.g. garbage is presorted by three categories - solid wastes, liquid wastes and industrial hazardous wastes. <u>General Waste (non-construction waste)</u> Adequate waste bins will be provided at the temporary work-camps to minimise littering of the sites. The collected refuse will then be transferred to the GPHA and STMA approved disposal site at Sofokrom. Management has entrusted with the management of waste within port to private entities who collect and transport the waste on daily basis. GPHA will continue with this arrangement during the construction period. Management will supervise the process. <u>Dredging</u> • The dredged spoil which will come in a form of slurry would not be more than 30% by volume of sediment material. The water will be drained back to the ocean where it originated and the spoil used for reclamation of portions of the log pond and the northeastern coast of the port between the fisheries department workshop and New Takoradi Beach. • Contaminated settled sediment/ mud will however be disposed at the STMA Sofokrom landfill site after investigating the metal composition to ascertain their concentrations (see Annex 11 for Dredging Management Plan).
Introduction of Invasive Marine	Marine water	<u>Ballast water</u>

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
Pest Species		GPHA to 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. These strategies include • Minimising uptake of organisms into ballast tanks • Routine maintenance of ballast tanks to remove sediments • Avoiding unnecessary ballast discharge, particularly when in port; using discharge to the waste reception facility at the port for treatment and disposal • Exchanging coastally sourced ballast mid-ocean or in deep water and where required • Treating ballast to remove or render inert any harmful organisms. <u>Biofouling</u> 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: • Using anti-fouling systems appropriate to a ship hull and activity • Applying appropriate operational management practices to reduce the development of biofouling (e.g. maintaining seawater intake system cleaning) • 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 • 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 • 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 inwater 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 • GPHA to ensure effective dissemination of information of relevance to biofouling management to ensure appropriate biofouling management systems are implemented by all vessels
Occupational health and safety hazards/ Public and Traffic safety	Workers/ Local communities and road users	<u>Adoption of Health and Safety Policies</u> It is the policy of GPHA and for that matter the Port of Takoradi to establish and maintain high standards of occupational health, safety and environmental protection at work, so as to prevent personal injury or illness, property damage, fires, security losses and environmental pollution. The health, safety and environmental protection at the workplace objectives defined in this policy statement have equal status

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		with all other primary business objectives. The responsibility for implementing this policy lies directly and personally with management through to employees. This is summarized in the Port's Occupational Health and Safety Policy (October 2005) objectives *viz* to: • 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; • establish regulatory and organizational framework for the efficient and effective management of occupational health, safety and environment issues in the Ports; • maintain safe plant, machinery and equipment in the Ports; • maintain safe and healthy work place for all Port workers and Port users • maintain incident and injury-free working environment in the Ports; • prevent occupational related diseases/ illness among Port workers; and • promote and maintain a clean, healthy and hygienic environment in the Ports of Ghana. (**see Annex 9 of EIS for the Occupational Health and Safety Policy Document**) GPHA 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 Environment and Estate Manager will ensure compliance with the Health and Safety Policy. GPHA will operate a hospital outside the Port for use by workers. First aid centers will be set up at the construction areas manned by trained first aiders to treat minor ailments and cuts. However, major cases will be referred to the Port Hospital, which is within 2km of the port for treatment or referral to Effia Nkwanta Hospital. <u>Use of Experienced Personnel</u> GPHA will ensure that well-trained workers are engaged to operate any heavy machine or equipment. 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		GPHA will ensure that regular defensive driving training sessions are organized for the drivers to ensure their safety and the safety of the general public. <u>Provision of Personal Protective Equipment (PPE)</u> GPHA will ensure that workers are provided with the appropriate personal protective equipment such as safety boots, rain-coats, hand gloves, earplugs and nose masks. Supervisors will be mandated to ensure the use of these protective devices and to implement sanctions when necessary. <u>Phasing out of Material Movements/ Scheduling Material Movements</u> 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 port at any given time to reduce the risk of accidents. GPHA intends to carefully plan materials movement to minimise these impacts. Materials and equipment will be transported to the sites during daylight, from 6am to 6pm.
Noise Nuisance	Workers/ Local communities and road users	GPHA will employ standard noise abatement measures and engineering best practices to ensure that the impact of these issues minimized and reduced to acceptable limits. • GPHA will ensure that earthworks and other construction activities will be phased out or controlled to reduce noise generation during construction. • New equipment will be used and properly maintained to reduce noise generation. • Ear muffs will be provided for workers where necessary.
Sanitation and hygiene	Workers	• Adequate waste bins will be provided at the temporary work-camps at the construction site to minimize littering. GPHA will ensure that waste generated is disposed of at the STMA landfill site. • Toilet and washroom facilities will be provided for workers in general to discourage “free-range” defecation and its attendant health problems. Workers will also be educated to use the waste collection and washroom facilities to be provided on site.

Table 12 Environmental Monitoring Programme for Dredging/Reclamation

Environmental component	Parameters to be monitored	Monitoring Sites	Methodology/ standards	Frequency/ Responsibility	Estimated cost/ annum (GH¢)
Noise Levels	Sound levels in dBA	Takoradi Port at Established Sampling Points	Noise Level Data Logger /EPA guidelines	Quarterly /EEM	4,000.00
Water quality	-General physicochemical parameters including: temperature, conductivity, dissolved oxygen, pH, turbidity, TSS, -Trace metals (V, Cu, Zn, Pb, Mn, Fe and Cd) -PAHs -Total and faecal coliforms	Harbour basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/EEM and HM	16,000.00
Sediment quality	Heavy metals (V, Cu, Zn, Pb, Mn, Fe and Cd) PAHs	Harbour basin at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/EEM and HM	24,000.00
Invertebrate biota	Mollusc and crustacean	Harbour area at specified locations	field work and laboratory analysis	Quarterly/EEM and HM	16,000.00
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	around the port	Physical inspections and reporting	Biannually/ EEM	8,000.00
Use of Personal protective gears	Life jackets, Safety boots, gloves, earplug, Helmet etc	Harbour area	Inspections and Audits/ Safety Policy of GPHA	Daily/PSM &FSM	40,000.00
Waste generation and disposal	-Metallic wastes -Garbage	Harbour area	Record quantity and type of waste generated. Inspect quantity and	Weekly /EEM	20,000.00

Environmental component	Parameters to be monitored	Monitoring Sites	Methodology/ standards	Frequency/ Responsibility	Estimated cost/ annum (GH¢)
	-Waste oil -Hazardous waste		condition of waste bins. Keep records of time and place of final disposal /KPIs of GPHA		
Accidents, injuries and worker health	Type and frequency of injuries /accidents	Harbour area	Observation, audits, complaint/ incident records/ Safety Policy of GPHA	-Daily-FSM -Quarterly-HMS	12,000.00
Public complaints	Type and nature of complaints and concerns	Takoradi Port	Complaint records, Stakeholder meetings	Daily –EEM/PSM/ FSM	10,000.00
TOTAL					**150,000.00**

5.4 Roles and Responsibilities

The Director-General shall have overall responsibility for the formulation, implementation, monitoring and evaluation of Health, Safety and Environmental Issues of the Port of Takoradi. This responsibility may be delegated to other Directors and Managers of the port.

Although the responsibility for implementation of the monitoring programme may be devolved to the dredging contractors, based on agreement with the port authority, the programme presented in **Table 10** assigns implementation responsibility to the following personnel of GPHA, as described in the EIS for the port development, and they shall report directly to the Director of Port, Takoradi:

- The Estate and Environmental Manager (EEM);
- Fire and Safety Manager (FSM);
- The Harbour Master (HM);
- The Head of Medical Services (HMS); and
- Port Security Manager (PSM).

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Dredging Management Plan.

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 are communicated to relevant personnel of GPHA.

The implementation strategy outlined in the Provisional Environmental Management Plan of the Revise Final EIS will be executed to ensure the effective implementation of plans.

5.5 Reporting and Notification

In order to comply with statutory as well as internal review, periodic reporting will be done. Reports to be prepared to serve as sources of environmental and safety information for stakeholders.

The contractor shall prepare the following reports to GPHA:

- Monthly reports on progress of dredging
- Monthly reports on progress of monitoring programme for each monitoring parameter (as listed in **Table 9**)
- Monthly report on resource utilisation (water, fuel, electricity etc.)

GPHA will prepare and submit the following reports:

- Annual Environmental Reports – statutory requirement to EPA;
- Quarterly Environmental Monitoring Returns – statutory requirement to EPA;
- Annual Environmental Audit Report – for in-house reporting; and
- Environmental Management Plan after 18 months of commencement of work - statutory requirement to EPA.

6.0 CONCLUSIONS

GPHA as part of the planned expansion of facilities at the Port of Takoradi will undertake this project in accordance with Ghanaian as well as International standards governing development projects of this nature. The dredging and reconstruction activities and operation of the facilities to be provided will satisfy the relevant local environmental protection laws and international conventions.

this Dredging Management Plan has identified major environmental, safety issues and impacts associated with the dredging activities and recommended mitigation measures to be implemented to help minimise any significant adverse effects. An environmental monitoring programme to be carried out during project implementation will help maintain environmental quality within acceptable guidelines, while a general environmental management conditions for construction contracts developed by the World Bank has been provided. The dredged materials will be used to reclaim portions of the coastline for other phases of the project involving construction of container terminals and other on shore facilities.

The provision of employment to the youth, revenue generation to the government, improvement in shipping traffic for bulk and cargo vessels drawing up to 14.0m draft at the port will go a long way to improve the status and image of the Port of Takoradi and impact positively on the socio-economy of the country. This will also assist and propel the country to achieving its oil and gas development strategies.

Annex 12: Report on the soil investigation by JDN

CONTRACTOR:

Jan De Nul GROUP

PROJECT NAME:

TAKORADI PORT EXTENSION

DOCUMENT TITLE:

FINAL REPORT – SOIL INVESTIGATION

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Jan De Nul n.v.

GHANA – TAKORADI- PORT EXPANSION

SOIL INVESTIGATION 2012-2013

FINAL REPORT 20130704

Ghana – Takoradi – Port Expansion

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1 Scope

In 2012 JDN has been awarded a project for the design and construction of the expansion of the port of Takoradi, by order of the Ghana Ports and Harbours Authority (GPHA).

The expansion will be executed in phases and foresees in the construction of new quays, the extension of the existing breakwater and the dredging of the new berths and turning basin.

In the present design for the first phase the existing breakwater will be extended with 1080m. About 200 m of new quay wall will be build +/- 1km north of the existing. The dredge depth varies along the scope from -14 mCD for the access channel and turning basin and -16 mCD next to the quay wall.

JDN executed a two phase soil investigation in the bay of Takoradi from 17-12-2012 till 5/03/2013. In a first phase a preliminary bathymetry survey (multibeam) and a sub bottom profiling campaign (reflection seismic - chirp) were done. Afterwards a jack-up platform was mobilized to do a borehole and CPT campaign.

The drilling campaign and the lab testing were witnessed by representatives from Selhorn, the consultant working for GPHA.

2 Project site and geology

2.1 Site location and marine environment

The project site is located in Ghana at the gulf of Guinea immediately north of the port of Takoradi. The existing port, constructed by the British in the 1920's, is situated 180 km south west of Accra and 150 km east of the border with Ivory Coast.
The total project covers an area of 4 km^2 (2x2 km). The actual water depth in the project area varies between -3m and -14m CD. See preliminary design with indication of proposed borehole locations in annex 1.

MHMS	MHWN	MLWN	MLWS
1.5 m	1.2 m	0.6 m	0.2 m

Table 1: Tide level Takoradi Port (Source Tide Tables 2001 GPHA)

The tide in Takoradi is a semidiurnal pattern and has generally two high and two low tides each day. Annual tidal predictions are computed and published by GPHA.

The JDN survey department computed a tide prediction for the months December 2012 to February 2013 (see annex).

Monthly distribution of wave height (m)

lower	upper	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0
0.2	0.4	5.1	2.6	2.2	0	0	0.1	0.2	1.2	0.1	0.7	0.4	3.3
0.4	0.6	55.5	48.1	36.1	19.3	12.4	6	4.7	6.9	10.1	13	23.3	46.3
0.6	0.8	31	36.4	42.8	48.8	39.9	25.9	23.6	29.6	40.1	49.3	53.2	40.3
0.8	1	7.3	10.5	14.8	23.3	29.6	38.1	37.8	31.8	28.2	24.3	16.7	9
1	1.2	0.7	1.7	3.2	6.4	12.8	21	21.4	18.1	12.7	8.8	5.2	0.7
1.2	1.4	0.3	0.4	0.7	1.6	4.2	6.3	9.3	9.3	6.7	2.2	1.2	0.4
1.4	1.6	0	0.3	0.2	0.1	1.2	2.1	2.3	2.2	1.4	1.1	0	0
1.6	1.8	0	0	0	0.1	0	0.5	0.2	0.5	0.5	0.4	0	0
1.8	2	0	0	0	0.1	0	0	0.4	0.5	0.1	0.2	0	0
2	2.2	0	0	0	0.1	0	0	0.1	0	0	0	0	0
2.2	2.4	0	0	0	0.2	0	0	0	0	0	0	0	0
2.4	2.6	0	0	0	0	0	0	0	0	0	0	0	0
total		100	100	100	100	100	100	100	100	100	100	100	100

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Your choices :

The way ray shallow water model SWRT was used
With refraction on, wave breaking on and localgrowth on and bottomfriction off
Nearshore location is at 4°53'44"N, 1°43'51"W
Depth at nearshore location is 10 m
Offshore frame 4° 00'N-5° 00'N, 2° 30'W-1° 15'W (3 model points)
Season is all year
Variable is wave height (m)
Data source is wavemodel
Results are based on 49680 model records
Distance between nearest model point and nearshore location is 55 km

Table 2: Monthly distribution of wave heights

Feedback from previous soil investigations with a jack-up in Takoradi shows that, even in good weather, sea conditions in Takoradi not always allow shifting a jack-up from

one to another location. The operational limits for shifting a jack-up are in between 0.6 and 1 m Hs (max) m.

To assess the workability in terms of sea state a simulation of the monthly distribution of the wave height at the project site (4°53'44"N, 1°43'51"W) was done using ARGOSS software. The maximum wave height to continue with a seismic survey is 1.0-1.5m, while the maximum wave height to proceed with the drill program is only 1.0m.

Based on a Ray model (ARGOSS) the workability is optimal (but still not good) in December, January or February with a workability of 46.3%, 55.5% and 48.1% respectively. Working during summer months should be avoided.

2.2 Local geology and soil conditions

The local geology is dominated by Birimian (pre Cambrium) sequences that consist of a mix of metamorphosed volcanic, sedimentary and plutonic rocks and low grade metavolcanics and metasediments. The rocks are formed over a period of about 50 million years between 2.200Ga and 2.100Ga years ago and consist of mafic intrusives. In between these mafic rocks massive intrusions of granitic rocks can be found.

At the coast there is a small strip of early Ordovician to Cretaceous sediments called the Sekondian, which is a mix of sandstones, mudstones conglomerate and shales.

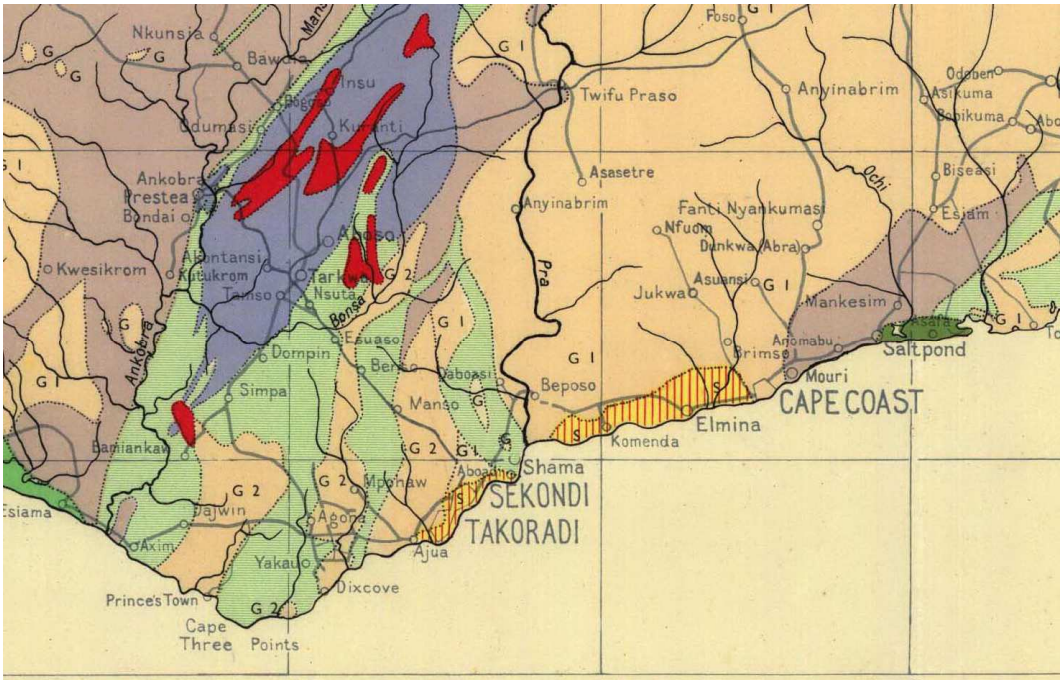


Figure 1: Geological map of the Gold coast 1955

The Sekondian Group covers an area of about 200 km^2 onshore with a thickness of about 1200 m. It consists mainly of feldspathic sandstone, siltstone, and shale resting unconformable on a complex of hornblende granite of the Dixcove type, biotite granite

of the Cape Coast type, and schists and granulites which are probably metamorphosed and partly granitized Birimian rocks of Precambrian age.

Previous site investigations in the Port of Takoradi reveal that below a sedimentary layer consisting of soft clay to stiff gravelly silt, one can find the sedimentary bedrock that consists of sandstone or mudstone with a significant UCS value of about 16MPa

Generally spoken distinct 2 rock types can be found. Firstly strongly lithified arkosic sand - (A1) and siltstones (A2) in which weathering and fracturing is not very severe. Secondly a carbonate cemented quartz sandstone (B1) that grades into sandy clay.

A1: Dark red micaceous arkosic (rich in feldspar) fine sandstone, sub horizontally layered and poorly bedded. Coarser lenses of medium sandstone are intercalated. Highly compacted and hard. Grains are coated with iron oxide and pores are filled with clay minerals.

A2: Purple-green banded clayey very fine sandstone with quartz concretions, sometimes with reduction spots. Clay content variable. Coarse arcosic sandstone bands of 2-4 cm. Bands with quartz concretional breccia components.

B1: Predominantly pale green & light brown carbonate cemented sub rounded well sorted fine quartz sandstone with foraminifera. Sub horizontally layered. Thin irregular bands of blue – green clay are intercalated. To the top it grades into sandy clay with some amorf SiO_2 breccia components.

Rock types A1 and A2 are very lithified, indicating a period of subsurface diagenesis. The process of lithification has produced a hard rock. The clayey part of these rocks is however less resistant. Within these zones shearzones developed, giving the rock a very anisotropic character. After this diagenesis rocktypes A1 and A2 were lifted up to the surface. Quartz sands were deposited in the vicinity of rock types A1 and A2. The field relation of these rocks is not clear. The sand is not significantly compacted but its cohesion is derived from carbonate cementation. This together with the occurrence of marine foraminifera indicates a marine environment

3 Historical soil data

During the planning of this project all previous executed soil investigations were gathered and studied. A list of all available data can be found below. Copies of the reports can be found in on the cd rom in annex 2.

1992 BOSKALIS, geotechnical site investigation, 8 boreholes in the existing port

2002 JICA, development study, 2 boreholes in the existing port & seismic survey

2006 FUGRO, geotechnical site investigation, 32 boreholes in the new project area and a sandsearch with 21 vibrocores along the coast.

4 Site investigation

4.1 Bathymetric multibeam survey

As no detailed bathymetry of the project area is available JDN choose to execute a (multi beam) bathymetric survey.

To perform the survey the pilot boat Nana Badu Bonsu was rented from GPHA. The survey equipment was send from Belgium and released by Ghanaian customs on the 14th of December.

On the 17th of December JDN started with the installation of the survey equipment on board of the Nana Badu Bonsu. Pictures of the setup can be found in annex 3. The survey setup consisted of:

Multibeam echosounder ODOM ES3

Gps C-NAV

Motion sensor

2 survey computers with Qinsy software and a survey screen for the helmsman

Onshore a TIDELOG 740 tide gauge was installed in a plastic tube close to the radar tide gauge of the port. The benchmark used for height is called TGBM GCS BM H4. See details about the benchmark in annex 4.

A position check has been performed on benchmark HB/TAK 3/1/2006. A difference with the port of 3 m is found. Since it was not clear which local system the port is using and no transformation parameters are known it was decided to do the work in WGS48 UTM30N.

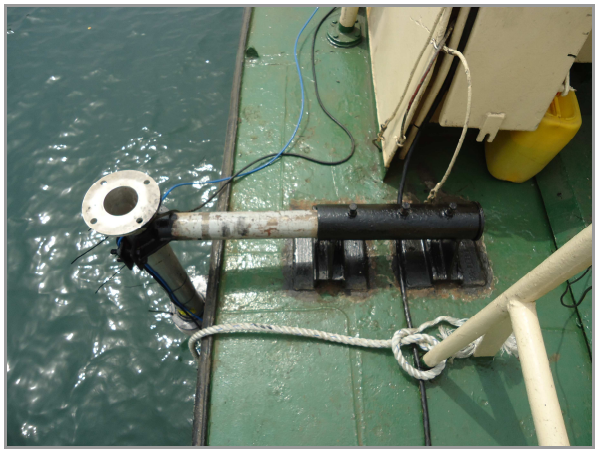


Figure 2 & 3: Survey vessel Nana Badu Bonsu (left) and echosounder setup (right)

The offset measurements, pitch and roll logging and a gyro check were done on 20th December. A patch test was done on 22 December. During the survey sound velocity tests were done on a daily basis

The total area that was surveyed is 1.8 x 1.8 km. The multibeam and seismic surveys were performed simultaneously. To finish the bathymetry 72 lines were sailed perpendicular to the coast line (E-W) with a line spacing of 25m.

The result of the bathymetric survey is shown in the bathymetric map in annex 5. A few important features can be seen in the new bathymetry:

- For the total area there is a gentle slope from -15 mCD to 0 mCD (coastline)
- Clear set of N-S oriented sandbars in the zone between -11 mCD and -16 mCD
- A number of narrow NW to NE oriented slightly curved ridges in the zone between -11 mCD and -5 mCD

4.2 High-resolution reflection-seismic survey

A high-resolution reflection-seismic survey was performed simultaneously with the multibeam survey. As JDN is interested in the uppermost 5-10m below seabed we choose to perform a high-resolution reflection seismic survey using a chirp (SBP). Based on the acoustic image of the seabed, areas with (softer) sedimentary deposits can easily be delineated from areas where harder material / rocks are outcropping.

4.2.1 Setup

The survey was sailed with a local boat (Nana Badu Bonsu) that was available on site. The seismic equipment that was used is the company owned Edgetech 3200 (SB512i) sub bottom profiler.

This system is a high-resolution seismic system that transmits FM pulses linearly distributed along the equipment's frequency spectrum (0.5 – 12 kHz). The returning acoustic signal is processed by the hydrophones and transformed into high resolution images of the sub bottom stratigraphy. This survey was done using a frequency range of 0.5 to 12 kHz.

The positioning was done using a C-NAV GPS with license. This survey was referenced to the UTM coordinate system, datum WGS-84, zone 30 N.

Figure 4 & 5: Seismic equipment and davit (left) and survey setup (right)

To hoist the seismic tow fish in and out of the water a davit was used that was fabricated in Aalst and that has been send to location with the other material. Once the tow fish was in the water the davit was secured with ropes.

According to the location of the GPS antenna, the layback of the fish was approximately 6 m and the offset was 5 m. The transducer was approximately 2 m below the water surface. During the survey a vessel speed of 4 knots was maintained.

Survey data was recorded using the Triton SB logger acquisition software. For processing the raw data SeismicSurveyEngine + from Coda Octopus was used.

Details of the equipment used and pictures of the setup can be found in annex 6.

4.2.2 Line planning

An overview of all lines that were sailed can be found in annex 7. In the port extension area every 25 m a line was sailed perpendicular to the coast line. Together with the cross lines that were sailed with a line spacing of 250m, and extra lines underneath breakwater and quay wall, this resulted in 92 sailed lines.

4.2.3 Results processed data

After studying the processed seismic data together with the available BH-logs the general image is as follows: on the east side the seabed mainly consists of mudstone and sandstone and in the western part this hard material is overlain with sandy/silty clay up to a thickness of 4 m.

See examples of the processed seismic lines in annex 8. A contour map created with thickness of the sediment layer in the port extension area is added in Annex 9.

The obtained results were compared with the borehole logs of the Fugro campaign in 2006 (see annex 2). For most of the boreholes the results show great resemblance. The seismic results for BH 21, BH 26, BH 27, BH 28 and BH 29 differ more from the borehole results, differences from 1 up to 3.5 m are encountered.

For a complete overview of the seismic study we refer to the separate report about the seismic study.which is included in annex 10.

4.3 Drilling campaign

In addition to the surveys mentioned above JDN also organized an offshore drill campaign. For this campaign JDN subcontracted IGEOTEST Marina. Igeotest is a Spanish company based in Girona with over 20 years of experience in geotechnical research.

Control y prospecciones Igeotest S.L.
Borrassà
17600 Figueres
Girona
Spain
Tel: +34972513466
www.igeotest.com – mail@igeotest.com

The final Igeotest report with a complete description of the used equipment, the borehole logs, pictures of the core boxes, daily reports etc can be found in annex 11

4.3.1 Scope

Initially 23 boreholes and 8 CPT's were planned. See the original borehole location plan in annex 1. During the execution of the campaign 4 extra boreholes were added. Borehole TAK-02 was cancelled so in total 26 boreholes were drilled (TAK-01 till and TAK-27).

Borehole TAK-02 was cancelled due to a combination of factors. The water depth on location TAK-02 was close to the operational limit of the jack-up. This together with a penetration of the spud legs of more then 1 meter in the seabed made it not safe to perform a borehole on this location.

Boreholes TAK-24 and TAK-25 were added on the location of the quay wall, respectively in between TAK-08 / TAK07 and TAK07 / TAK-06. Both boreholes were drilled up to -30 mCD to give extra information from underneath the planned construction.

Borehole TAK-23 was moved from its original position to check the boundary between sand and mudstone and to get an idea about the consistency of the ridges in the dredge area.

TAK-26 and TAK-27 were added as well to check the location of the sandstone / mudstone boundary.

If drilling confirmed the presence of a soft top layer of more than 1 m in thickness a Cone Penetration Test (CPT) was done. In total 13 CPT tests were performed. A map with the as build locations of all boreholes and CPT tests can be found in annex 5 and 12

4.3.2 Fieldwork

To perform the offshore drilling campaign the Igeotest owned IG-III jack-up platform was mobilized to Takoradi in the first week of January 2013. After some delay the actual fieldwork started on 26/01/2013 and was finished 28/02/2013.

Daily reports and all information regarding the equipment used can be found in the Igeotest report in annex 11.

4.3.3 Results

In general the geology in the project area is build up of sandstone and mudstone / siltstone.

In the eastern part there is a top layer of very soft clay (as explained in 4.3.2) underlied by bedrock consisting of mudstone / siltstone. The transition zone between top layer and bedrock is rather thin. The soft clay gradually changes into to stiff clay with gravel (average thickness 1 – 2 m, maximum thickness of 4 m in TAK-07). Sometimes the soft clay also lays directly on top of the bedrock (for example TAK-16 and TAK-17).

In the western part the top layer is less thick or nonexistent and consists of loose to very dense sand to soft silt mixed with gravel. In this part the bedrock consists of sandstone.

As explained above the project area can be roughly divided into 2 parts. The boundary between the sandstone and mudstone area can be seen on the map in annex 5 and is indicated with a red line. To check and justify this boundary boreholes TAK-26, TAK-27, TAK-21 and Fugro boreholes BH12, BH13, BH20 and BH29 were taken into consideration.

Boreholes TAK-13, TAK-14 and TAK-19 were performed on top of the narrow NW to NE oriented ridges in the mudstone area. Here we can find a thin layer of sandstone (or sandstone gravel)on top of the mudstone. This indicates that these ridges consist of sandstone.

Igeotest also describes some considerable amounts of sandstone in boreholes, TAK-08, TAK-09, TAK-11, TAK21 and TAK-24. After investigation JDN decided this is no sandstone but a less foliated and little sandier form of mudstone / siltstone.

In total 13 CPT tests were done next to boreholes: TAk-07, TAK-09, TAK-10, TAK-11, TAK12, TAK-15, TAK-16, TAK-17, TAK-18, TAK20, TAK-22 and TAK25. Following parameters were measured: tip resistance *qc*, sleeve friction *fs* and pore pressure *u.*
The cpt's give a good idea about the consistency of the top layer and give refusal once the bedrock is reached. In order not to damage the equipment the tests were terminated as the tip resistance reached +/- 20 MPa.

All borehole and CPT Logs can be found in the Igeotest report in annex 11.

5 Lab testing

5.1 Lab tests on rock samples

A selection of rock samples was send to Belgium for laboratory testing at Labo Magnel in Gent.

Magnel Laboratory for Concrete Research
Ghent University
Department of Structural Engineering
Technologiepark-Zwijnaarde 904
9052 Gent
Phone: +32(0)9 264 55 35
Fax: +32(0)9 264 58 45
E-mail: Labo.Magnel@UGent.be

Following tests were performed on rock samples: wet density, dry density, UCS, BTS.
Due to the foliation in the mudstone it was not always possible to prepare (cut and polish) the samples without breaking up the samples into pieces. Some samples cracked during preparation and were no longer useful for UCS testing (for UCS testing sample dimensions: length / diameter should be 2 / 1). If the remaining pieces were still large enough they were selected for BTS testing (for BTS testing the sample dimensions length / diameter should be

1 / 1). All lab tests on rock samples were performed on 19, 29 and 30 April and were witnessed by a representative from Selhorn.

A list with the results of the UCS and BTS test can be found in the table below. The original lab test results can be found in annex 13. Please note that the depths mentioned in the lab report are the depths measured from the deck of the jack-up platform. The sample depths in the table below are recalculated to depths in mCD.

BH	FROM (mCd)	TO (mCD)	UCS (MPa)	BTS (MPa)	Density Dry (kg/m3)	Density Sat. (kg/m3)	Sample name
TAK-01	16.49	16.64	17.1		2300	2310	UCS_18
TAK-01	16.52	18.78	21.1		2410	2420	UCS_21
TAK-01	16.52	18.78		1.44	2405	2420	BTS_21
TAK-01	17.78	18.04	25.3		2340	2350	UCS_23
TAK-03	15.36	15.96	11.9		2260	2260	UCS_27A
TAK-03	15.36	15.96	11.1		2205	2210	UCS_27B
TAK-03	15.36	15.96		0.81	2220	2215	BTS_27
TAK-03	18.65	19.31	18.5		2235	2235	UCS_1A
TAK-03	18.65	19.31	18.3		2230	2235	UCS_1B
TAK-03	18.65	19.31		1.22	2265	2265	BTS_1
TAK-04	21.05	21.55	19.3		2350	2380	UCS_8
TAK-04	21.05	21.55		1.16	2390	2410	BTS_8A
TAK-04	24.5	25.1	7.5		2295	2305	UCS_6A
TAK-04	24.5	25.1	8.1		2270	2275	UCS_6B
TAK-04	24.5	25.1		0.74	2335	2345	BTS_6
TAK-04	26.82	27.32	13.2		2200	2205	UCS_5A
TAK-04	26.82	27.32	13.4		2185	2190	UCS_5B
TAK-04	26.82	27.32	11.5		2305	2310	UCS_5C
TAK-04	29.6	30.25	15.5		2250	2250	UCS_4A
TAK-04	29.6	30.25	14		2220	2225	UCS_4B
TAK-04	29.6	30.25	12.2		2180	2185	UCS_4C
TAK-04	29.6	30.25		0.91	2140	2150	BTS_4
TAK-05	13.21	14.21	18.6		2280	2285	UCS_3A
TAK-05	13.21	14.21	17.1		2270	2275	UCS_3B
TAK-05	13.21	14.21	16.4		2330	2335	UCS_3C
TAK-05	13.21	14.21	25.9		2435	2445	UCS_3D
TAK-05	13.21	14.21		1.24	2235	2245	BTS_3A
TAK-05	13.21	14.21		1.68	2305	2315	BTS_3B
TAK-05	15.6	16.18	18.4		2290	2295	UCS_2A
TAK-05	15.6	16.18	23.3		2285	2290	UCS_2B
TAK-05	15.6	16.18	18.2		2280	2290	UCS_2C
TAK-08	13.43	13.66	20.4		2670	2680	UCS_24
TAK-08	15.65	15.9	8.3		2560	2570	UCS_25
TAK-09	6.28	6.44	18.4		2550	2565	UCS_20
TAK-09	6.06	6.28	10.1		2550	2565	UCS_14
TAK-09	7.08	7.31	10.2		2560	2560	UCS_15
TAK-09	8.46	8.66	13.8		2555	2565	UCS_19
TAK-11	13.35	13.56	22		2560	2570	UCS_32

BH	FROM (mCd)	TO (mCD)	UCS (MPa)	BTS (MPa)	Density Dry (kg/m3)	Density Sat. (kg/m3)	Sample name
TAK-13	9.65	9.85	35.1		2380	2400	UCS_26
TAK-19	10.25	10.55	40.4		2225	2235	UCS_35
TAK-19	10.25	10.55		3.85	2375	2390	BTS_35
TAK-19	10.55	10.8	37.7		2325	2335	UCS_36
TAK-24	26.52	26.82		3.12	2515	2550	BTS_37
TAK-24	27.93	28.34	18.5		2550	2555	UCS_40A
TAK-26	12.8	12.25	21		2345	2350	UCS_9
TAK-26	14.21	14.41	16.5		2315	2325	UCS_12
TAK-26	14.83	15.02	20		2370	2380	UCS_13
TAK-26	16.18	16.48	28.5		2425	2430	UCS_30
TAK-26	23.05	23.35	18.7		2350	2360	UCS_7A
TAK-26	23.05	23.35	23.1		2350	2355	UCS_7B
TAK-27	14.51	14.76	7		2285	2305	UCS_17
TAK-27	15.16	15.41	13.8		2315	2335	UCS_11
TAK-27	16.37	16.6	28.6		2270	2285	UCS_16
TAK-27	17.32	17.59	24.4		2295	2310	UCS_10
TAK-27	17.32	17.59		1.5	2315	2325	BTS_10
TAK-27	18.53	18.73	24.2		2295	2310	UCS_29

Table 3: USC and BTS results lab tests Labo Magnel

Remarks: Samples without lab results broke during sample preparation or saturation
Borehole TAKAB04 is renamed to borehole TAK-27

The tables below give an overview of minimum, maximum and average values for the different parameters for sandstone and mudstone. The graphs in figure 6 & 7 show the relationship between UCS values for sand and mudstone and depth respective to mCD and m below seabed. The original lab test report can be found in annex 13.

SANDSTONE	UCS (MPa)	BTS (MPa)	Density Air dry (kg/m3)	Density Saturated (kg/m3)
MIN	7.00	0.74	2140	2150
AVG	17.70	1.19	2294	2302
MAX	28.60	1.68	2435	2445

Table 4: Minimum, average and maximum values for sandstone

MUDSTONE	UCS (MPa)	BTS (MPa)	Density Air dry (kg/m3)	Density Saturated (kg/m3)
MIN	8.30	3.12	2225	2235
AVG	21.35	3.49	2490	2503
MAX	40.40	3.85	2670	2680

Table 5: Minimum, average and maximum values for mudstone

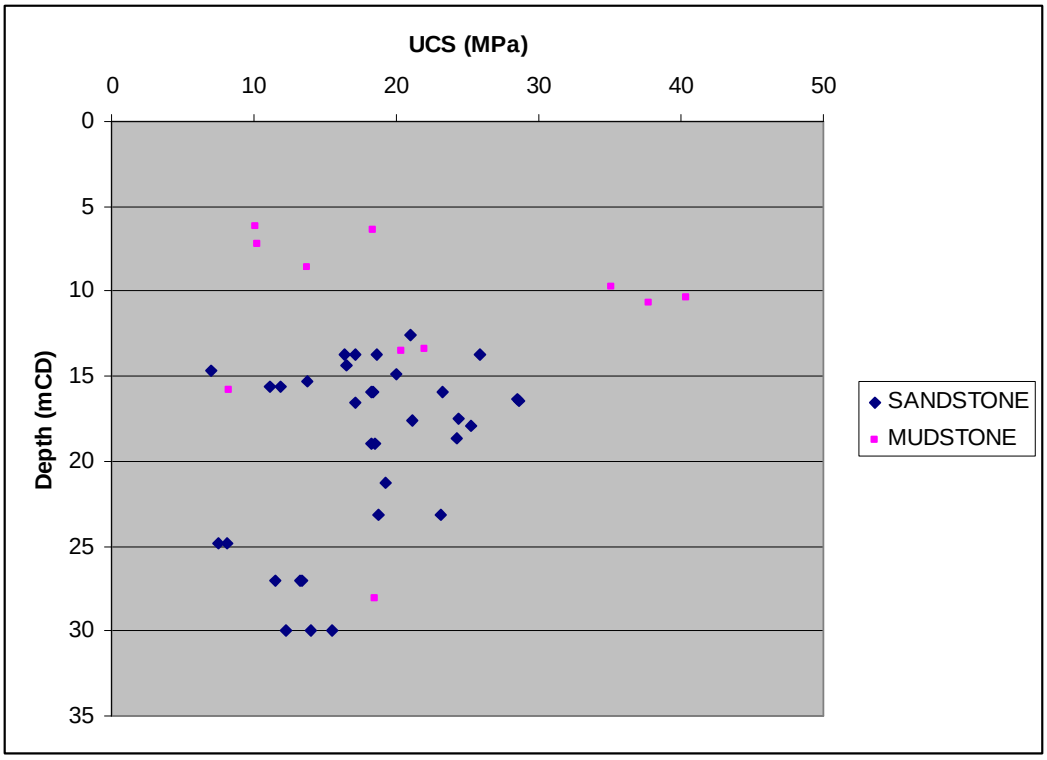


Figure 6: Graph with UCS values (MPa) in relation to depth in mCD

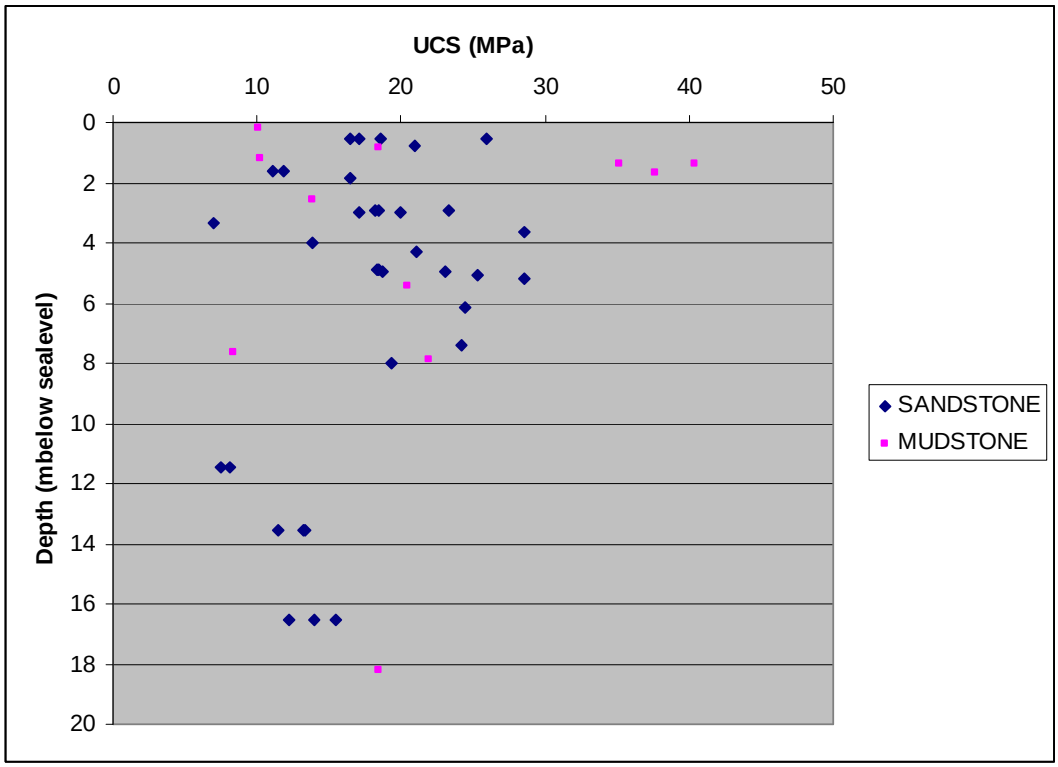


Figure 7: Graph with UCS values (MPa) in relation to depth in m below seabed

5.2 Lab tests on soil samples

A selection of soil samples (SPT) was send to Belgium for laboratory testing at GMA in Zelzate.

Geo Measuring and Ananlyses nv
Industriepark Rosteyne 1
9060 Zelzate
tel. +32 (0)9 326 86 30
fax +32 (0)9 326 86 31
info@gma-nv.com

Following tests were performed on the soil samples: PSD analysis (wet sieving), Aerometer and Atterberg limits. The table below gives an overview of the lab test results. The original lab test report can be found in annex 14.

BH	Average depth mCD	%clay	%silt	%sand	%gravel	d50	dmf
TAK-01	14.5	0.0	10.8	69.6	19.6	0.308	1.243
TAK-01	16.5	0.0	75.2	24.7	0.1	0.050	0.054
TAK-04	13.0	0.0	11.7	84.9	3.4	0.132	0.127
TAK-04	14.0	0.0	12.0	87.8	0.2	0.128	0.124
TAK-04	15.0	0.0	9.2	82.4	8.4	0.173	0.317
TAK-04	15.9	0.0	18.4	81.4	0.2	0.155	0.168
TAK-04	16.9	0.0	5.2	94.7	0.1	0.184	0.201
TAK-04	18.8	0.0	21.3	78.7	0.0	0.130	0.152
TAK-07	10.4	24.3	30.3	28.5	16.9	0.028	0.741
TAK-07	11.6	38.1	58.9	3.0	0.0	0.004	0.009
TAK-07	12.6	49.2	48.8	2.0	0.0	0.002	0.006
TAK-07	14.0	42.9	55.7	1.4	0.0	0.003	0.006
TAK-08	8.1	19.9	32.5	23.7	23.9	0.052	1.852
TAK-08	9.3	26.1	36.8	20.4	16.7	0.031	1.460
TAK-09	6.0	14.9	24.1	29.8	31.2	0.197	1.576
TAK-10	5.5	10.2	26.0	14.3	49.5	1.908	3.455
TAK-24	9.7	21.5	12.9	64.8	0.8	0.099	0.106
TAK-25	10.5	41.4	40.7	7.9	10.0	0.004	0.231
TAK-25	11.5	41.8	55.1	2.2	0.9	0.003	0.007
TAK-25	12.5	45.1	52.6	2.3	0.0	0.002	0.006
TAK-25	13.5	38.3	59.1	2.6	0.0	0.004	0.009

Table 6: Overview of lab results for soil samples

The graph in figure 8 shows 3 major groups of sediment covering the rock. The red curves represent very silty clay. The blue curves represent clayey sandy silt and the yellow curves represent silty fine sand (dmf 160 µm).

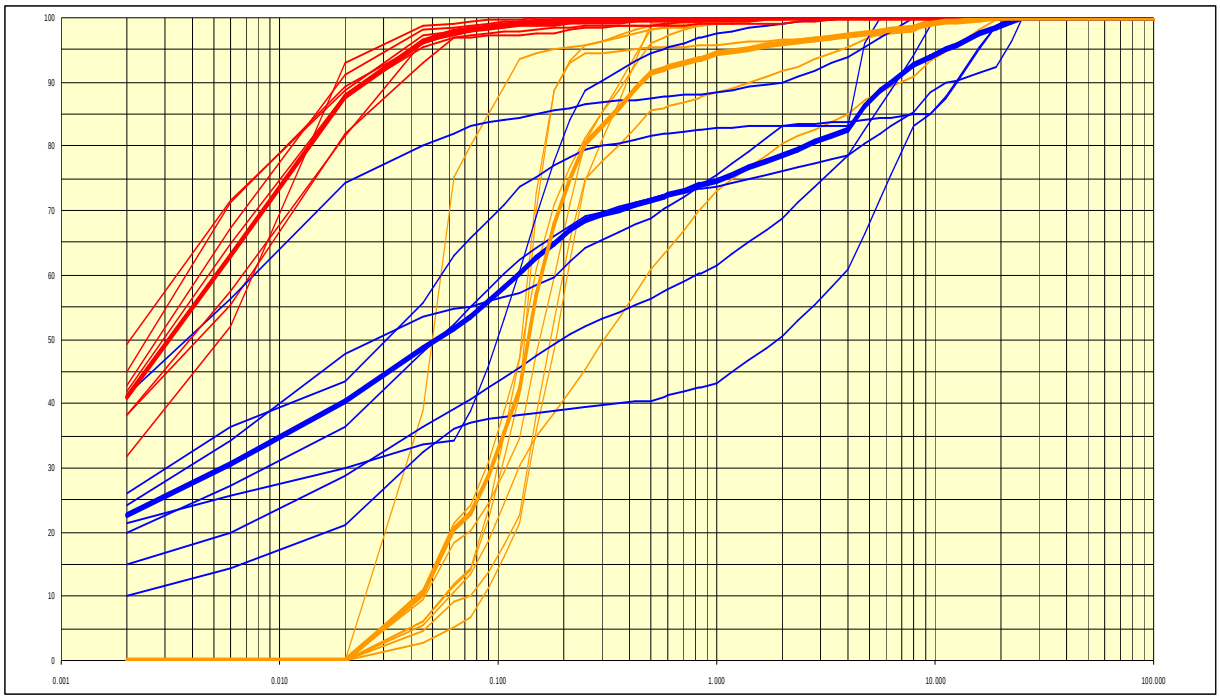


Figure 8: Particle Size Distribution summary graph

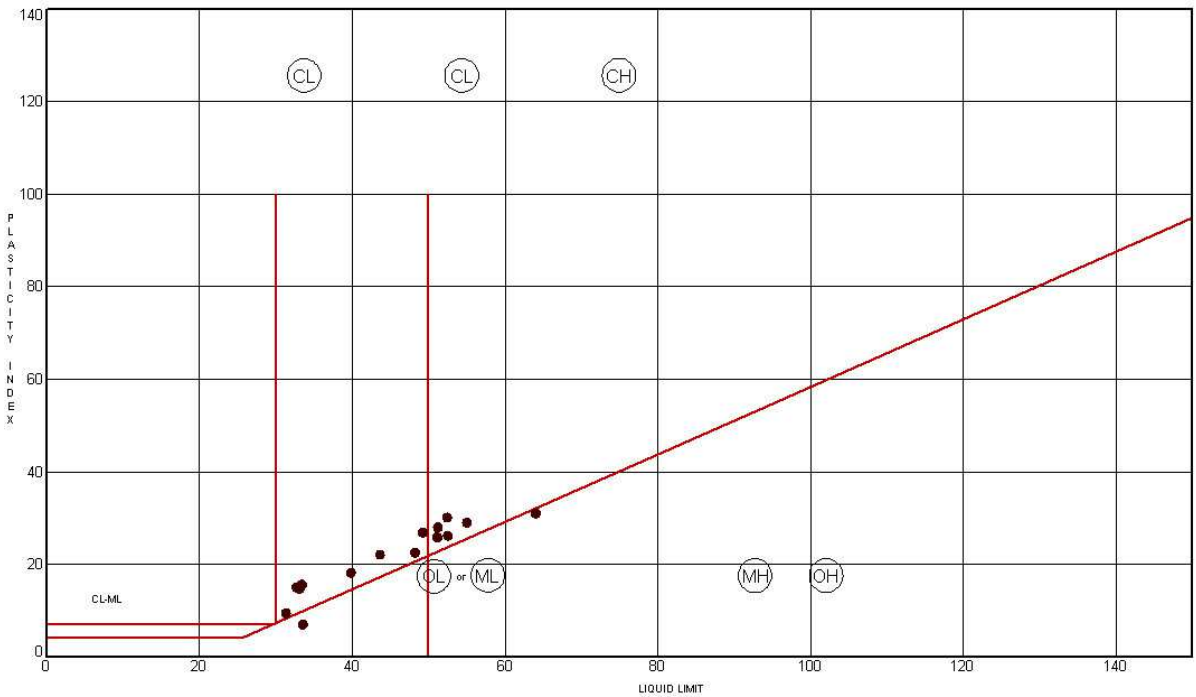


Figure 9: Casagrande plasticity chart

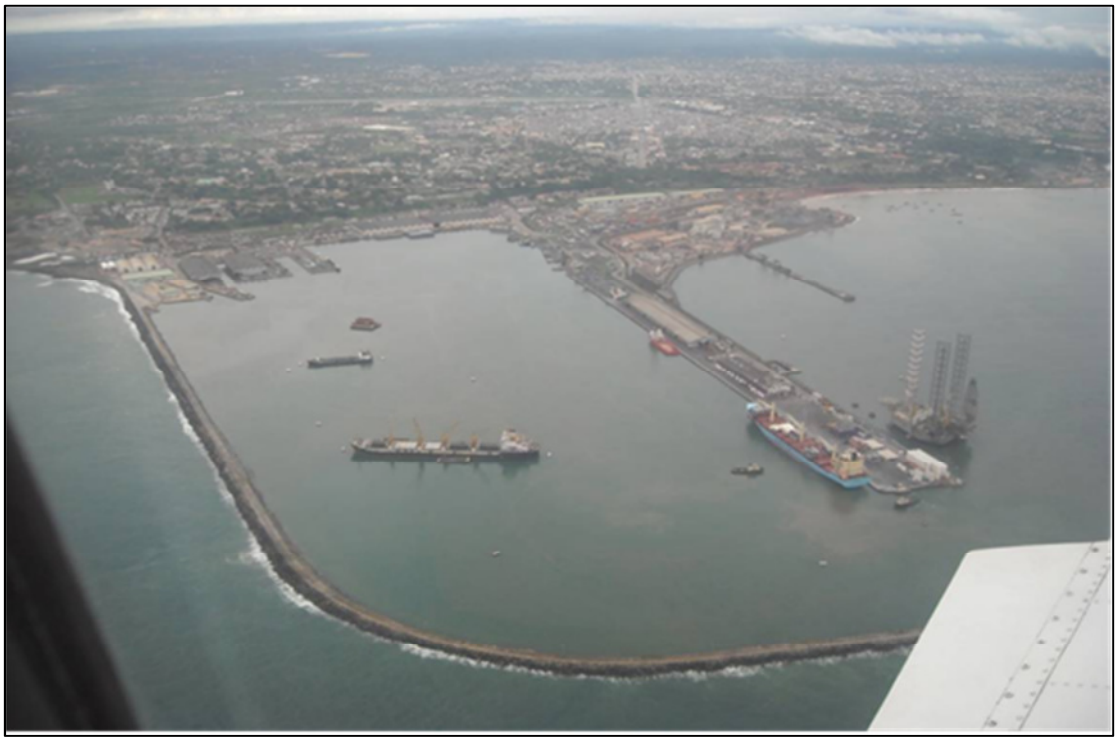
The casgrande chart in the figure above indicates that the clay in the project area has a low to medium plasticity.

Annex 13: Summary of Takoradi Port Master Plans

Ghana Ports & Harbours Authority

MASTER PLAN FOR THE PORT OF TAKORADI

Draft Final Report



Sellhorn Ingenieurgesellschaft mbH
HPC Hamburg Port Consulting GmbH
June 2012

Ghana Ports & Harbours Authority

MASTER PLAN FOR THE PORT OF TAKORADI

Draft Final Report

HPC Hamburg Port Consulting GmbH

Container Terminal Altenwerder
Am Ballinkai 1
21129 Hamburg
Germany
Phone: +49-40-74008-123
Fax: +49-40-74008-133
E-Mail: info@hpc-hamburg.de
Internet: http://www.hpc-hamburg.de

Sellhorn Ingenieurgesellschaft mbh

Teilfeld 5
20549 Hamburg
Germany
Phone: +49-40-361201-0
Fax: +49-40-361201-28
E-Mail: info@sellhorn-hamburg.de
Internet: http://www.sellhorn-hamburg.de

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0. EXECUTIVE SUMMARY

0.1 Introduction

Takoradi Port is located about 250km west of Accra. The port was constructed in the 1920s. Most of the main export products of Ghana such as bauxite, manganese, wood, and cocoa are shipped from Takoradi Port where mining companies have specialized facilities. Additionally volumes of clinker and other cement raw materials are imported. These volumes are expected to increase due to existing expansion plans of the mining industry and growing demand for construction materials.

In recent years oil was discovered off-shore in a distance of approximately 100 nautical miles from Takoradi. Part of Takoradi port was made available for supply vessels, storage areas etc. Conditions in the port are further characterized by draft restrictions that lead to time consuming barge operation. These conditions are a considerable impediment for cost efficient dry bulk handling.

Over the past decade various master plan studies have been undertaken but they failed to adequately predict the current needs of the port. Before this background the Government of Ghana has engaged the services of Sellhorn Ingenieurgesellschaft mbH and HPC Hamburg Port Consulting GmbH of Hamburg, Germany to provide technical assistance to the Ghana Ports and Harbours Authority (GPHA) in the development and expansion of Takoradi Port.

0.2 Physical Conditions at Takoradi Port

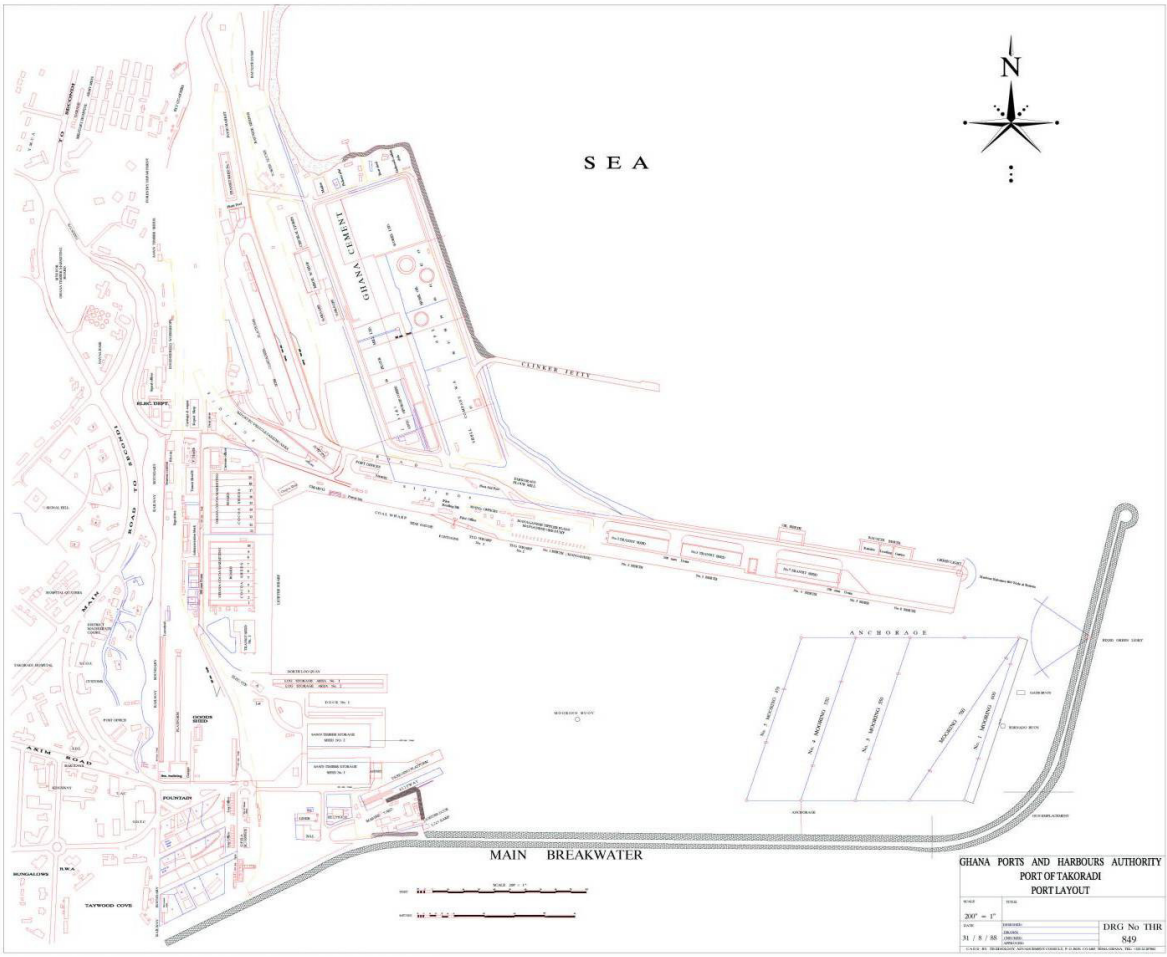
Takoradi area is located within a tropical zone with rainy and dry seasons each year. It is one of the moderate rainfall areas of Ghana. The prevailing wind is generally out of the south to south-west direction. The monthly average wind velocity at the Takoradi area ranges between 4.0 and 6.0 knots. Tidal differences are comparatively small (0.6 to 1.1 m). During the last 40 years the predominant waves came from the south to south-west direction with a significant wave height of approximately 3.0m.

Available geotechnical site investigations suggest that seabed material can be dredged using cutter suction dredgers; some small portions may need to be blasted. Further data/geotechnical investigation is needed for a more accurate assessment. Ghana is not located close to any of the world's well-known seismic

zones. However, significant earthquakes activities have been reported in some areas of southern Ghana.

The present port layout and the main port facilities are shown below.

Figure: Port of Takoradi - Current Layout



Source: GPHA, 1988

The maximum entrance channel depth is -11.3m CD and the channel width is approximately 150m. Vessels with a length of up to 220 m are visiting the port regularly. The main pier comprises coal wharf, tug wharf, and six berths for vessels with a maximum draft of 7.5 to 9.0 m. In the harbour basin a total of seven pairs of mooring buoys at water depths ranging from 8.0m to 11.0m exist. Thus, 45,000 dwt bulk carriers with a typical draft of 11.5 m which regularly call the port cannot enter if fully laden. Due to limited water depth of the main berths a significant share of bulk cargo is handled at the mooring buoys and transhipped to/from the berths by barges.

Present technical condition of the port's main marine facilities range from critical (Berth no. 1) to satisfactory (Berths nos. 2 to 6). Sheds on the main, as well as the pavement (mostly block pavement) throughout the port area are in fair condition. It is estimated that approximately 35% of the existing pavement have to be renewed. The port's electricity sub-stations are 50 years old and break down frequently. The electricity network in the port is in an equally bad shape.

Apart from container and general cargo facilities port land areas are used by a wide range of commodities and companies, i.e. GHACEM cement factory, a flour mill, manganese and bauxite exporters, cocoa exporters and oil exploration companies, just to name the important ones. The port area is fully used and congested at times. Container yards are small and in a distance from the berths. The capacity of the yards is nearly exhausted.

The port of Takoradi can be reached by road through five different gates. Most of the streets leading to the port are quite narrow and in bad condition. Already with the present traffic volume congestions and long queues of trucks at the main gate can be observed in peak times. The port is connected to the national railway network by two railroad gates. Rail traffic interferes with road traffic.

0.3 Traffic Forecast

Takoradi port provides facilities for handling of containerised and non-containerised cargo and - since a few years - services for the emerging off-shore oil industry. Cargo volumes are dominated by four commodities, namely manganese and bauxite exports, clinker imports, and containers. Projections for this Port Master Plan are based on a review of previous analyses, information received from main stakeholders and customers of the port in February 2012 and intensive desk top research of the Consultants.

Forecasting values for a 20-year projection inevitably entail considerable uncertainties. Therefore, the forecast comprises three scenarios:

- **A low (or pessimistic) scenario** with a comparatively small probability. The macro-economic assumptions include continued power shortages, limited oil revenues, a deficit in public services and infrastructure upgrading, an increasing trade deficit, rising inflation, increasing taxation, and a slowing demand for imports.

- **A high (or optimistic) scenario** is based on very good development prospects, including continued Government policies to encourage private investment, unconstrained electricity supply, very high revenue from oil

and natural gas production, heavy investments in infrastructure, and social services, a decreasing trade deficit and reduced debt service.

- **A medium scenario** which is less speculative and based on economic activities already documented or plans well advanced in the near future. Power supply shortage is assumed to overcome by 2020. Oil production royalties yields about 600 million USD per year by 2015. Rail and road infrastructure improves, especially the Western railway is rehabilitated, but water supply continues to constrain certain industries. The trade deficit stabilizes at current levels.

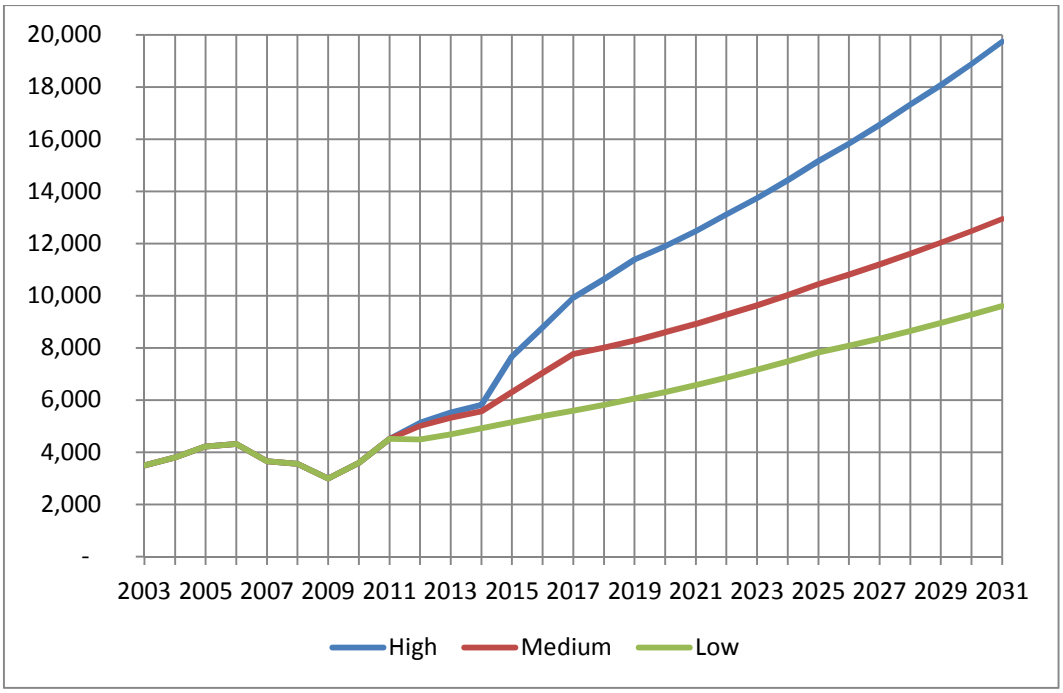
For layout planning the medium scenario has been used.

With regard to **non-containerised cargo** 22 commodity groups have been analysed and for each of them detailed projections have been made. The total cargo volume projections for Takoradi Port are shown in Figure 1. Their structure for selected years is illustrated in Figure 2.

From its moderate level of approximately 50,000 TEU **container traffic** is forecast to grow at an average annual rate of 6.4 percent in the next 20 years (medium scenario). All three scenarios are depicted in Figure 3.

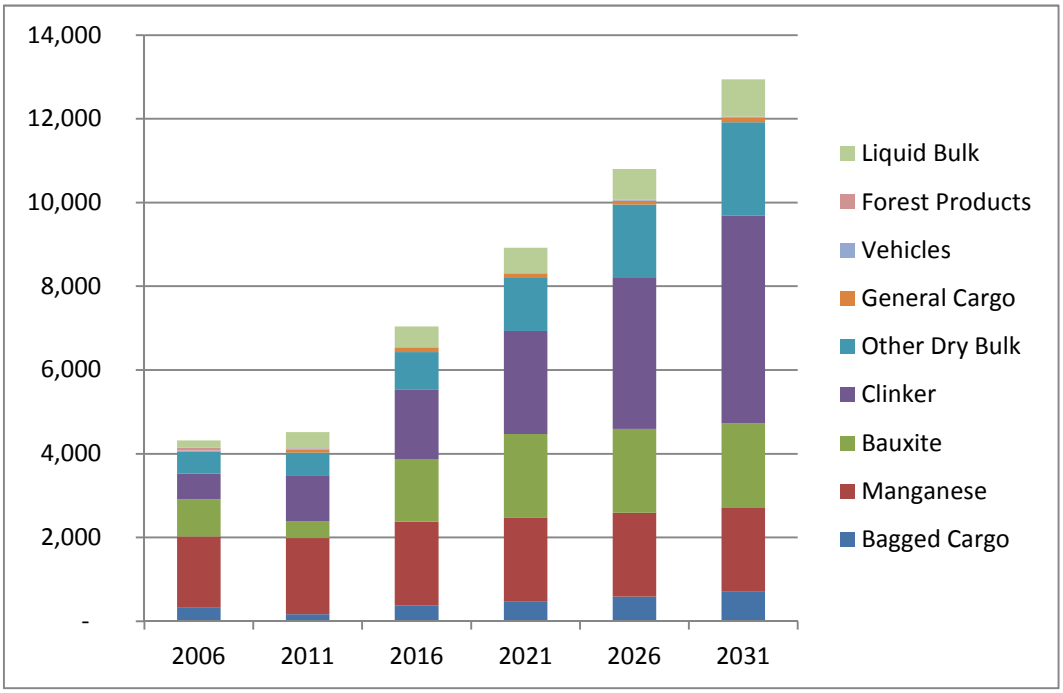
Since a number of years Takoradi Port serves as a basis for **oil and gas exploration and productions companies** working at the fields off the Ghanaian shoreline. Meanwhile approximately 2 ha of port land have been leased out to the oil industry. Oil supply vessel traffic has increased drastically since 2008. The forecasts of essential facility requirements for the oil service industry are based on a recent report prepared for TULLOW Ghana Ltd., projected investments of the oil and gas industry in Ghana as per GNPC and other information. Present plans indicate a reduction of exploration activities after 2016. For the continued market success of Takoradi as an oil service port it will be essential to attract business from the fields off the shores of Ghana's western neighbours. Projected berth requirements vary between two and eight berth with a maximum land requirement of 11ha in the medium scenario. In any case In any case the development of Takoradi Logistics Platform at New Amanful must be closely monitored in order to avoid duplication of facilities.

Figure 1: Non-containerised Cargo Projections until 2031 (mio tons)



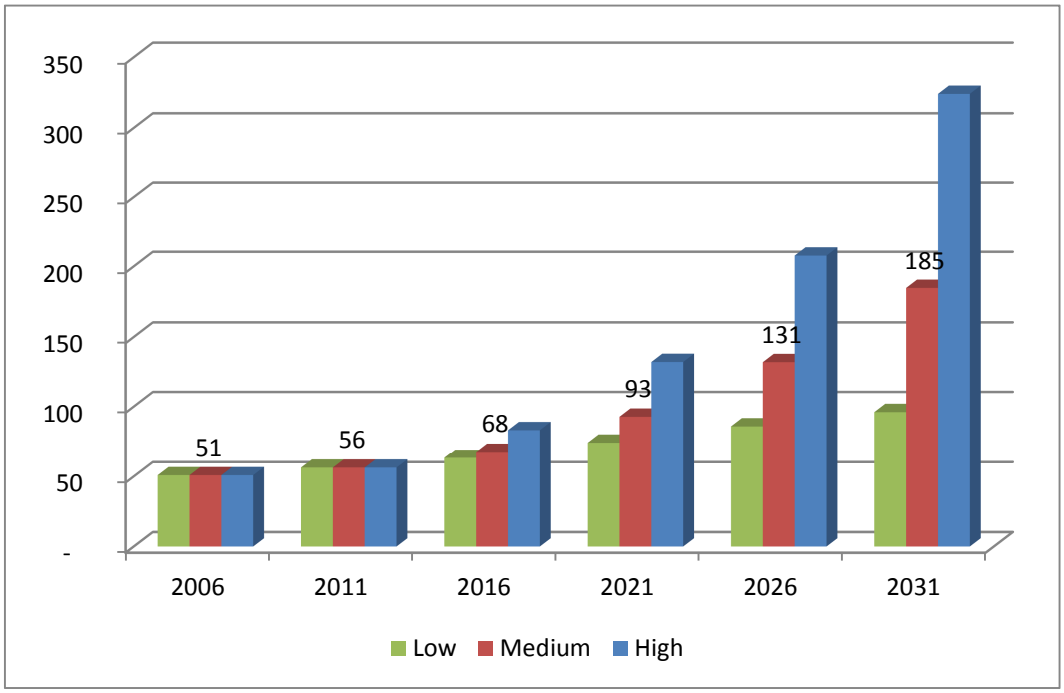
Source: HPC 2012

Figure 2: Non-cont. Cargo Pattern - Medium Scenario (mio tons)



Source: HPC 2012

Figure 3: Container Traffic Forecast until 2031 (1,000 TEU)



Source: HPC 2012

Current physical restrictions of the port are reflected in the ships' sizes presently calling Takoradi port. Given the anticipated increase in commercial relations to VR China especially in bulk trades, and expected developments in container pattern in West Africa the following key design vessel types are considered for this Master Plan:

	DWT [t]	Length [m]	Width [m]	Draft [m]
Bulk Carriers	65.000	230	34	13.0
Containers	30.000	200	33	11.4
Oil Service Vessels		100		8.5

0.4 Required Port Facilities until 2031

The required extension of Takoradi Port comprises the creation of two new harbour basins. The water depths in the harbour basins and at the berths must generally be sufficient for safe manoeuvring. The design depth for the new basins and dedicated berths shall be -14.0m CD for the outer basin, where mostly bulk carriers with drafts up to 13.0 m will be handled, and -12.5m CD for the inner basin, where mostly container vessels with drafts up to 11.4m will be handled.

The entrance channel of Takoradi Port has to be extended and has to be deepened to -14.5m CD, allowing vessels to use the entrance channel independently from tidal constraints. A new turning basin with a diameter of about 500m and a depth of -14.5m CD will allow safe turning of vessels with a maximum LOA of 250m with tugboat assistance.

The computation of the required number of berths distinguishes four different types, with the following design parameters for new berths:

Type	Length	Minimum Water Depth
Dry Bulk	260m	14m
Liquid Bulk	130m	10m
Multipurpose	230m	11.5m
Oil Services	120m	9m

Computation of requirements are based on usual ratios of berth availability, productivity etc. The required number of berths is summarised in the following table:

		2012	2016	2021	2026	2031
Medium Scenario	Dry Bulk	1	2	2	2	2
	Liquid Bulk	1	2	2	2	2
	Oil Service	5	6	2	2	2
	Multipurpose	3	3	4	5	5
	Total	**10**	**13**	**10**	**11**	**11**

Up to 8,000 TEU slots are required for container storage. Thus, two additional areas are required in the short run:

- a dedicated Container Freight Station (Devanning Area) of approximately 17,000 m^2 with a capacity of up to 45 containers and a customs area of at least 4,000m^2 including scanning facilities. Preferred handling equipment is reachstackers and terminal trucks with chassis.

- An additional container storage yard operated by reachstackers with a stacking height of three containers should be put in place at the present manganese yard (2ha), once the latter has been relocated.

As from 2019 these short term extensions would be exhausted. Additionally these measures have operational disadvantages as the container yard will be divided into four parts plus the CFS. Therefore it is highly recommended to build a productive state-of-the-art container terminal in the port of Takoradi even before 2019. This terminal is proposed to be operated by a combination of two mobile harbour cranes for ship to shore operations and up to eight rubber tired gantry

cranes (RTGs) for the handling of containers in the storage area. The horizontal transports between these cranes should be done by terminal trucks with chassis.

Required storage areas for non-containerised cargo are projected as follows:

- Manganese: 1.7ha with 2 x 400m of rail track
- Bauxite: 2.1ha with tracks to offload 800m trains
- Cocoa: total area 0.68ha with 0.45ha of shed
- Alumina (optional – high scenario): 2.1ha
- Vehicles: 1.8ha
- Bio Fuel: 2.7ha
- Other Dry Bulk: 2.4ha
- Other cargo: from 3ha up to 6.9 ha in 2031.

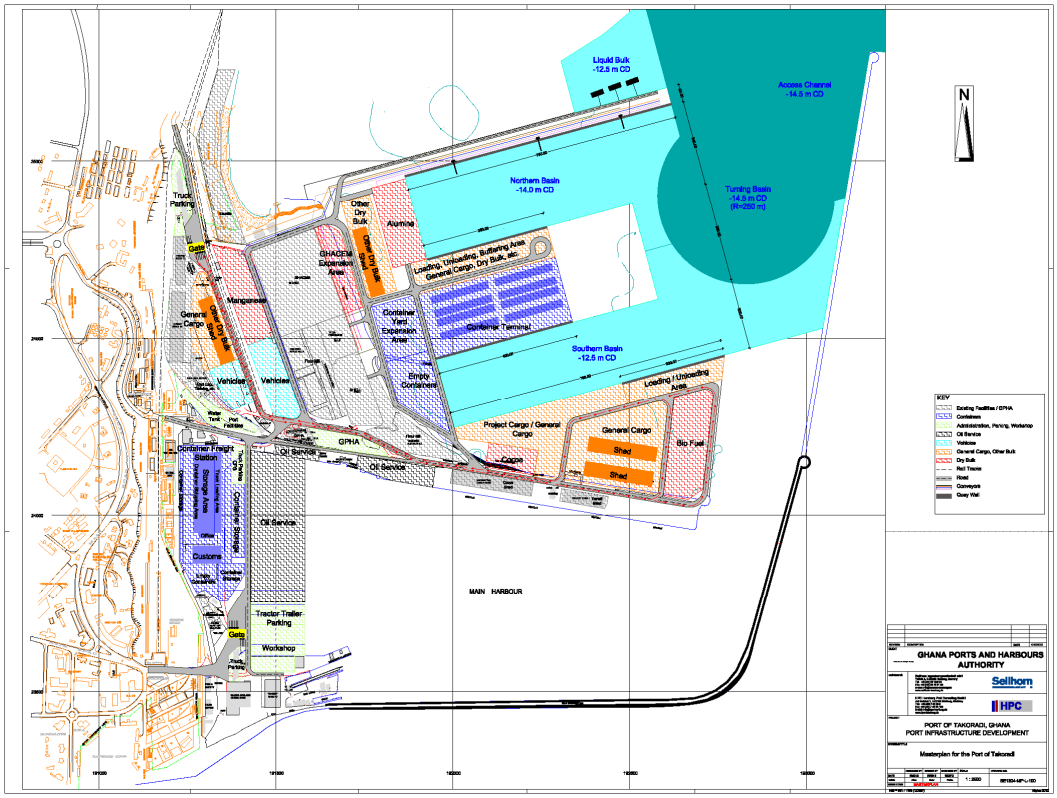
It is possible to access the port via three different roads. The northern and the southern access roads should be improved for truck traffic with separate access for container and non-container traffic. A total of up to 19 gate lanes are required in the period under review. In front of each gate a truck parking area should be built. All internal roads should have a width of minimum ten meters.

The railway accesses the port from the north. The bauxite yard can be accessed directly from the north of the yard and the manganese yard will be reached from the northwest corner of the port. Up to six trains per day have to be offloaded in the forecast period.

0.5 Draft Conceptual Design of Takoradi Port

This master plan is predominantly based on plans recently prepared by GPHA. Alternative layouts of the Takoradi Port extension were extensively discussed with GPHA management in April 2012. In consultation with GPHA the layout presented below was selected to further development. The planned marine infrastructure ensures sustainable development of Takoradi Port even beyond the planning horizon 2031.

Figure 4: Proposed Layout



Source: HPC 2012

The layout shows the final extension as of 2031. Proposed development works include

- Extension of the main breakwater by 1,150m
- Deepening of the access channel to -14.5m CD;
- Dredging of a new 500m turning basin;
- Construction of two harbour basins in the north of the existing main pier.
- Construction of
    - a deep water pier with 780m of berths for dry bulk and 260 m for liquid bulk
    - a total of 1,050m of container and multipurpose berths
- Reclamation of 48 ha of terminal area at the new harbour basins
- Building of a state-of-the art container terminal including a 7.5ha devanning area
- Relocation of the mechanical workshop, storage yard for imported vehicles, and the manganese yard
- Construction of 3.2 ha of new sheds

- Preparation of 6.5 ha storage and working area for the oil and gas service industry
- Improvements of access roads, internal roads and gates
- Relocation and rehabilitation of railway tracks

Traffic flows through the new port arrangement separate container and non-container traffic. The proposed traffic management avoids crossings between railroad and truck traffic.

Investment costs for the final extension of the Port of Takoradi are estimated at 761 million USD. A rough breakdown is given in the table below.

Items	Costs [million USD]
Design and mobilisation, overheads	79.3
Dredging	110.1
Land reclamation	27.5
Quay walls	215.6
Shore protection	16.1
Breakwater	115.9
Oil Jetty	2.5
Rehabilitation manganese berth	4.0
Sub-Total Marine Works	**571.1**
General Land Infrastructure	81.6
Dedicated Facilities	78.9
Sub-Total Shore Investments	**160.5**
Container Handling Equipment	**29.3**
Grand Total	**760.9**

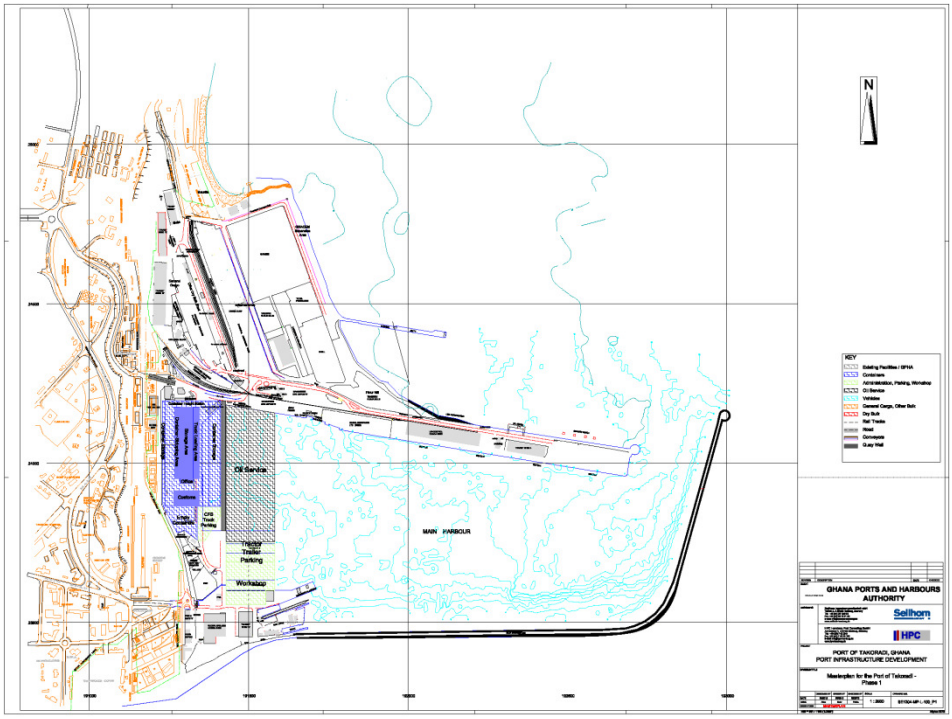
Source: HPC, 2012

0.6 Staged Development Programme

According to forecast capacity demand it is proposed to accomplish construction works at Takoradi Port in three phases, becoming operational in 2013, 2015 and 2018 respectively. The corresponding port layout for the first two phases is shown in the following two plans (Phase 3 layout is shown above in chapter 0.5).

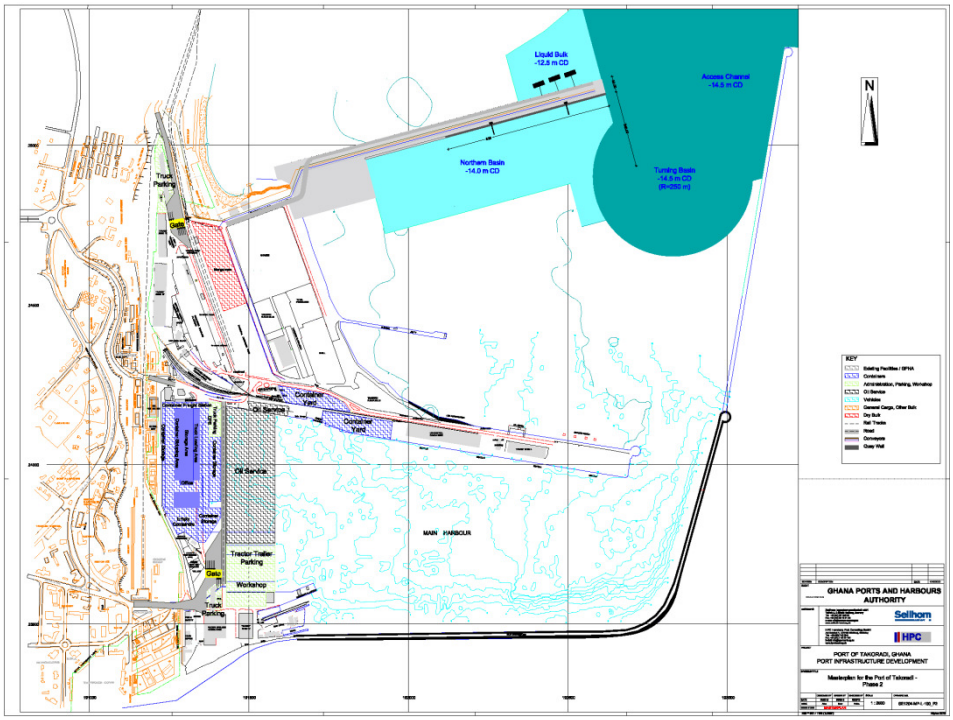
Investment costs for the main construction phases are illustrated in Figure 7.

Figure 5: Layout Phase 1



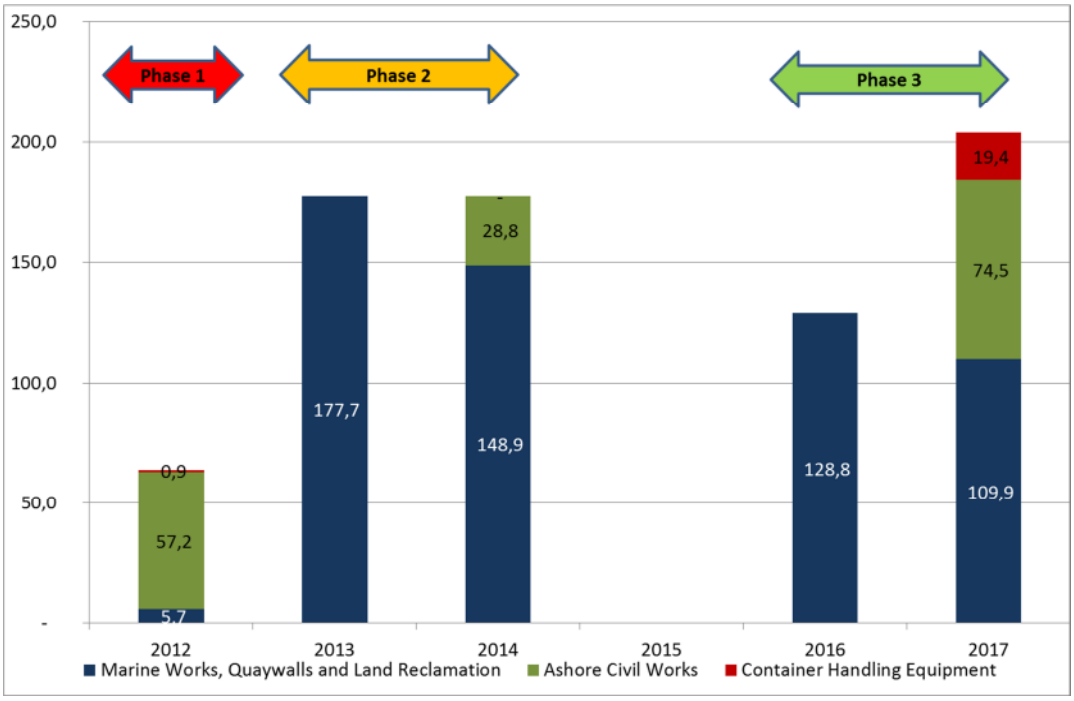
Source: HPC 2012

Figure 6: Layout Phase 2



Source: HPC 2012

Figure 7: Investment Costs by Development Phase (million USD)



Source: HPC 2012

0.7 Economic Feasibility Analysis

The proposed port development for Takoradi will require capital expenditures. It will extend capacities and reduce certain costs. The proposed works will allow larger vessels to operate in the port than it would be the case in the "without project" condition, it will improve ports operation (especially it will avoid the present lightering of bulk cargos), and it will increase port capacity in terms of cargo throughput and services for the oil industry. The project's overall economic feasibility is determined by the discounted balance of these two aspects.

The total economic cost/benefit results for Takoradi Port are summarized in the table below. The discounted benefit stream calculated by the model is approximately 760 million USD. The NPV of the project discounted at 8%, including investment cost, is 240 million USD. The positive NPV of the project will be complemented by an induced substantial increase of economic activities and jobs in Ghana's economy. The envisaged construction works alone could yield positive primary and secondary economic impacts in the tune of 450 million USD. The proposed port extension would additionally generate jobs and income as related production and exports increase.

Table: Project Cost-Benefit Summary

Item	million USD
Total Benefits NPV 2012	**757.7**
Total Costs NPV 2012	516.6
Net Benefit NPV 2012	241.2
Discounting Factor	*8.0 %*
EIRR	12.9 %

Source: HPC 2012

The Economic Internal Rate of Return (EIRR) of the proposed port development is 12.9%, which exceeds the standard threshold for developing countries of 12%, but is not at a very comfortable level. Moreover, a number of project risks exist; the most important is the conversion of savings from the use of larger vessels into port's cash flow. These savings account for more than 90 percent of all benefits. They will not "automatically" benefit the port but must be converted to cash flows through appropriate port charges

The narrow range of commodity flows that account for these benefits makes it necessary

- that the major port users participate in the financing of a substantial part of the port development or
- to conclude "take or pay" contracts from these major port users to obtain other private funding and/or ensure the conversion of their benefits into port cash flow.

A timely and intensive involvement of the main port users is of utmost importance to successfully implement the proposed development of Takoradi Port. Another inevitable prerequisite for a financially feasible port development is a strict and very tight cost management.