REPUBLIC OF GHANA

MINISTRY OF TRANSPORT

GHANA PORTS AND HARBOURS AUTHORITY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY OF PORT INFRASTRUCTURE DEVELOPMENT, PORT OF TEMA

Revised EIS

Prepared By:
SAL Consult Limited, P O Box GP20200, Accra,
June 2015

PROJECT TEAM

No.	Name	Position	Qualification	Contribution to Report
1.	S.A. Larmie	Chief Consultant	MSc (Applied Science), VUB Brussels	-Quality Assurance, - identification of impacts -Stakeholder Consultations - Review of Draft Report
2.	E. K. Acquah	Senior Consultant, *Environmental Policy Specialist*	MSc (Environmental Policy), University of Hull, UK	- Stakeholder Consultations - Analysis of impacts - Review of Draft Report
3.	N.Y. Otu-Ansah	Consultant, *Environmental Quality Specialist*	MPhil (Environmental Science), University of Ghana, Legon	-Consultations - Baseline Studies - identification of impacts -Drafting of Report
4.	Esenam Adzo Ziwu (Mrs.)	Consultant, *Environmental Scientist*	BSc. (Environmental Science), University of Cape Coast	-Consultations -Baseline Studies
5.	H. N. A. Asare-Awuku	Consultant, *Environmental Scientist*	BSc. (Environmental Science), Kwame Nkrumah University of Science and Technology	Consultations -Baseline Studies -Drafting of report

Email: info@salconsultgh.com

TABLE OF CONTENTS

List of Tables

List of Figures

GLOSSARY

ACS	Africa Coastal Services
ALARP	As Low As Reasonably Practicable
CFS	Container Freight Station
CLC	Convention on Civil Liability for Oil Pollution Damage
CSD	Cutter Suction Dredger
DVLA	Drivers and Vehicles Licensing Authority
EA	Environmental Assessment
EC	Environmental Coordinator
EEZs	Exclusive Economic Zones
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Engineering and Maintenance supervisors
EMS	Environmental Management System
EPA	Environmental Protection Agency
ESIA	Environmental & Social Impact Assessment
ESMF	Environmental and Social Management Framework of the
FSM	Fire and Safety Manager
FUND	International Fund for Compensation for Oil Pollution Damage
GCHC	Ghana Cargo Handling Company
GJT	Golden Jubilee Terminal
GPHA	Ghana Ports and Harbours Authority
GRCL	Ghana Railway Company Limited
GRDA	Ghana Railway Development Authority
GWCL	Ghana Water Company Limited
HSE	Health, Safety and Environment
HSSE	Health, Safety, Security and Environment
ICD	Inland Container Depot
IFC	International Finance Corporation
IFC	International Finance Cooperation
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
ISPS Code	International Ship and Port Facility Security Code
ITCZ	Inter Tropical Convergence Zone
JICA	Japan International Co-operation Agency
LDCs	Less Developed Countries
LGP	Low Ground Pressure
LI	Legislative Instrument
LLMC	Liability for Maritime Claims
MARPOL	International Convention for the Prevention of Pollution From Ships
MCT	Maersk Container Terminal

MGD	Million Gallons A Day
MoFAD	Ministry of Fisheries and Aquaculture Development
MoFEP	Ministry of Finance and Economic Planning
MOT	Ministry of Transport
MTTU	Police Motor Transport and Traffic Unit
NAAQG	National Ambient Air Quality Guidelines
NANLG	National Ambient Noise Level Guidelines
NE	North East
NGO	Non-Governmental Organisation
NPK	Nitrogen, Phosphorus and Potassium
OOG	Out-of-Gauge
OP	Operational Policies
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation
PEMP	Provisional Environmental Management Plan
PID	Public Investment Division
PNDC	Provisional National Defence Council
PPE	Personal Protective Equipment
PPP	Public Private Partnership
RAMSAR	Convention on Wetlands of International Importance, especially as Waterfowl Habitat
RPF	Resettlement Policy Framework
RTG	Rubber Tired Gantry
SEA	Strategic Environmental Assessment Report
SFH	Sekondi Fishing Harbour
SHB	Split Hopper Barges
SOLAS	International Convention for the Safety of Life at Sea
STCW	Standards of Training, Certification, and Watch-keeping for Seafarers
STO	Senior Traffic Officer
SW	South West
TBT	Tema Bonded Terminal
TCT	Tema Container Terminal
TDC	Tema Development Corporation
TLC	Takoradi Lighterage Company
TMA	Tema Metropolitan Assembly
ToR	Terms of Reference
TSHD	Trailing Suction Hopper Dredger
UNCLOS	UN Convention on the Law of the Sea
UNEP	United Nations Environmental Programme

EXECUTIVE SUMMARY

Introduction

The Ghana Ports and Harbours Authority (GPHA) acting on behalf of the Republic of Ghana intends to apply budgetary allocations towards a port infrastructure development project to Upgrade and Expand the Port of Tema, Ghana. As part of this project, GPHA requires consulting services for the Social and Environmental Impact Assessment Studies related to the planned development works in the Port of Tema. The Port Authority subscribes to all governing environmental protection conventions and the provisions under the laws of the Republic of Ghana to acquire the necessary permits prior to all development works such as envisaged under the upgrade and expansion of the Port of Tema.

The Management of GPHA approved a master plan for the Port of Tema with a phased development agenda towards the realization of the ultimate plan. As part of the earlier phases, major marine and civil engineering works would be required to prepare the new port cluster for accelerated growth and regional leadership. The following basic port infrastructure and facilities, in summary, have been identified for development under the expansion programme:

i. Construction of breakwaters;
ii. Dredging and reclamation;
iii. Construction of quay;
iv. Cargo handling and berthing furniture at all the respective berths;
v. Cargo handling and operations terminals;
vi. Upgrading of ports' access roads and the development of new major dedicated access roads to the Port of Tema; and
vii. Coastal reclamations and/or reformations, especially near the Sakumo beach as a result of possible accretion and growth of sandy beach landforms.

In keeping with the Environmental Assessment Regulations 1999, LI 1652, the project was successfully registered with the EPA by completion of the prescribed EPA Registration Form EA2. The EPA in a response letter referenced CI: 2524/01/02 of 10 January 2014 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 LI 1652. The scoping report for the proposed port expansion project was submitted to the EPA. The EPA's review comments on the scoping report, dated 31 October 2014 and referenced CI: 2524/01/05 requested the Agency to prepare two separate EIAs for the proposed project covering the following components:

- Port Expansion Infrastructure including: construction of breakwaters, dredging and reclamation, construction of quay walls, cargo handling and berthing furniture at all the respective berths cargo handling and operations terminal and coastal reclamation and/or reformations
- Upgrading of ports' access roads and development of other new dedicated access roads to the port

A Scoping Notice, which aims at inviting public comments on the proposed project was published on page 56 of the March 12, 2014 edition of the Daily Graphic, a national newspaper. A copy of the notice is provided in **Annex 2.**

Legal Framework

National Policies and regulations related to the proposed project include:

- 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 2013 (L.I. 2206);
- Ports Regulations, 1964, LI 352;
- Factories, Offices and Shops Act 1970, Act 328;
- Factories (Docks Safety) Regulations, 1960;
- Labour Regulations, 2007;
- The Labour Act 2003, Act 651;
- Wetland Management (RAMSAR Sites) Regulations, 1999.
- The Fire Precaution (Premises) Regulations 2003, LI 1724;
- Ghana National Fire Service Act, 1997 (Act 537);
- Ghana Maritime Authority Act 2002, Act 630;
- Ghana Shipping Act 2002, Act 645;
- Oil in Navigable Waters Act 1964, Act 235;
- Local Government Act 1993, Act 462;
- National Ambient Air Quality Guidelines (NAAQG);
- National Ambient Noise Level Guidelines (NANLG);
- Water Resources Commission Act;
- Abandoned Property (Disposal) Act, 1974;
- Local Government Act (Act 462), 1993
- Workmen's Compensation Law, 1987;
- Children's Act, Act 560 (1998);
- Public Holidays Act, Act 601 (2001);
- Standards Authority Act, NRCD 173 (1973); and
- Human Trafficking Act, Act 694 (2005).

Existing Tema Port

It is located in Tema in the Greater Accra Region. Tema is located about 25 km east of Accra, Regional Capital. The area falls within Latitude 5°38'1"N and Longitude 0°0'47"E and lies within the coastal savannah zone. The port of Tema has a total area of 5.5 km^2. The water-enclosed area of the port measures 1.7 km^2 and the total land area are 3.9 km^2.

<u>Facilities</u>

Infrastructure at the Port of Tema include the following.

- quays,
- berths,
- fuel bunkers,

- storage facilities,
- Transshipment; and
- Fishing harbour.

Proposed Project

The facilities planned be provided under the proposed project include the following:

i. **Construction of breakwaters** – new rubble-mound breakwater profiles to be constructed to water depths of about -17mCD and founded on firm seabed sub-soil;
ii. **Dredging and reclamation** – for the deepening of access channels, ports' basins, the berths and the preparation of heavy-duty cargo storage and transfer areas, the new port basins would be dredged to water depths of -16mCD on the average. Access channels are to be deepened to a maximum of -18mCD. There would be two – 300m-radius turning basins, also at least -16mCD water depths. Preliminary soil investigations indicate that dredged materials would be suitable for re-use as reclamation materials. Nonetheless, substantial reclamation materials would be imported from land-based burrow pits or quarries.
iii. **Construction of quay walls** – for the design vessels of post panamax-plus classes, foundations of quay walls would be in the region of -18mCD, and proposed to be gravity block wall structures. Where appropriate, sheet piling and rubble revetments would be designed to shore reclamation slopes of terminals, especially in the phased development schemes;
iv. **Cargo handling and berthing furniture at all the respective berths** – container crane rails, fenders, bollards, cargo conveyors, oil piping corridors and other berthing furniture would be provided at all berths and quay fronts;
v. **Cargo handling and operations terminals**: more than 350 Hectares of terminal space is expected to be provided under the expansion programme. Such areas are designed for heavy-duty operations for containers, Roll-on/roll-off ships (Ro-Ro), passengers / cruise services and break bulk cargos. All terminals would be operated with full gear – equipment, plant, utilities services, personnel, HSSE gear and logistics and administration buildings and facilities in accordance with best practices for modern terminal operations.
vi. **Coastal reclamations and/or reformations**, especially near the Sakumo beach as a result of possible accretion and growth of sandy beach landforms. There is also the need to ensure that the Sakumo lagoon retains its estuarine nature with unhindered flood and ebb discharge levels of the lagoon. This would require minor, yet important, engineering structures to ensure the flow exchanges.

Baseline Information

The existing physical and socioeconomic environment of the project area of influence i.e., the Tema Metropolis is presented in this chapter. The proposed port upgrade and expansion will be entirely at the Western portion of the current port location. The baseline has been described in terms of the following:

- Physical Environment
  - Land Use
  - Marine Water Uses

  - Geology & Soil
  - Seismicity
  - Bathymetry
  - Climate
  - Topography
  - Coastal Processes
  - Sediment Transport
  - Marine Sediment Quality
  - Marine Water Quality
  - Marine Ecology
  - Characteristics of the Sakumo II RAMSAR Site
  - Ambient Air Quality
  - Ambient Noise Levels
- Socioeconomic Environment
  - Population, Ethnicity and Religion
  - Economy
  - Cultural Heritage and Archaeology
  - Traffic and Transport

Potential Positive Impacts

- Employment opportunities;
- Improvement in local/national economy;
- Increase in institutional and national revenue;
- Improvement in harbour performance; and
- Improvement in harbour environment.

Potential Adverse Impacts and Mitigation Measures Proposed

The significant adverse impacts (rated as moderate or major) identified from the analysis and evaluation of the potential impacts include the following.

Preparatory Phase

The potential impacts from this phase of the project development is from Land acquisition/compensation issues.

Constructional Phase

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

- Impact on cultural resources;
- Air pollution;
- Waste generation and disposal problems;
- Occupational health and safety risks;
- Sanitation challenges;
- Traffic impacts and public safety challenges; and
- Impact on Ecologically Sensitive Sites (Sakumo II RAMSAR site)

Operational and Maintenance Phase

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

- Impact from Sediment Transport and on the Sakumo II Lagoon
- Contamination of marine environment;
- Introduction of Invasive Marine Pest Species
- Waste generation and disposal challenges;
- Occupational health and safety risks; and
- Sustainability of the Tema Port.

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.

Recommended Mitigation Measures

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

Proposed mitigation measures for potential impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Preparatory Phase Impacts
Land Acquisition and Compensation Issues	Ave Maria Resort	Where any property needs to be affected, the Project-Affected-Persons (PAPs) will be involved in every stage of the compensation process. As much as possible, movable structures will not be destroyed or damaged but salvaged. GPHA will engage the Lands Valuation Division to carry out valuation of the affected property in collaboration with the Management of Ave Maria Resort. Ave Maria will be consulted extensively on the terms of resettlement and compensation. GPHA will ensure that appropriate Government of Ghana compensation methods/procedures are followed to ensure that all the identified project affected persons (PAPs) are well catered for, as per the provisions of **OP 4.12 on Involuntary Resettlement**. A compensation framework for the project is provided in **Annex 7**.
		Construction Phase Impacts
Impact on Cultural Resources	Tema Traditional Council/ Meridian Rock	The Tema Traditional Council will be consulted prior to the commencement of work to ensure that all the necessary customary rites are performed and required royalties paid to the stool to ensure peaceful coexistence. As much as possible, the traditional authorities will be permitted to carry out their annual rites .
Air Pollution	Workers/ Port users	Visibly dry soil to be disturbed, as well as stockpiles of sand aggregates to be used for construction, will be dampened at least three times a day. Speed of vehicles over any unpaved landscape will be controlled to minimise dust generation. Materials dumping will be regulated to reduce dust emissions.
Waste Generation and Disposal Problems	Workers/ Port users	<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 TMA approved disposal site. Management has entrusted with the management of waste within Tema 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 disposed of at the approved disposal site of the TMA. Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction. Contaminated soil will be considered as waste material and disposed of accordingly at the TMA approved disposal site. <u>Dredging</u> The dredging will generate 3,600,000m^3 of dredge material, mostly solid/slurry waste. All the dredge materials will be used for reclamation of portions of the Port.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
Occupational Health and Safety Risks	Workers	<u>Adoption of Health and Safety Policies</u> It is the policy of GPHA, and for that matter the Tema Port, 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 contractor(s) for the project will be required to comply with the safety requirements of GPHA. 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. A first aid center 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 Medical Centre or the Tema General Hospital for treatment. <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. 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 life jackets/vests, 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 project site 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Use of Road Worthy Vehicles 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.
Sanitation Challenges	Workers/Port users	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	Restriction of Access GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area. Use of warning signs 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. Scheduling of Work The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods. Announcement and Notification of Work The TMA and TDC will be informed at least seven days before start of work. All port users will also be informed of the schedule of work through their respective organisations. 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. Transport of Equipment and Materials 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 the Main Harbour and Meridian 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. . 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

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		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.
Impact on Ecologically Sensitive Sites	Sakumo II RAMSAR site	• GPHA will ensure that the Contractor's will utilise best practices in handling construction materials and equipment, and to minimise sedimentation impacts to the marine environment during the construction period • The contractor 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
Operational and Maintenance Phase Impacts		
Impact from Sediment Transport and on the Sakumo II lagoon	Sakumo Lagoon/Marine species	• The nearby existing culvert pipes providing outlet and connection between the marine environment and the lagoon, will be extended further into the ocean, beyond the region of the reclamation area to maintain an open connection between the sea and the lagoon. In this regard GPHA will investigate the current status of the sluice assess the possibilities on re-use of this structure or the necessity to completely replace it. • The outlet of the existing structures increase will be increased, to secure a safe discharge of water from the lagoon to the marine environment. • The long shore movement of sand will be restored by pumping sand from the side where sand accumulates through a pipeline to the eroded leeward side. • GPHA will consider the implementation of some weir jetties perpendicular to the coastline upstream to the breakwater to avoid sedimentation in front of the drainage outlets.
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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• 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 • 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

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• 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 vesels
Waste Generation and Disposal Challenges	Workers/Port user	<u>Education campaigns</u> • GPHA will utilize the Port community network to continuously conduct education campaigns for all port users to ensure the proper disposal of waste. <u>Waste Collection and Disposal</u> • 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 TMA.
Occupational Health and Safety Risks	Port workers	<u>Training in chemical handling</u> GPHA will ensure that workers handling chemicals are trained in its in line with the Material Safety Data Sheet (MSDS). Such workers will have access to the MSDS as information and reference sources on the dangers and ways of handling these chemicals safely. <u>Provision of appropriate PPEs</u> 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Emergency Provisions 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.. Traffic accidents 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. Housekeeping 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.
Sustainability of the Tema Port	GPHA/Ministry of Transport	• The Management of GPHA will seek to operate profitably by implementing a system to collect appropriate user charges to cover the running and maintenance cost of its facilities to be installed. • Management will ensure a minimum harbour water depth is controlled and periodically measured to ensure the safety of fishing vessels using the harbour. • 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. • 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; o Regular calibration of equipment; and o Emergency response plans and procedure.

Environmental Monitoring

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

It is estimated that about **GH¢171,000.00** will be spent on monitoring activities annually from the implementation of the project.

Provisional Environmental Management Plan

A Provisional Environmental Management Plan for the project is included in this EIA Report in line with the Environmental Assessment Regulations 1999, LI 1652. The objectives will be to:

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

Measures to be instituted to meet the above objectives include:

- Responsibility/ Policy Implementers;
- Management Structuring;
- Establishment of Unit Safety/Environment Committee (USEC);
- Engagement of Environmental Consultants;
- Technical Co-operation;
- Staff Information and Training;
- Public Participation;
- Monitoring;
- Annual Audits and Reviews;
- Responsibility of policy implementers.

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. Tentatively,

about **GH¢611,000.00** will be needed in the first year for environmental as well as occupational health and safety management actions.

Decommissioning

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 TMA designated dumping site.

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 Tema will not require decommissioning in the medium to long term. The facilities will be rehabilitated as the need arises as a result of depreciation, wear out, damage.

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.

Conclusion

GPHA is fully aware of its corporate responsibility to sound environmental practices, and also the provisions in the Environmental Protection Agency Act 1994, Act 1994 and Environmental Assessment Regulations 1999, LI 1652. The major potential environmental and socio-economic issues and impacts associated with the proposed Harbour Expansion Project have been identified and duly assessed in this EIA Report.

The implementation of the proposed project will significantly improve the performance of the harbour and wholesomeness of the fish from the port. All stakeholders have given their full commitment to help ensure that this project is implemented in the earliest possible time, and in an environmentally friendly manner, to the benefit of the consumers.

GPHA will put in place measures to enhance the benefits of this project as well as ensure that mitigation measures are implemented to minimize the adverse impacts from the proposed project so as to enhance the positive ones.

1.0 INTRODUCTION

1.1 Background

The Ghana Ports and Harbours Authority (GPHA) acting on behalf of the Republic of Ghana intends to apply budgetary allocations towards a port infrastructure development project to Upgrade and Expand the Port of Tema, Ghana. As part of this project, GPHA requires consulting services for the Social and Environmental Impact Assessment Studies related to the planned development works in the Port of Tema. The Port Authority subscribes to all governing environmental protection conventions and the provisions under the laws of the Republic of Ghana to acquire the necessary permits prior to all development works such as envisaged under the upgrade and expansion of the Port of Tema.

The Management of GPHA approved a master plan for the Port of Tema with a phased development agenda towards the realization of the ultimate plan. As part of the earlier phases, major marine and civil engineering works would be required to prepare the new port cluster for accelerated growth and regional leadership. The following basic port infrastructure and facilities, in summary, have been identified for development under the expansion programme:

i. Construction of breakwaters;
ii. Dredging and reclamation;
iii. Construction of quay;
iv. Cargo handling and berthing furniture at all the respective berths;
v. Cargo handling and operations terminals;
vi. Upgrading of ports' access roads and the development of new major dedicated access roads to the Port of Tema; and
vii. Coastal reclamations and/or reformations, especially near the Sakumo beach as a result of possible accretion and growth of sandy beach landforms.

Development of port infrastructure and facilities of these scales makes significant contributions to the economic development through the growth of maritime transport and the related port business clusters. At the same time it may also create adverse impacts on the surrounding environment. Port development may create a range of impacts on the environment by way of construction works, dredging, reclamation, discharges from ships and waterfront industries, cargo operations, and other port-related activities.

In keeping with the Environmental Assessment Regulations 1999, LI 1652, the project was successfully registered with the EPA by completion of the prescribed EPA Registration Form EA2. The EPA in a response letter referenced CI: 2524/01/02 of 10 January 2014 (see **Annex 1a**) 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 LI 1652. The scoping report for the proposed port expansion project was submitted to the EPA. The EPA's review comments on the scoping report, dated 31 October 2014 and referenced CI: 2524/01/05, (see **Annex 1b**) requested the Agency to prepare two separate EIAs for the proposed project covering the following components:

- Port Expansion Infrastructure including: construction of breakwaters, dredging and reclamation, construction of quay walls, cargo handling and berthing furniture at all the respective berths cargo handling and operations terminal and coastal reclamation and/or reformations
- Upgrading of ports' access roads and development of other new dedicated access roads to the port

After the submission of the draft EIS for the Port Infrastructure Development, the Agency recommended the submission of a revised EIS, incorporating its review comments, as per the letter of 11 May 2015 and referenced CI: 2524/01/07 (see **Annex 1c**).

A Scoping Notice, which aims at inviting public comments on the proposed project was published on page 56 of the March 12, 2014 edition of the Daily Graphic, a national newspaper. A copy of the notice is provided in **Annex 2.**

1.2 Legal Framework of the Project

1.2.1 Relevant National Policies

The relevant national policies related to the proposed project include the following:

- National Land Policy; and
- National Environmental Policy.

National Land Policy, 1999

The Land Policy of Ghana aims at the judicious use of the nation's land and all its natural resources by all sections of the Ghanaian society in support of various socio-economic activities undertaken in accordance with sustainable resource management principles and in maintaining viable ecosystems. The specific objectives of this policy include:-

- Ensure that shared water bodies are utilised to the mutual benefit of all stakeholder countries.
- Ensure that every socio-economic activity is consistent with sound land use through sustainable land use planning in the long-term national interest.
- Protect the rights of landowners and their descendants from becoming landless or tenants on their own lands.
- Ensure the payment, within reasonable time, of fair and adequate compensation for land acquired by government from stool, skin or traditional council, clan, family and individuals.
- Instil order and discipline into the land market to curb the incidence of land encroachment, unapproved development schemes, multiple or illegal land sales, land speculation and other forms of land racketeering.

The National Environment Policy, 2013

The Ghana National Environmental Policy presents a road map to address major environmental threats jeopardizing the natural and common resource base of the country and has integrated the most urgent environmental concerns of present time to provide clear

strategies for overcoming existing hurdles. It validates the Strategic Environmental Assessment (SEA) process as a tool for mainstreaming environment into all government policies, programmes and projects.

1.2.2 World Bank 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	The proposed project falls in Category A, thus an EIA is required
2	**OP 4.04: Natural Habitats**	Do not finance projects that degrade or convert critical habitats. Support 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).	Potentially triggered	No critical habitats identified at the proposed project location. The Sakumo II RAMSAR Site is located Northwestern of the port reclamation area.

4	**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.
6	**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	Potentially triggered	Potential impact on culturally sensitive area identified in this project.
7	**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	Although the proposed site is earmarked for port development, The landward portion of the site is well secured. The Ave Maria Resort is potentially affected by the proposed development
8	**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
9	**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
10	**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
11	**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.

1.2.3 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:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: 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.

1.2.4 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 2014 (L.I. 2216);
- Ports Regulations, 1964, LI 352;
- Fisheries Act (Act 625), 2002;
- Factories, Offices and Shops Act 1970, Act 328;
- Factories (Docks Safety) Regulations, 1960;
- Labour Regulations, 2007;
- The Labour Act 2003, Act 651;
- Wetland Management (RAMSAR Sites) Regulations, 1999.
- The Fire Precaution (Premises) Regulations 2003, LI 1724;
- Ghana National Fire Service Act, 1997 (Act 537);
- Ghana Maritime Authority Act 2002, Act 630;
- Ghana Shipping Act 2002, Act 645;
- Oil in Navigable Waters Act 1964, Act 235;
- Local Government Act 1993, Act 462;
- National Ambient Air Quality Guidelines (NAAQG);
- National Ambient Noise Level Guidelines (NANLG);
- Water Resources Commission Act;
- Abandoned Property (Disposal) Act, 1974;
- Local Government Act (Act 462), 1993
- Workmen's Compensation Law, 1987;
- Children's Act, Act 560 (1998);
- Public Holidays Act, Act 601 (2001);
- Standards Authority Act, NRCD 173 (1973); and
- Human Trafficking Act, Act 694 (2005).

<u>Ghana Ports and Harbours Authority Law 1986, PNDC Law 160</u>

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.

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...".

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.

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 Harbour Upgrade and Expansion 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.

Fees and Charges (Amendment) Instrument 2014 (L.I. 2216)

The Fees and Charges (Amendment) Instrument 2014 (L.I. 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 LI 2216 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.

Factories, Offices and Shops Act 1970, Act 328

The Factories, Offices and Shops Act of 1970 (Act 328), as amended by the Factories Offices and Shops (Amendment) Law 1983 PNDCL 66, the Factories Offices and Shops (Amendment) Law 1991 PNDCL 275 s.1(a), and the Ghana National Fire Service Act, 1997 (Act 537) requires all proponents to register every factory/workplace with the Chief Inspector of Factories Inspectorate Division. The Act makes requires all factories, offices and shops to among others, notify the Chief Inspector of accidents, dangerous occurrences and industrial diseases, post in a prominent position in every factory the prescribed abstract of the act and other notices and documentations, as well as outlines the regulations to safeguard the health and safety of workers. The Act compliments the provisions made in the Factories (Dock Safety) Regulations 1960, LI 86.

The 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.

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.

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.

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.

Fisheries Act, 2002 (Act 625)

The Fisheries Act, 2002 (Act 625) consolidates, with amendments the law on fisheries, to provide for the regulation and management of fisheries, for the development of the fishing industry and the sustainable exploitation of fishery resources and for related matters. The act establishes the Fisheries Commission to regulate and manage the utilisation of the fishery resources of the Republic and co-ordinate the policies in relation to them. Subsection 2(i) mandates the commission to correlate fisheries with other water uses and environmental protection particularly with respect to the fish resources and food chain in the rivers, lagoons, lakes and the continental shelf along the coast of the country. The Fisheries Commission has therefore being consulted for their concerns on the proposed port expansion project.

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.

Wetland Management (RAMSAR Sites) Regulations, 1999.

These Regulations, in exercise of the powers conferred on the Minister responsible for Forestry by section 11 of the Wild Animals Preservation Act 1961, establishes wetlands ("RAMSAR sites") for purposes of the Convention of Wetlands of International importance especially as Waterfowl Habitat and assigns specified powers to the Minister responsible for lands and forestry, the Director of the Wildlife Division of the Forestry Commission and District Assemblies in respect of such sites. The Regulations also define activities in such sites that are prohibited or restricted. The Minister may declare closed seasons during which certain activities such as fishing are prohibited. A District Assembly where a RAMSAR Site is located may in consultation with the Minister, by Bye-law, prescribes custody and traditional conservation practices which are compatible with the RAMSAR Convention and permitted under these Regulations.

Children's Act, Act 560 (1998)

The Children's Act, Act 560 (1998) provides for the rights of the child, maintenance and adoption, regulate child labour and apprenticeship, for ancillary matters concerning children generally and to provide for related matters. Section 91 (1) sets the minimum age for the engagement of a person in hazardous work as eighteen years. The activities of the proposed project fall under the category of hazardous work as defined by the Act. The minimum age for the engagement of a person will therefore be eighteen years

Local Government Act 1993, Act 462

The Local Government Act 1993, Act 462 empowers the Assemblies to establish Waste Management Departments to be responsible for the development and management of waste disposal within their areas of jurisdiction.

Human Trafficking Act, Act 694 (2005)

Human Trafficking Act makes provisions for the prevention, reduction and punishment of human trafficking, for the rehabilitation and reintegration of trafficked persons and for related matters. The Act defines Human trafficking as "the recruitment, transportation, transfer, harbouring, trading or receipt of persons within and across national borders by:
(a) the use of threats, force or other forms of coercion, abduction, fraud, deception, the abuse of power or exploitation of vulnerability, or
(b) giving or receiving payments and benefits to achieve consent".

Human trafficking will therefore need to be avoided in all aspects of the proposed project by GPHA, contractors employed in the construction phase as well as the users of the port during the operation phase.

National Ambient Air Quality Guidelines (NAAQG)

The guidelines provide advice permissible levels for a variety of air pollutants.

National Ambient Noise Level Guidelines (NANLG)

The guidelines provide advice on maximum permissible noise levels for various locations ranging from residential to heavy industrial areas.

1.2.5 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
- International maritime conventions (MARPOL, SOLAS, OPRC, IMDG codes, etc.);
- 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.

Convention on Civil Liability for Oil Pollution Damage (CLC)

The key Conventions under liability and compensation are the International Convention on Civil Liability for Oil Pollution Damage (CLC), 1992 and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, (FUND) 1992. The CLC places liability for pollution damage in the event of oil spillage on the ship owner and ensures that compensation is paid for the destruction of the shoreline ecosystem as well as to affected victims such as fishermen, beach resort hotels and recreational facilities, restaurants etc.

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

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

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

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

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

The London Dumping Convention is intended to promote the effective control of all sources of marine pollution and regulate dumping into the sea of waste materials, whilst the OPRC

provides a framework for cooperation among countries for responding and combating oil spillage. The OPRC Convention has been ratified by Ghana but MARPOL Annexes III - VI and the London Dumping Conventions are yet to be ratified.

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

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

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).

RAMSAR Convention, 1975

The RAMSAR Convention is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources, as a contribution towards achieving sustainable development throughout the world. Wetlands are defined in Article 1 of the Convention as areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Article 2(4) requires that each Contracting Party, when acceding to the Convention, shall designate at least one wetland for inclusion in the List of Wetlands of International Importance. Ghana has six (6) designated RAMSAR sites, one of which is the Sakumo II lagoon. It is therefore important that all development projects, such as the proposed Port Expansion, incorporates the conservation and sustainable use of the Sakumo II lagoon.

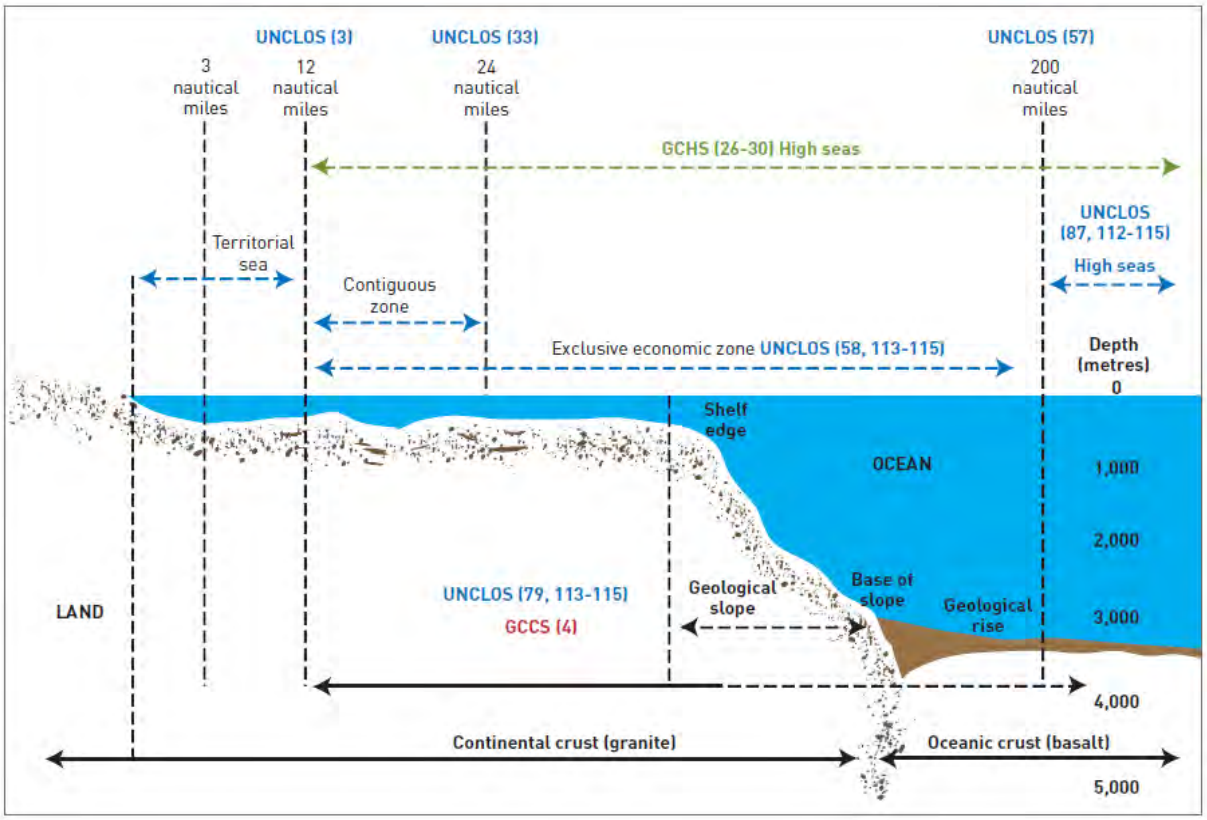
1.2.6 Legal Boundaries of the Ocean

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.



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)

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.

1.3 Terms of Reference for the EIA Study

The terms of reference (ToR) for the EIA study is briefly described under the following headings:

- Aim/purpose of the EIA study;
- Scope of work for the EIA study;
- Approach and Methodology for the EIA study and reporting; and
- Data Analysis and Reporting.

1.3.1 Aim/ Purpose of the EIA Study

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

The study also aims at satisfying both legal and institutional obligations specified under Environmental Protection Agency Act 1994 (Act 490), Environmental Assessment Regulations 1999 (LI 1652), the relevant World Bank Safeguard Policies and Procedures and the International Finance Cooperation (IFC) Performance Standards.

1.3.2 Scope of Work for the EIA Study

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

- provide adequate description of the proposed upgrade and expansion of the Tea Port, and identify all activities of environmental/social concern;
- establish the existing environmental and socio-economic baseline conditions of the project area of influence;
- predict and examine all the significant environmental impacts on the surrounding communities and the general environment during implementation of the proposed

project and advise on appropriate mitigation and abatement measures against potential adverse impacts;
- provide a monitoring programme for predicted impacts in a Provisional Environmental Management Plan (PEMP) framework; and
- document the socio-economic and cultural advantages and disadvantages associated with the proposed project for stakeholders and interested groups to make an informed decision on the level of environmental compromise and permitting.

1.3.3 Methodology and Approach for the EIA Study

The methodology and approach for the study involved:
- Field visits/inspection;
- Environmental sampling and analysis;
- Land use studies;
- Socio-economic studies;
- Stakeholder Consultation;
- Review of available literature; and
- Data analysis and reporting.

Field Studies

Field inspections and visits were undertaken to the project sites in December 2013 to confirm the project area of influence, existing socio-economic and cultural conditions as well as existing bio-physical and marine environment including:
- Land use within the projects area of influence;
- Identification of project affected persons and/or institutions; and
- Present shoreline uses.

Land Use Studies

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

Socio-economic Studies

The methodology used for the studies included:
- Observational studies;
- Interviews with users of the Port facility; and
- Interviews with the Tema Municipal Assembly and Tema Development Corporation.

Stakeholder Consultations

Stakeholder consultations were carried out with some relevant stakeholders to obtain their comments and concerns on the proposed project with respect to the potential environmental and socio-economic issues and impacts that have been addressed in the study. These include relevant Government Institutions and regulatory bodies, the project beneficiaries and engineers, local political authorities and project affected persons groups.

Public Consultations

Stakeholder 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. Concerns raised and evidence of public consultations are provided in **Annex 4.** The stakeholders identified include the following:

Project Proponent

- GPHA, Head Office, Tema

Project Contractors/Consultants

- Transtech (Road Consultants); and
- JV Sellhorn Ingenieunurgesellschaft (Port Consultants).

Local Authorities

- Tema Metropolitan Assembly (TMA); and
- Tema Development Corporation.

Regulatory Institutions

- Environmental Protection Agency, Head Office, Accra.
- Ghana Maritime Authority;
- Ghana National Fire Service;
- Ghana Navy;
- Forestry Commission; and
- Fisheries Commission.

Other Stakeholders

- Ave Maria Resort;
- Sakumono Fishing Community;
- Tema Traditional Council; and
- Tema Community 3 Site A and Site B Residents Association.

Public Notices

A Scoping Notice, which aims at inviting public comments on the proposed project has been published, as required under the procedure for the conduct of EIA in accordance with Regulation 15 (1) of LI 1652. The publication was made page 56 of the March 12, 2014 edition of the Daily Graphic, a national newspaper. A copy of the notice is provided as **Annex 2**.

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:

- Feasibility Studies and Engineering Designs for the Upgrade and Expansion of the Port of Tema, Ghana, JV Sellhorn-HPC, 2014
- Environmental Best Practice Port Development: An Analysis of International Approaches, GHD, 2013

- Environmental, Health, and Safety Guidelines for Ports, Harbors, and Terminals, IFC, 2007
- 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 TMA;
- Strategic Environmental Assessment Report (SEA) for the Port of Tema, GPHA;
- 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);
- Relevant information from internet sources.

1.3.4 Data Analysis and Reporting

The data obtained from the desk and field studies were analysed and have been presented in this Environmental Impact Statement (EIS) following the EPA's approved format. The major headlines making the report are:

a) Executive Summary;
b) Introduction;
c) Description of Existing Port Facilities;
d) Proposed Project Description;
e) Alternatives Project Considerations;
f) Environmental Baseline Conditions;
g) Impact Identification and Evaluation;
h) Mitigation and Management Measures;
i) Environmental Monitoring;
j) Provisional Environmental Management Plan;
k) Decommissioning; and
l) Conclusion.

2.0 DESCRIPTION OF EXISTING PORT FACILITIES

2.1 The Location of the Tema Port

It is located in Tema in the Greater Accra Region. Tema is located about 25 km east of Accra, Regional Capital. The area falls within Latitude 5°38'1"N and Longitude 0°0'47"E and lies within the coastal savannah zone. The port of Tema has a total area of 5.5 km^2. The water-enclosed area of the port measures 1.7 km^2 and the total land area are 3.9 km^2. There are 5 km of breakwaters, 12 deepwater berths, an oil tanker berth, and a dockyard, warehouses, and transit sheds.

The Ghana Ports and Harbour Authority (GPHA) is mandated by Ghana Ports and Harbour Authority Law, 1986 (PNDC Law 160) to manage the Ports in Ghana. Presently, over 90% of Ghana's international Trade is sea borne, and about 80% occurs through the Port of Tema. The container throughput at Tema Port has more than doubled since 1998. Over the years, the Port of Tema has seen significant increases in the level of cargo traffic and is poised to become a maritime hub in the West Africa sub-region.

2.2 Port Infrastructure

Infrastructure at the Port of Tema include quays, berths fuel bunkers, storage facilities. **Figure 2** shows the layout of the infrastructure at the Port of Tema.

2.2.1 Berths

The Ghana Ports and Harbour Authority (GPHA) handles cargo at fourteen berths within the port zone. Berths 1 through 5 at Quay 2, Berths 6 through 12 at Quay 1, and the Oil Berth and the Valco Berth at the South Breakwater. The two quays have a total paved quay apron of 2,196 m^2. The berths are described in **Table 2**.

Berths 1 and 2 on quay 2 is a dedicated Container Terminal fitted with three 45 tons Ship- to-Shore Gantry Cranes and four 40 tons Rubber Tyred Gantry Cranes. Productivity per gantry crane is approximately 19 moves per hour. Berths 3-11 are multi-purpose berths and berth 12 is a clinker berth.

Figure 2: Layout of the Port of Tema

Table 2: Brief description of existing berths in the Tema Port

Berth	General Dimensions
Berth No 1	Length 283m Depth 11.6m CD
Berth No 2	Length 283m Depth 12.0m CD
Berth No 3	Length 189m Depth 11.5m CD
Berth No 4	Length 189m Depth 10.5m CD
Berth No 5	Length 189m Depth 9.5m CD
Berth No 6	Length 183m Depth 8.5m CD
Berth No 7	Length 183m Depth 8.5m CD
Berth No 8	Length 183m Depth 8.5m CD
Berth No 9	Length 183m Depth 8.5m CD
Berth No 10	Length 183m Depth 8.5m CD
Berth No 11	Length 183m Depth 8.5m CD
Berth No 12	Length 183m Depth 8.5m CD
Oil Berth	Length 175m Depth 9.8m CD
Valco Berth	Length 183m Depth 9.6m CD

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

The access channel of the port has been dredged to 12.5 m while the harbour basin is dredged to 11.5 m. The transfer of container traffic to the new terminal, Quay 2, has led to a restriction of operation on it requiring the handling of bulk cargo vessels at Quay 1. The depth of each of the three berths is 0.8 mCD. It is the intention of the GPHA to redevelop Quay 1 which will include reconstruction of the quay wall to enhance cargo handling, also dredging and redevelopment of Berth 10-12 on Quay 1 to enable it receive vessels drawing up to 11.5 m draft. The deep draft berth (berths 1 and 2 with depth of 11.0-11.5 m) at Quay 2 handles the deep draft vessels of about 30,000 DWT. The western section of the port holds a Container Terminal consisting of a new devanning area, cocoa shed, cement bagging company and vehicle parking lots.

The Port has good anchorage from 1.5 km to 4 km ENE to SW off the main harbour entrance in depths of 9 m to 18 m with good holding ground. Deep draft vessels enter only at high tide to avoid the effect of heavy swells which causes vessels to roll heavily up to 40-80 during the rainy season from April to September.

2.2.2 Fuel Bunkering

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

2.2.3 Storage Facilities

The Tema Port has a total of 53,270m^2 covered and 92,200 m^2 of open storage. A total of 19,000 m^2 storage area for transit cargo is available at Berths 1,2,3,4,5,7,9, and 11. There is storage capacity for cocoa in 4 sheds for a capacity of 60,000 tonnes.

The open storage area is used almost entirely for containers and roro/vehicles, leaving hardly any space for conventional cargoes. Conventional cargo can be found everywhere between storage sheds, and alongside or on roads.

The lack of storage space in the port requires the cargo to be removed from the port directly. Trucks need to be available in the port to immediately pick up the cargo. And with the slightest delay in getting the cargo out of the port, for instance because of shortage of equipment, shortage of trucks, delays with clearance of the cargo, the port area gets clogged up, causing delays in getting the cargo out of the port.

If the direct delivery can be changed into indirect delivery, delays in the port can be reduced. This will require storage space in the port or in bonded off dock yards. Plans exist to demolish some of the sheds to create more open storage space, however this will create no more than approximately 10,000 m^2 storage yard.

2.2.4 Security

The Port maintains a 24 hr watch on VHF Channels 14 and 16 which can reach vessels within a radius of 140 km and during Harmattan conditions, vessels can hear the signal 400 km from port. The Port operates four tugs fitted with pumps and monitors for fire-fighting. Towage is compulsory within the harbour.

2.2.5 Container Handling Facility

The Port boasts of a state-of-the-art container handling facility comprising ship-to-shore and rubber-tyred gantry cranes. The total quay length of the new container terminal is 570 km with a draft of 11.50 m. The new container on-dock and near dock operations is under the management of Meridian Port Services Limited (MPS), a joint venture of APM Terminals International, Bollore Group and GPHA. Various off dock container terminals exist as well as car parks run by private operators. The Golden Jubilee Terminal (GJT), an off-dock container devanning terminal was commissioned in March, 2007. The construction of the terminal was undertaken to overcome space constraints posed by large volumes of containerized cargoes which required stuffing and un-stuffing as well as parking space for imported vehicles. The GJT

is located 300 m from the western gate of the Tema main harbour and is linked by an excellent road system.

Off-Dock Container Terminals

Off dock yards have been created already, but mainly for containers. In Tema there are five off dock terminals providing receipt, storage and delivery services for containers discharged in Tema port**.** These terminals and their areas are:

1. Golden Jubilee Terminal (GJT) 130,000 m^2;
2. Maersk Container Terminal (MCT) 50,000 m^2;
3. Africa Coastal Services (ACS) 50,000 m^2;
4. Tema Bonded Terminal (TBT) 15,000 m^2; and
5. Tema Container Terminal (TCT) 7,500 m^2.

These terminals have enhanced cargo flow through the port of Tema.

2.2.6 Transshipment

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

2.2.7 Fishing Harbour

A separate fishing harbour with cold-storage and marketing facilities is east of the lee breakwater. The fishing Harbour comprises of an Inner Harbour, Outer Harbour, Canoe Basin and a Commercial Area. The Inner Fishing Harbour was commissioned alongside the main harbour in 1962 to provide landing facilities for semi-industrial and industrial fishing vessels and to promote the development of the Ghanaian fishing industry. The Outer Fishing Harbour was added in 1965 to provide deeper draft for larger vessels of the national fishing fleet. More recently, a tuna wharf was commissioned in 1995 to accommodate larger tuna fishing vessels to encourage landing of tuna in Ghana.

3.0 BRIEF DESCRIPTION OF THE PROPOSED PROJECT

3.1 Need for the Project

Ghana's two main seaports are the Port of Tema and the Port of Takoradi. Sir William Halcrow and Partners of U. K. designed Tema Port in 1951 primarily as a general cargo port for the export of agricultural produce from Ghana and also a strategic part of the Volta River Development Project. It was constructed by Parkinson Howard and commissioned in 1960 with 12 berths with a maximum draft of 9.6m available only at one berth of quay 2. As part of the then government's economic recovery programme, the Port of Tema was rehabilitated in 1990 with the sole objective of repairing the sheds and paving areas, providing basic equipment to enhance the operations of the port as well as cleaning the harbour basin to the originally designed depth to meet the expected cargo traffic in the recovery of the Ghanaian economy.

In the course of time, major works were programmed and executed in response to the increasing changing cargo dynamics. With part funding from the Dutch ORET Grant Aid facility, limited deepening of the harbour from the entrance to berths 1 & 2 at quay 2 was completed by the year 2001. This provided 11.5m-drafts at berths 1 and 2 to cater for second-generation container vessels that frequently called at the port. Prior to the dredging works, some quay wall foundation reinforcements were conducted to sustain the stability of the foundations during and after the dredging works.

Since 1991, traffic through the Tema Port has increased significantly from 3,647,010 metric tons in 1991 through 6,154,647 metric tons in 2000 to over 11.5 million-metric tons in 2012. Container traffic witnessed dramatic increase from 70,923 TEUs in 1991 to 176,523 TEUs in 2000. By year 2012, containers through the port exceeded 900,000-TEUs with an average growth of 10%-per annum over the last decade. Tema Port was ironically not designed to handle container traffic of any form.

It is expected that the volumes of goods carrying vehicles entering the port area will also increase significantly. This has a tendency to slow down traffic flow within the Tema metropolis, especially on the Harbour Road, Beach road and Meridian road, which lead to the Harbour. A dedicated access to the port has therefore become a necessity to ease traffic within the Tema Metropolis.

The improvements to the port of Tema is justified not only by the rapidly increasing traffic and demand for services at Ghana's ports, but also by the more private sector approach to infrastructure development that the Government of Ghana has embraced. Over $100 million in public and private investment has been spent on port facilities in Ghana in recent years, demonstrating the high priority being given to port facilities by the Government, and the high level of interest from the private sector.

Ghana is one of the rapidly growing economies in West Africa. The nation's seaborne traffic has grown substantially since 1999 when violence erupted in neighboring Cote d'Ivoire causing much traffic to be moved through Ghana as an alternative route. The Government of Ghana views an efficient port system as crucial to its plans to become the trade and investment gateway to West Africa.

The proposed project will provide huge benefits to the country. Besides economic gains, there would be significant social benefits including the provision of jobs and job security to several Ghanaians during the constructional and operational phases of the project.

3.2 Proposed Development Layout and Phasing of Port Extension Project

The proposed development can be categorized under three main location:

1. New Port Area – Container Terminals
2. Existing Commercial Port
3. Fishing Port

3.2.1 New Port Area - Container Terminals

The start phase for the realisation of the Port Master Plan for the port of Tema is determined by the construction of the new container terminals westerly of the existing commercial port. The final layout of the proposed port area is shown in **Figure 3**.

It has to be clarified that all function units shown in the layout plans only serve as a placeholder. A fine adjustment of all items has to be made in a later step when the decision for the alternative has been made. This further detailed layout cannot be provided in the framework of a port master plan as this task requires enormous input and participation of GPHA, stakeholders, potential operators etc. However, all function units shown in the following drawings are shown in realistic sizes, although the shape of the units may differ in the final layout plan. This ensures that all facilities will fit on the terminal footprint.

Two independent container terminal operators will settle in the new port. Thus, the layout has been developed accordingly. The new port boundaries have been defined by GPHA and also the boundaries for the two operators. Furthermore, in the north-western corner of the area a customs inspection area is planned with direct access to both operators and in the north-eastern corner an off-dock railway terminal as an option for the future is planned.

The two new container terminals (Northern and Southern) will start with two berths each and adequate hinterland facilities. In the final development stage both container terminals will provide a total number of four berths each. The container terminals is planned to be developed in three phases as shown in **Figure 3** and described below:

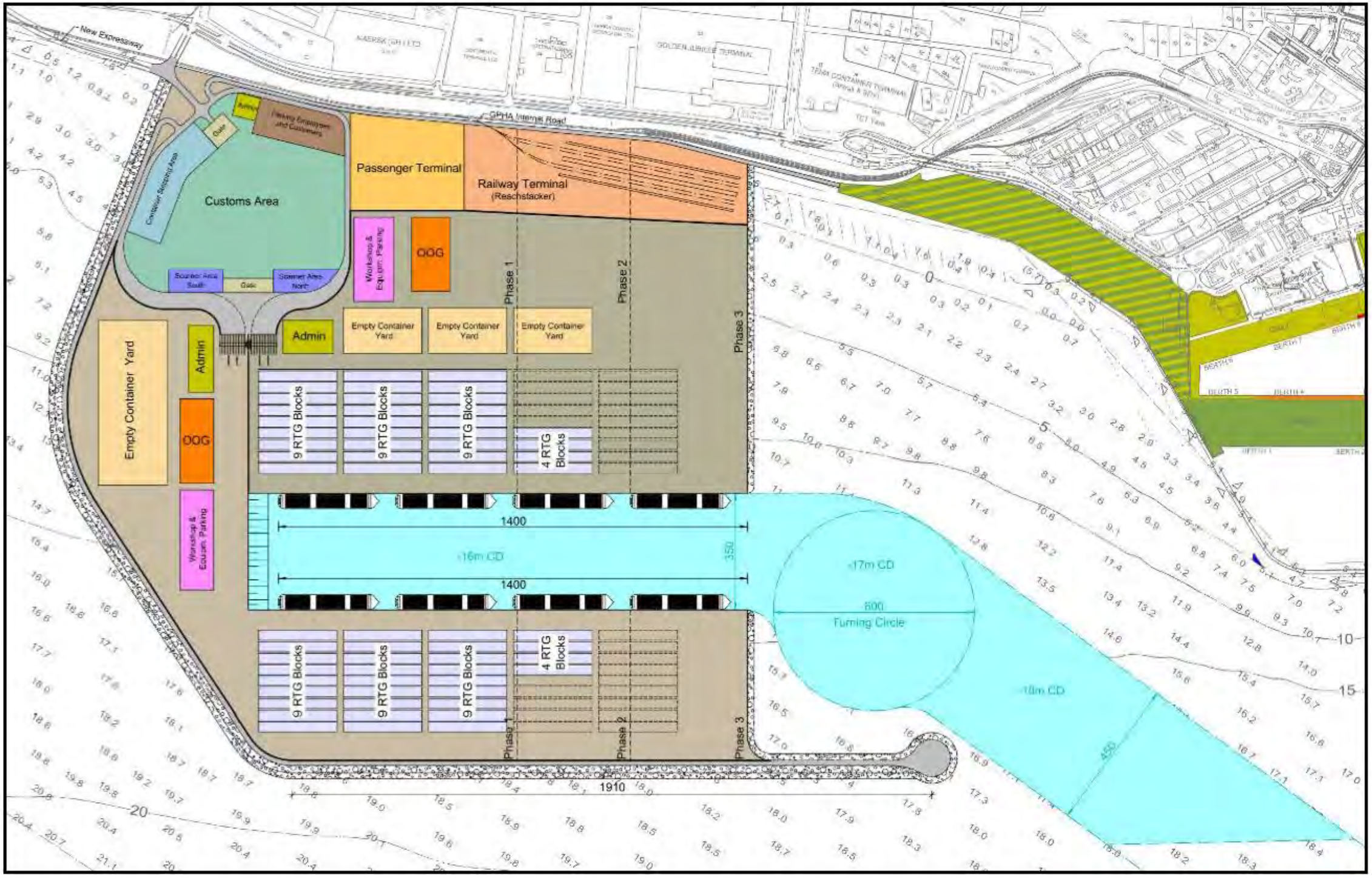


Figure 3: Proposed Port Development Layout (Source: Sellhorn/HPC, 06/2014)

Phase 1 (2014-2023)

Phase 1 with the construction of two berths for each of the two planned operators. The breakwater shall be constructed in Phase 1 with a sufficient length to protect the berths up to development Phase 2. Dredging in Phase 1 shall include also all dredging works required for the implementation of Phase 2.

Phase 2 (2024-2032)

Phase 2 involves the construction of the third berth for each operator.

Phase 3 (2033-2043)

Phase 3 involves the construction of the fourth berth for each operator, required extension of breakwater and dredging works. The construction of repair facilities for oil rigs may take place simultaneously to Phase 3.

Description of the Layout of the New Port Area

Northern Terminal

The terminal consists of a total area of around 114 hectares and provides a usable quay length of 1 ,400m in the final development stage. The quay wall and adjacent land will be built from west towards east. Possible extension can be built to the east in a later stage if necessary.

Road access is in the north-western part of the terminal between the customs area and the passenger terminal. The latter has no access to the quayside as GPHA decided that passenger vessels will berth at the old port at one of the quays that are still used by MPS. Transfer of passengers between the passenger terminal and the berths and vice versa will be provided by buses.

South of the customs inspection area there is the main gate of the terminal and next to the gate the administration building is located. The administration building provides access from the landside as well as from the terminal side. Access control according to ISPS regulations has to be made within the building or at the landside entrances. It is also possible to keep some areas of the building public accessible by strict separation within the building. Parking areas for employees and visitors should be provided in sufficient number at the landside of the administration building.

The main gate also provides an internal access between the terminal and the customs inspection area. One lane each direction is planned. Possible procedures regarding customs inspections are defined in a subsequent section of this report.

The customs inspection area needs an access gate to the northern side so that consignees may reach the customs inspection area without entering one of the two terminals.

The quayside has a 60m wide quay apron area that accommodates the quay cranes and two traffic lanes behind the cranes. Typically the seaside crane rail is located around 3m behind the edge of the quay wall. The rail gauge has a common distance of 100 feet (30.48m) and the back reach of the crane is considered being 18m.

Behind the quay apron the area for full container storage is planned along the berth line. A total number of 31 blocks is needed; each block will be 7 rows wide and 36 TEUs long which lead to a dimension of 33m width x 254m long each block.

Nine parallel rows of blocks are needed in the initial phase. Due to expected reduced dwell times in the future, in later development stages the number of parallel blocks is four respectively zero but the space behind the future berth numbers three and four can be prepared as RTG blocks as well which will allow to spread especially import containers over more ground slots which will drastically reduce the number of necessary shuffle moves and thus will increase the equipment performance and reduce waiting times for trucks picking import containers.

Furthermore, special RTG areas may be provided to accommodate containers that are already inspected by customs.

Behind the RTG blocks the necessary other facilities are located, namely the workshop area for equipment repair and maintenance, an equipment parking area and storage areas for special OOG-containers (out-of-gauge= oversized) and for MTs.

Southern Terminal

The southern terminal consists of a total area of around 112 hectares and provides a usable quay length of 1 ,400m in the final development stage. The quay wall and adjacent land will be built from west towards east similar to the northern terminal.

Road access is in the north-western part of the terminal between the customs area and the breakwater. The main gate complex and the administration building are mirrored from the layout of the layout of the northern terminal. All remarks regarding access between the terminal and the customs area, access control to/from the administration area and necessary parking areas apply likewise.

The quay apron is similar to the northern terminal with a total width of 60m and all dimensions equal to the northern terminal.

For the full container storage area the same amount of RTG blocks is needed due to the fact that similar market shares for both potential operators are considered. Consequently, the space requirement is equal. Due to the different land shape, 11 parallel RTG blocks or 10 blocks respectively have been chosen as they fit behind the quay wall. Along the breakwater there is still sufficient place for an access road to the eastern extension area. As for the RTG blocks behind berth nos. three and four the same applies as already mentioned for the northern terminal.

Other facilities such as workshop, OOG area and MT yard are located on the triangle shaped area within the western breakwater.

Customs Inspection Area

The location of the customs inspection area in the north-western corner of the new area is ideal as it provides access for externals (like e.g. consignees who have to attend the customs inspections on site) as well as internal access to and from both terminal operators. Thus, no external person has to enter the terminals of the two independent operators. The ICDs will remain for CFS operations.

3.2.2 Existing Commercial Port

In total, 19 berths are required at the end of the project horizon in 2043 of which 18 berths will already be available after the completion of the new dry bulk jetty. The proposed assignment of commodities to berths is as follows:

- General cargo / break bulk (berth nos. 5 – 8)
- RoRo / ConRo (berth nos. 1 – 2)
- Mineral Bulk (berth no. 12 + new jetty + VALCO berth)
- Agricultural bulk (berth nos. 3 - 4 + 1 0 – 11)
- Liquid bulk (vegetable oil, chemicals etc.) (berth no. 9)
- Mineral oil (Oil berth(s)).

As the port is a multipurpose port and as most of the commodities have no special requirements on the infrastructure, the assignment mentioned above is to some extent flexible. **Figure 4** illustrates the above mentioned assignments.

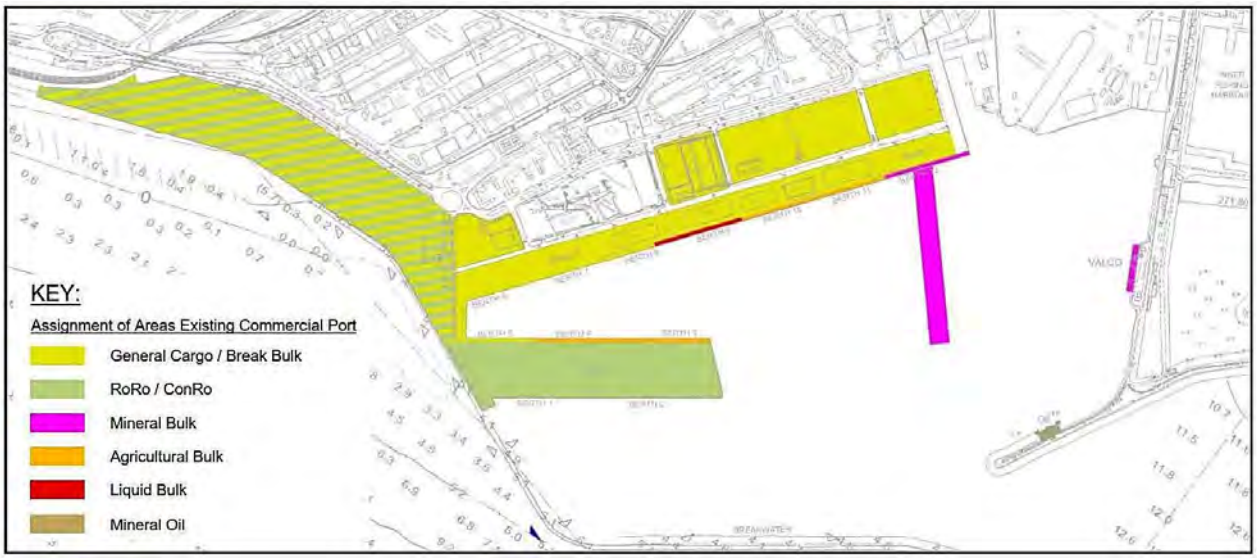


Figure 4: Recommended Assignment of Berths and Yard Areas at the Commercial Port (Source: Sellhorn /HPC, 06/2014)

For the existing commercial port the phases are proposed as follows:

Phase 1

Phase 1 involves the completion of the new jetty in front of berth 12.

Phase 2

Phase 2 involves the re-assignment of areas and berths after moving of the container business to the new port.

Phase 3

Phase 3 involves construction of a new oil berth.

The timing for the different phases at the existing commercial port mainly depends on the progress of the construction of the new jetty and the construction of the new port areas.

3.2.3 Fishing Port

A new breakwater to expand the fishing port was proposed by GPHA as shown in **Figure 6**. The new basin that is formed by the new breakwater shall have a usable water depth of 1Om in order to attract also bigger fishing vessels and to terminate the current situation that fishing vessels discharge their cargo in the commercial port and thus compete for berths with commercial vessels.

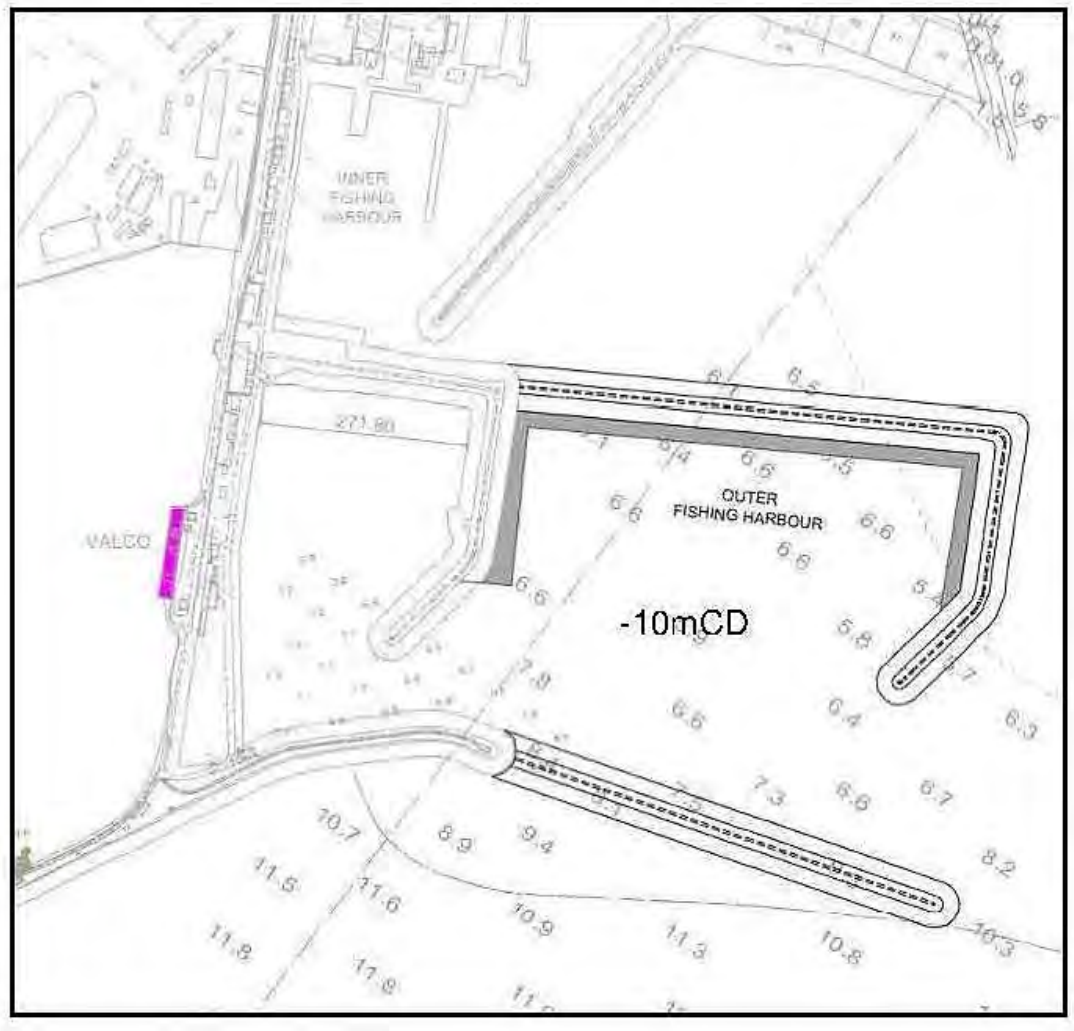


Figure 5: New Breakwater Proposed for the Fishing Port

Phasing

As the fishing port is already overloaded, the extension should start as soon as possible. There is no phasing necessary.

3.3 The Main Activities of the Proposed Project

The main activities planned to be carried out for the completion of the proposed project include the following:

- Construction of breakwaters;
- Dredging and reclamation;
- Construction of quay walls;
- Cargo handling and berthing furniture at all the respective berths;
- Cargo handling and operations terminals; and
- Coastal reclamations and/or reformations.

3.3.1 Construction of Revetments and Breakwaters

The development of the port includes the construction of rock structures, i.e., revetments and breakwater, to protect the exposed edges of the reclamation areas (revetments), as well as to reduce wave disturbance within the berthing basin (breakwater). Armour sizing for revetments and breakwater shall be determined during the detailed design phase. The design life for these structures shall be 50 years and they shall be designed to withstand a 100 years return event.

Revetment

Quay walls are provided where vessel berthing is to take place. At all other locations around the perimeter of the reclaimed land areas of the port, revetments, i.e., protected slopes, will be provided to protect the fill against wave action. The elevation of the crest of the revetment needs to be established during the detailed design phase based on the acceptable degree of overtopping that will occur during the design storm event. This, in turn, will depend on the use of the area immediately upland of the revetment and the cost of the damage that would be incurred by various degrees of overtopping.

Breakwater

A new breakwater is required to provide sufficiently mild wave conditions within the basin so as not to interfere with cargo transfer operations. This new breakwater will be amongst the biggest capital investment cost items in the port development.

A 3,880m rubble mound breakwater is needed to limit the wave height at the new berths to approx. 0 .30m. The location of the breakwater enables the creation of a turning basin for the design vessel with a diameter of 600m. The breakwater roots to the East of the Sakumo II Lagoon and comprises 3 main sections:

- Section 1**:** Initial straight section with 1,065m approximately in S-SE direction with root on existing land embankment.

- Section 2: a second straight section with approx. 1,175m oriented SE and with depth between -14.00mCD and -21.00mCD.
- Section 3: Straight section with 1,640m, approximately in E-NE direction. This section protects the harbour and turning basins and the entry of the port. Depths are between -18.00mCD and -19.00mCD.

For the development phase 3, breakwater will be extended by 350m to protect the new berths foreseen in this phase (1 new berth for each operator). Initial estimates shows that the crest of the breakwater (for rubble mound structure) shall be located by approx. +7.00mCD.

In order to provide access to potential future terminals to be development along the breakwater (e.g. rig repair terminal), provision shall be made on the crest of the breakwater for at least 2 x 2 road lanes.

3.3.2 Dredging and Reclamation

Dredging and reclamation will be required for the deepening of access channels, ports' basins, the berths and the preparation of heavy-duty cargo storage and transfer areas, the new port basins would be dredged to water depths of -16mCD on the average. Access channels are to be deepened to a maximum of -18mCD. There would be two – 300m-radius turning basins, also at least -17mCD water depths. Preliminary soil investigations indicate that dredged materials would be suitable for re-use as reclamation materials. Nonetheless, substantial reclamation materials would be imported from land-based burrow pits or quarries.

Phase 1 and 2

Dredging works in Phase 1 include the layout of the turning basin and access channel in Phase 1. This is designed such that no additional dredging is required for the construction of the additional berths in Phase 2.

Phase 3

Phase 3 will require shifting of the turning circle and access channel for construction of the fourth berth. Additional dredging works will therefore be required.

Volume of Dredged Material and Use as Reclamation Material

The dredged material is mostly dense medium sand and it is suitable for the reclamation purposes.

Dredging and reclamation quantities for the future port development are estimated as follows:

- Total dredging volume for the 3 phases - 3,600,000 m^3
- Total reclamation volume for the 3 phases - 39,200,000 m^3

Only a limited amount of medium sand suitable for reclamation purpose is available inside the project area. A great volume of reclamation material will have to be dredged from offshore borrow pits.

Due to the type of soil (ground material is dense sand and rock), three different dredging vessels shall be mobilized for the main dredging and reclamation works:

- Trailing Suction Hopper Dredger (TSHD);
- Cutter Suction Dredger (CSD); and
- Split Hopper Barges (SHB).

TSHD is used mainly to dredge medium sand for a long distance and great quantities through floating pipelines. CSD is used for the rock material under the sand horizon and for dense medium sand as well, which could not be dredged by the TSHD. Auxiliary equipment shall also be mobilized like reclamation plant, wheel loaders, Low Ground Pressure (LGP) bulldozers, trucks and trailers for transport of pipelines and heavy equipment.

Depending on the loading depth of the vessels, the dredging work shall start at the shallowest sections in the approach channel or harbour basin and run further to the deeper areas. Frequent bathymetric surveys shall be undertaken to evaluate or adapt the dredging areas on site. The reclamation work shall be mainly performed in two different steps to fill up the designated areas and enclose them by revetments (permanent and temporary). First the hydraulic fill starts on different locations by TSHD and CSD. The backfill of the quay wall will be carried out in the second step.

3.3.3 Coastal Reclamations and/or Reformations

Coastal reclamations and/or reformations especially near the Sakumo II beach as a result of possible accretion and growth of sandy beach landforms. There is also the need to ensure that the Sakumo II lagoon retains its estuarine nature with unhindered flood and ebb discharge levels of the lagoon. This would require minor, yet important, engineering structures to ensure the flow exchanges.

Works to ensure unhindered interaction between the lagoon and marine environment include the extension of the existing culvert pipes further into the ocean. In order to raise catchment flows into the lagoon in the future, it is proposed that existing structures the existing structures will also be increased, to secure a safe discharge of water.

Additionally, to avoid sedimentation next to the breakwater and protect the outfall of the Lagoon, the following shall be carried out:

- The long shore movement of sand will be restored by pumping sand from the side where sand accumulates through a pipeline to the eroded down drift side.
- Another possibility would be to implement some weir jetties perpendicular to the coast line upstream to the breakwater to avoid sedimentation in front of the drainage outlets.

3.3.4 Construction of Quay Walls

The new Master Plan for the lema Port foresees the construction of several waterfront structures in the different phases to allow berthing of vessels, container handling and other ship-to-shore operations. Quay wall construction works will comprise, for every phase:

- Phase 1: 2 x 700 m Container Berth

- Phase 2: 2 x 350m Container Berth
- Phase 3: 2 x 350m Container Berth

For the design vessels of post panamax-plus classes, foundations of quay walls would be in the region of -18mCD, and proposed to be gravity block wall structures. Where appropriate, sheet piling and rubble revetments would be designed to shore reclamation slopes of terminals, especially in the phased development schemes.

The concrete block wall is a typical gravity wall, which is built up of precast concrete blocks and a cast in situ or precast capping beam, which carries the waterside crane rail. The landside crane rail is to be installed on a separate pile supported reinforced concrete beam (see **Figure 6**)

A gravel bed shall be placed for the foundation of the blocks. This type of construction relies on a careful levelling of the foundation level.

The concrete blocks (hollow or solid) are cast at the construction site, being placed by a floating crane with divers' assistance to check the required careful execution of both the foundation bed, the block placing and the backfill work.

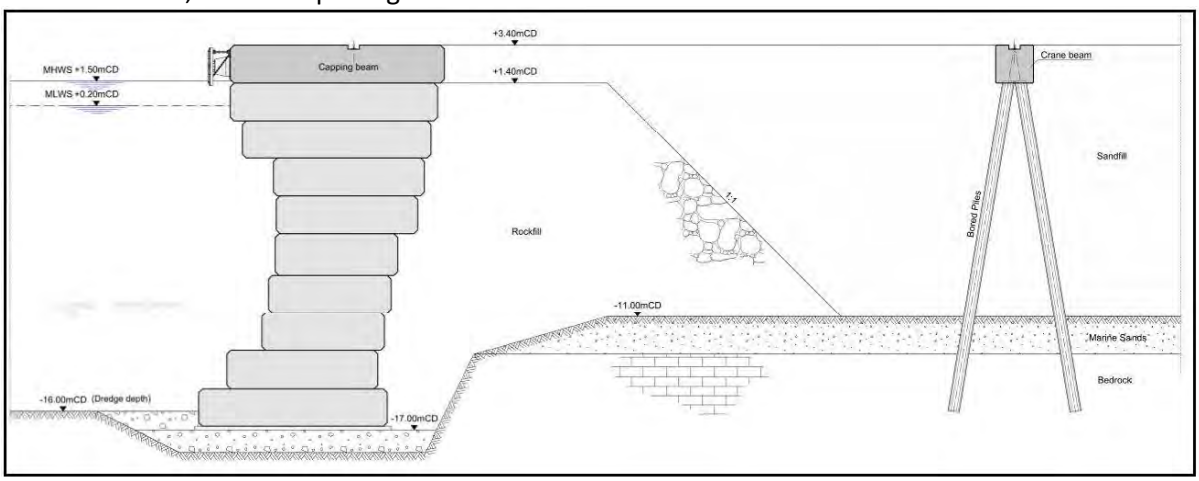


Figure 6: Typical Block Wall Cross Section (Source: Sellhorn!HPC, 06/2014)

3.3.5 Cargo handling and Berthing Furniture at all the respective Berths

Container crane rails, fenders, bollards, cargo conveyors, oil piping corridors and other berthing furniture would be provided at all berths and quay fronts.

3.3.6 Cargo handling and Operations Terminals

More than 300 Hectares of terminal space is expected to be provided under the expansion programme. Such areas are designed for heavy-duty operations for containers, Roll-on/roll-off ships (Ro-Ro), passengers / cruise services and break bulk cargos. All terminals would be operated with full gear – equipment, plant, utilities services, personnel, HSSE gear and logistics and administration buildings and facilities in accordance with best practices for modern terminal operations.

3.3.7 Roads and Railway

Connection to Public Roads

Existing Tema Port is connected to the national road system via the Harbour Road. It is a 4 lane road of approx. 6 km from the Port to the Tema Motorway. The road has 5 roundabouts and several side roads causing important traffic jam. The Beach Road linking Tema to Accra is often used as alternative road but this road has only a low capacity and is often crowded as well.

Traffic to and from the port of Tema is expected to significantly increase beyond the capacity of the existing roads to support. The expected truck traffic by the two terminal operators at the new port is provided in **Table 3**.

Table 3: Expected Truck Traffic for the 2 Operators at New Port Area (Source: Sellhorn/HPC, 06/2014)

	Phase 1					Phase 2					Phase 3				
	2014	2015	...	2022	2023	2024	2025	...	2031	2032	2033	2034	...	2042	2043
Max.Trucks per hour Gate-In	22	24		46	so	55	59		93	99	106	113		169	176
Max.Trucks per hour Gate-Out	96	101		177	188	198	208		265	274	282	291		345	350

To ameliorate the above situation, GPHA is proposing to develop a road scheme to connect the new Port area to the national road system. This involves the following:

- construction of a dedicated, 6-lane heavy-duty expressway to link the new port area to the Accra-Tema motorway ; and
- upgrade of the existing Harbour and Meridian roads.

The connection from the new port development to the dedicated expressway is shown in **Figure 7**.

The following roads are also considered in the design:

- Access road to terminal operators **1** and 2;
- Access road to customs area;
- Internal road connecting the new and existing ports; and
- Road along the breakwater as access for future potential extension.

A separate Environmental and Social Impact Assessment is being prepared by GPHA (as per the comments of the EPA on the scoping report) to cover the proposed roads, including a detailed Traffic Impact Assessment.

Figure 7: Traffic junction concept between expressway and the new port (Source: Sellhorn/HPC, 07/2014)

Rail Linkage and Railway Container Transfer Station

In 2010 Ghana Railway Corporation began to upgrade Ghana's railway line network and the construction of the Ghana rail infrastructure. It has been planned to be completed at the end of 2014.

For the elaboration of this Port Master Plan, provision was made for a railway corridor within the port area to connect the port to the national grid in case the relevant infrastructure to the hinterland will be implemented in the future. The corridor is foreseen in the north of the port area, east to Ave Maria resort, for an off-dock rail way terminal (see **Figure 8**). Rail connection has to be considered in the initial planning phase in order to avoid the future reconstruction of various port areas.

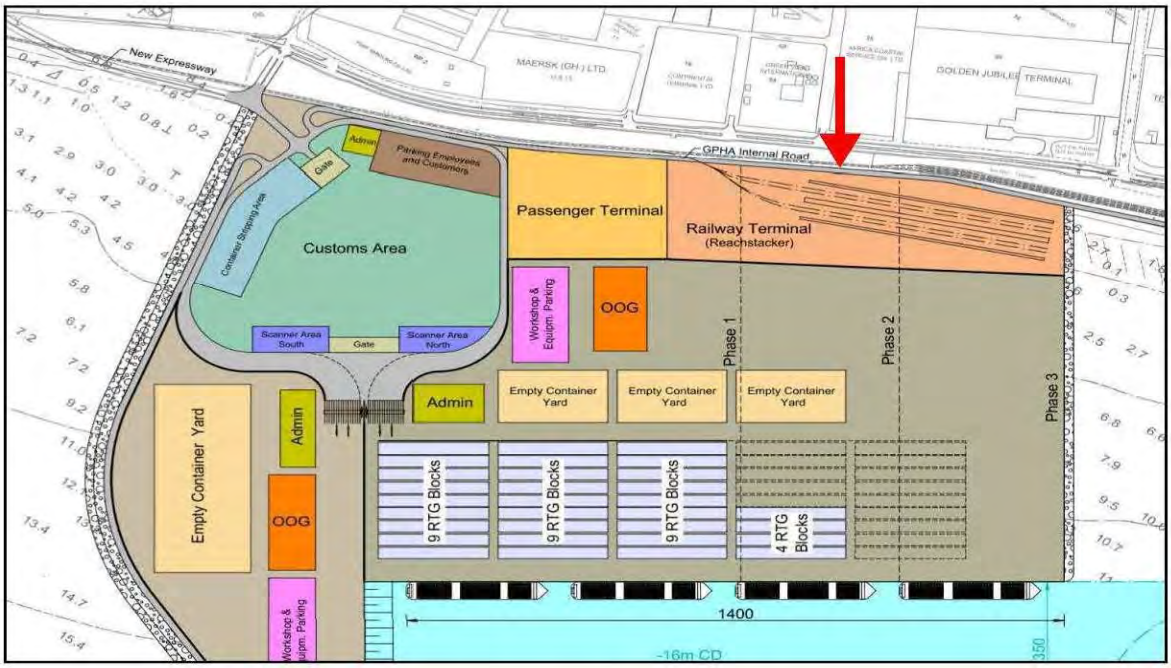


Figure 8: Corridor for Potential Off-Dock Railway Terminal

It is understood that continuous studies are being developed for Ghana's future rail system, whose particular focus is cargo haulage. It is further understood, that the rail consultants are considering the linkages to the seaports to associate the inland areas. Planning criteria are not yet at hand.

For future assessments on the required rail linkage the following shall be considered:

- container volumes using rail;
- average/ maximum train length;
- handling/ arriving/ departing block trains;
- necessity of an onshore shunting yard;
- rail standards; and
- designating the rail operator.

In order to link the new port with the Ghana rail network, it would be advantageous to install a second rail track in addition parallel to the west-east track along the coast of Tema.

3.3.8 Buildings, Utilities and Pavements

The new Tema Port Development requires a series of buildings to accommodate the operations, administrative and public authorities. These include:

- Terminal administration and operations building;
- Maintenance and repair building;
- Fuel Station; and
- Gates.

A wide range of utilities will also be provided to support the main facilities described above to ensure the environmental friendliness and smooth operation of the port. They include the following:

- Storm water network;
- Potable water network;
- Fire-fighting water network;
- Sewage network;
- Electrical power network;
- Lighting; and
- Weak current circuit network.

Pavement

The Tema Port Development requires extensive areas of paving for stacking and moving containers. The pavement is an essential and integral part of the terminal. There is no standard solution for the pavement of the average terminal as for a particular terminal the choice will usually be a compromise between durability and cost. The most important aspect is to be aware of the available choices and the relevant factors affecting the design. Pavement may be required in the following areas of the port. Recommended pavement types are in parenthesis.

- Container stacking areas (Interlocking Block Pavement)
- Reefer container stacking areas (Interlocking Block Pavement)
- Empty container stacking area (Cast-in-Place Concrete Pavement)
- Dangerous/hazardous goods stacking areas (Interlocking Block Pavement with gravel Base)
- Terminal access roads (Asphalt Concrete Pavement)
- Terminal internal roads (Cast-in-Place Concrete)
- Fuel station, workshop and maintenance bays (Asphalt Concrete Pavement)
- Gate/Truck and car parking areas (Cast-in-Place Concrete Pavement)

Details of the Buildings, utilities and pavements to be provided in this project are given in **Annex 3**.

3.4 Project Management and Implementation Schedule

Ghana Ports and Harbours Authority is the employer and beneficiary of the proposed project. The Authority has overall responsibility for the design, construction and operation of the proposed port.

The proposed implementation schedule for the development of the new port area is indicated in **Table 4**. The following superior topics are affecting the development progress of the port:

- Respecting the forecast container traffic and implementing construction Phase 1, handling requirements will reach the terminals' installed handling and storing capacities by 2023.
- A continuing prosperous economic development of the port requests that begin 2024 Phase 2 container port facilities are at hand and begin 2033, Phase 3 facilities.

- In order to meet necessary handling capacities beyond 2023, design work for container terminals Phase 2 starts by 2020/2021 with following construction works from 2022 to end 2023. For Phase 3 design works are requested to start in 2029, followed by construction period from 2030 to end 2032.

Table 4: Milestone Implementation Schedule for the New Port Area

Activities	Phase 1										Phase 2									Phase 3										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Phase 1																														
Design/contracting																														
Construction																														
Operation																														
Phase 2																														
Design/contracting																														
Construction																														
Operation																														
Phase 3																														
Design/contracting																														
Construction																														
Operation																														

(Adapted from Sellhorn/HPC, 07/2014)

The implementation schedule of the developing of Tema Port is strictly ruled by a well-balanced correlation between the forecast traffic flow within the next 30 years and the due provision of adequate installed cargo handling capacities. As outcome the operational Phases 1, 2 and 3 are defined, covering the market potential resp. the coming container cargo traffic growth from 2014 till 2043. The relevant capacity demands are met by distinct port construction measures realizing the geometrical "footprint" as approved by GPHA. The construction works, however, have to be started prior to the said operation Phases, in order to be operational as the demand arises.

4.0 ALTERNATIVES CONSIDERATION

A number of options were considered in the development of the proposed port expansion with respect to technology and location..

4.1 Breakwater Alternatives

Two alternatives for the breakwater (see **Figure 9**) were considered:

- rubble mound structure breakwater, and
- caisson structure breakwater.

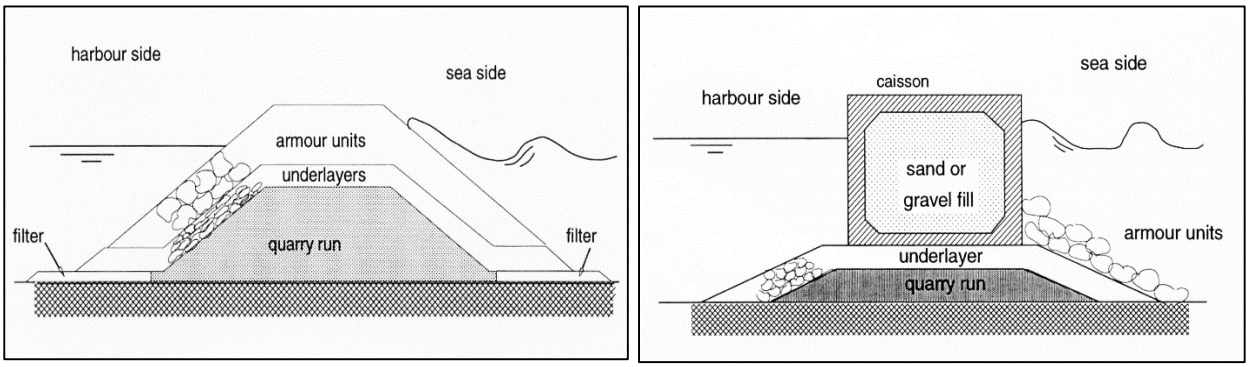


Figure 9: Illustration of a section of a typical rubblemound breakwater (left) and caisson breakwater (right)

Rubble mound breakwaters use structural voids to dissipate the wave energy. Rock or concrete armour units on the outside of the structure absorb most of the energy, while gravels or sands prevent the wave energy's continuing through the breakwater core. The slopes of the revetment are typically between 1:1 and 1:2, depending upon the materials used.

Caisson breakwaters typically have vertical sides and are usually erected where it is desirable to berth one or more vessels on the inner face of the breakwater. They use the mass of the caisson and the fill within it to resist the overturning forces applied by waves hitting them.

The advantages and disadvantages of each type is described in **Table 5**.

Table 5: Analysis of options for breakwater

Type of Breakwater	Advantages	Disadvantages
Rubble mound breakwater	• Suitable for irregular bottom • Suitable for weak soil (disbursed load) • Progressive damage • Low toe scour • Simpler construction • Simpler maintenance • Not sensitive to differential settlements	• Availability of adequate quarry needed • Large quantity of material required in deeper water • Transport of large amounts of materials • Large space required for storing of materials (rock and concrete units) • Separate structure needed to establish moorings • High maintenance cost

Type of Breakwater	Advantages	Disadvantages
	• largest waves (15 to 30 feet high) require rubblemound structures that are able to absorb wave energy	• Wider extent of sediment transport during construction due to the larger quantities of materials required
Caisson breakwater	• Construction time short on location • Relatively small amounts of materials for structures in deeper water (waterdepths exceeding approx. 10 m) • Moorings are easily established along the caissons • More limited sediment transport relative to rubblemound structure	• Brittle failures • Sensitive to poor subsoil foundation conditions in terms of weak soils prone to large settlements by consolidation • High reflection of waves • More difficult to repair • High Construction requirements • More Susceptible to breaking waves

The breakwater might be a rubble mound structure, usually consisting of core stone, a rock filter layer over the core, and an armour layer over the filter layer consisting of either rock or precast concrete units. Preliminary calculations show that a double layer of 6-10 T rocks (D_{n50} of 1.45m and a W_{n50} of 8000 kg) will be required for the armour layer of exposed part of the breakwater. Depending on factors to be evaluated later on by the Contractor, like local availability of stones in this size range, logistic considerations, etc. stones for the amour layer might be replaced by precast concrete amour units like Accropodes™ or similar.

The caisson structure made out of reinforced concrete and filled with sand, would be a preferable option in case procurement of stones is limited in quantity due to logistic problems (transport from quarry to construction site). This alternative shall be considered during the design of the breakwater with special attention to cost, technical feasibility, availability of construction material and logistic advantages.

4.2 Quay Wall Alternatives

Four alternative quay wall concepts are evaluated based on local geotechnical conditions, constructability and cost issues and a reasonable recommendation is presented. These alternatives are: Concrete block wall, Piled deck, Concrete caisson, and Cellular cofferdam.

4.2.1 Alternative 1: Concrete Block Wall

The concrete block wall is a typical gravity wall, which is built up of precast concrete blocks and a cast in situ or precast capping beam, which carries the waterside crane rail. The landside crane rail is to be installed on a separate pile supported reinforced concrete beam.

A gravel bed shall be placed for the foundation of the blocks. This type of construction relies on a careful levelling of the foundation level. The concrete blocks (hollow or solid) are cast at the construction site, being placed by a floating crane with divers' assistance to check the required careful execution of both the foundation bed, the block placing and the backfill work.

Settlements due to the deadweight of the structure and the shore side gantries may be avoided in preloading the block wall by an earth fill dam before casting the capping beam. Unreinforced concrete blocks have the advantage over reinforced concrete blocks in that there will be no reinforcement subjected to corrosion, and they would thus result in a less maintenance intensive product over a long life expectancy. Hollow blocks may also be considered, since they can be made larger than solid blocks without substantially increasing their weight. Therefore, for the same weight as a solid block, the hollow block creates a larger surface area of wall, resulting in fewer blocks being lifted with heavy-lift equipment. The hollow vertical cavities may be filled with either crushed stones or concrete, which could be installed using lower cost equipment. The blocks are typically sized with a design weight of approximately 70 tonnes. However, the future contractor would have the option to fabricate larger, heavier blocks to suit the capacity of his construction equipment.

4.2.2 Alternative 2: Piled Deck

The piled pier concept comprises a concrete deck above an open embankment, being supported by piles. The construction works are carried out in the open water; therefore steel piles or prefabricated reinforced concrete piles are recommended. The design of the piled deck and the embankment are determined by the slope stability analysis. The design of the deck has to correspond to the impact of vertical loads and horizontal loads in case of seismic events through bedding and bending of piles.

Driving of piles into the rock cannot be provided by hydraulic hammer or similar. The rock strata has to be pre-drilled and rock-sockets have to be installed. Pile load tests shall be undertaken early during design process to evaluate the results for an economical construction design.

The quay slab is generally constructed as cast-in-situ concrete capping beams with prefabricated concrete slabs and cast-in-place concrete topping. Construction works are carried out in open waters, formworks therefore will be expensive. The rigid connection between piles and slab is constructed by using reinforced concrete plugs at the pile heads. The underwater slope below the quay deck is stabilized by a riprap-layer to withstand erosion caused by waves and bow thrusters. The relevant slope stability has to be verified.

As the piles are the only deck supporting components, they require a sufficient embedding length in the ground, which has to be guaranteed by adequate measures even in the prevailing bedrock. Fixing piles in bedrock causes high construction cost. With modification of its geometry and applying particular construction methods the piled pier system is adaptable to different ground conditions. During installation of steel piles limited technical adaptations like rock sockets are possible, in order to react on varying subsoil conditions. Moreover, the length of steel piles can be adjusted. Steel piles have to be protected against corrosion by painting, cathodic protection or wall thickness allowance.

The minor deadweight of the piled deck structure enables economic solutions for seismic load cases.

4.2.3 Alternative 3: Concrete Caisson

Caissons are retaining, watertight structures, forming large cellular elements. As well as block walls they are typical gravity walls. Their stability against failure by sliding, overturning, shear failure in the ground and their overall stability have to be verified.

The caisson type of the quay wall option to be considered within this concept is the so called box caisson which is a prefabricated concrete box with side walls and bottom. The box caissons have to be placed on a prepared foundation base. Once in place they will be filled with sand to become part of the permanent structure.

The caissons are floated from their construction site to the planned quay alignment, where they are sunk onto the well levelled gravel bed. After placing and filling the caissons will be covered by an in-situ concrete slab. The landside crane beam will be arranged separately on piles. Because of their minor weight and the vertical backside caissons are of larger dimensions than block walls. Caissons are produced in dry or floating docks or even in specifically dredged basins ashore or slipways, all of considerable dimensions. Floating and dropping of caissons request capable floating cranes, the availability of which has to be clarified during the design phase.

Preloading of the filled caissons before casting the covering concrete slab is recommended. Natural conditions at the site, such as wind, waves and currents, may cause down times of cranes and thus prolong execution periods considerably. A disadvantage in the construction progress may be that box caissons must be ballasted or anchored to prevent floating until they can be filled with sand. This type of construction relies on the adequate bearing capacity at foundation level. Therefore it is of some priority to evaluate thoroughly the bearing capacity of the ground within the alignment of the quay wall, because improving measures during execution works regarding soil conditions may be very difficult.

Caissons shall be backfilled with granular soil material of higher shear strength, in order to minimize resulting earth pressure. According to seismic design referring to Eurocode 8 caissons as gravity structures are considered to be rather unsusceptible and this allows for reduced horizontal design loads and higher allowable deformations as compared to anchored systems. On the other hand large mass structures do generate high acceleration forces due to seismic activities. Caissons request a sufficient concrete cover of the reinforcement and rather resistant concrete, in order to provide adequate durability. Construction site logistics are very challenging.

4.2.4 Alternative 4: Cellular Cofferdam

Cellular Cofferdams are robust structures, capable of withstanding significant deformation without collapse. They are constructed of straight web piling. The structure of cellular cofferdams is composed of main and secondary cells. Circular cells are the main cells, which are linked by small cells. This has the advantage, that each cell can be individually constructed and filled and is therefore independently stable. The cofferdam wall is formed from sheet piles that are supported by walers and internal braces, and cross braces.

Since cofferdams are constructed offshore maintaining close tolerances is difficult. Under these circumstances, deformation of cofferdam elements may happen during the course of construction. To prevent scour in the quay area, it is recommended to use a mattress of filter fabric, covering it with rock to hold it in place. The sheet piles shall reach the soil bearing layer.

The cells and the sand fill, compacted to a minimum relative density of 70%, absorb vertical and horizontal forces and moments. This combined action is secured by skin friction between the sheet piles and the fill, along the perimeter and shear resistance of the sand central plane.

At rest and active soil pressure of the fill induce pure tension stresses in the sheet piles, acting as continuous tensile rings. The sheet piles need to be protected from corrosion. Below low tide level sheet piles can for example be epoxy coated down to 1.5 m below design dredged level and further protected by a passive cathodic protection system composed of sacrificial anodes, which can be replaced when needed. From low tide to top of sheet piles a concrete precast apron is mounted on the sheet piles and cast in situ concrete poured, fully filling the gap between them. Corrosion can affect durability of the structure greatly.

Crane rails shall be supported by additional piles. Cellular cofferdams can be used singularly in a group or at end and it will not collapse in the event of failure of adjoining cells. Each cell can be filled independent of the other without hampering the progress of work. It can be difficult to construct the cofferdams in hard grounds.

4.2.5 Evaluation of Quay Wall Options

Table 6 summarizes the advantages and disadvantages of the analysed quay wall options.

Table 6: Evaluation of quay walls options *(Source: Sellhorn/HPC, 07/2014)*

Parameter	Block Wall	Piled Pier	Caisson	Cofferdam
Buildability	+	-	o	+
Durability	+	o	+	-
Local Experiences	+	+	-	-
Availability of local Equipment	+	o	-	-
Adapted to local soil conditions	+	-	+	o
Wave reflection	o	+	o	o
Construction cost	+	+	o	o
Total	+	o	o	-

(Legend: + =favourable; o = indifferent; - = unfavourable)

The prevailing subsoil conditions at Tema Port (adequate load bearing capacity at foundation level) favour a gravity wall variant, i.e. block wall or caisson. Weighting the cost and the local experience acq uired from the actual development of Tema Port, a block wall concept is recommended.

Table 7 analyses the available alternatives for the development scheme for the propose Port Infrastructure Development Project, as well as the no action option.

Table 7: Analysis of environmental and socioeconomic implications of main project development scheme alternatives

No.	Consideration	Options	Potential Environmental Implications	Potential Socioeconomic Implication	Conclusion
1	Development scheme for the Upgrade and Expansion of the Port	**Option A (Proposed by GPHA) –** Seaward expansion of the current Tema port facility with little disturbance to the current port operations.	• Impact on aquatic life as a result of dredging and land reclamation. • Potential impact on the tidal inlet of the nearby Sakumo II Lagoon (a RAMSAR site) • More cumulative impacts on the marine environment since there may be more discharges per unit area	• Water use for the area is maintained and conflicts avoided. • No land acquisition and compensation payment required since the proposed site is designated for port expansion and under the jurisdiction of the GPHA • Fits seamlessly into the current port operations, therefore existing administrative structures will be adequate to successfully manage the port. Additionally, staff will not require extensive training to be familiar with the operational procedures. • Less expensive to develop	Option A is preferred as it is the most its environs is the most environmentally and economically feasible option
		Option B – Construction of a new port at an alternative location to supplement the current Tema Port.	• Impact on port water quality and aquatic life as a result of dredging and land reclamation of the new port area • Less cumulative impacts on the marine environment since discharges will be less concentrated and therefore more easily dispersed • Traffic impact within the proposed area for the development of the port • Water use for the area will be changed which may result in conflicts • Visual impact will be significant since it is a new development	• More staff may need to be employed which provide employment opportunities • Land acquisition and compensation payment required • More expensive to develop • New administrative structures will be needed at the alternative location to successfully manage the port. Additionally, staff will require extensive training to be familiar with the operational procedures. • Smaller port will allows for better supervision of the Port operation	

No.	Consideration	Options	Potential Environmental Implications	Potential Socioeconomic Implication	Conclusion
		Option C- Relocating the storage facilities and other land based activities to create space within the port area, especially for container handling and dredging the current port basin to accommodate larger vessels	• Traffic impact within the proposed location for facilities. The roads in the area may also suffer damage as a result of heavy goods carrying vehicles traversing the road. • Impact on port water quality and aquatic life as a result of dredging	• Land acquisition and compensation payment required • Security concerns for goods stored at the alternative location • Space to be gained not adequate to meet the future needs of the port – the storage area is (145,470 m^3) only)	
3.	No Action Option	Current conditions at the port will persist. No development will take place	• High risk of pollution of the marine environment from increased waste • Increased risk of accidents from overcrowded port area • Traffic within the Tema metropolis will deteriorate • Pressure on the port facilities will lead to rapid deterioration	• The nation will lose the opportunity to generate revenue from the proposed port development through customs charges, employment provision etc.	This option is untenable

5.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The existing physical and socioeconomic environment of the project area of influence i.e., the Tema Metropolis is presented in this chapter. The proposed port upgrade and expansion will be entirely at the Western portion of the current port location.

5.1 Physical Environment

5.1.1 Land Use

Most of the land within the immediate vicinity of Tema port is owned by the Ghana Ports and Harbor Authority. **Figure 10** shows the layout of Tema Municipality and the land use features. Eastward of the Tema port is located two important coastal lagoons; the Chemu and Gao lagoons. At the north western portion is the Sakumo II RAMSAR site, which supports diverse populations of migratory and residence shorebirds (see Section 5.1.10 for more detailed information on the Sakumo II RAMSAR Site).

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

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

This rocky breakwater, located between Tema New Town and the Gao lagoon, has a number environmental issues associated with it. These include erosion of adjacent shoreline, disruptions in sediment movement and deposition patterns, changes in near shore hydrology, biodiversity and impacts on the Gao Lagoon. Within the vicinity of the lagoon is a 25 m. Right of Way (ROW) for the gas pipeline that passes through maritime strand, coastal scrub, and grassland vegetation types for a distance of about 800 m from the shoreline to the regulating and metering (R&M) station of WAPCO. Much of the area is used as farmland where vegetables, grains, and pulses are grown on a small scale.

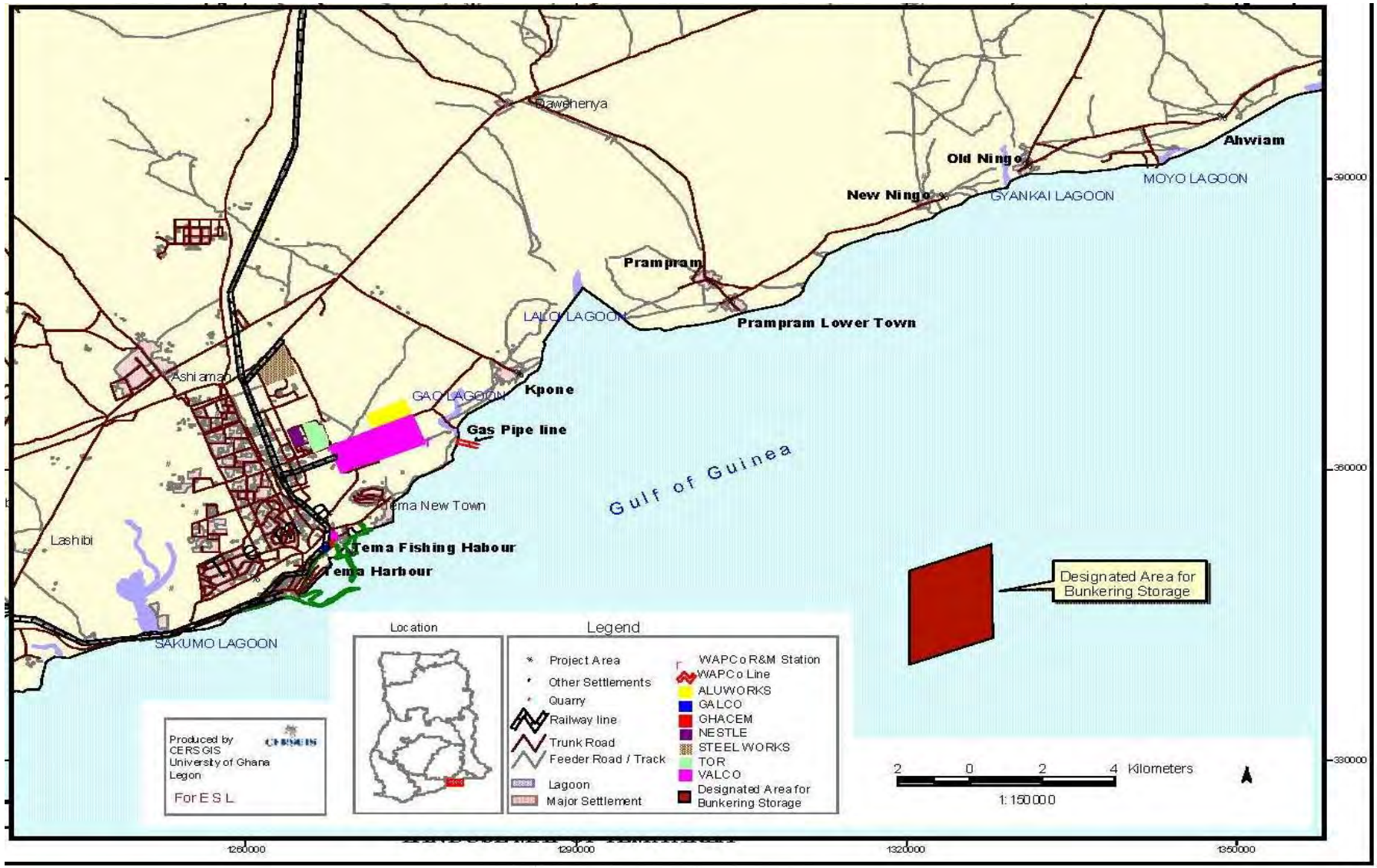


Figure 10: Layout of Tema Municipality and the land use features

5.1.2 Marine Water Uses

The main water uses at the marine environment are shipping vessels related to the Port and fishing vessels ranging from canoe to steel hulled dragnet fishing boats. Single point moorings (SPM) for petroleum products loading and offloading are installed east of the harbour. Conflict between large and small vessels may occur especially when the smaller fishing canoes drift near the port entrance or when they fish near the SPMs and gas pipeline.

5.1.3 Geology & Soil

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

The topography of the project area is generally flat with gentle slope towards seaward of the Gulf of Guinea in the southwestern direction. The area lies in the Accra plains and falls under the Dahomeyan Precambrian formation. The decomposed weathered rocks are predominantly sandy clay. The lithological composition of the Dahomeyan System indicates that it represents a metamorphosed sedimentary or volcano-sedimentary sequence. The proposed project site forms part of the middle Precambrian Dahomeyan rock system consisting of basic and acidic gneisses and schist with occasional bands of quartzite, which are hard, foliated and folded.

The basic gneiss and/or gneiss schist on the project site depict fresh state and fully competent with high bearing capacity.

The residual soil within the site consists of dark gray calcareous clay/sandy clay in areas of poor drainage, and sandy/clayed sand in areas of good drainage. The clay soil has the potential to exhibit swelling and shrinking characteristics if the moisture content changes and this may cause cracking damages to even light structures if their foundations are laid on this soil.

Recent site investigation was carried out by CHEC in 2013 in the western expansion area, as shown in **Figure 11.** Results and interpretation of the investigations and laboratory tests are given in an interpretative report prepared by GPHA (Geotechnical Investigation And Engineering Works, Part 1 of Volume 1, Geotechnical Investigation Factual Report, February 2014). According to the report the strata consist of Quaternary deposits and gneiss of Dahomeyan System of Middle-Late Precambrian age. Collected samples show that the site is mainly underlain by clay, sand, gravel/cobbles and rock. The surface layer consists of a thin clay stratum followed by silty clay and silty sand strata. Characteristic geotechnical profile is shown in **Table 8**. Rock was not encountered in the Southeast area and the interface between soil and rock was generally found out to decline towards the ocean.

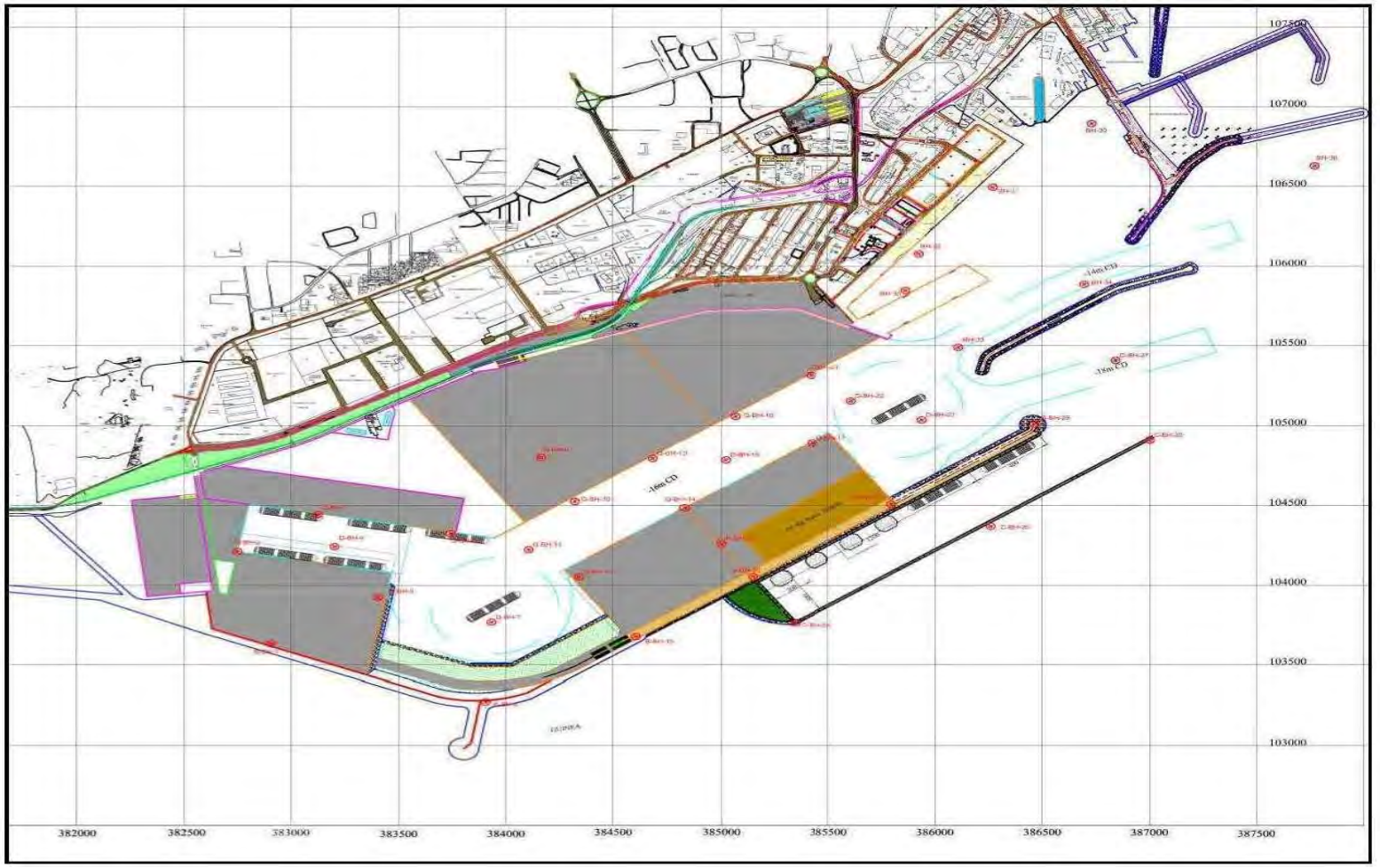


Figure 11: Location of boreholes for geotechnical survey at the new port area (CHEC, 2013)

Table 8: Characteristic of Stratigraphy (Source: Sellhorn/HPC,2014)

Stratum No.	Strata	Average thickness (m)	Average elevation of top (m)	Average elevation of base (m)
1-1	Clay	1.70	-11.20	-12.90
1-2	Clayey Silty fine SAND	2.28	-12.04	-14.32
1-3	Silty medium to coarse SAND	1.86	-16.05	-17.91
1-4	Sandy GRAVEL/COBBLES	1.30	-11.76	-13.06
2-1	Clayey sandy GRAVEL/COBBLES	2.39	-15.74	-18.65
2-2	Clayey gravelly medium to coarse SAND	2.14	-15.46	-17.60
2-3	Silty CLAY/ Gravelly CLAY	2-70	-17.98	-20.69
3	Silty CLAY/CLAY	18.57	-27.23	-45.80
4-1	Completely weathered GNEISS	1.10	-14.91	-16.01
4-2	Highly weathered GNEISS	8.68	-14.53	-23.21
4-3	Moderately weathered GNEISS	6.65	-22.91	-29.56
4-4	Slightly weathered GNEISS	4.38	-31.27	-35.65

Messrs Alluvial Mining and Shaft Shifting Company Limited conducted underwater investigation of the harbour basin on behalf of GPHA in the 1990s under the supervision of Messrs Boskalis International BV. The geotechnical survey involved drilling of 17 boreholes to an average depth of 4m, using a pilkton Traveller P.N.4 hydraulic rotary rig with a triplex pump, to obtain a reliable impression of the soil and rock conditions.. The findings from the investigation are presented below. The harbour basin has a general hard ground consisting of mainly metamorphic rock (light/dark banded gneisses), subdivided into rock types A1, A2, A3 and A4.

Rock Type A1

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

Rock Type A2

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

Rock Type A3

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

Rock Type A4

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

5.1.4 Seismicity

The design specifications for seismic parameters in Ghana are determined by the seismic zoning map (**Figure 12**), which shows the two main seismogenic zones of Ghana as the Axim-Elmina (A) and Accra-Ho (B) regions. The Accra-Tema corridor of the Accra-Ho seismic region is the most active and most susceptible earthquake area in Ghana. Therefore as a precautionary measure it will be prudent to factor seismic concerns into the designs.

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

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

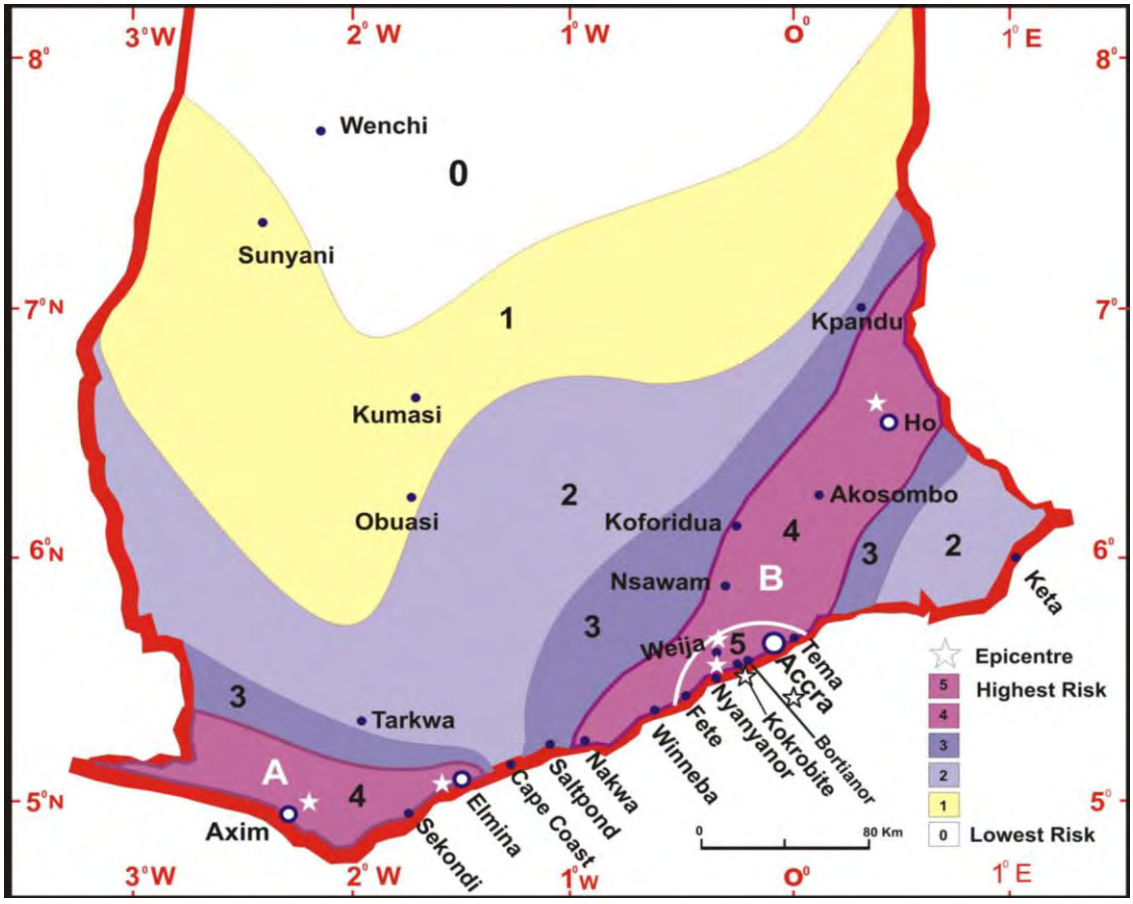


Figure 12: Seismic zoning map of Southern Ghana (Source: Kutu, 2013)

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

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

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

5.1.5 Bathymetry

A bathymetric survey was executed in 2013 by CHEC. The results of the study indicate that the seabed elevation ranges approximately between +0.2m and -20mCD with gentle to gradual slopes from coastline towards the sea. Particularly, some reefs can be seen in shallow water area.

In the existing harbour basin, the seabed elevation varies approximately between -5 mCD and -13 mCD.

5.1.6 Climate

Tema is characterised by a dry equatorial climate. Tema is influenced by three air masses namely, the South-West Monsoon, the North-East Trade Winds (Tropical Continental Air Mass) and the Equatorial Easterly. The warm but moist South-West Monsoon which 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).

Climatic data obtained from http://www.ghanahydrodata.com for Tema is presented in this section.

Rainfall

Tema lies in the driest part of southern Ghana, experiencing average annual rainfall of about 713 mm (see **Figure 14**). The slow and irregular north-south oscillations of the ITCZ gives rise to the regime of wet and dry seasons. This region generally moderate amount of rainfall during the wet (rainy) season when the area comes under the influence of the South-West Monsoons. The wet season is characterized by two main rainfall regimes, i.e. from March to July with a peak in June (i.e. mean of 187 mm), and September to November with a second peak in October (i.e. mean of 59 mm) as shown in **Figure 13**. In the dry season the region comes under the influence of the North-East Trade winds or the Harmattan.

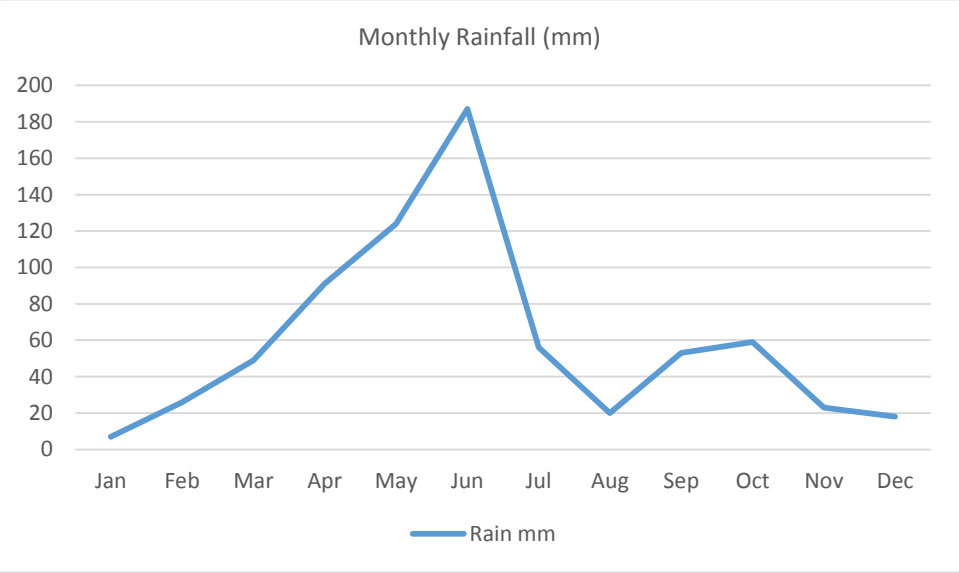


Figure 13: Monthly variation in mean rainfall quantities

Figure 14: Mean Annual Rainfall (mm) from 1961-1990 (after Mote, 1998)

Maximum and minimum 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 31.1 ^{0}C occurs between February and April and the lowest of about 21.7^{0}C in August.

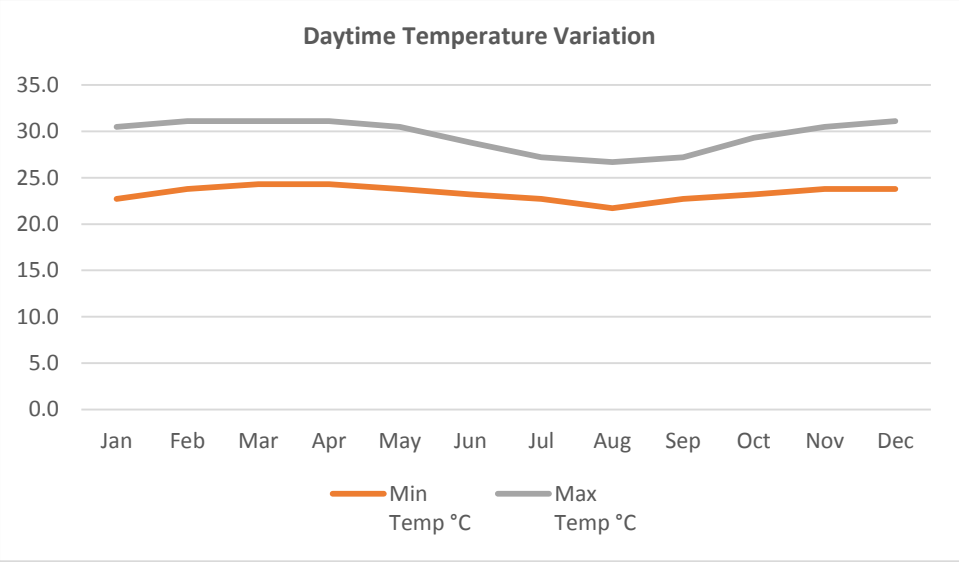


Figure 15: Variation in daytime temperatures

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

Generally the driest periods are between January and February, while June to August is the most humid. **Figure 16** illustrates the variation in relative humidity.

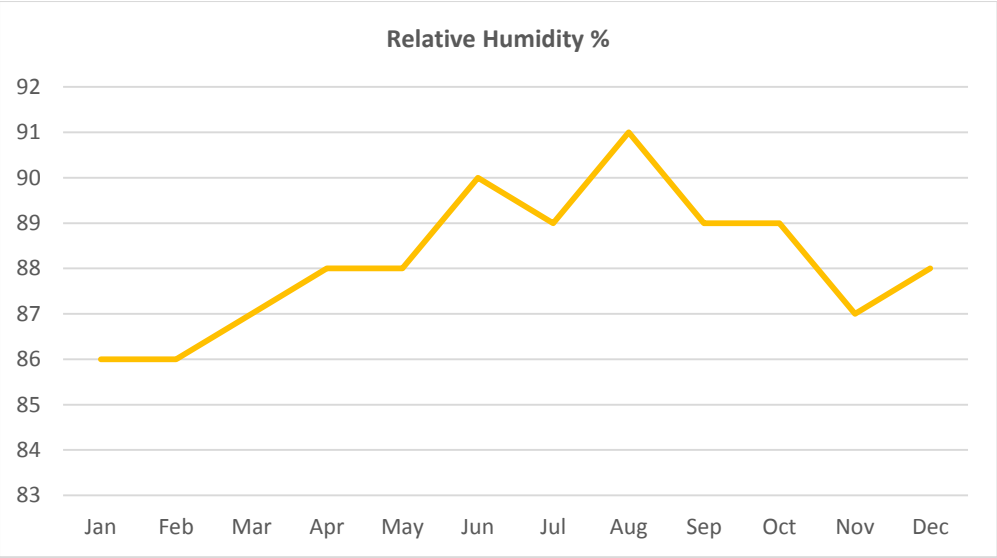


Figure 16: Monthly variation in mean relative humidity

Wind

The North-East Trade and the South-West Monsoon are the major winds which influence the project area. In addition to this is the daily changes in the wind direction, resulting from the differential heating and cooling of the land and sea, During the day, the local breeze is therefore from off-shore and the reverse occurs in the night. The prevailing wind influencing the area is from south to south-west.

5.1.7 Topography

Generally from land to sea, geomorphic types of the site are coastal terrace, sea plain of intertidal zone and neritic zone in proper order.

In the expansion area, the elevation of onshore portion ranges between +3 m and + 12 mCD. The highway and Tema railway, which is oriented east-westwards, pass through the onshore site. The elevation of highway varies between about +5 m and + 11 mCD while the elevation of railway varies between about +5.5 m and +8 mCD. The coastline is mainly covered by sand, partially with exposed rock. Revetment made of gneiss block can be found along coastline. In the western part of the site, Sakumono lagoon is connected to the ocean through outfalls. According to" Environmental and Engineering Geology for Urban Planning in the Accra- Tema Area" by R. Muff and J. Quaye (see **Figure 17**), the shore stability is medium to high at the site, but the shore stability is low near Sakumo II lagoon.

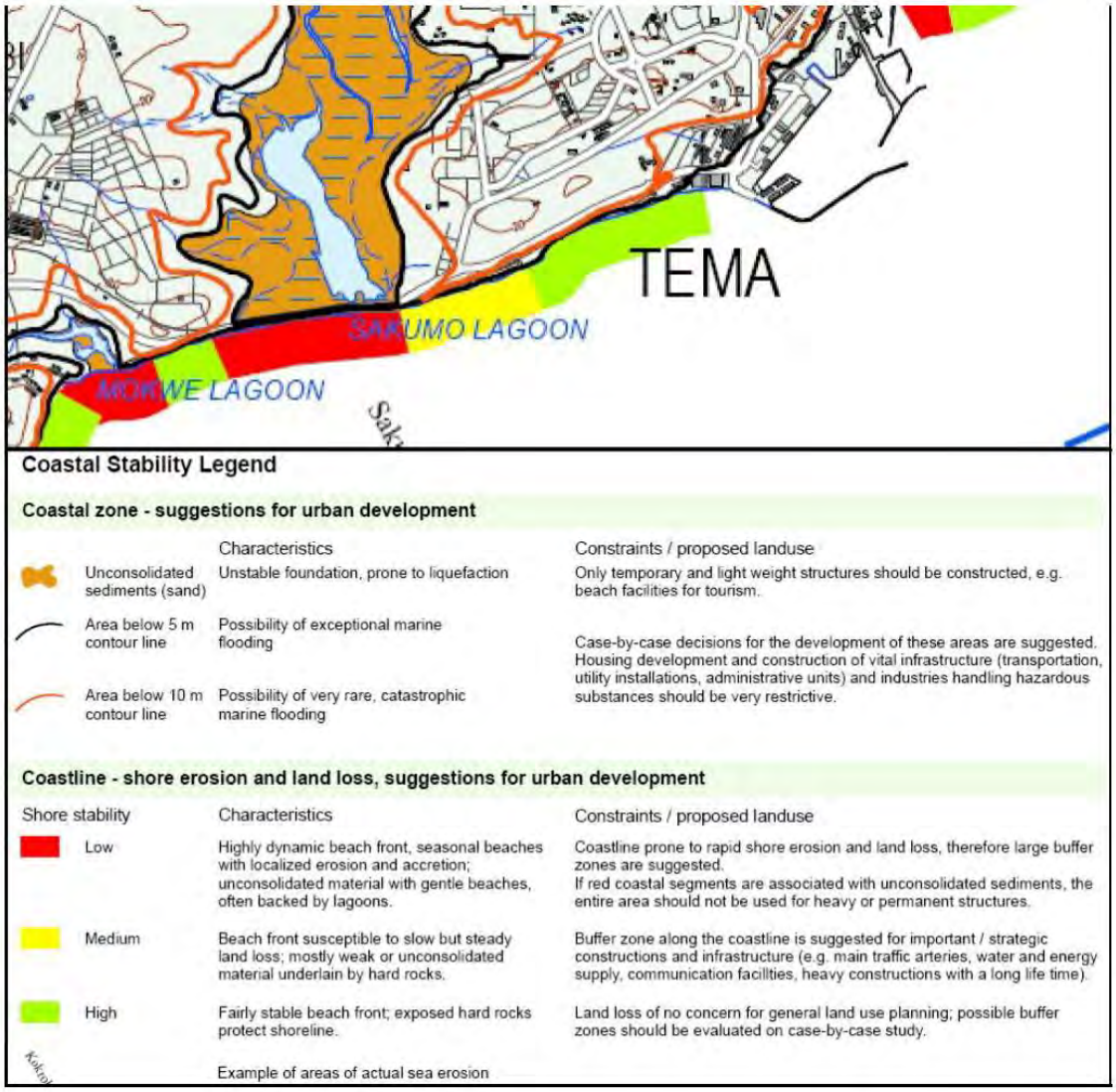


Figure 17: Coastal stability map of the project area (Source: *R. Muff and J. Ouaye, 2006)*

5.1.8 Coastal Processes

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

Currents

The hydrography of the area, which is within the Gulf of Guinea, is influenced largely by subtropical gyres of the north and south Atlantic oceans (see **Figure** 1**8**). The major current influencing the area is the Guinea Current flowing from west to east. This current runs opposite to the south westerly equatorial current between Africa and South America. The Guinea Current reaches a maximum between May and July during the strongest South-West Monsoon Winds when it peaks at 1 to 2 knots. For the rest and greater part of the year, the current is weaker. Near the coast, the strength of the current is attenuated by locally

generated currents and winds. The current is less persistent near-shore than farther offshore. Geostrophic effects induce the tendency of Guinea Current to drift away from the coast especially during its maximum strength.

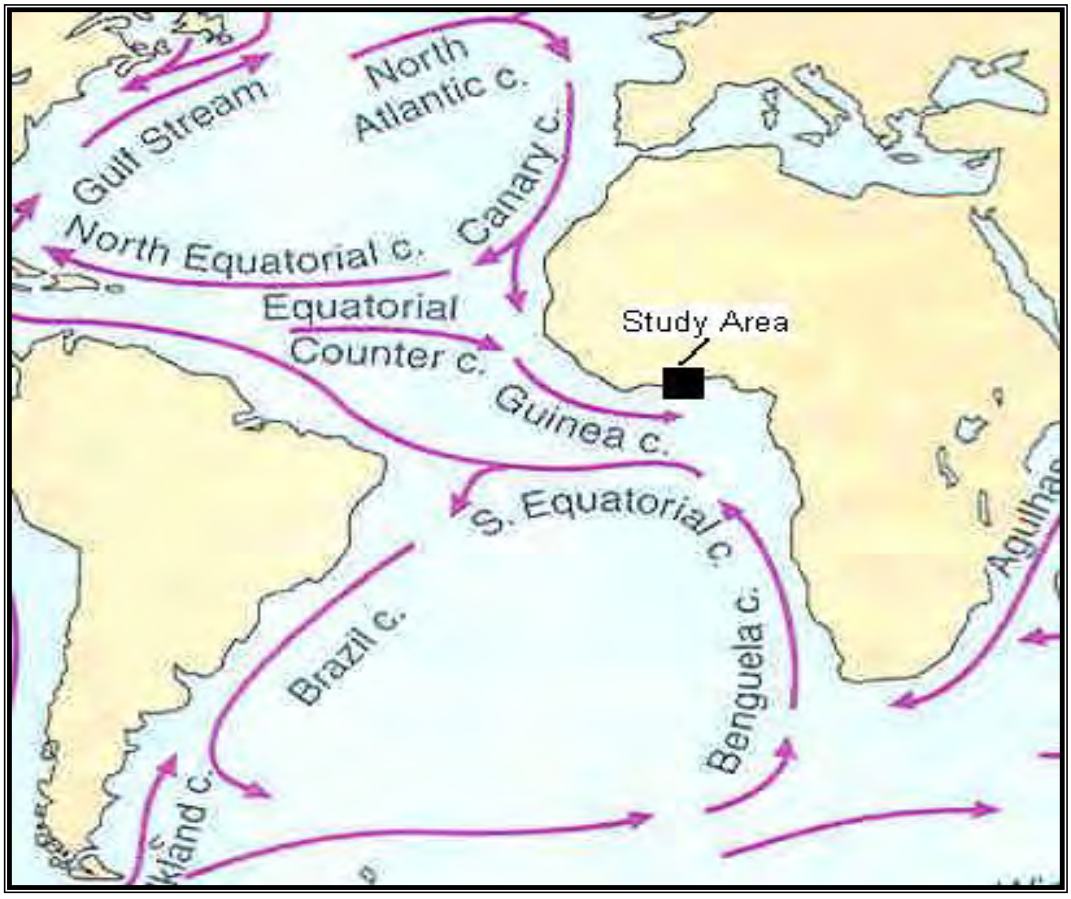


Figure 18: Major current systems influencing the Gulf of Guinea

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

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

Tide Level

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

Waves

Waves reaching the shores of Ghana consist of swells originating from the oceanic area around the Antarctica Continent and seas generated by locally occurring winds. The significant height of the waves generally lies between 0.9 m and 1.4 m and rarely attains 2.5 m or more. The most common amplitude of waves in the region is 1.0 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 19**).

Other observations on the wave climate include a long swell of distant origin and with wavelengths varying between 160 and 220 m. This swell has a primary period of 12 seconds and a relatively regular averaged height between 1.0 and 2.0 m. The swells generally travel from southwest to northeast.

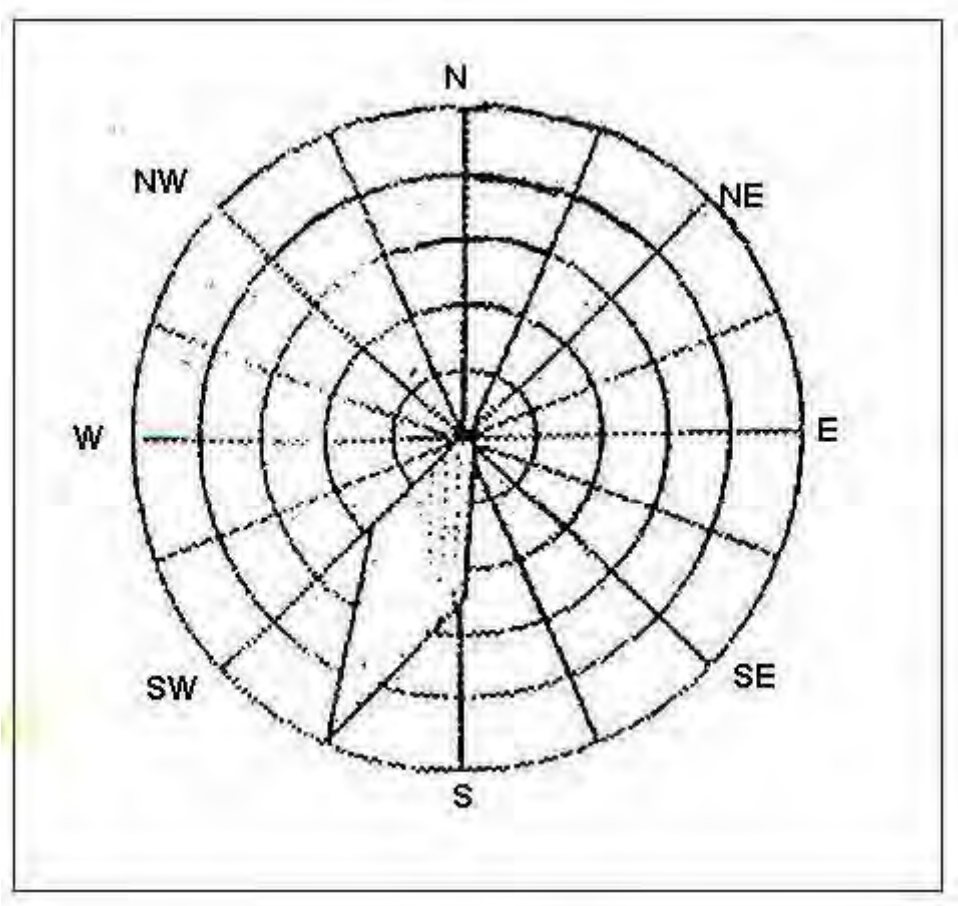


Figure 19: Wave Rose Indicating Predominant Swell Wave Direction

5.1.9 Sediment Transport

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

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

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

The rough approximation of the sedimentation next to the breakwater, until the sediment is passing by the harbour again, is illustrated in **Figure 20**. The different stages of the sedimentation are describe as follows:

- 1 "' accretion after one year,
- 2 "' after 3 years,
- 3 "' after 5 years and
- 4 "' after 7 years.

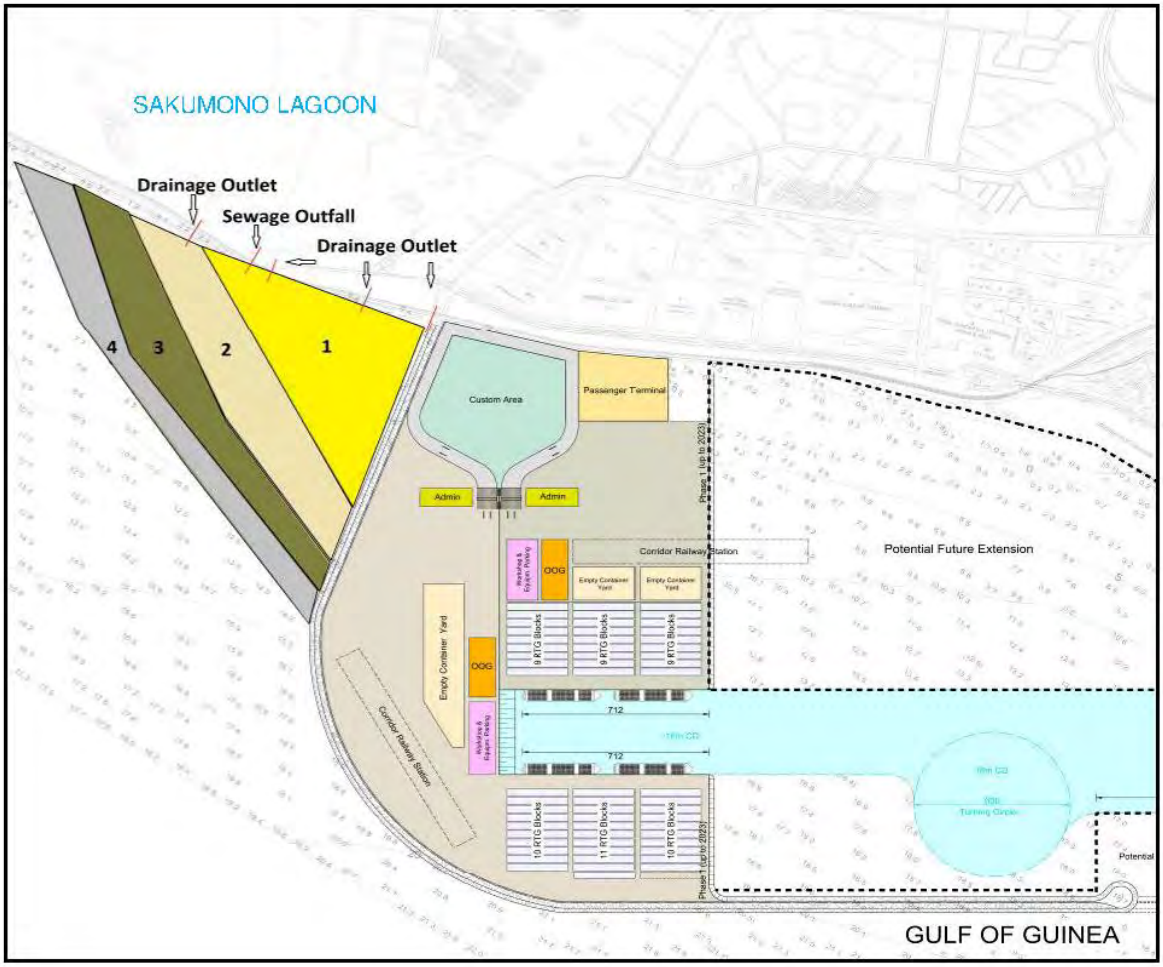


Figure 20: Rough Approximation of the Sedimentation next to the Breakwater (Source: Sellhorn/HPC, 06/2014)

The location of existing drainage outlets and sewage outfall which might be sealed by the sediments is also shown in **Figure 20.**

5.1.10 Marine Sediment Quality

Shipping activities, rapid industrial developments and urbanisations associated with ports and harbours make them potential sites of marine pollution. Pollution in port environments may come from several sources such as vessel oil spills, disposal of industrial effluence from nearby industries, use of anti-fouling paints, discharge of ballast water, and sewage from human settlements. Sediments provide records of metal pollution in aquatic environment and can also serve as a source of metals to the overlying water during re-suspension [Bryan et al (1992), Savvides, et al (1996)].

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

Samples were taken from within the main port basin (stations MH1, MH2, MH3, MH4 and PE), from the station OS (open sea), from the station IFH (inner fishing harbour), OFH (outer fishing harbour) and station CB (canoe basin).

Analysis of samples was done using INAA (instrumental neutron activation analysis) for Mn, V, Cu, As and Cd, and AAS (atomic absorption spectrophotometry) for Fe, Cr, Zn, Ni and Co. Contamination effects in sediment were assessed using NOAA's SQuiRTs (screening quick reference tables) by Buchman. The results of the analysis compared to the sediment quality guidelines (Sediment quality Screening values prepared by NOAA) in **Table 9.** Level of contamination are assessed using estimated enrichment factors for analysed metals at Tema Port as presented in **Table 10**.

Table 9: Comparison of metal concentrations (mg/kg) in the Tema Port to sediment quality guidelines

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

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

Table 10: Estimated Enrichment factors for analysed metals at Tema Port

Period	Location	Sites	Fe	Mn	Cu	Zn	Cd	Ni	As	V	Pollution Load Index, PLI
Dry season	Port Basin	MH1	1	3	6	5	1244	10	6	11	0.293
		MH2	1	1	3	2	840	4	6	2	0.001

		MH3	1	0	5	2	1230	4	4	8	0.012
		MH4	1	0	1	1	1086	4	6	31	0
		PE	1	0	2	1	3576	5	-	7	0.001
	Open sea	OS	1	0	3	1	11467	8	-	10	0.004
	Fishing Harbour	OFH	1	0	6	3	312	2	4	3	0.003
		IFH	1	0	9	2	-	7	-	-	0
	Canoe Basin	CB	1	-	-	-	1719	2	-	-	0.056
Wet season	Port Basin	MH1	1	1	13	5	1397	15	6	13	0.366
		MH2	1	0	10	4	1323	12	2	3	0.012
		MH3	1	0	7	3	-	9	2	10	0.001
		MH4	1	0	4	2	859	17	2	36	0.02
		PE	1	0	3	2	1057	11	2	9	0.006
	Open sea	OS	1	0	1	1	2011	16	3	12	0.001
	Fishing Harbour	OFH	1	0	14	7	-	5	3	4	0.003
		IFH	1	0	32	20	-	-	-	-	0.009
	Canoe Basin	CB	1	0	-	1	-	-	-	-	0

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

Comparison to Sediment Quality Guidelines

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

Metal concentrations and accumulation patterns

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

Metal contamination outside the port basin

7. Metal contamination from outside of the port is mainly of urban origin (sanitation discharge outlets and storm discharges) and industrial activities in the environs of the port. It is, however, suspected that the high levels of V and Cd recorded could come from sources such as oil pollution within and outside the harbour environment.
8. Although sediments were extremely enriched with some individual metals such as V and Cd, the estimated overall pollution load index indicated that the sediments at all the nine stations of the Tema Port show good sediment quality, however, periodic monitoring is required for effective management of pollution in the Tema Port.

Textural classes of sediment

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

Polycyclic Aromatic Hydrocarbons

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

5.1.11 Marine Water Quality

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

Physico-chemical Parameters of Seawater in Tema

Table 11 shows the temperature range from 28.5 ± 0.2 to 30.7 ± 0.3°C were recorded in Tema. pH values recorded in Tema ranged from 7.4 ±0.5 to 8.4 ± 0.3. Dissolved oxygen (DO) values recorded for Tema varied from 4.9 ± 0.3 to 5.5 ± 0.2 mg/L. Conductivity values ranged from 53.8 ± 0.2 to 54.9 ± 0.4 µS/cm recorded in Tema. Total suspended solids recorded ranged from 9.0 ± 1.5 to 16.3 ± 2.4 mg/L in Tema, while total dissolved solids ranged from 0.03 ± 0.34 to 0.03 ± 0.01 ppm in Tema. Finally, salinity of seawater recorded in Tema during the study period varied from 35.4 ± 0.2 to 35.6 ± 0.4 ppt.

Table 11: Results of physicochemical analysis of seawater

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

Temp: Temperature; DO: Dissolved Oxygen; Cond: Conductivity; TSS: Total Suspended Solids; TDS: Total Dissolved Solids

Microbiological Quality of water obtained from Tema

Table 12 below shows the results of colony counts of bacteria in water samples obtained from the sea at Tema for the three month sampling period. From the results, Tema recorded a THC ranging from 9.4 X 102 to 3.1 X10^3cfu/100 ml. In Tema TCC ranged between 7.4 X10^2 and7.9 X 10^2 cfu/100 ml. Tema was between 2.4 X 10^1 and 2.4 X 10^2 cfu/100 ml. The ECC in Tema ranged from 3.4 X 101 to 1.2 X 102 cfu/100 ml.

Table 12: Results of microbial quality analysis

Site/Month	Total Heterotrophic Count (THC)	Total Coliform Count (TCC)	Fecal Coliform Count (FCC)	E. coli Count (ECC
March	9.4 X 10^2	7.4 X 10^2	2.4 X 10^1	101 3.4 X 10^1
April	1.5 X 103	7.9 X 102	1.3 X 101	5.9 X 101
May	3.1 X 103	7.4 X 102	2.4 X 102	1.2 X 102
Mean	1.8 X 103 [b]	8.9 X 10 [ab a]	9.1 X 10 [1 a]	9.1 X 10 1 [a a]

Faecal coliform counts of the seawater were below the WHO guideline of ≤ 1000 cfu/100 ml of water. This suggested that, the idea that the assimilation capacity or carrying capacity of the ocean is high enough to naturally deal with pollutants is a fact.

5.1.12 Marine Ecology

Coastal Zone

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

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

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

General Fisheries

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

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

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

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

Both the pelagic (migratory fish that feed above ocean bottom) and the demersal (sea bottom-feeding fish) fishery resources are exploited in Ghana. The most common fish captured in Ghana are the small pelagics such as mackerel, horse mackerel, chub mackerel, sardines, sardinella and anchovies. These small pelagic species account for about 70 percent of the total marine fish capture in Ghana. The biomas of the small pelagic resources fluctuate significantly.

According to industry and GOG sources the quantities of captured sardinella, chub mackerel and anchovy fluctuate and have reached a point of near collapse. In addition most shrimp vessels have shifted to tuna fishing due to consistently low levels of shrimp catch. The shrimp industry had subsequently collapsed over the past ten years. The large pelagic type is mainly tuna.

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

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

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

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

- **Emperors** (Lethrinidae: e.g., Atlantic emperor - *Lethrinus atlanticus*).

Local Marine Biodiversity

A study by Nunoo et al (2006) examined spatio-temporal trends in fish species composition in relation to biotic, abiotic and anthropogenic factors, towards achieving better-informed management of the beach-seine fisheries. Fishery-dependent data were collected between November 1999 and October 2001 from 94 beach-seine hauls fished at two stations at Sakumono (see **Figure 21**), near the proposed site for the Port Infrastructure Expansion Project.

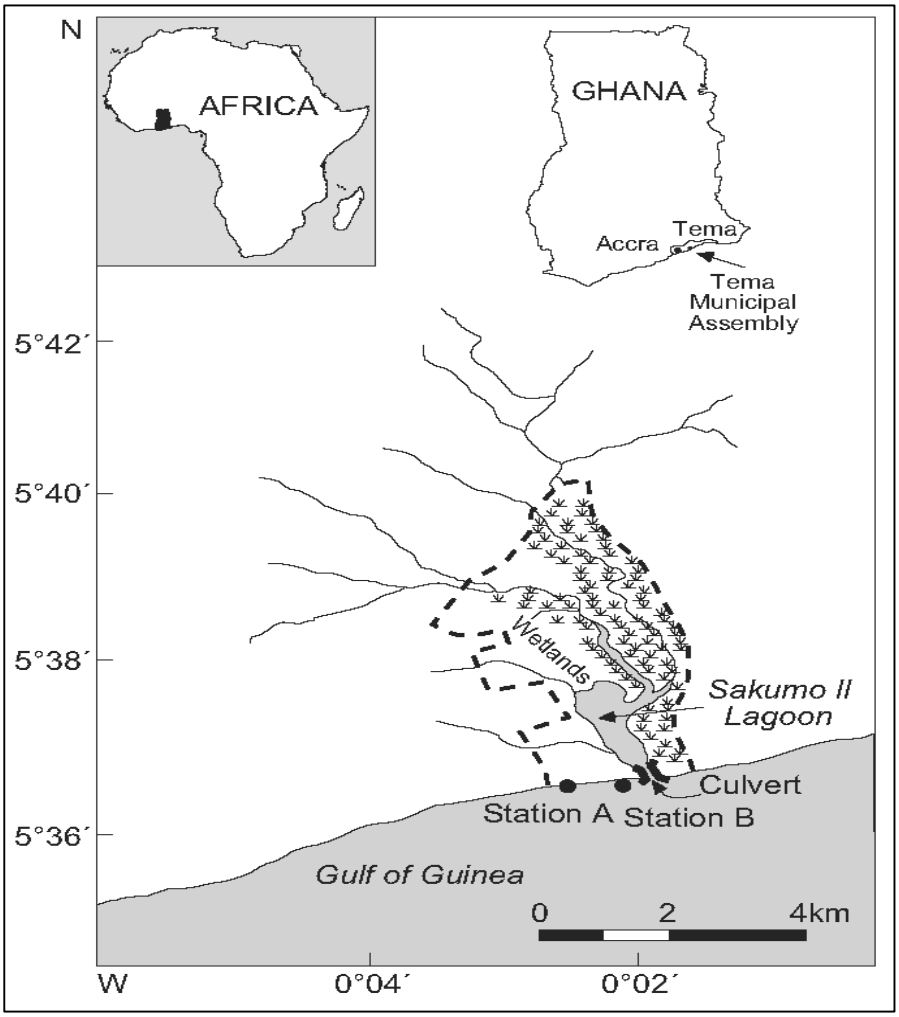


Figure 21: Map showing location of two study stations on the Sakumono fish-landing beach in Accra, Ghana

Sakumono Beach is located 3km west of Tema and about 18km east of Accra. The beach occupies an area between two lagoons: Mukwe, and the Ramsar wetland (Sakumo II), which is noted for its high biodiversity.

Sakumo II Lagoon is connected to the sea via a culvert, and there is tidal exchange. The beach has a gentle slope and consists of fine to coarse sand grains. To assess the spatial variation in the nearshore fish community, two adjacent sampling sites were chosen on the basis of their substrata, depth, and proximity to the estuary. Station A (5°36'08"N, 0°02'28"W) has rocky

substratum and is relatively shallow, and far from the estuary, whereas Station B (5°36'41"N, 0°02'16"W) has a sandy beach with boulders on land and is relatively deep and close to the estuary. The average water depth at which the nets were set was 8.7m at Station A and 9.7m at Station B.

Species composition and size

In all, 63 fish species from 30 families, 14 crustacean species from five families, eight other invertebrate species from five families (**Table 13**), and 18 species of macroalgae (Nunoo and Ameka 2005) were recorded in the catch.

Table 13: Species assemblage recorded in the catches of beach-seine nets at Sakumono, Ghana, between November 1999 and October 2001

Fish	Crustaceans	Other Invertebrates
Alectis alexandrinus	*Callinectes marginatus*	*Alloteuthis africana*
Balistes aculeatus	*Callinectes pallidus*	*Aplysia spp.*
Balistes punctatus	*Exhippolysmata hastatoides*	*Aurelia aritus*
Balistes capriscus	*Nematopalaemon hastatus*	*Echinometra lucunter*
Bothus podas africanus	*Panulirus regius*	*Sepia officinalis hierredda*
Brachydeuterus cuvieri	*auritus Paramola*	*Sepiella ornata*
Caranx crysos	*Parapeneopsis atlantica*	*Thais haemastoma*
Caranx hippos	*Parapenaeus longirostris*	*Thais nodosa*
Caranx senegallus	*Penaeus kerathurus*	
Chloroscombrus chrysurus	*Penaeus notialis*	
Cynoglossus monodi	*Plesiopenaeus edwardsianus*	
Cynoglossus senegalensis	*Isopod (unidentified)*	
Daysatis margarita	*Amphipod (unidentified)*	
Decapterus punctatus		
Decapterus rhonchus		
Drepane africana		
Echeneis naucrates		
Elops lacerta		
Ephippion guttifer		
Epinephelus aeneus		
Ethmalosa fimbriata		
Eucinostomus melanopterus		
Fodiator acutus		
Galeiodes decadactylus		
Gerres nigri		
Gymnura sp.		
Hemiramphus brasiliensis		
Hemicaranx bicolor		
Ilisha africana		
Lagocephalus laevigatus		

Fish	Crustaceans	Other Invertebrates
Lagocephalus lagocephalus		
Lethrinus atlanticus		
Lichia amia		
Liza falcipinnis		
Monacanthus setifer		
Melicthys niger		
Pellonula leonensis		
Pentanemus quinquarius		
Plectoryhncus macrolepis		
Pomadasys rogerii		
Polydactylus quadrifilis		
Priacanthus arenatus		
Pseudotholithus brachygnathus		
Pseudotholithus elongatus		
Pseudotholithus senegalensis		
Pseudotholithus typus		
Rhinobatus cemicullus		
Sarda sarda		
Sardinella aurita		
Sardinella maderensis		
Selene dorsalis		
Sphyraena sphyraena		
Stromateus fiatola		
Torpedo nobliana		
Trachinotus glaucus		
Trachinotus goreensis		
Trachinotus ovatus		
Trichiurus lepturus		
Tylosorus crocodilus crocodilus		
Umbrina canariensis		
Umbrina steindachneri		

The catch composition varied with time, but on average comprised of about 90% fish, 7% crustaceans and other invertebrates, and 2.5% macroalgae. The nine most commonly caught species accounted for 85% numerically and 78% by weight of the total fish catch. These were, in order of importance: bigeye grunt *Brachydeuterus auritus,* Atlantic bumper *Chloroscombrus chrysurus,* West African ilisha *Ilisha africana,* bobo croaker *Pseudotholithus elongatus*, African moonfish *Selene dorsalis*, Madeiran sardinella *Sardinella maderensis,* barracuda *Sphyraena sphyraena*, bonga shad *Ethmalosa fimbriata* and round sardinella *S. aurita*. The most common families in terms of both abundance and biomass were Carangidae, Sciaenidae, Clupeidae and Haemulidae.

The study indicated that over 90% of the fish examined were small, ranging between 1cm and 10cm total length (TL). Few fish ranged between 11cm and 32cm TL. The small fish were

mainly juveniles of larger, commercially important species targeted by local offshore fisheries. However, a few relatively larger fish (range 11–32cm) were caught in the beach-seine nets. These were often mature females, some with eggs. The biggest fish recorded in the catch was a longneck croaker *Pseudotholithus typus* of 101cm TL. The dominance of juveniles of commercially important species found in the beach-seine catches at Sakumono concurs with other studies, both locally and elsewhere.

The study also showed that species abundance and occurrence in the nearshore fish community at Sakumono is high from November to January and low from May to July as illustrated in **Figure 22**.

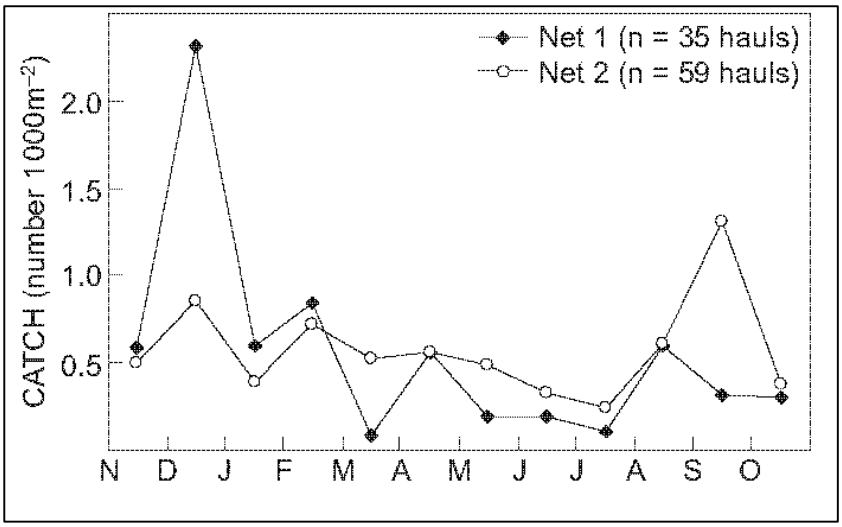


Figure 22: Monthly standardised catch per area swept by each net (pooled data for 1999–2001)

Although short-term seasonal variations have been found to mask seasonal perturbations in fish abundance and biomass (e.g. Lasiak 1984b), many fish species in nearshore areas worldwide exhibit predictable seasonal changes in abundance, biomass and species occurrence (Gunther 1958, Ross 1983, Ansari *et al*. 1995, Nash and Santos 1998).

Seasonal changes in nearshore fish assemblages have been attributed in part to changes in environmental conditions (Lefkaditou *et al*. 1998). Although statistically tenuous, the current data suggest that tidal level and duration of solar radiation are important predictors of the fish community structure in the nearshore waters of Sakumono. Juvenile fish could be driven by the tide to the nearshore areas where they could rely on vision provided by sunlight penetration to feed in the highly productive waters. Further, solar insolation could relate to the fishes' reproductive periodicity and could account for the high number of young fish found in the surf zone. Consequently, the young fish could be more vulnerable to capture by the seine-nets during periods of longer sunshine and high tidal levels. The tide has been suggested as an important factor in influencing seasonal abundance of fish.

The relatively high species richness, the dominance of juveniles in the beach-seine catches, and the seasonality of fish abundance and occurrence, has resource and habitat conservation implications for the Sakumono nearshore waters. In the spirit of both the precautionary

principle as enshrined in the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries (FAO 1995), and the objectives of the United Nations Convention on Biodiversity (United Nations 1994).

Plankton

Studies on the biodiversity and distribution patterns of certain species include work on characteristic species associated with upwellings and periods of hydrographic stability. **Table 14** shows the major plankton groups and the number of species known for each group in the sub-region (i.e. Ghana, Benin and Togo).

Table 14: Major plankton groups in the subregion (after Wiafe and Frid, 2001)

GROUPS	NUMBER OF SPECIES
Anthomedusae	7
Leptomedusae	8
Limnomedusae	3
Trachymedusae	7
Narcomedusae	8
Scyphomedusae	4
Ctenophora	3
Cladocera	3
Ostracoda	2
Copepoda	190
Chaetognatha	8
Chordata	3
Diatoms	35
Dinoflagellates	37
Coccolithophores	10

Aquatic Flora

Seaweed diversity is considerably higher on rocky shores than any other habitat. Differences in biotope complexity, exposure to waves, rock type as well as grazing pressure all influence seaweed diversity. Subtidal habitats are generally less known than the intertidal zone. In Ghana, subtidal seaweeds account for as much as 41% of 209 flora species and 109 genera.

Reptiles and Mammals

Not much is known about the distribution and occurrence of marine reptiles and mammals. Some studies have been conducted on sea turtles in Ghana and on the occurrence of marine mammals. Five species of sea turtles (*Dermochelys coriacea, Erectmochelys imbricata, Chelonia mydas, Caretta caretta* and *Lepidochelys olivacea*) have been reported from Ghanaian coastal waters.

Eight species of dolphins (*Stenella clymene, S. attenuata, Steno bredanensis, Tursiops truncatus, Grampus griseus, Lagenodelphis hosei, Globicephala macrorhynchus* and *Delphinus capensis*) have been recorded in a recent study in Ghana (Debrah, 2000) with *S. clymene* as the most abundant species. The diversity of whales is poorly known although several whales, some with calves, have been sighted or washed ashore in the region.

5.1.13 Characteristics of the Sakumo II RAMSAR Site

Location and Size

The effective catchment area of Sakumo II RAMSAR Site (see **Figure 23**) is approximately 27,634ha. The wetland, which is approximately 812ha, comprises an open lagoon, a floodplain and a freshwater marsh. The lagoon, covering about 3.5km² is the smallest coastal RAMSAR site in Ghana and lies between latitude 5°35' N to 6°40' and longitude 0°00W. The size of the open lagoon varies from 100–350 ha depending on the season.

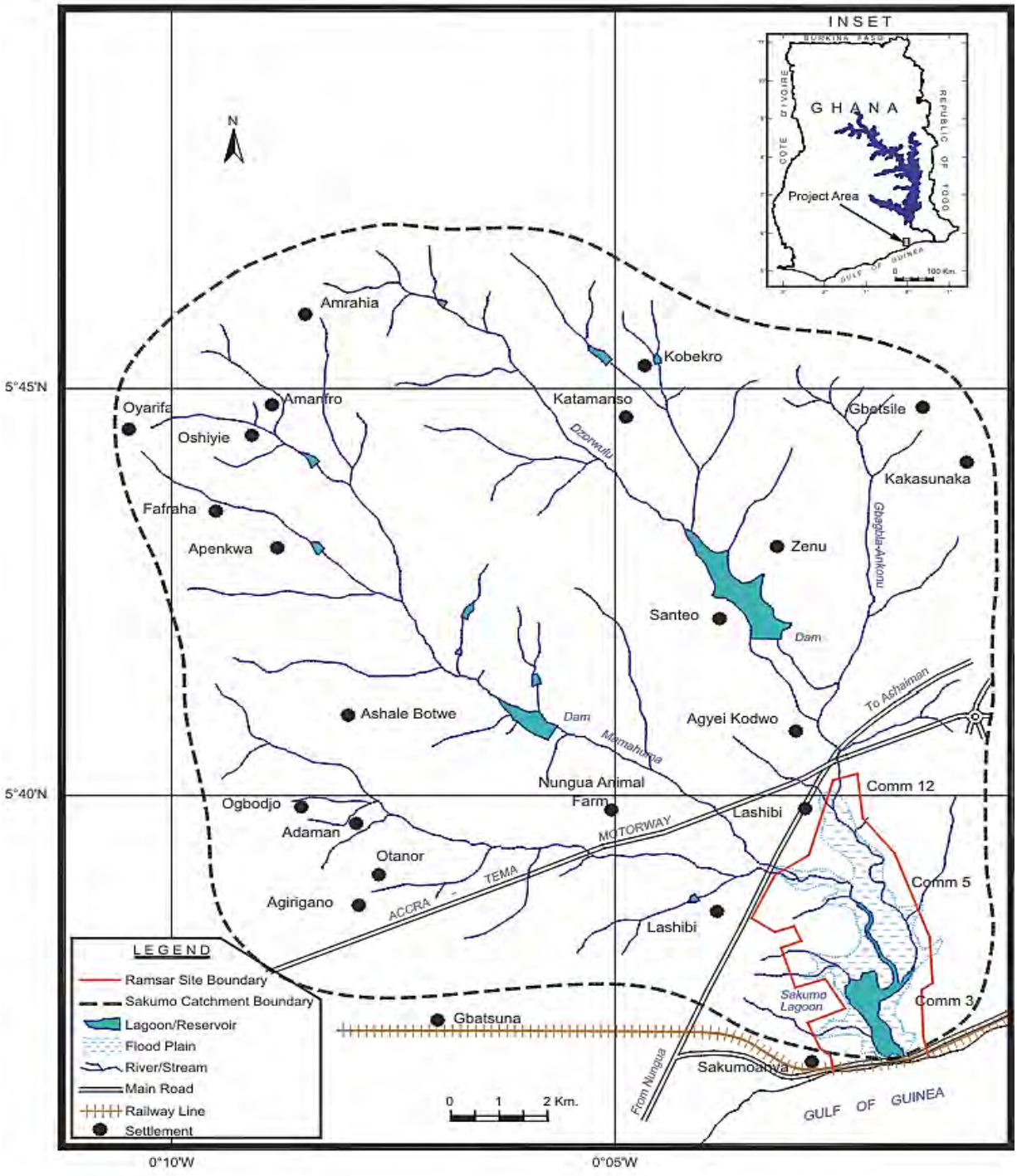


Figure 23: Catchment map of the Sakumo II Lagoon showing the RAMSAR site boundary

The lagoon is separated from the sea by a narrow sand-dune, on which the Accra–Tema road is built (Ntiamoa-Baidu and Gordon 1991).

Geology

Gbeckor P. et al (2015) shown the geology of the Sakumo catchment as underlain by Dahomeyan (Pre – Cambrian) acidic schists and gneisses with minor areas underlain by intrusive granite and pyroxenite, basic gneisses and quartzite schist. Alluvium occupies the valleys of the major streams and the lagoons that drain the area. The predominant soils consist of black calcareous, heavy plastic clays suitable for mechanized irrigated cultivation of rice and vegetables (Klake *et al* 2012).

Seven soils series have been delineated within the catchment area and these are Oyarifa Mamfe complex (603 ha); Nyigbenya-Hatso complex (6047ha); Nyigbenya consociation (1402 ha); Simpa-Agawtaw complex (16788 ha) and Kuse-Ashaiman complex (1334ha). The others are Oyibi - Muni Complex (1,459ha) and Keta consociation (less than 0.5%). Five of the soil series are Simpa, Agawtaw, Akuse, Oyibi and Muni which are responsible for the supply of the greater part of the site to the lagoon (Agbemehia 2014).

Hydrology

The catchment area of the Sakumo RAMSAR site is drained by a number of streams, which flow into the brackish water of the Sakumo lagoon. A number of freshwater marshes are present along most of the river course within the RAMSAR Site.

Other works on the lagoon cited by Agbemehia (2014) shown four principal sub-drain-age basins have been identified in the area. The major ones are the Mamahuma-Onukpawahe (at the western side) and the Dzorwulu-Gbagbla-Ankonu (situated at the northern end) sub-basins. The Eastern and Southern sub-basins constitute the minor ones. The catchment area has limited groundwater potentials because of low rainfall and the impermeability of the soil.

The main feeder streams, the Dzorwulu and Mamahuma-Onukpawahe have been re-channeled for irrigation. The Dzorwulu stream has a dam on it situated north of Ashaiman town near Santeo. The Mamahuma stream also has a dam on its upper catchment area. Both streams have been dammed to provide water for crop and livestock farming but have become polluted due to industrial and domestic activities. This has resulted in very little flow of freshwater into the lagoon during the dry season (Nartey V. K *et al.,* 2011)

The lagoon is connected to the sea by a sluice, constructed in 1953 to prevent flooding of the coastal road. This sluice is presently non-operational and there is free exchange of water between the lagoon and the sea, with the direction of flow depending on the tide. (Ntiamoa-Baidu and Gordon 1991).

Water Quality

Nutrient Concentration

Nutrients are naturally occurring substances which are found in low concentrations in aquatic ecosystems. Compounds such as phosphates serve as source of nutrient for some aquatic plant species, and reduction in their supply affect the spawning and growth cycles of marine fish and prawn species, as well as fisheries further offshore (UNEP, 1997). However, availability of excessive nutrients may result in pollution. Nartey et al (2011), conducted a six (6) month study of the Sakumo II RAMSAR site and compared the results to two earlier studies carried out in 1995 and 2003.

Three samples were collected from three designated zones across the lagoon (i.e. one sample for each zone), at intervals of 100 m between September 2007 and February 2008. These zones were designated A, B and C, and described as:

- Zone A- southern part of the lagoon (nearest area adjacent to the sea);
- Zone B- central stretch of the lagoon; and
- Zone C- northern section of the lagoon.

The results of the study are shown in **Tables 16** and **17.**

Table 15: Mean concentration of nutrients in the Sakumo II RAMSAR Site

Nutrient	Sampling Locations			Mean levels for entire lagoon (mg/l)	EPA guideline values(mg/l)
	A	B	C		
	Mean nutrient levels at sample sites (mg/l)				
Rainy season					
NO2-N	0.042	0.034	0.025	0.034	–
PO4-P	0.0805	1.564	1.006	1.125	2.000
NO3-N	1.433	2.077	2.704	2.071	0.100
NH3-N	1.352	2.453	0.992	1.599	1.500
			Dry season		
NO_2-N	0.031‘	0.047	0.041	0.040	-
PO_4-P	5.125	5.438	7.777	6.113	2.000
NO_3-N	1.001	1.537	1.530	1.356	0.100
NH_3-N	1.175	1.901	5.653	2.910	1.500

Observations from **Table 16** showed that, of all the nutrients studied, phosphates were the highest in the Sakumo lagoon. The decreasing order of nutrient concentrations in the lagoon were PO_4-P > NH_3-N > NO_3-N > NO_2-N.

Table 16: Nutrients comparison in Sakumo II RAMSAR site

Nutrient C	Sakumo/mgl^{-1} (study by Koranteng, 1995).	Sakumob/mgl^{-1} (study Yawson, 2003).	Sakumoc/mgl^{-1} (Study by Nartey et al, 2011),
NO_2-N	0.250	3.910	0.037
PO_4-P	0.644	0.000	3.618
NO_3-N	0.134	1.440	1.713
NH_3-N	0.390	1.650	2.254

Comparing the results of the study with those of 1995 and 2003 there has been obvious increases in the levels of the nutrients in the lagoon over the years. The increases have been in the order, PO_4-P > NH_3-N > NO_3-N > NO_2-N. The nitrite concentration in the lagoon has shown a significant decrease from 2003 study, 3.910 mg/l to as low as 0.037 mg/l in 2008. The decrease may be attributed to the thermodynamic instability of nitrite (Commonwealth Science Council, 2001).

The study concluded that The Sakumo lagoon is polluted with nutrients from diffuse and direct sources of agricultural, urban and industrial pollutants. This leads to algae bloom and growth of water weeds in the lagoon. The high level of phosphate in the lagoon also contributes to eutrophication, resulting in a decline in dissolved oxygen content of the water. This may, consequently, affect aquatic life in the lagoon. There would, therefore, be the need to look at the decline in the level of aquatic life of the lagoon.

Heavy Metal Concentration in Water

The presence of toxic metals such as lead (Pb) and cadmium (Cd) in environmental matrices is one of the major concerns of pollution control and environmental agencies in most parts of the world. This is mainly due to the health implications of these toxic metals since they are non-essential metals of no benefit to humans (Borgman, 1983). Their presence in aquatic ecosystems, mainly due to anthropogenic influences has far-reaching implications directly to the biota and indirectly to man.

Trace metal (Cu, Zn, Pb, Mn, Fe and Cd) levels were determined in water from the Sakumo II lagoon and the Mamahuma and Gbagbla Ankonu feeder streams, which feed the Sakumo II lagoon, were studied by Tay et al (2009) over a 1-year period. Some physical parameters (temperature, *p*H and electrical conductivity) were also investigated. The results of the study are presented in **Table 18**.

Table 17: Mean values of trace metals in water (mg/l ±SD) from Sakumo II lagoon with other physical parameters

Sampling station	Cu mg/l	Zn mg/l	Pb mg/l	Mn mg/l	Fe mg/l	Cd mg/l	pH units	Temp. ^{o}C	EC(µS/cm)
FDS 1	0.268 ± 0.06	0.113 ± 0 .01	0.020 ± 0.00	0.942 ± 0.06	0.71 5± 0.03	< 0.002	7.52	29.0	3,438
FDS 2	0.099 ± 0.01	0.099 ± 0.01	0.037 ± 0.00	0.777 ± 0.05	1.65 ± 0.20	0.006 ± 0.001	7.47	29.3	1,684
SN	0.124 ± 0.01	0.121 ± 0.02	0.032 ± 0.01	0.247 ± 0.01	1.82 ± 0.63	0.004 ± 0.001	8.61	29.8	10,674
MS	0.158 ± 0.01	0.160 ± 0.01	< 0.005	0.798 ± 0.07	0.888 ± 0.22	0.009 ± 0.001	8.59	29.8	15,740
SS	0.112 ± 0.02	0.077 ± 0.01	0.057 ± 0.03	0.240 ± 0.01	1.32 ± 0.73	0.004 ± 0.001	8.54	29.5	18,102
US EPA water quality criteria (*for the Protection of Aquatic Organisms and Their Uses)*		0.120*	0.065*	-	1**	0.002*	6.5-9	-	

Legend:

Number of samples (n) collected at each site = seven, FDS 1 = Feeder stream 1, FDS 2 = Feeder stream 2, SN = Sakumo-North, MS = Sakumo -Midstream, SS = Sakumo –South and SD = Standard deviation

** acute concentrations*
***chronic concentration*

The results showed that upper mean values in water were Zn (0.160 ± 0.01 mg/l), Pb (0.057 ± 0.03 mg/l), Mn (0.798± 0.07 mg/l), Cu (0.158 ± 0.01 mg/l), Fe (1.32 ± 0.73 mg/l), for the Sakumo II lagoon. Cd levels in water ranged from 0.004 ± 0.001 to 0.009 ± 0.001 mg/l. Compared to the maximum contaminant level (MCL) of 0.005 mg/l, the Cd levels in water from the Sakumo II lagoon may be detrimental to the 'health' of the aquatic ecosystem and, consequently, consumers of fish products from the Sakumo II lagoon.

Heavy Metal Concentration in Sediment and Biota

Heavy metals are usually present at low concentrations in water; however, deposits from anthropogenic sources could increase the concentrations of these heavy metals in the aquatic to high levels therefore creating environ- mental problems in coastal zones, lakes and rivers.

High concentrations of Heavy metals in fish could pose health hazards to consumers. Heavy metals such as Lead (Pb), Copper (Cu), Cadmium (Cd) and Mercury (Hg) are non-degradable. Consequently, they accumulate in the components of the environment where their toxicity is expressed. The ultimate sinks for these heavy met-als are soils and sediments. Many aquatic organisms do however bioconcentrate heavy metals (Klake, 2012).

Klake et al (2012) carried out a study of the heavy metal concentration in Fish and sediment from the Sakumo II lagoon. Sediment samples were taken from five points to depth of 5 cm, at intervals of 200 m, along the bank of the la- goon using an auger. At each point, three samples were taken and combined to form a composite sample of about 150 g. Thirty (30) fish (*Sarotherodon melanotheron*) samples, caught with a net from various points, were bought from five fishermen. The results of the study are shown in **Table 19**.

Table 18: Trace heavy metal concentration in µg/g dry weight in sediment and fish from the Sakumo II Lagoon

Sample	Zn (µg/g)	Cu (µg/g)	Pb (µg/g)	Mn (µg/g)	Cd (µg/g)
S1	63.72	63.48	38.94	299.54	<0.25
S2	81.03	84.73	53.98	594.09	<0.25
S3	51.78	65.51	12.98	522.00	<0.25
S4	46.39	65.55	6.47	279.98	<0.25
S5	61.95	42.93	16.95	655.12	<0.25
Canadian Sediment Quality Guidelines for the Protection of Aquatic Life	315	197	91.3	-	3.5
Mean	60.97	64.44	25.86	470.15	
Range	46.39 - 81.03	42.93 - 84.73	6.47 - 53.98	279.98 - 655.12	
S. D	13.30	14.81	19.89	171.42	
Sm	±16.51	±18.39	±24.69	±212.81	
CV	21.81	22.98	76.91	36.46	
Fish	21.36	29.81	<0.625	0.82	<0.25
WHO Guideline for trace metal concentration in Fish	1,000.0	30.0	2.0	-	2.0

The study observed that the levels of the trace metals were not uniformly distributed within the sampling area of the Sakumo II lagoon. There were no well-defined trends in the levels of the trace metals sea-ward. This is because the area is low-lying and drains the surrounding areas during the rainy season. The levels of Cd were below the detection limit of 0.25 µg/g. Thus the sediments were free of Cd pollution. Mn levels were the highest in sediments, the highest level being 655.12 µg/g. The lowest concentration of 6.47 µg/g was recorded for Pb. The coefficients of variation of the trace metals increase in the order Zn < Cu < Mn < Pb. Pb showed the greatest variation in concentration while Zn levels were most consistent. Using the mean concentrations of the trace metals, the Pearson correlation analysis [15], was used to assess correlation between metals. The results were within the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life.

For the fish samples, Cu levels were the highest (29.81 µg/g) while Pb and Cd levels were below detection limits of 0.625 µg/g and 0.25 µg/g respectively. Fish consumption therefore does not pose any health hazard from Pb and Cd. Mn levels were the lowest (0.822 µg/g) detected in fish though the highest in sediments. This could be due to their low availability in the feeds of the fish or their rate of excretion is higher than Cu.

Flora

Agbemehia (2014) cited four habitat types which exists in the Sakumo catchment; open lagoon, surrounding flood plains, freshwater marsh and coastal savannah grassland. The main vegetation found in the freshwater marsh includes the succulent forbs, *Sessuvium portulacastrum* (90%) and the grasses: *Imperata cylindrica* and *Paspalum vaginatum. Avicennia africana* forms the main plant of the mangrove community associated with the surrounding flood plains. The flood-plain is periodically inundated and the flooded areas are largely devoid of vegetation.

Paspalum vaginatum, Sesuviumpor tulacastrum and *Philoxeru svermicularis* are associated with the coastal savannah grassland. The reed Typhaaustralis is associated mainly with the estuarine brackish-freshwater marsh. (Agbemehia 2014).

Fauna

Water Birds

Many water bird species forage in the flood plains and marginal waters of the lagoon with few species making use of the open water. Sakumo Lagoon serves as a habitat for about 70 species of water birds, with an estimated maximum number of 32,500. This makes the site the third most important seashore bird site on the Ghana coast in the study of Gbogbo, F., *et al.,* (2012). Popular among the birds at Sakumo are Black-tailed Godwit *Limosa limosa*, Spotted Redshank *Tringa erythropus*, Common Redshank *Tringa totanus*, Common Greenshank *Tringa nebularia*, Black-winged Stilt *Himantopus himantopus*, Marsh Sandpiper *Tringa stagnatilis*, Common Ringed Plover *Charadrius hiaticula* and Grey Plover *Pluvialis squatarola* crowd the shoreline. Depending on the water levels, the larger waders may patrol the open expanse of water, moving around in impressive noisy groups. At some times of the year, Sakumo supports 90 -

100% of the total populations of black heron, teal, black tailed godwit and ruff recorded on the Ghana coast (www.ghanahotspots.com).

Over 80% of the seashore bird species recorded at Sakumo is accounted for by palaearctic migrants. Migrant birds are most abundant on the site during September to March/April. Resident birds recorded breeding on the site include Kittlitz's sand plover, pratincole, little tern, pied kingfisher, yellow throated long claw, plain-backed pipit, fantail warbler and red bishop (Ntiamoa-Baidu and Gordon, 1991).

Fish

Klate et al., (2012) identified 13 fish species belonging to 13 genera and 8 families in the Sakumo lagoon with *Sarotherodon melanotheron* (black chin tilapia) being the dominant species and the horse mackerel *Caranax hippopo.*

Fish species in the open lagoons include brackish water species *Sarotherondon melanotheron, Tilapia zillii, Gobious ansorgii, Periothalmus spp.,* the freshwater species are *Oreochromis niloticus, Claria anguillaris, Hemichromis bimaculatus,* marine forms are *Gerres melanopterus, Lethrinus atlanticus, Lutjanus fulgens, Albula vulpes* and the juvenile forms of *Liza falcipinnis and Mugil sp*. defined the following four groups of fish and shrimps encountered in open coastal lagoons in Ghana *(www.tullowoil.com).*

Three species of marine turtles nest on the beaches, i.e. Olive Ridley turtle, green turtle Lepidochelys olivacea, Chelonia mydas, Dermochelys coriacea and leatherback turtles (www.dearghana.com).

Arthropods

Bivalves, crustaceans, gastropods, insects, molluses and polychaetes also occur in the Sakumo II RAMSAR site. Arthropods which are important food source for water birds have a large population within the Sakumo lagoon totalling about 3,037 individual arthropods belonging to three (3) classes, eleven (11) orders and 23 families. Arachnida constituted 52.68%, compared to Insecta (47.29%) and Crustacea (0.03%) The most dominant families of insects were the ants, Formicidae, and the True crickets, Gryllidae (Gbogbo, F., et al., 2012).

Three crab species are found in the Sakumo II lagoon and its adjacent flood plains with the dominant being the blue legged lagoon swimming crab *Calliectes latimaus*. Others identified are *Uca tangerii, Cardiosoma armatum, Sesarmia africana,* juveniles of the shrimps are *Parapenenaeopsis atlantica and Penaeus duorarum*, and the *molluscs Tympanotons fuscatus, Macoma cumana, Semifusis morio, Turritella ungulina, Turitella meta, Tivela tripla, Anadara senilis and Crassostrea tulipa (www.tullowoil.com, 2009).*

Land Use

Agbemehia (2014) cited that Intensive marine and lagoon fishing is the main occupation of the people of Sakumono and the surrounding coastal communities. However, the catchment of the Sakumo lagoon is found to be an area with a high concentration of human activities, such as industrialization, residential and road construction, arable farming, fuel wood gathering, livestock rearing and disposal of solid wastes and municipal sewage.

Additional developments such as the Celebrity Golf course, a recreational land use which maintains continuous grass cover represents a compatible usage within the wetland ecosystem. Industrial and manufacturing developments comprise mainly food processing, metal products, textile, chemicals, oil refinery and garment industries extending to the Motorway and East industrial area which covers the KGM industries, Johnson Wax all at the Spintex area which threatens the survival of the wetland through pollution (Agbemehia 2014).

Studies done in 2011 by Nartey V. K *et al* showed Land-use in the catchment are for rice, cassava and vegetable cultivation. This has decreased significantly as built up developments comprising residential, industrial and other constructional activities are on the increase. Most of the farmers rely on inorganic fertilizers, pesticides and other chemicals to boost the yield of their farm produce. Pesticide residues, nitrate from fertilizers such as NPK 15-15-15 and 20-10-10 and microorganisms (Faecal Coli forms) from animal waste are sometimes found in the water bodies located near the farms.

Other organophosphate pesticides are, however, applied at regular intervals as well. The unfortunate thing is that during the rainy season, the run-offs from the non-point sources and point sources are channeled into the streams that drain the catchment area, and these eventually end up in the coastal lagoon (Nartey V. K *et al.,* 2011). The semi-nomadic grazing of cattle competes with arable agriculture in the available vacant areas. The urban expansion has decreased the pasture available for cattle, the waste generated from the cattle may pose a threat of pollution to the wetland (Agbemehia 2014).

Cultural Aspects

Traditionally, the Sakumo Lagoon is owned by the people of Teshie, Sakumono and Tema. It is situated North of the coastal road between the cities of Accra and Tema, approximately 3 km from the Tema Township (Gbeckor P. *et al,* 2015).

Ntiamoa-Baidu and Gordon (1991) in their studies brought out a number of traditional beliefs and taboos, associated with the Sakumo lagoon. The lagoon is regarded as a fetish by the local community and it has a Fetish Priest, the Sakumo Wulomo and a Priestess, Naa ¥oo Wulomo. The black heron *Egretta ardesiaca* is considered a sacred bird associated with the lagoon fetish and its capture or killing was forbidden.

Fishing is regulated through closed fishing days, seasons and areas. Sakumo is closed for fishing for about four months of the year and fishing is not allowed before noon on Fridays. The use of drag-nets and certain mesh sizes for fishing is also not permitted in the Sakumo Lagoons. (Entsua-Mensah *et. al*, 2000)

Crab collection is not affected by these rules. The beginning of the closed season is determined by the status of the lagoon crab stocks. The closure is instituted when fishermen feel that the stocks are becoming depleted (Ntiamoa-Baidu and Gordon 1991).

5.1.14 Air Quality Assessment of the Project Site

Air quality assessment was carried out in May 2015 at six monitoring sites, described as follows:

- Community 3 Site B Block 39A, 100m from Beach Road;
- Sakumono Cluster of Schools; and
- Sakumo lagoon outlet.

The main objective of the air quality assessment was to determine the ambient baseline 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 impacts on human health and the environment as a result of the operation of the harbour.

Sampling Equipment and Methodology Employed

The active principal sampling mechanism employed was the installation of portable motor-driven SKC Hi-volume dust samplers 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 levels of Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide (CO) in the ambient air were determined using dragger diffusion tubes. Wind speed/directions were determined for the sampling period to facilitate the effective determination of possible areas of impact for air borne pollutants using minimet.

The individual samples were gravimetrically analysed using the formula given below

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

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

Result of Air Quality Assessment

The results of the air quality assessment are as shown in **Table 19.**

Table 19: Results of Air Quality Assessment

No	Sampling Site	TSP μgm^{-3}	PM_{10} μgm^{-3}	NO2 μgm^{-3}	SO2 μgm^{-3}	CO mgm^{-3}
1	Community 3 Site B Block 39A	158	30.0	<1.00	<0.5	2.5
2	Sakumono Cluster of Schools	190	31.5	<1.00	<0.5	2.00
3	Sakumo lagoon outlet bridge	162	30.1	<1.00	<0.5	2.00
EPA National Ambient Air Quality Guidelines (NAAQG) for Residential Areas over 24 hours		**150**	**70**	**100**	**60**	**10****

***CO guideline value over 8 hours*

The following observations can be made from the results in **Table 1:**

- The TSP level ranges from 158μgm^{-3} to 162μgm^{-3} which exceeds the EPA's maximum permissible guideline of 150 μgm^{-3}.
- The PM_{10} level ranges from 30.0 μgm^{-3} to 31.9 μgm^{-3} which is within the EPA's maximum permissible guideline value of 70 μgm^{-3}.
- The concentration of the noxious gases was within the EPA's maximum permissible limits. SO_2, NO_2 and CO were not in detectable concentrations for the measurement method at both locations.
- The predominant average wind blowing from South-East (SE) at a rate of 0.45ms^{-1}.

5.1.15 Noise Level Assessment

The noise level assessment was carried out simultaneously with dust levels at the same sampling sites using a Quest 2900 type A Precision Sound Level Meter. 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 data was compared to the EPA's National Ambient Noise Level Guidelines (NANLG) are presented in **Table 20.**

Table 20: EPA National Ambient Noise Level Guidelines

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

Source: Environmental Protection Agency, 1994

Results of Noise Assessment

The results of the noise level assessment are summarized in the **Table 21** below.

Table 21: Results of noise level assessment

No	Sampling Site	Zone	NANLG	Leq	Lmax	Lmin	L10	L50	L90
1	Community 3 Site B Block 39A*	A	55	58.0	71.1	48.8	61.0	55.2	51.9
2	Sakumono Estuary Bridge**	B2	60	68.3	79.3	57.5	72.0	65.0	61.1
3	Sakumono Cluster of Schools***	B1	55	58.8	70.1	49.7	61.4	57.0	53.6

* Noise levels recorded was significantly influenced by vehicular movement on the beach road

** Classified as a predominantly commercial area due to the influence of vehicular movement

*** Noise levels recorded was significantly influenced by ongoing nearby commercial activity

Legend

L_{eq} - Integrated noise level during the measurement period

L_{max} - Maximum noised level

L_{min} - Minimum noise level

L_{50} - Average noise level

L_{10} - Nuisance noise level

L_{90} - Background noise level

It can be observed from **Table 21** that the noise levels measured exceeded their respective permissible noise limits. Integrated noise levels measured ranged between 58.0 dB(A) to 68.3dB(A).

5.2 Socioeconomic Environment

5.2.1 Population, Ethnicity and Religion

The Tema municipality has a total land area of approximately 396 square kilometers. It is a recipient of a large number of migrants. The population of the Municipality stood at 402,637 in 2010 when the census was conducted. Less than 10% of the population lives in rural communities. Several communities have come into being in the last decade or so with the development of housing estates. In addition, communities that might have been described as hamlets have registered dramatic increases in population. The urban area of the Municipality includes Ashaiman, Tema Manhea and Tema Township. The Tema Municipality is the traditional home of the Ga-Dangme. However, because it is a popular destination of migrants, several ethnic groups can be found. Three groups dominate. These are the Akan, Ga-Dangme and Ewe. Other fairly well represented groups are the Mole-Dagbani and the Guans The Municipality has well developed network of roads and most areas are provided with electricity. The total length of the urban road network is over 400 kilometers. Thirty-nine percent of the roads are in poor condition whilst 36% and 24.8% of the road network is in good and fair condition. About 87% of the feeder roads are motorable. Some communities, such as Ashaiman, have experienced an improvement in access due to improved road conditions. The Municipality has many industries and therefore ranks as the highest electrical power consumer in the country. The Tema fishing harbour located to the east of the main

harbour is the principal landing port for fish catches and exports. The fishing harbour therefore caters for the fishing vessels, trawlers and inshore boats.

Physical access to health facilities in the Municipality is high with 94% of households in the Municipality having to travel less than half an hour to arrive at a health facility. This definition of access does not take into account the range and variations in the quality of health services that the facility provides. The Tema general hospital and urban health centers as well as other public clinics and privately owned ones are located in the Tema Township.

5.2.2 Economy

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

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

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

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

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

More than half of the economically active population is employed in the services sector. Employment in agriculture and related activities in the Municipality is not as widespread as in other parts of the country because of the concentration of industry in the Municipality. In recent years agriculture activity may be described as coming under threat. In those communities that may be described as peri-urban, a major concern is the loss of agriculture

land to new developers. Women are concentrated in the wholesale and retail trade sectors. The majority of workers are self-employed and this is especially the case for women of whom about 76% are self-employed.

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

5.2.3 Cultural Heritage and Archaeology

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

The 'meridian rock', located close to the proposed site, is also regarded as a sacred rock. Annual rituals are performed at this site by the Tema Traditional Council.

5.2.4 Traffic And Transport

Port statistics show that the traffic passing through the Port of Tema has been increasing over the years. Available data show that of 4.29 million tons of total imports registered from January to September of 2000, the Tema port accounted for 80 percent of the cargo. For exports, Tema port registered 26 percent of the total cargo volume.

There are 220 km of roads in the Tema municipality. The road network in the Tema municipality and the suburban Tema Manhean or Tema New Town is fairly dense although some streets are in poor condition. A coastal road (Paradise Beach Road) from Tema Township passes through Tema Manhean and extends to the Gao lagoon. There is a diversion from the coastal road to the next town of Kpone. The Port of Tema has access to good roads. However, there is significant traffic congestion on routes serving the port. The public transport system in the Tema Township is fairly developed, with buses of different sizes providing services within and to other towns and cities. Two first class roads including a motorway link Tema to the capital, Accra. Tema is also accessed by a third first class road from the East linking Ghana and Togo. Articulated trucks for hauling goods to the hinterland and Burkina Faso have become a traffic issue near the port. The number of such trucks has increased tremendously in recent times due to diversion of transit cargo to Burkina Faso from Abidjan port to Tema.

6.0 POTENTIAL ENVIRONMENTAL ISSUES AND IMPACTS

The scope 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.

6.1 Project Area of Influence

6.1.1 Geographical Area of Influence

The immediate geographical area of influence of the proposed project is the demarcated site for the Tema Port expansion, construction waste disposal site and Tema Metropolis as a whole.

6.1.2 Institutional and Organisational Influence

The public institutions and organisations to be influenced, directly or indirectly, by the proposed project include:

- Environmental Protection Agency;
- Ghana Maritime Authority;
- Forestry Commission;
- Fisheries Commission;
- Ministry of Fisheries and Aquaculture (MoFAD);
- Lands Commission;
- Ministry of Finance;
- Ministry of Transport;
- Ghana Navy;
- Ghana Highways Authority;
- Department of Urban Roads;
- Tema Metropolitan Assembly; and
- Tema Development Corporation.

6.1.3 Environmental Media of Influence

The main environmental media to be influenced are:

- Soil/land of the project sites;
- Sakumo II RAMSAR site;
- Visual landscape;
- Ambient air around the project site; and
- Coastal/ocean environment/waters.

6.1.4 Socio-economic Influence

The proposed upgrade and expansion of the Tema Port will have significant influence on the socioeconomic status and wellbeing of workers at the Port, port users and the residents in the Tema Metropolis, Greater Accra Region and the export and import potential of Ghana as a country.

6.2 Project Activities of Environmental and Social Concern

Activities of potential environmental and social impacts identified with the proposed project are outlined under the four main phases of the project activities as follows:

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

6.2.1 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 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.

6.2.2 Construction Phase Activities

Constructional phase activities to potentially impact on the environment include among others:

- Transportation of materials and machinery to site;
- Dredging to deepen port basin and widen two accesses into the new harbour enclave (i.e. the northern access of the existing port and the new southern access) as well as increase turning basins;
- Reclamation for the construction of the breakwater and other seaward expansion works;
- Construction of structures to ensure connection between the Sakumo II lagoon and the marine environment, in order to maintain the lagoon's estuarine nature; and
- Civil and concrete works for construction of quay walls, wharf, berths (including new container berths, bulk goods berths, and other berthing furniture), terminal offices, installation of various utilities and supporting facilities etc.;

6.2.3 Operation and Maintenance Phase Activities

Specific operational and maintenance phase activities to potentially impact on the socioeconomic and physical environment include the following:

- Increased vessel activity in the ports;
- Increased cargo volumes and the workforce in the port;
- Storage and dispensing fuel to vessels;
- Traffic management;
- Maintenance of equipment and machinery;
- Maintenance dredging of port basin;
- Disposal of waste (garbage, waste oil, sewage); and
- Provision of security.

6.2.4 Decommissioning Phase

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.

6.3 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 by the provision of mitigation measures.

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 by the provision of mitigation measures.

6.4 Evaluation of Potential Impacts Associated with Preparatory Phase Activities

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

- Land Acquisition and compensation issues;
- Anxiety from potentially affected persons; and
- Occupational health & safety issues.

6.4.1 Land Acquisition and Compensation Issues

Land acquisition issues are not expected from the proposed port infrastructure development, as the location of the proposed expansion area is owned by GPHA and earmarked for the expansion of the current port. The onshore area of the proposed works is well secured and therefore excludes squatters or encroachers.

Studies subsequent to the submission of the Draft EIS however indicate that Ave Maria Resort, who are operating under a land lease agreement with GPHA, could be potentially affected by the proposed Port Infrastructure Development as the resort is expected to be submerged during the implementation of the proposed project. Consultations are ongoing between GPHA and the Management of Ave Maria Resort to arrive at an acceptable compensation payment.

This impact is of moderate significance.

6.4.2 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 the potentially affected property owners (including shop owners, fishermen etc.) as a result of the potential 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.

6.4.3 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.

6.5 Evaluation of Potential Constructional Phase Impacts

6.5.1 Potential Positive Impacts

The potential positive impacts from the constructional phase activities include:

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

Employment Opportunities

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

Hundreds of thousands of Ghana Cedis is expected to be injected into the local/national economy in the form of payment to labourers, artisans, engineers, technicians and consultants. Premixed concrete, stone aggregates, interlocking blocks, electrical equipment and roofing materials will be obtained from local industries. The purchase and use of such construction materials will impact positively on both the local and the national economy and it 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.

6.5.2 Potential Adverse Impacts

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

- Disruption in local economic/commercial activities;
- Impact on cultural resources;
- Impacts on visual intrusion;
- Air pollution;
- Noise nuisance;
- Marine pollution;
- Impacts on aquatic life;
- Waste generation and disposal problems;

- Occupational health and safety risks;
- Sanitation challenges;
- Traffic impacts and public safety challenges; and
- Impact on ecologically sensitive sites (Sakumo II outfall).

Disruption in Local Economic/Commercial Activities

Fishing is a major economic activity in Tema. The seaward expansion of the port could result in conflicts with the operations of fishermen in the area. These artisanal fishermen and small trawler operators also use water space near the harbour for navigation. The fishermen mainly operate at the fishing harbour, located on the east of the main harbour and routinely navigate near the main harbour. Potential conflicts include an increased risk of collision as a result of the increased maritime activity. It is however identified that no fishing activity occurs within the vicinity of the harbour and to its immediate west (proposed port expansion area). Consultations with the fishermen at the Sakumo beach (about 2km to the west), indicates that no fishing activities take place at the proposed project area due to rocky nature of the area, which leads to entanglement of their nets.

The community beach, about 2km on the west of the proposed port expansion area, is patronized by the local communities within the Tema and Accra East on public holidays. Commercial activities spring up in the area during these occasions. The planned port expansion and development envisages the preservation of this beach facility.

The impact on local economic/commercial activity therefore of minor environmental significance.

Impact on Cultural Resources

The 'Meridian Rock', located in the sea close to the proposed site, is regarded as sacred, and annual rituals are performed at its nearby shore by the Tema Traditional Council. Although the land in the area belongs to GPHA, any disturbance of the rock during construction, prior to consultation with the traditional authorities could lead to agitation and unrest. The rock also symbolises the line of the Greenwich Meridian, the world's prime meridian for longitude and time. It thus serves as a potential tourist attraction site in Tema.

This impact is of moderate significance.

Impacts on Visual Intrusion

The construction activities will not significantly alter the physical landscape features of the area since is mainly an expansion of the current operation at the Harbour. However waste generated and the presence of heavy machinery near the proposed site for the port development and along the road corridors may have deleterious effect 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 as a result of the operation of heavy duty equipment during construction of the breakwater, quay walls and land reclamation activities. Air pollution will also result from exhaust/smoke emissions from

vehicles and construction equipment as well as dust emission to air during the transport of quarry products and filling materials.

The major recipients of dust, smoke emissions, and noise nuisance will be construction workers, port workers/users and residents, offices and schools along the haulage route and near the port expansion area. It is expected the impact from dust emission the seaward activities will be dampened by the sea. The application of standard dust suppression measures such as dampening of unpaved surfaces will assist significantly reducing the impact of land based construction on air quality. This impact is of moderate environmental significance.

Noise and Vibration Nuisance

The use of heavy equipment for the construction activities will generate elevated noise and vibration levels at the respective construction sites. Noise will also be generated from the conveyance of machinery, equipment and construction materials, as well as the operation of power generators.

The potential recipients of noise and vibration nuisance during construction period will be project workers, users of the Tema Port, residents and offices near the port expansion area. Construction noise will mainly occur at the waterfront area that is far from the residential area. The distance will reduce the noise level reaching to the residential areas and the existing port.

The application of standard noise abatement measures and engineering best practices will assist to ensure that the impact of these issues are reduced to acceptable limits.

The impact from noise and vibration is of minor environmental significance.

Marine Pollution and Impact on Aquatic Life

Construction works 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. Potential impacts on marine life are likely to be localized, and non-persistent. .

The impact marine pollution and aquatic life is of minor significance.

Waste Generation and Disposal Problems

About 3,600,000 m^3 of dredged material are expected to be generated from the proposed project. It is anticipated that the dredge material to be obtained is suitable for filling of the proposed port area, thus extending port seaward. Excavated spoil from land based activities such as the road construction will be used to supplement the required filling material for land reclamation. Additionally existing breakwater section at berth 1 will be breached during dredging and the materials obtained from it may be reused as part of the new breakwater works.

Other wastes to be generated include packaging material used for various inputs, broken concrete blocks and metal pieces. These wastes would have to be disposed of appropriately by reuse, recycle or at the TMA designated landfill. Scrap metal generated will be given to recognised scrap metal dealers.

This impact is of moderate significance.

Occupational Health and Safety Risks

Workers will be exposed to risks during the civil works when excavations, loading, lifting and handling of equipment/machinery 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. Electrocution and fire risks from welding may also occur. Accidents from the dredging, construction of breakwater and other land reclamation activities could lead to drowning of workers if adequate preventive and safety measures are not taken.

This impact is of major 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 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 cargo trucks on the roads can induce traffic and serious accidents. Poor management of construction activities may result in stagnant water in uncovered trenches. Unsecured trenches may also compromise public safety.

This impact is of major significance.

Impact on Ecologically Sensitive Sites

Three lagoons characterise the immediate outskirts of the Port. The larger RAMSAR designated Sakumo II lagoon lies about 1km to the north-west of the Port and the polluted and almost silted Chemu lagoon, which serves as the major effluent drain for the majority of the industries of Tema abuts the Canoe basin of the Fishing Harbour, and the third is the Gao lagoon located 3 km further east of the Port. The construction activities are to the west of the port and the existing port and fishing harbour serves to protect the eastern lagoons from any impacts from the proposed port expansion.

The Sakumo II lagoon's outfall serves as a tidal inlet, though on a small scale, with estuarine characteristics. Construction of the breakwater may induce the transport of sediment which may block the outfall of the lagoon. Littoral sand drift to the East, i.e. away from the lagoon outfall and towards the breakwater. Sediment transport is therefore expected to be predominantly to be away from the lagoon's outfall. It is however possible that accretion effects from the construction could block the outfall as a result of the construction of the breakwater, if correct procedures are not followed.

The GPHA upholds the environmental convention to protect the Sakumo II as an integral part of the port environs.

The impact is of moderate environmental significance.

6.6 Evaluation of Potential Operational Phase Impacts

6.6.1 Positive Impacts

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

- Improvement in harbour performance;
- Improvement in harbour environment; and
- Increased employment

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 Harbour Environment

The expansion of the port will allow for the reorganisation of the port to ensure proper housekeeping at the port and thereby improve on operations and safety of workers. This will. This impact is of major significance.

Provision of Employment

Staff requirements for the two terminals start with little more than 600 employees and end with around 1,800 employees at the end of the planning horizon. 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

Hundreds of thousands of Ghana Cedis is expected to be injected into the local/national economy in the form of increases in the earnings of port service agencies such as ship agents, freight forwarders, haulage companies etc. This is of major significance. Other beneficiaries include truck drivers, etc.

Increase in Institutional and National Revenue

Revenue will accrue to the State in the form of import and export taxes. GPHA is expected to earn more than double its present earnings.

6.6.2 Potential Adverse Impacts

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

- Impact from Sediment Transport and on the Sakumo II lagoon;
- Contamination of marine environment;
- Introduction of invasive marine pest species;
- Air pollution;
- Noise nuisance;
- Waste generation and disposal challenges;

- Public safety risks;
- Occupational health and safety risks; and
- Sustainability of the Tema Port.

Impact from Sediment Transport and on the Sakumo II Lagoon

Sakumo II Lagoon outfall

At the area of Tema Port, due to the coast orientation and wave climate direction and energy, a littoral sand drift to the East can be observed. The construction of the new breakwater will change the sediment transport along the shore and it is expected that some accretion will occur at the western root of the breakwater as described in Section 5.1.9.

This could potentially lead blockage of the drainage outlet of the Sakumo II lagoon, which serves as tidal inlet for the lagoon, and permanently deprive the lagoon of its estuarine characteristics. This will hinder the movement of fishes and crustaceans between the lagoon and ocean environment. The maintenance of the lagoon outfall is also necessary to avoid flooding of the Beach road, which separates the lagoon from the ocean.

Erosion

It is also likely that the project may impact on the sediment transport within the immediate vicinity of the port area. Extension to the breakwaters could lead to potential erosion at the leeward side, since this may be deprived of sediments, leading to erosion of substrate. Generally, substrate types to the leeward side of the harbour at Tema are of unconsolidated materials interspersed with rocky outcrops, which are liable to erosion.

The impact is of major environmental significance.

Contamination of Marine Environment

There is potential for contamination of the marine environment of the harbour include 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. 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.

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

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.

Air Pollution

It is anticipated that exhaust emissions within the port area will increase in the operational phase as a result of the expected increased number of vessels, operation of goods carrying trucks and power generators. Volatile organic compounds (VOC) may also be emitted from fuel storage and transfer facilities.

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 average noise levels within the port was reported to be between 64 dB(A) to 72 dB(A) in April 2007. The National Ambient Noise Level Guidelines and the Factories Inspectorate Division operational noise level guidelines are 70dBA and 85 dB(A) respectively. 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 haulage of materials by goods vehicles and power generators will add

to noise levels. The orderliness of the operational terinals 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 solid and liquid wastes pose disposal challenges. Inappropriate disposal of the wastes will contaminate the sea water and create sanitation problems within the port environment. The port has put in place reception facilities to handle oil waste and garbage of vessels that call in Tema, to prevent the pollution in Ghana's coastal waters

This impact is of moderate significance.

Public 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 provision of dedicated 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 significance.

Sustainability of the Tema 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. Operational problems are anticipated from tariff setting, revenue

collection, port management and theft, and these can impede the sustainability of the system. The losses in the system could be higher if appropriate measures are not put in place to manage the system efficiently.

This impact is of major significance.

6.7 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.

7.0 IMPACT MITIGATION AND MANAGEMENT MEASURES

The anticipated impacts from the proposed Upgrade and Expansion of the Tea Port have been evaluated in the previous chapter. Mitigation and management measures have been proposed in this chapter to ensure that the project impacts are managed within reasonable and acceptable limits.

The following general rules were followed in designing these mitigation measures:

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) Minor impacts occur where effects are experienced, but the impact magnitudes are sufficiently small and well within accepted standards, and/or the receptors are of low sensitivity/value.

7.1 Type of Mitigation Measures

The mitigation measures adopted may be grouped under three major types which comprise:

- Preventive measures;
- Control measures; and
- Compensatory measures.

7.1.1 Preventive Measures

These are measures to be incorporated during the planning and pre-development phase. They 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 with the potential of causing an impact is:

i. designed out (e.g. exclusion of areas identified as high social or environmental risks);
ii. altered (e.g. phasing of development); or
iii. avoided (e.g. ensuring the connection between the Sakumo II outfall and the ocean is maintained).

7.1.2 Control Measures

These are measures adopted to abate or remedy the impacts occurring during construction and operation/maintenance phases. Impacts can be abated on site or at receptor end. Repair or remedy of impacts involves unavoidable damage to a resource, e.g. sediment disturbance as a result of dredging of the port area. In this case repair essentially involves careful implementation in accordance with best engineering practices.

7.1.3 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.

7.2 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.

7.2.1 Preparatory Phase

The significant potential impacts from this phase of the project development arises from Land acquisition/compensation of affected persons.

7.2.2 Constructional Phase

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

- Impact on cultural resources;
- Air pollution;
- Waste generation and disposal problems;
- Occupational health and safety risks;
- Sanitation challenges;
- Traffic impacts and public safety challenges; and
- Impact on Ecologically Sensitive Sites (Sakumo II RAMSAR site).

7.2.3 Operational and Maintenance Phase

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

- Impact from Sediment Transport and on the Sakumo II Lagoon
- Contamination of marine environment;
- Introduction of Invasive Marine Pest Species
- Waste generation and disposal challenges;
- Occupational health and safety risks; and
- Sustainability of the Tema Port.

7.2.4 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.

7.3 Recommended Mitigation Measures

Table 22 provides a summary of the significant impacts, as per the evaluation, the impact receptors and the recommended mitigation measure for each impact.

Table 22: Proposed mitigation measures for potential impacts

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Preparatory Phase Impacts
Land Acquisition and Compensation Issues	Ave Maria Resort	Where any property needs to be affected, the Project-Affected-Persons (PAPs) will be involved in every stage of the compensation process. As much as possible, movable structures will not be destroyed or damaged but salvaged. GPHA will engage the Lands Valuation Division to carry out valuation of the affected property in collaboration with the Management of Ave Maria Resort. Ave Maria will be consulted extensively on the terms of resettlement and compensation. GPHA will ensure that appropriate Government of Ghana compensation methods/procedures are followed to ensure that all the identified project affected persons (PAPs) are well catered for, as per the provisions of **OP 4.12 on Involuntary Resettlement**. A resettlement/compensation framework for the project is provided in **Annex 7**.
		Construction Phase Impacts
Impact on Cultural Resources	Tema Traditional Council/ Meridian Rock	The Tema Traditional Council will be consulted prior to the commencement of work to ensure that all the necessary customary rites are performed and required royalties paid to the stool to ensure peaceful coexistence. As much as possible, the traditional authorities will be permitted to carry out their annual rites.
Air Pollution	Workers/ Port users	Visibly dry soil to be disturbed, as well as stockpiles of sand aggregates to be used for construction, will be dampened at least three times a day. Speed of vehicles over any unpaved landscape will be controlled to minimise dust generation. Materials dumping will be regulated to reduce dust emissions.
Waste Generation and Disposal Problems	Workers/ Port users	<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 TMA approved disposal site. Management has entrusted with the management of waste within Tema 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 disposed of at the approved disposal site of the TMA. Excavated soils/concrete will be reused as much as possible for backfilling trenches dug during construction. Contaminated soil will be considered as waste material and disposed of accordingly at the TMA approved disposal site. <u>Dredging</u> The dredging will generate 3,600,000m^3 of dredge material, mostly solid/slurry waste. All the dredge materials will be used for reclamation of portions of the Port.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
Occupational Health and Safety Risks	Workers	<u>Adoption of Health and Safety Policies</u> It is the policy of GPHA, and for that matter the Tema Port, 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 contractor(s) for the project will be required to comply with the safety requirements of GPHA. 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. A first aid center 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 Medical Centre or the Tema General Hospital for treatment. <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. 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 life jackets/vests, 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 project site 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Use of Road Worthy Vehicles 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.
Sanitation Challenges	Workers/Port users	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	Restriction of Access GPHA will maintain security at the proposed site to ensure that only authorised persons are allowed into the construction area. Use of warning signs 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. Scheduling of Work The contractor will analyse traffic flows and ensure that the transport of equipment is carried out during low peak periods. Announcement and Notification of Work The TMA and TDC will be informed at least seven days before start of work. All port users will also be informed of the schedule of work through their respective organisations. 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. Transport of Equipment and Materials 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 the Main Harbour and Meridian 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. . 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

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		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.
Impact on Ecologically Sensitive Sites	Sakumo II RAMSAR site	• GPHA will ensure that the Contractor's will utilise best practices in handling construction materials and equipment, and to minimise sedimentation impacts to the marine environment during the construction period • The contractor 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
Operational and Maintenance Phase Impacts		
Impact from Sediment Transport and on the Sakumo II lagoon	Sakumo Lagoon/Marine species	• The nearby existing culvert pipes providing outlet and connection between the marine environment and the lagoon, will be extended further into the ocean, beyond the region of the reclamation area to maintain an open connection between the sea and the lagoon. In this regard GPHA will investigate the current status of the sluice assess the possibilities on re-use of this structure or the necessity to completely replace it. • The outlet of the existing structures increase will be increased, to secure a safe discharge of water from the lagoon to the marine environment. • The long shore movement of sand will be restored by pumping sand from the side where sand accumulates through a pipeline to the eroded leeward side. • GPHA will consider the implementation of some weir jetties perpendicular to the coastline upstream to the breakwater to avoid sedimentation in front of the drainage outlets.
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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• 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 • 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

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		• 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 vesels
Waste Generation and Disposal Challenges	Workers/Port user	<u>Education campaigns</u> • GPHA will utilize the Port community network to continuously conduct education campaigns for all port users to ensure the proper disposal of waste. <u>Waste Collection and Disposal</u> • 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 TMA.
Occupational Health and Safety Risks	Port workers	<u>Training in chemical handling</u> GPHA will ensure that workers handling chemicals are trained in its in line with the Material Safety Data Sheet (MSDS). Such workers will have access to the MSDS as information and reference sources on the dangers and ways of handling these chemicals safely. <u>Provision of appropriate PPEs</u> 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.

POTENTIAL IMPACT	RECEPTOR(S)	PROPOSED MITIGATION MEASURES
		Emergency Provisions 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.. Traffic accidents 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. Housekeeping 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.
Sustainability of the Tema Port	GPHA/Ministry of Transport	• The Management of GPHA will seek to operate profitably by implementing a system to collect appropriate user charges to cover the running and maintenance cost of its facilities to be installed. • Management will ensure a minimum harbour water depth is controlled and periodically measured to ensure the safety of fishing vessels using the harbour. • 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. • 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; o Regular calibration of equipment; and o Emergency response plans and procedure.

8.0 ENVIRONMENTAL MONITORING

Management of GPHA is committed to ensuring effective protection of the environment, property, workers and the general public safety 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.

8.1 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. The major environmental issues on which monitoring will be focused include:

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

The environmental monitoring programme is set out in **Table 23**. About **GH¢171,000.00** will be spent on monitoring activities annually from the implementation of the project. The overall responsibility for the environmental monitoring programme lies with Director of Port. The following personnel will be responsible for the various environmental monitoring activities and they shall report directly to the Director of Port, Tema:

- 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 23: 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	Tema Port at established Sampling Points	Noise Level Data Logger /EPA guidelines	Quarterly /EEM	12,000.00
Air quality	Noxious gases (NOx, COx, SOx), and particulate matter (PM_{10} and TSP)	Tema Port at established Sampling Points	HiVol Sampler and DraeggerTubes/ EPA guidelines	Quarterly/ EEM	18,000.00
Water quality	General physicochemical parameters including Oil/grease and trace metals	basin/ Sakumo lagoon at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA guidelines	Quarterly/EEM and HM	16,000.00
Sediment quality	General physicochemical parameters, heavy metals (V, Cu, Zn, Pb, Mn, Fe and Cd)	Port basin/ Sakumo lagoon at Established Sampling Points	Sampling, field work and laboratory analysis/ EPA or internationally accepted 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 (especially outlet of the Sakumo II lagoon	Physical inspection of accretion and erosion of windward and leeward areas of the port respectively	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/EM, FSM, EMS & STO	40,000.00
Waste generation and disposal	-Metallic wastes -Garbage -Waste oil	Harbour area	Record quantity and type of waste generated. Inspect quantity and condition of waste bins. Keep	Daily /EM	32,000.00

Environmental component	Parameters to be monitored	Monitoring Sites	Methodology/ standards	Frequency/ Responsibility	Estimated cost/ annum (GH¢)
	-Hazardous waste		records of time and place of final disposal /KPIs of GPHA		
Accidents, injuries and worker health	Type, frequency and cause of injuries /accidents	Harbour area	Observation, audits, complaint/ incident records/ Safety Policy of GPHA	-Daily-FSM -Quarterly-HMS	-
Traffic and public safety	Human and vehicular traffic	Harbour area	Observations and complaints/incidents records/ Safety Policy of GPHA	-Daily -PSM	-
Public complaints	Type and nature of complaints and concerns	Tema Port	Complaint records, Stakeholder meetings	Daily –EEM/PSM/ FSM	5,000.00
TOTAL					**171,000.00**

9.0 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 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 Tema 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.

9.1 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 Tema shall:

- Incorporate environmental considerations into its planning, management and operational activities;
- Have an Environmental Management System (EMS) to stimulate the Port into efficient and effective environmental management through systematic environmental care and continuous improvement;
- Allocate and maintain resources for the effective implementation of environmental management and compliance programme;
- Ensure environmental knowledge, communication and participation among Port employees, Port users, Port tenants, Port operators, transporters' and the Port community, and encourage them to actively give due regard to the environment in their daily activities;
- Demand that operational activities and services are done in a way that minimizes negative environmental impacts;
- Influence, specify demands and cooperate with clients, suppliers, Port users, Port operators, Port tenants, transporters and the entire Port community to 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 Tema shall ensure that:

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

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

9.2 Occupational Health and Safety Policy

At the Port of Tema, the Authority's policy on Occupational Health and Safety Administration shall be applied (**see Annex 5**). Thus, the Port of Tema will lead the drive for improvement in the occupational health of all persons employed to work in the port, whether or not they are employees of GPHA.

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

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

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 Tema 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.

9.3 Programme to meet Requirement

9.3.1 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 Tema. 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 24 indicates the main responsibilities of the above named key players in the implementation of the policy on environment, health and safety of GPHA.

Table 24 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 Tema.
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.

9.3.2 Management Structuring

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), assisted by the Port Estate and Environment Officer, 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 Tema 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 Tema management structure is shown in **Figure 24.**

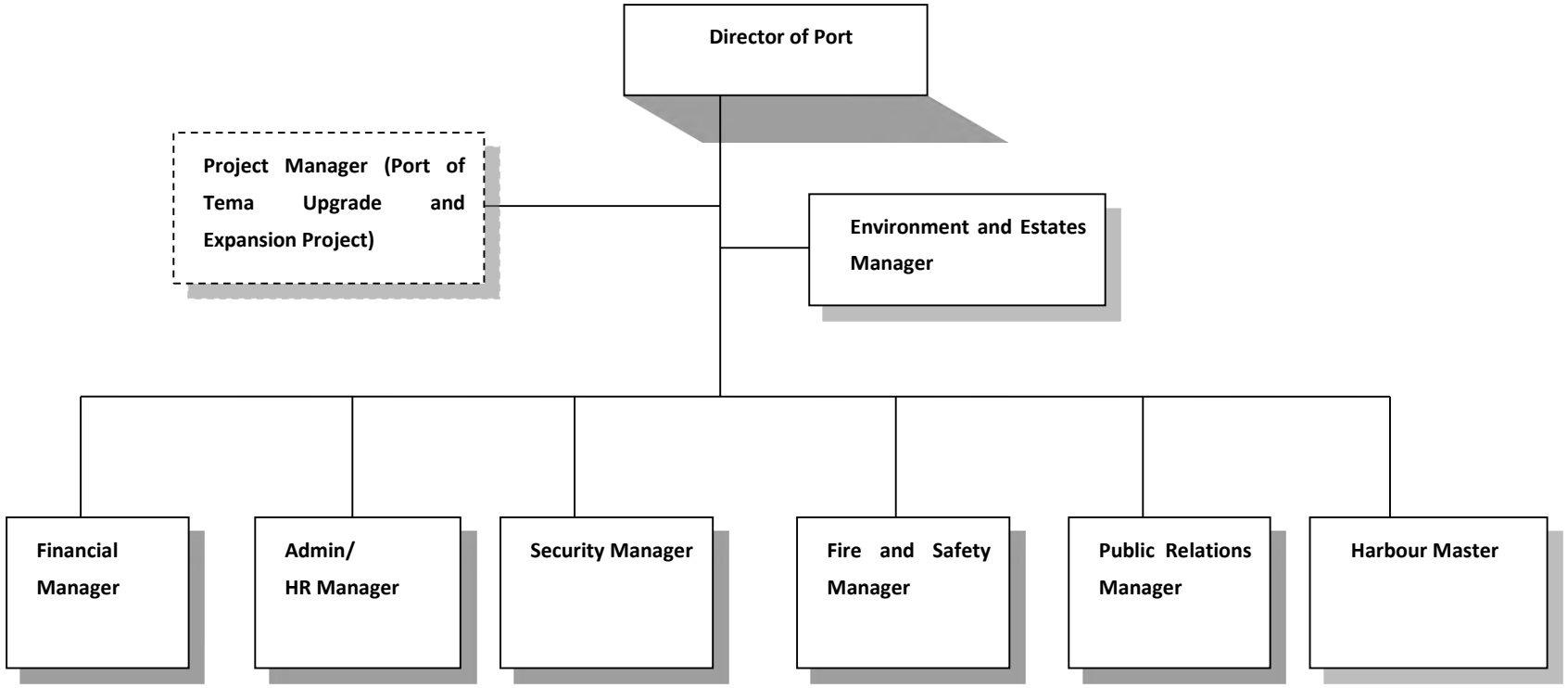


Figure 24: Environmentally Based Organisational Structure of the Port of Tema

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 Tema;
- 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 6.**

9.3.3 Establishment of Unit Safety/Environment Committee (USEC)

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

9.3.4 Engagement of Environmental Consultants

As part of measures to implement environmental actions, the Port of Tema 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 Tema.

9.3.5 Technical Co-operation

The Port of Tema 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.

9.3.6 Staff Information and Training

<u>Environmental Awareness Creation</u>

The Port of Tema 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.

<u>Environmental Information Dissemination</u>

The Port of Tema 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.

9.3.7 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.

9.3.8 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 Tema 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.

9.3.9 Annual Audits and Reviews

The Port of Tema 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.

9.3.10 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.

9.4 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 Tema and the contractor. Provisional cost estimates are provided in **Table 25.**

Tentatively, about **GH¢611,000.00** will be needed in the first year for environmental as well as occupational health and safety management actions.

Table 25: Provisional Environmental Management Budget

NO	ISSUE	COST (GH¢)/ YEAR
1	Environmental Monitoring Plan	171,000.00
2	Provision of personal protective/ safety clothes and equipment	240,000.00
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	40,000.00
Total		**611,000.00**

10.0 DECOMMISSIONING

10.1 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 TMA designated dumping site.

Dredgers, bulldozer, hydraulic excavator, pumps, generator, vehicles and other equipment and machinery used for the project will be relocated to new or other project sites managed by the Contractor.

10.2 Other Harbour 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 Tema will not require decommissioning in the medium to long term. The facilities will be rehabilitated as the need arises as a result of depreciation, wear out, damage.

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.

11.0 CONCLUSION

GPHA is fully aware of its corporate responsibility to sound environmental practices, and also the provisions in the Environmental Protection Agency Act 1994, Act 1994 and Environmental Assessment Regulations 1999, LI 1652. The major potential environmental and socio-economic issues and impacts associated with the proposed Harbour Expansion Project have been identified and duly assessed in this EIA Report.

Mitigation and management measures for the identified impacts have been proposed at the design, planning and implementation stages in order to minimise significant adverse effects and enhance the positive impacts. A monitoring programme to help detect changes arising from the predicted adverse impacts has also been prepared and presented in the report together with a provisional environmental management plan (PEMP).

The implementation of the proposed project will significantly improve the performance of the harbour and wholesomeness of the fish from the port. All stakeholders have given their full commitment to help ensure that this project is implemented in the earliest possible time, and in an environmentally friendly manner, to the benefit of the consumers.

GPHA will put in place measures to enhance the benefits of this project as well as ensure that mitigation measures are implemented to minimize the adverse impacts from the proposed project so as to enhance the positive ones.

12.0 REFERENCES

1. C. Caplat, H. Texier, D. Barillier, C. Lelie`vre, An inventory of sediment pollutions in a French harbour—Comparison to a non polluted local area identified in bay of eine, Journal of Coastal Research (inpress).
2. C. Savvides, A. Papadopoulos, K.J. Haralambous, M. Loizidou, Sea sediments contaminated with heavy metals:
3. Commonwealth Science Council (CSC) (2001). *Nutrient analysis in water.* Commonwealth Secretariat, Marlborough House, Pall Mall, London, U.K. pp. 13–22.
4. E Nyarko, A Fletcher, S Addo, B A K Foli and E Mahu, Department of Marine and Fisheries Sciences, University of Ghana, Accra, Ghana*. Geochemical Assessment of Heavy Metals in Surface Sediments: A Case Study of the Tema Port, Ghana,* Journal of Shipping and Ocean Engineering 4 (2014) 79-92
5. Emmanuel O. Kombat, Francis K. E. Nunoo, Joseph A. Ampofo and Phillis G. A. Addo (2013).Effects of environmental conditions on the microbiological quality of two small marine pelagic fishes landed in Accra and Tema, Ghana. Archives of Applied Science Research, 2013, 5 (2):180-188
6. G.W. Bryan, W.J. Langston, Bioavailability, accumulation and effects of heavy metals in sediments with special reference to United Kingdom estuaries: A review, Environmental Pollution 76 (1992) 89-131.
7. Ghana Ports and Harbours Authority: Strategic Environmental Assessment Report (SEA) for the Port of Tema, June 2008 by AY&A Consult Limited.
8. Ghana Ports and Harbours Authority: Summary of Phases: Takoradi Port Development July 2012.
9. 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
10. 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)
11. Ghana Statistical Service: 2010 Population and Housing Census, Summary Report of Final Results, May 2012.
12. GHD 2013, *Environmental Best Practice Port Development: An Analysis of International Approaches*, report prepared for the Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia
13. JICA. The Preparatory Survey for Outline Design on the Project for Fisheries Promotion in Sekondi.
14. Klake R.K. et al (2012). *Correlation between Heavy Metals in Fish and Sediment in Sakumo and Kpeshie Lagoons, Ghana,* Journal of Environmental Protection, 2012, 3, 1070-1077.
15. Metal speciation and removal, Water Science and Technology 32 (1996) 65-73.
16. 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.
17. Muff et al (2006). Ghana-Germany Technical Cooperation Project: Environmental and Engineering Geology for Urban Planning in the Accra-Tema Area. [Ghana]: Ghana Geological Survey Department .

18. Nartey *et al.* (2011) *Nutrient load of the Sakumo lagoon at the Sakumo RAMSAR site*, West African Journal of Applied Ecology, vol. 19, 2011
19. Nunoo FKE, Eggleston DB, Vanderpuye CJ. *Abundance, biomass and species composition of nearshore fish assemblages in Ghana, West Africa*, *African Journal of Marine Science 2006, 28(3&4): 689–696*
20. P. Adamo, M. Arienzo, M. Imperato, D. Naimo, G. Nardi, D. Stanzione, Distribution and partition of heavy metals in surface and sub-surface sediments of Naples city port, Chemosphere 61 (2005) 800-809.
21. Seismic and Tectonic Correspondence of Major Earthquake Regions in Southern Ghana with Mid-Atlantic Transform-Fracture Zones*, Jacob M. Kutu, **International Journal of Geosciences,** Vol.4 No.10(2013), Article ID:41164,7 pages
22. UNEP (1997). *Global Environmental Outlook "for Life on Earth".* Oxford University Press, New York.

ANNEXES

Annex 1a:	EPA Response to Project Registration
Annex 1b:	EPA Response to Scoping Report
Annex 1c:	EPA Response to Draft EIS
Annex 2:	Copy of Scoping Notice
Annex 3:	Designs for the Proposed Project
Annex 4:	GPHA Occupational Health and Safety Policy
Annex 5:	Evidence of Consultation
Annex 6:	World Bank's General Environmental Management Conditions for Construction Contracts as shown in.
Annex 7:	Compensation Framework

Annex 1a: EPA Response to Project Registration

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

Our Ref.: CI: 2524/01/02
Email: info@epa.gov.gh

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

January 10, 2014

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

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED INFRASTRUCTURE DEVELOPMENT AT THE TEMA PORT

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) copies of the scoping report must be submitted for study and agreement on the TOR, prior to the EIA studies.

It is important to note that the scoping report and Environmental Impact Statement should contain a summary profile of the main consultants who took part in the studies. The summary information should include: Name, Address and Tel. No., E-mail address, Qualification and Experience of the relevant staff and their specific contributions to the report. Failure to provide this information would make the submission incomplete and would delay the review of the report.

Do not hesitate to consult with the EPA Head Office (Room 305) or the EPA Accra East Regional Office in Tema for further guidance.

Yours faithfully,

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

cc: The Director, EPA, Accra East Regional Office, Tema

Annex 1b: EPA Response to Scoping Report

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

Email: info@epa.gov.gh

Our Ref.: CI: 2524/01/02

Environmental Protection Agency

P. O. Box MB 326
Ministries Post Office
Accra, Ghana

January 10, 2014

DIRECTOR GENERAL
RECEIVED
24 JAN 2014
TIME 12:44
No 27
GHANA PORTS & HARBOURS AUTH. HQRS

ENGINEERING
21 JAN 2014
TIME 2:45
No 35
PORTS & HARBOURS HQ

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

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED INFRASTRUCTURE DEVELOPMENT AT THE TEMA PORT

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) copies of the scoping report must be submitted for study and agreement on the TOR, prior to the EIA studies.

It is important to note that the scoping report and Environmental Impact Statement should contain a summary profile of the main consultants who took part in the studies. The summary information should include: Name, Address and Tel. No., E-mail address, Qualification and Experience of the relevant staff and their specific contributions to the report. Failure to provide this information would make the submission incomplete and would delay the review of the report.

Do not hesitate to consult with the EPA Head Office (Room 305) or the EPA Accra East Regional Office in Tema for further guidance.

Yours faithfully,

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

cc: The Director, EPA, Accra East Regional Office, Tema

Annex 1c: EPA Response to Draft EIS

No.	Comment from EPA	Section addressed
LEGAL FRAMEWORK		
1.	Section 1.2.4	
1a.	• Include Fisheries Commission Act	Fisheries Commission Act included
1b.	• Give further details of how Acts such as the Children's Act, Human trafficking Act, Water Resources Commission Act, Standard Authority Act mentioned in the report will influence the proposed development and its operations	Details of how Acts will influence the proposed development and its operations have been provided
2.	Section 1.2.5	
2a.	• Elaborate further on how conventions such as RAMSER, STCW and LLMC will be brought to bear on the development as mentioned in the report	Relationship between n the conventions and the proposed development and its operations have been provided
DESCRIPTION OF EXISTING PORT FACILITIES		
3.	Figure 2 page 19 Layout of the Port of Tema	
3a.	• Provide a more legible map possibly on A3 sheet to aid detail observation and review of the information.	A3 map provided
DESCRIPTION OF THE PROPOSED PROJECT		
4.	Figure 3 page 25 proposed port development Layout	
4a	• Provide the Layout on an A3 sheet	A3 map provided
4b.	• Provide some details on the type of engineering works to be undertaken at the SAKUMONO II where accretion is likely to interfere with flow exchanges.	See page 33
CONSIDERATION OF ALTERNATIVES		
5.	• Alternatives considered focused on the geographical locations of the proposed port. Technology to be employed in the expansion works were not considered	See pages 39-45
DESCRIPTION OF EXISTING ENVIRONMENT		
6.	Section 5.1.3	
6a.	• It will be useful to link the baseline conditions to the stability of port structures and risk elements for example, how does the description of geology and soil or the coastal process influence the design of breakwater structures.	See section 4.1 and 4.2
7.	Pg 60 Fig 19	
7a.	• Show Sakumono II Lagoon on the map	Sakumo II Lagoon provided on the map (See Figure 20)
8.	Section 5.1.12 and Section 6.2.5	
8a.	• (Water quality)-It is not clear how one sample each for analysis could be taken over a 6 month period. This is not clear. Just a sample cannot also provide a fair representation of the water quality situation. Please clarify	Three samples collected form the lagoon in the southern part of the lagoon, i.e. nearest area adjacent to the sea (Zone A); central stretch of the lagoon (Zone B); and northern section of the lagoon (Zone C). One sample for each zone.
8b.	• Aquatic Biota- No baseline information was provided on marine invertebrates within the port environment and what pertains at the new proposed site. Therefore is not clear which invertebrates will potentially be impacted.	See Section 5.1.2
IMPACT IDENTIFICATION, PREDICTION AND EVALUATION		
9.	• Indicate the number of businesses to be affected and the contingency measures to be put in place since the number of persons will provide an indication of the significance of the impact.	Ave Maria Resort
MITIGATION MEASURES		
10.	• Consider mitigation measures for the social impacts on businesses to be affected	
11.	Page 91 • State the specific measures that GPHA will implement with regards to the existing culvert pipe in order to avoid siltation of the lagoon	See Table 17 (Impact from Sediment Transport and on the Sakumo II lagoon)
ENVIRONMENTAL MONITORING		

12.	• Monitoring of material accretion at the Sakumo II and shore recession at the down-drift areas should be included in the bullets listed	See section 8.1
13.	• Though the overall sediment le el is good, the elevated levels of V and Cd in the sediments observed require close attention. This therefore should be vigorously monitored	See Table 18
CONSULTATIONS		See Annex 4
14.	Consult the following and provide evidence	See Annex 4
14a.	• fishing community close to the port	See Annex 4
14b.	• surrounding communities	See Annex 4
14c.	• traditional authorities	See Annex 4
14d.	• Include evidence of consultation from the awaiting official responses from the stakeholder institutions as indicated in the report	See Annex 4

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Our Ref: CI: 2524/01/07 **May 11, 2015**

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

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED PORT INFRASTRUCTURE DEVELOPMENT LOCATED AT THE PORT OF TEMA IN THE TEMA METROPOLIS OF THE GREATER ACCRA REGION

We refer to the draft Environmental Impact Statement (EIS) on the above proposal submitted to the Agency for the purpose of obtaining environmental approval 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 revise the report taking into consideration the attached comments and submit **Eight (8) hard copies** of the revised Environmental Impact Statement (EIS) to the Agency

In accordance with the Fees and Charges (Amendment) Instrument, 2014 (LI 2216), you are required to pay a permit fee of **Twenty-Five Thousand Ghana Cedis (GH 25, 000.00)** as per the attached invoice. The payment must be made at **any ECOBANK Branch** by presenting the attached invoice. Kindly submit a copy of the Ecobank receipt to Room 305 EPA Head Office after payment.

Do not hesitate to contact the Agency for further clarification you may require in this regard.

Yours Faithfully

KWABENA BADU-YEBOAH
AG. DIRECTOR/EAA DIVISION
FOR: EXECUTIVE DIRECTOR

Attached:

NON-TECHNICAL EXECUTIVE SUMMARY

Legal framework

Section 1.2.4

- Include Fisheries Commission Act
- Give further details of how Acts such as the Children's Act, Human trafficking Act, Water Resources Commission Act, Standard Authority Act mentioned in the report will influence the proposed development and its operations

Section 1.2.5

- Elaborate further on how conventions such as RAMSER, STCW and LLMC will be brought to bear on the development as mentioned in the report

DESCRIPTION OF EXISTING PORT FACILITIES

Figure 2 page 19 Layout of the Port of Tema

- Provide a more legible map possibly on A3 sheet to aid detail observation and review of the information.

DESCRIPTION OF THE PROPOSED PROJECT

Figure 3 page 25 proposed port development Layout

- Provide the Layout on an A3 sheet
- Provide some details on the type of engineering works to be undertaken at the SAKUMONO II where accretion is likely to interfere with flow exchanges.

CONSIDERATION OF ALTERNATIVES

- Alternatives considered focused on the geographical locations of the proposed port. Technology to be employed in the expansion works were not considered

DESCRIPTION OF EXISTING ENVIRONMENT

Section 5.1.3

- It will be useful to link the baseline conditions to the stability of port structures and risk elements for example, how does the description of geology and soil or the coastal process influence the design of breakwater structures.

Pg 60 Fig 19

Show Sakumono II Lagoon on the map

Section 5.1.12 and Section 6.2.5

- (Water quality)-It is not clear how one sample each for analysis could be taken over a 6 month period. This is not clear. Just a sample cannot also provide a fair representation of the water quality situation. Please clarify
- Aquatic Biota – No baseline information was provided on marine invertebrates within the port environment and what pertains at the new proposed site. Therefore is not clear which invertebrates will potentially be impacted.

IMPACT IDENTIFICATION, PREDICTION AND EVALUATION

- Indicate the number of businesses to be affected and the contingency measures to be put in place since the number of persons will provide an indication of the significance of the impact.

MITIGATION MEASURES

- Consider mitigation measures for the social impacts on businesses to be affected

Page 91

- State the specific measures that GPHA will implement with regards to the existing culvert pipe in order to avoid siltation of the lagoon

ENVIRONMENTAL MONITORING

- Monitoring of material accretion at the Sakumo II and shore recession at the down-drift areas should be included in the bullets listed
- Though the overall sediment level is good, the elevated levels of V and Cd in the sediments observed require close attention. This therefore should be vigorously monitored

CONSULTATIONS

Consult the following and provide evidence

- fishing community close to the port,
- surrounding communities
- traditional authorities
- Include evidence of consultation from the awaiting official responses from the stakeholder institutions as indicated in the report

Annex 2: Copy of Scoping Notice

Freeze Single Spine Pay Policy

• Continued from Page 3

down if the minister does not do it," he stressed, urging that cuts should be done in the medium term in the next two to three months, "so Ghana can regain its credibility".

In response, Mr Terkper said while he admitted that the incidence of deficit was an issue, the overrun in expenditure was incensed by volatility in world commodity prices such as cocoa, gold and petroleum products.

He further stated that a committee was set up by the President, after the forum on the Single Spine Salary Structure (SSSS) in Ho last year, headed by the Minister of Employment and Labour Relations, and it is expected to submit a report soon on many of the issues raised.

Ho forum

A two-day national forum on the SSSS on the theme, "Building national consensus for sustainability of the Single Spine Pay Policy (SSPP)", was held in Ho from August 6 to 7, 2013.

At the Ho forum, Mr Terkper said "Current trends in the compensation bill resulting from the implementation of the SSPP, however, suggest that the pay policy is not sustainable on the trajectory we are currently observing."

He added that the mounting wage bill resulting mainly from the implementation of the SSSS posed systemic risks to the annual budget and threatened macroeconomic stability, pointing out that "the phenomenon has exerted tremendous pressure on service delivery in the public service, as it tends to crowd out other important expenditure areas".

Moratorium on wage increase

The Finance Minister, however, said the issue of wages was addressed when the last budget was presented and the government proposed a moratorium on wage increases, stressing that when the committee finished its work, the government would then come out with its position.

"What has come out of this forum is to buttress the importance of Ho, and the President, in his State of the Nation Address, promised that there would be a post-Ho forum after these reports have been submitted," he added.

He said the government was adopting an approach which addressed the short-term challenges and also recognised that some of the challenges being experienced now were structural in nature.

"You don't implement one, finish it and then you go. You do them concurrently," Mr Terkper said.

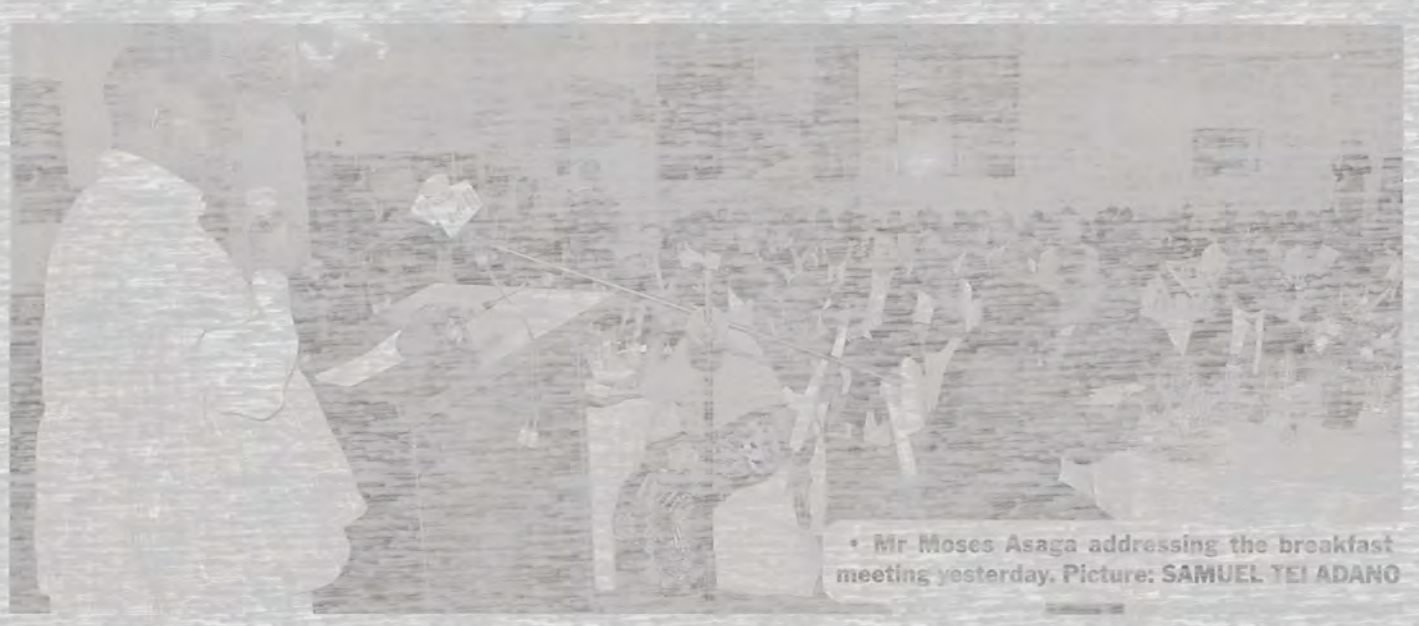
For Mr Asaga, however, deficit financing was good if it could be proved that it had been used for development purposes.

"I don't think deficit financing is out of the way if it can be proved it was used for something important," he said.

He said although deficit financing might have its negative side, it also had positive sides, and gave examples of many developments in the country that showed that Ghana's middle-income status was real.

"The future is bright for Ghana, despite the macro deficits that have been distorted lately," he said.

Writer's email: *Edmund.Asante@graphic.com*



• Mr Moses Asaga addressing the breakfast meeting yesterday. Picture: SAMUEL TEI ADANO

- The *Graphic*/Fidelity Bank Breakfast Meeting will be held every quarter.
- Ghana's inflation rate was 13.6 per cent as of January 2014.
- Last year, compensation for government employees was budgeted at GH¢9 billion, out of which GH¢7.46 billion was allocated for wages and salaries.

SCOPING NOTICE

Ghana Ports and Harbours Authority proposes the Upgrade and Expansion of Facilities at the Port of Tema in the Tema Metropolitan Area of the Greater Accra Region.

Notice of the proposed Port of Tema Upgrade and Expansion 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 Director General,
Ghana Ports and Harbours Authority
9th Floor, GPHA Towers, Tema Port

P. O. Box 150, Tema

Tel: 0303 202631-to-9

Fax: 0303 202812

ranamoo@ghanaports.net

kofori@ghanaports.net

projects_hq@ghanaports.net

and

The Executive Director
Environmental Protection Agency
P. O. Box M326
Accra

Tel: 0302 708175-8 / 0302 664698

Fax: 0302 662690

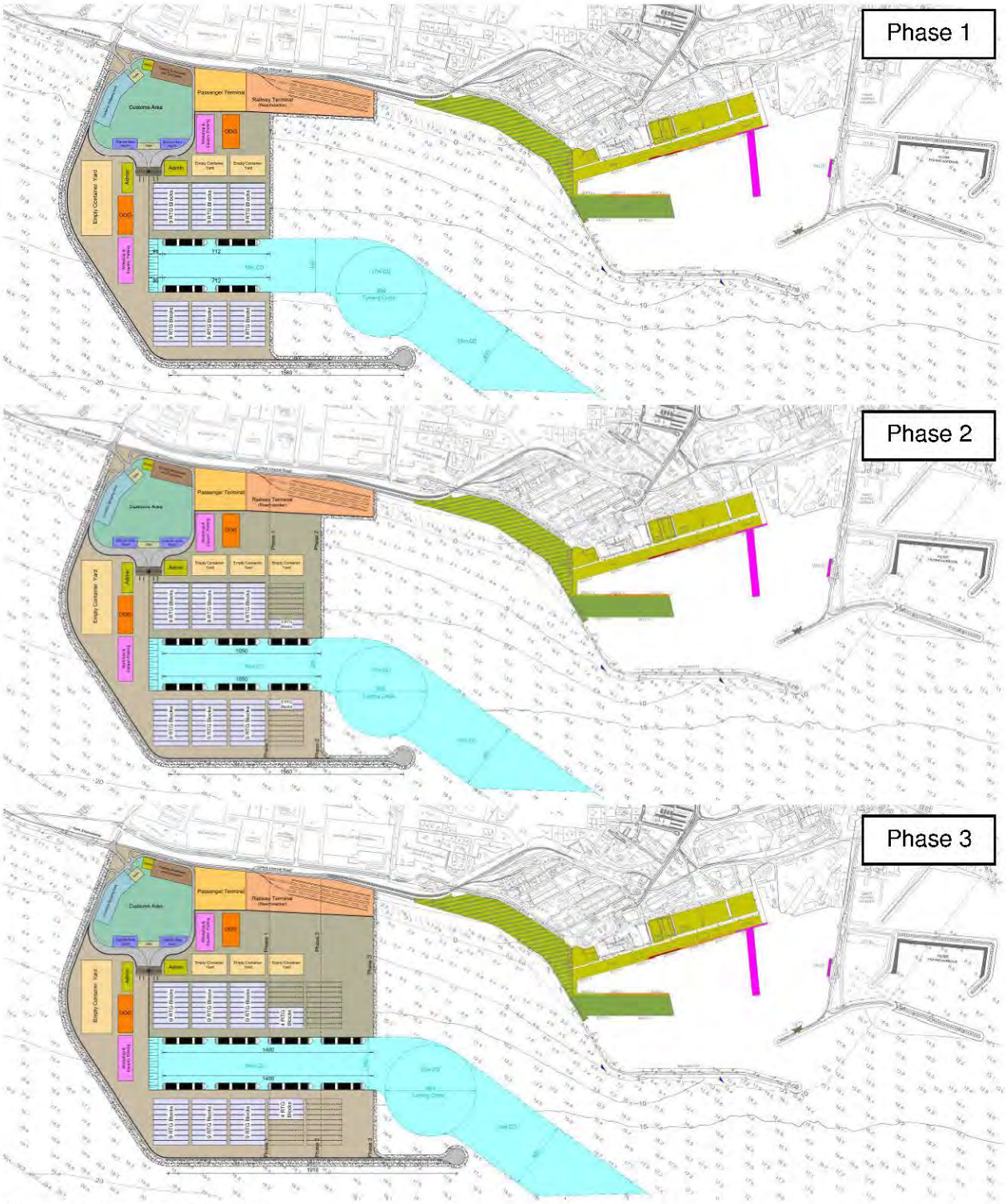
support@epaghana.org

Annex 3: Designs for the Proposed Project

- Phase 2 (2024-2032) with the construction of the third berth for each operator
- Phase 3 (2033-2043) with the construction of the fourth berth for each operator, required extension of breakwater and dredging works.

The construction of repair facilities for oil rigs may take place simultaneously to Phase 3.
The 3 development phases are shown in Figure 4-18 below.

Figure 4-18 Development Phases 1, 2 and 3 of Port Expansion Project



Source: Sellhorn/HPC, 07/2014

5.7 Buildings

The new Tema Port Development requires a series of buildings to accommodate the operations, administrative and public authorities.
For this Master Plan, the size of the buildings advised is largely schematic only and meant to reserve an appropriate amount of space. If the building sizes change, they should still be accommodated within their designated areas. Only possible required buildings for the foreseen Container Terminals have been analysed, mainly:

- Terminal administration and operations building
- Maintenance and repair building
- Fuel Station
- Gate

Detailed configuration of the terminals and buildings requirements shall be developed in further stages of the project.

Terminal Administration and Operations Building
Each Container Terminal shall dispose of an Administration building. This shall be developed to provide offices for the management and administrative staff based on the terminal. It shall also house the container terminal´s control staff for day-to-day operations to accommodate all operations and administration functions of the terminal:

- Yard operations control
- Marine operations control
- IT control
- Computer centre for yard control, marine control and gate control
- Terminal security control and monitoring
- Terminal telecommunications equipment
- Uninterruptible power supply

The buildings shall provide female and male toilets including facilities for disabled people; reception desk and waiting area; conference and meeting rooms, with associated kitchen facilities, projection facilities and store; first aid room including treatment area and recovery space.
The buildings will also contain locker rooms, labour break facilities for staff in the container yard, and a canteen for workers and staff.
It shall be located near the gate area for better access.

The required area for the administration building can be estimated with the staff requirements, which are the same for both operators.

Staff requirements per Operator	**Phase 1**	**Phase 2**	**Phase 3**
Administration	48	56	65
Operations	344	575	679
Technical Department	82	129	155
TOTAL	**474**	**760**	**899**

The following tables show the required areas per operator. For the common areas, two thirds of the staff have been considered, as there shall be two shifts.

Table 5-16 Administration Building – Area Requirement Phase 1

Phase I	Admin	Operative	Technical	Guests	Total Persons	Area Requirement per person	Total Area Requirement
Admin area							
Office	48	17			65	15,5	1007,5
Toilets	48	17		12	77	0,7	53,9
Kitchenette	48	17			65	1,1	71,5
Conference room	48	17		12	77	0,6	46,2
Archive	48	17			65	0,6	39
Storage	48	17			65	0,6	39
Reception	48	17		12	77	0,4	30,8
Construction area	48	17		12	77	3	231
Utilities	48	17		12	77	3	231
Circulation area	48	17		12	77	4,5	346,5
Total							**2096,4**
					0		
Common areas					0		
Common room	32	218	55	12	317	1	317
Sanitary facilities (Lockers, Showers, WC)		218	55		273	2	551
Canteen	32	218	55	12	317	2,3	729,1
Utilities		218	55	12	285	3	855
Circulation area		218	55	12	285	4,5	1282,5
Construction area		218	55	12	285	3	855
AC-Room					-		100
Total							**4689**
							6786

Source: Sellhorn/HPC, 06/2014

Table 5-17 Administration Building – Area Requirement Phase 2

Phase II (additional)	Admin	Operative	Technical	Guests	Total Persons	Area Requirement per person	Total Area Requirement
Admin area							
Office	8	12			20	15,5	310
Toilets	8	12		2	22	0,7	15,4
Kitchenette	8	12			20	1,1	22
Conference room	8	12		2	22	0,6	13,2
Archive	8	12			20	0,6	12
Storage	8	12			20	0,6	12
Reception	8	12		2	22	0,4	8,8
Construction area	8	12		2	22	3	66
Utilities	8	12		2	22	3	66
Circulation area	8	12		2	22	4,5	99
Total							**624,4**
Common areas							
Common room	5	146	31	2	184	1	184
Sanitary facilities (Lockers, Showers, WC)		146	31		177	2	357
Canteen	5	146	31	2	184	2,3	423,2
Utilities		146	31	2	179	3	537
Circulation area		146	31	2	179	4,5	805,5
Construction area		146	31	2	179	3	537
AC-Room					-		20
Total							**2864**
							3488

Source: Sellhorn/HPC, 06/2014

Table 5-18 Administration Building – Area Requirement Phase 3

Phase III (additional)	Admin	Operative	Technical	Guests	Total Persons	Area Requirement per person	Total Area Requirement
Admin area							
Office	9	5			14	15,5	217
Toilets	9	5		1	15	0,7	10,5
Kitchenette	9	5			14	1,1	15,4
Conference room	9	5		1	15	0,6	9
Archive	9	5			14	0,6	8,4
Storage	9	5			14	0,6	8,4
Reception	9	5		1	15	0,4	6
Construction area	9	5		1	15	3	45
Utilities	9	5		1	15	3	45
Circulation area	9	5		1	15	4,5	67,5
Total							**432,2**
Common areas							
Common room	6	66	17	1	90	1	90
Sanitary facilities (Lockers, Showers, WC)		66	17		83	2	167
Canteen	6	66	17	1	90	2,3	207
Utilities		66	17	1	84	3	252
Circulation area		66	17	1	84	4,5	378
Construction area		66	17	1	84	3	252
AC-Room					-		15
Total							**1361**
							1794

Source: Sellhorn/HPC, 06/2014

Maintenance and Repair Building

The workshops shall be readily equipped to assure that all maintenance works can be executed.

It will house most of the equipment maintenance operations for the container terminal. It is supported by additional capacity when other maintenance facilities are built at successive phases.

The Primary M&R building shall be divided, at least, into the following different areas:

- WS 1 – Spreader Workshop
- WS 2 – Offices/ Electronic Workshop
- WS 3 – Spare Parts Store
- WS 4 – Truck/ Trailer Workshop
- WS 5 – Welding Workshop
- WS 6 – Tyre Store
- Outdoor Workshop Area

A total footprint of 4000 m² is approximately required.

The building shall be equipped with fume extract systems; compressed air system; fire hose reels and pipework system; overhead crane; heavy duty vehicle lifts; oil and grease storage and supply pipework and systems.

Fuel station

A fuel station shall be constructed, to supply diesel to trucks, crew buses and handling equipment in the terminal. In addition to avoid long vehicles travel distances to the station tank trucks could be operated.

Gates

Gates will regulate the access to the terminals. The incoming and outgoing gates shall be equipped with control booths, traffic control barriers and surveillance cameras.

The gates for each terminal shall be in the same line, forming a single structure, but separated for the entrance and exit to the different container terminals. At the final development stage, 15 lanes per terminal are required. In the middle of the gate, access to the customs area for each terminal is provided.

A fixed roofing structure shall allocate the control booths and the islands. The booths shall be installed on elevated concrete bases in order to stand on the same level as the truck drivers. The recommended minimum dimensions are:

- Width of lane 3.5 m
- Width of island 3.0 m

5.8 Utilities

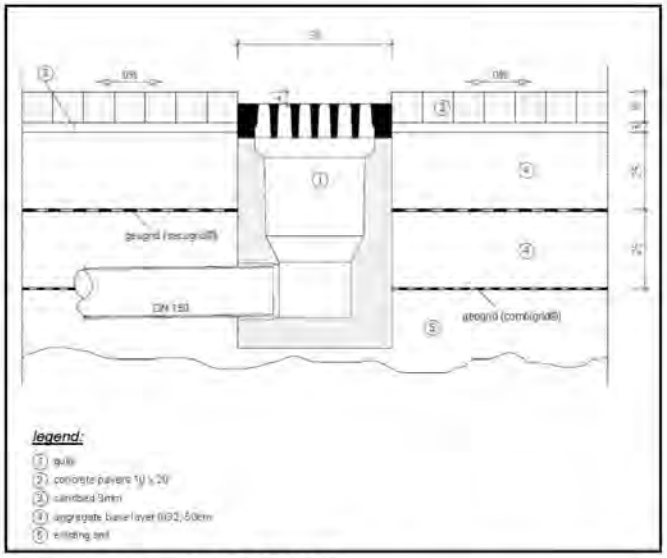
In the following, recommended concepts for the further design of the utility services according to the identified local conditions and the phasing of the master plan are presented.

5.8.1 Storm Water Network

A storm water network of the terminal areas shall be designed for the proper drainage of the terminal surface.

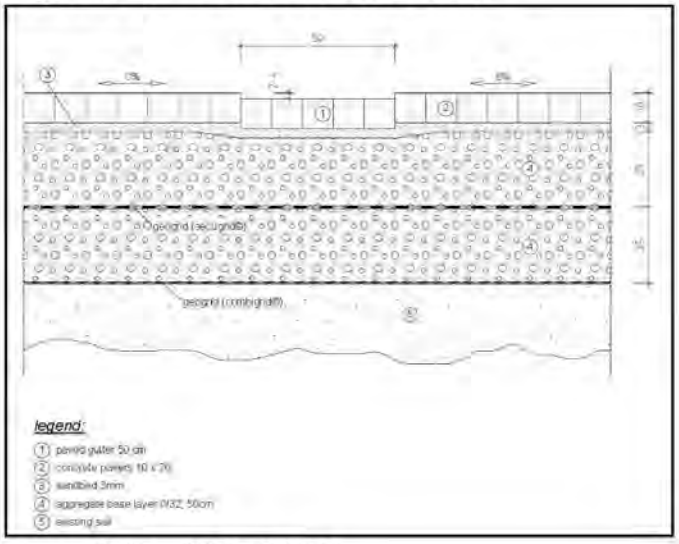
Rainwater from terminal traffic and storage areas will be directed on the surface to gullies and covered or open precast concrete channel drains, which will lead it to manholes, where it will be discharged to the drainage pipe network. To achieve a proper discharge a cross gradient of at least 2 % shall be applied and the drainage shall be large enough to ensure it cannot be blocked by sand build up.

Figure 5-20 Detail of Paved Gully



Source: Sellhorn/HPC, 06/2014

Figure 5-21 Detail of Paved Gutter



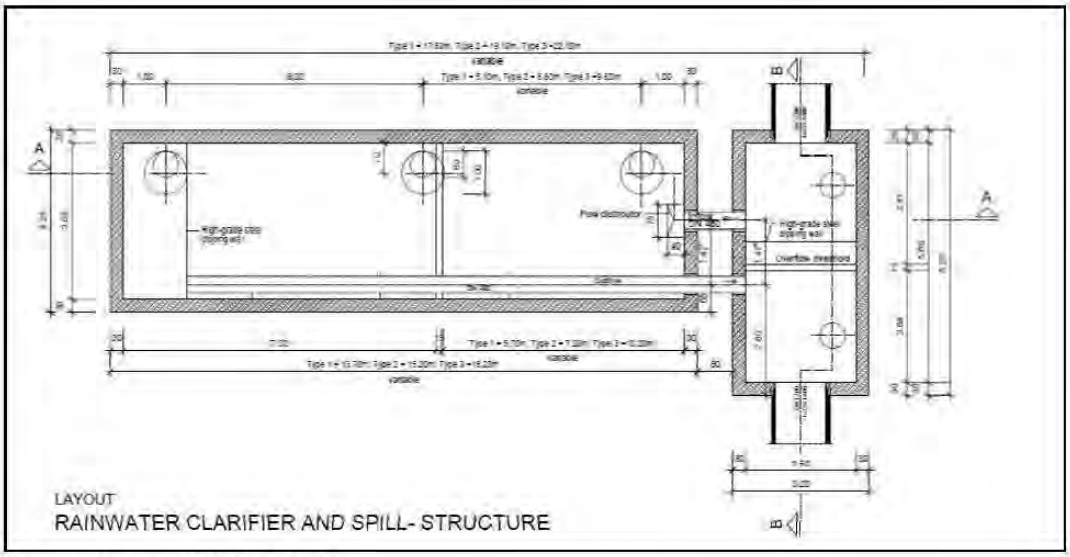
Source: Sellhorn/HPC, 06/2014

In areas where fuels and light liquids are handled (e.g. fuelling station, workshop) a coalescence separator with integrated mud separator and a subsequent control and sampling manhole shall be installed before connected to the superior drainage system. The coalescence separator shall be connected to the sewage system.

Before rainwater will be discharged into the sea, it will flow through a purification stage to deposit solid and liquid pollutants. Purification of rainwater shall be carried out in a combined rainwater clarifier and spill- and overflow structure consisting of a dipping wall and a sedimentation basin located in the vicinity of the outlet structure.

Through a connecting pipe the rather polluted water will flow into the sedimentation basin of the rainwater clarifier where solid substance will settle. Oily water floating at the surface will be withheld by a high-grade steel dipping wall.
The clarified water will flow into the spill- and outlet structure through another connecting pipe allocated at the side wall of the structure. If rainfall duration and intensity are too high, excess water will discharge more directly into the harbour regarding the fact that an already flushed pipe work will not contain a high percentage of solid substances and oily matters anymore compared to the initial rainfall.
Nevertheless another high-grade steel dipping wall as well as a small sand trap shall be installed in the spill structure in order to guarantee a minimum of purification. Clarified and excess water shall flow into the harbour through an outlet pipe respectively.

Figure 5-22 Combined Storm Water Clarifier/ Spill Structure (Example)



Source: Sellhorn/HPC, 06/2014

Every port development phase shall comply with the above mentioned requirements for drainage.

5.8.2 Potable Water Network

The potable water system will serve all terminal facilities and buildings for domestic and sanitary purposes. In addition, fresh water is supplied to all quays for possible sale to visiting ships.

Every development phase of the port shall foresee the construction of a potable water reservoir (or the expansion of the existing one for phases 2 and 3) in each terminal to fulfil the water requirements. This will ensure a regular supply in the port, at least for one week. A feed line from Ghana Water Company Ltd will supply the network.

Water is pumped into the system with centrifugal pumps located inside the water storage building.

The system is designed to prevent dead ends as far as possible. If for any reasons dead end cannot be prevent a flush and cleaning facility shall be arranged to flush the pipelines in regular time intervals. Additionally, the largest consumer shall be located at the end of the line to guarantee constant circulation of water.

Supply to vessels will be provided every 100 m along the quay for possible sale to visiting ships.

For a preliminary water demand estimation per terminal, an average daily water consumption rate of 50 liters per capita (no. of employees) and a peak hour rate factor of 3.5 has been considered. Thus the water consumption during working time in the terminal is assumed to be:

Table 5-19 Water Demand Daily Average Rate

	Phase I	Phase II	Phase III
	2023	**2033**	**2043**
Employed persons [nos]	474	760	899
Daily average demand [l/d]	23700	38000	44950
Daily average rate [l/h]*	3456,25	5541,67	6555,21
Rounded rates [l/h]	**3460**	**5540**	**6560**

Source: Sellhorn/HPC, 06/2014

For calculation of water supply to vessels, following assumptions are made:

- average water demand per vessel, e.g. 200 m^3
- supply rate per vessel 30 m^3/h
- servicing 2 vessels simultaneously (peak) 60 m^3/h
- servicing 2 vessels per day, max. 400 m^3/d

In addition, potable water shall also be used for automatic fire sprinkler service in buildings and for street fire hydrants adjacent to buildings (see 5.7.3 for water demand and hydrant arrangement).

The total fresh water demand per terminal amounts to:

Table 5-20 Total Potable Water Demand

	Phase I	Phase II	Phase III
	2023	2033	2043
Domestic Water Total [m3/d]	237	380	450
Vessels Water Supply [m3/d]	400	400	400
Total, rounded [m3/d]	640	780	850
Water losses (10%) [m3/d]	64	78	85
Grand total [m3/d]	**704**	**858**	**935**

Source: Sellhorn/HPC, 06/2014

Additional occasional demand for fire fighting (2h event):

192m³/h x 2 h = 384 m³/event

5.8.3 Fire-Fighting Water Network

The fire-fighting water system in the new Port of Tema incorporates two systems: seawater and potable/fresh water. These two systems shall be separate from each other and cover different areas within the terminal facility. The seawater shall cover the yards and quay wall areas. The potable/fresh water fire suppression system shall provide protection at the buildings and hydrants in the areas around the buildings (see 5.7).

The seawater will be drawn from a special pumping station with submersible borehole pumps. Hydrants are not spaced further apart than 90 m or 45 m from a dead end.

The demand of fire fighting water for the entire system has been specified to be 192 m³/h, according to technical rules (leaflet W405 water supply pipe work, fire fighting water of German Association of Gas and Water (DVWG)).

The system shall be expanded in every development phase to cover all areas.

5.8.4 Sewage Network

To avoid dependence from the public sewage network, it is recommended that the new Port of Tema builds its own local sewage network.

Sewage water flows from buildings and facilities through free surface flow pipes to collecting manholes in front of those facilities. Submersible sewage pumps inside the collecting manholes will pump the sewage water into the sewage pressure lines, which will lead it to the Port's waste water treatment plant.
Treated water shall be then discharged directly into the sea.

Another possible cost-saving option would be to equip each building or facility with a septic tank to accumulate sewage water. The septic tanks are periodically emptied by trucks and sewage water is transported to the public waste water treatment plant.

The system shall be able to be extended in every phase. Total preliminary amount of sewage accumulation equals total potable water demand.

5.8.5 Electrical Power Network

The public authority (Electricity Company of Ghana Ltd) shall provide electricity to the new Port Development. This company is expanding its network to the new project area.

The port shall have a new main substation, from where the terminals will be fed. This substation will be supplied from the local utility with 33 kV, 50 Hz cable systems.

The port has to be equipped with an 11 kV distribution network. A number of customized 11/0.4 kV substations need to be installed next to the consumers and loads. The network has to be designed as a loop system. The distribution loops shall route around the site through underground ducts and manholes. All electrical power and communications shall be installed underground in a duct bank system. Power demand and location of substation shall be determined in further stages of the project.

5.8.6 Lighting

In the following a recommended light concept for the new terminal is presented.
This light concept is based on German and European Standards and experience from the terminals in the Port of Hamburg. These Standards define lighting requirements for different locations with work activities.
For Industry and Storage Areas which are also applying for container terminals:

Table 5-21 Design Light Requirements

Nature of Area, Tasks or Activity	Nominal Illumination Degree [lux]	Uniformity of Illuminating Intensity [-]
Short time Handling of big units and commodities, Loading and Unloading of bulky goods	20	0.25
Permanent Handling of big units and commodities, Loading and Unloading of bulky goods, Flying Range of Cranes	50	0.40
Reading of Signs, Use of Tools	100	0.50

Source: DIN EN 12.464-2, Table 5.7, 2009]

Table 5-22 Light Requirements Industrial Areas

Nature of Area, Tasks or Activity	Nominal Illumination Degree [lux]	Uniformity of Illuminating Intensity [-]
Regular Traffic (max. 40 km/h)	20	0.40

Source: DIN EN 12.464-2, Table 5.1, 2009]

As a result of these two tables the general light demands for the terminal shall be 20 lux. The areas of container handling at the quay close to the quay cranes, the portal cranes and the yard cranes shall be illuminated according to permanent handling of big units with a requirement for light of 50 lux. The light requirements for the traffic areas shall be covered with the terminal light masts whereas the demand of light for the handling area shall be covered with extra lights at the cranes, portal cranes and yard cranes.
The lighting system should be operated from the facility automation system. All perimeter lights have to be shields to reduce lateral glare.

5.8.7 Weak Current Circuit Network

To operate a state of the art infrastructure a plurality of Control and Communication Systems are available:

- SCADA System
- Security System
- Fire alarm system
- Video monitoring
- Port operation system
- Navigations aids
- Telecommunication (wired and mobile)
- Radio system

To operate the communication systems a backbone cable system is needed. Due to the requirements of the different systems a 24 multimode fiber cable system and a 24 single mode fiber cable system shall be provided for the back bone ring.
The complex distribution system needs a sophisticated control and communication system. For that purpose special distribution SCADA-Systems are available. That system should also implement the other infrastructure systems like water supply, sewage, Compressed air etc. The control room has to be occupied 24 hours. The employees of the control room should be accountable for operation, service and maintenance.

5.9 Pavement

5.9.1 General

The Tema Port Development requires extensive areas of paving for stacking and moving containers.
Paving is amongst the largest capital cost items of the terminal development. Moreover, these areas can be expensive to maintain if they are not designed properly, with reconstruction being both time-consuming and inconvenient. Certainly, the provision of unsuitable pavements will impede the terminal operations.
Accordingly, the terminal surface must be designed for an appropriate lifetime comparable to those of quays, cranes, electric power, etc. In addition, the financial implications of an error in pavement selection and design can be enormous. If the pavement is improper designed, it may become unserviceable very quickly and the resulting remedial cost may be greater than the original construction cost. If the pavement is over-designed, capital will be tied up unnecessarily in the pavement.
The pavement is an essential and integral part of the terminal. There is no standard solution for the pavement of the average terminal as for a particular terminal the choice will usually be a compromise between durability and cost. The most important aspect is to be aware of the available choices and the relevant factors affecting the design.

Port terminals in general consist of different area sections of distinct operational functions each:

- Container stacking areas
- Reefer container stacking areas
- Empty container stacking area
- Dangerous/hazardous goods stacking areas
- Terminal access roads
- Terminal internal roads
- Fuel station, workshop and maintenance bays
- Gate/Truck and car parking areas

5.9.2 Pavement Types

The pavement of dedicated operational areas shall be designed individually for the expected operational impacts. In order to allow for flexible and unimpeded operation of the equipment fleet on all accessible areas, wide sections of the terminal are paved identically. Moreover, the implementation of large identical areas will bring about attractive low tender prices.
Some standard pavement types, laid out according to state-of-the-art design methods and proven in heavy duty terminal operations and being designated to specific operational terminal areas are given below:

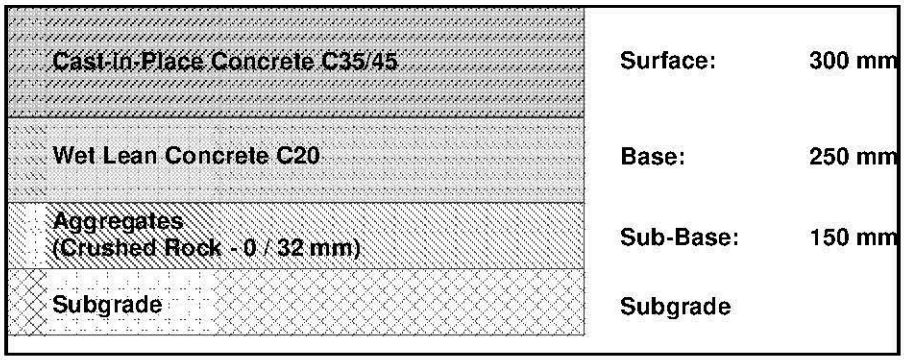
- Cast-in-place concrete pavement
- Interlocking concrete block pavement
- Asphalt concrete pavement
- Gravel bed

Layer thickness for the pavement types described below are at this stage not final and shall be defined/verified at further design stage with regard to applied operational loads.

Cast-in-place concrete pavement

In situ concrete pavement is regarded as a very rigid pavement form which provides a durable and hard-wearing surface that can withstand high contact stresses.

Figure 5-23 Cast-in-place Concrete Pavement



Source: Sellhorn/HPC, 06/2014

Advantages:

- Smooth surface resulting in minor wear and tear of terminal equipment.
- High load-bearing capacity, no permanent deformation under concentrated load; concrete pavement is generally resistant to rough usage.
- Excellent resistance to high temperatures and chemicals, especially to oil spillage.
- Materials and construction equipment are available.

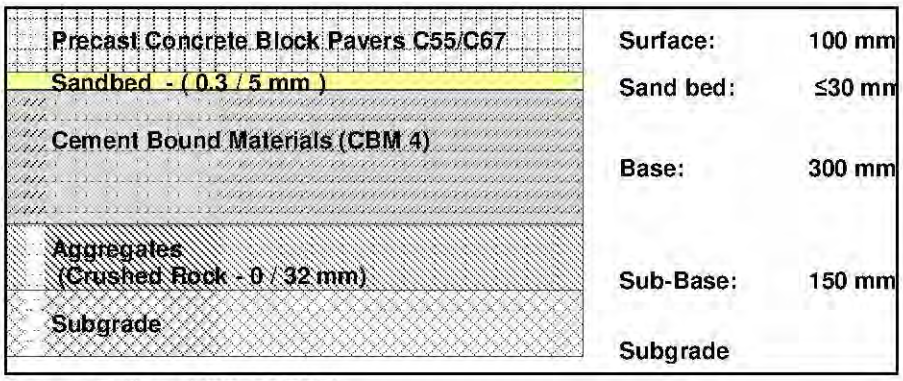
Disadvantages:

- Future changes of the terminal operation which necessitate higher design loads will often require a removal and replacement of the concrete pavement. Adaptations to operational changes are generally difficult or even impossible.
- Repair of distressed concrete surface (failures, cracks, deformations) is very difficult and expensive.
- No adjustment is possible for differential settlement. Subgrade settlement cannot be accommodated without excessive cracking due to the high rigidity of the material.

Interlocking concrete block pavement

Concrete block paving has become the most commonly used and successful form of surfacing for ports throughout the world in recent years. This pavement type withstands concentrated, repetitive loads as well, whilst combining the high durability of the hard surface with the flexibility associated with asphalt pavement types. Concrete blocks can also be placed on a concrete layer as base, if higher loads are expected.

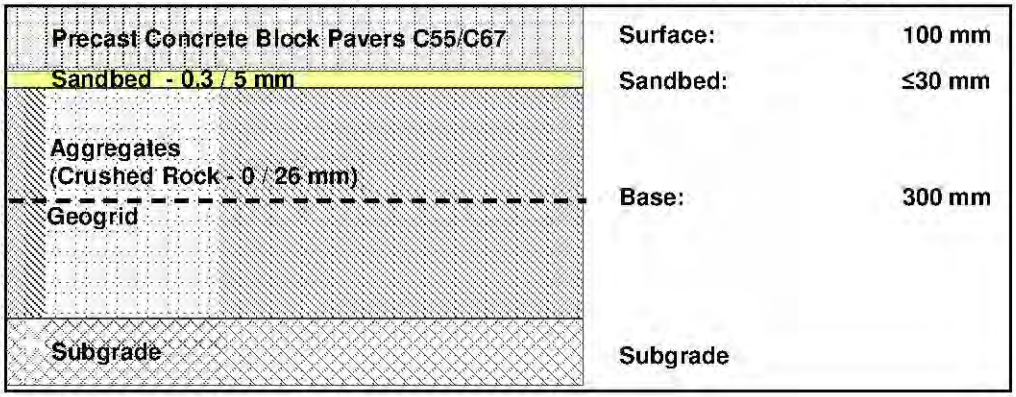
Figure 5-24 Interlocking Concrete Block Pavement – CBM Base



Source: Sellhorn/HPC, 06/2014

An economical solution with aggregates base reinforced with geogrid would also be applicable for lower loads or as temporary solution.

Figure 5-25 Interlocking Concrete Block Pavement – Aggregates Base



Source: Sellhorn/HPC, 06/2014

Advantages:

- High load-bearing capacity, no permanent deformation under concentrated load; concrete block pavement is resistant to rough usage.
- Good resistance to high temperatures and chemicals, especially to oil spillage.
- Full strength achieved in off-site curing which allows immediate use at full design load after laying.
- Tensile cracking of pavers does not occur, the surfacing can accommodate extensive deformation without damage.
- Pavers are easily to remove and replace as needed for settlement adjustment, operational changes (converting general cargo terminal to container terminal) or repair works.
- Ease of access to underground utilities.
- Rapid draining.

Disadvantages:

- Heavy punctual loads can cause local dents and cracks. Load transfer due to insuffient bond between pavers is worse in comparison to cast-in-place concrete or large concrete slabs.

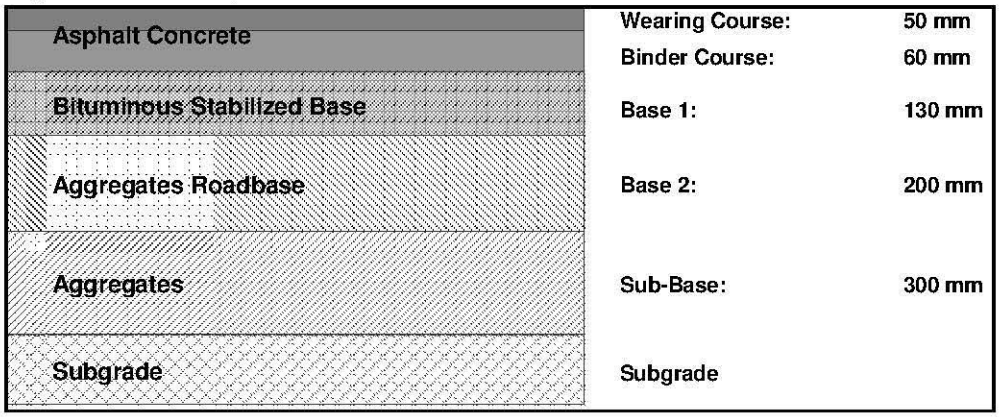
Asphalt concrete pavement

Asphalt concrete, normally known simply as asphalt or AC, is a composite material commonly used for construction of pavement, highways and parking lots. It consists of asphalt binder and mineral aggregate being laid down in layers and compacted.

Asphaltic pavements are considered to be very flexible constructions, and therefore this pavement type has been applied in many terminals throughout the world. Surface cracking caused by excessive differential settlement can be repaired as easily as rutting by replacing the destroyed wearing course by a new one, while extensive surface settlement can be adjusted by placing of overlays. The most common type of bituminous pavements is asphaltic concrete which consists of a certain bitumen-aggregate mixture. Unfortunately, asphaltic concrete tends to rutting and formation of indentations under high wheel loads, high contact stresses and low vehicle speeds due to the plastic deformation property of the bitumen.

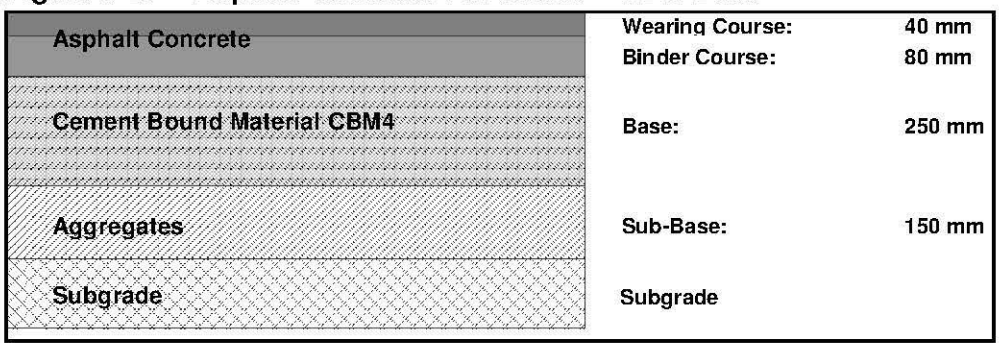
The base of asphalt concrete pavement can either be built with wet lean concrete / a cement bound materials base or with a bituminous stabilised base.

Figure 5-26 Asphalt Concrete Pavement – Bituminous Stabilized Base



Source: Sellhorn/HPC, 06/2014

Figure 5-27 Asphalt Concrete Pavement – CBM Base



Source: Sellhorn/HPC, 06/2014

Repeated, concentrated loads result in permanent deformations. Therefore only asphalt concrete with special additives (hardener) such as polymer-modified bitumen shall be applied on roads and areas subject to heavy load vehicles and equipment and areas where traffic is channelled.

Advantages:

- Smooth surface resulting in minor wear and tear of terminal equipment.
- Adaptations to operational changes are feasible, e.g. by placing of additional overlays.
- Repair of surface damages (cracks, rutting, indentations) and correction of surface settlement can be done by overlays or by replacing the distressed wearing course by a new asphaltic layer.
- Low construction and maintenance/repair costs.
- Materials and construction equipment are available.

Disadvantages (relevant for standard binder only):

- Surface is too soft to carry large wheel loads, especially in case of low vehicle speeds.
- Permanent deformation under long-term concentrated load. Special load distributing measures need to be provided.
- Poor resistance to high temperatures (if not designed specifically) and many chemicals, e.g. oil and oil products, which slowly dissolves the bituminous binder.

Gravel bed

A gravel bed solution for the container stacking areas shall only be implemented, when containers are placed on special reinforced concrete bearing foundation. By doing so, container will not be subject to unbalanced settlement and lie directly on their corner fittings so that damages of the hull will not occur.

A gravel bed solution for the container stacking areas without concrete bearing foundation, although having lower initial cost, is rejected given the disadvantages listed below.

Advantages:

- Construction and maintenance costs are much lower than those of bounded pavement types.
- Gravel beds cannot be damaged by differential settlement and heavy static and impact loads.
- Certain amounts of rainfall may be hold temporarily from outflow in the void within the gravel bed.
- Containers are prevented from cantilevering caused by uneven rigid surfaces due to differential settlement.

Disadvantages:

- Gravel beds can only be applied for storage areas being served by cranes which are operated on fixed runways.
- Requires curbing around the perimeter of the gravel to act as an edge restraint and differentiate the different pavement areas.

- Increased wear and tear of yard equipment, as stones caught in castings drop down an terminal road network, affecting equipment tyres.

5.9.3 Pavement Recommendations

At the gates and truck and car parking areas all vehicles have to stop and accelerate in the same location continuously resulting in elevated abrasion of the pavement. Concrete pavements have more wear resistance than asphalt pavements. Leakages of oil and fuel from the stopped trucks are typical in these areas. Therefore, a concrete pavement is preferred.

For container stacking, it is recommended to use a standard hard pavement such as interlocking block pavement. The storage areas for empty containers could be designed with a cheaper solution (gravel base instead of concrete base), as the induced loads are lower.

Pavement for main traffic areas in the terminal has to withstand shearing forces and single compact loads (corner fittings of trailer). The interlocking block pavement is recommended. This would also allow for operational flexibility in the terminal, as it will be the same pavement as in the stacking areas.

Dangerous goods stacking areas, as well as fuelling and maintenance and repair areas must be paved in a way to prevent leakage of hazardous substances to drip into the ground. Concrete pavement is therefore recommended.

For the access roads to the terminals, asphalt concrete pavement is recommended, as the traffic has relatively high speed (in comparison to the traffic in the terminal).

The following table shows an overview of the recommended pavement section for the different terminal areas. However, other possible and feasible pavement sections as mentioned in this chapter could be used in the design of the terminal if its utilisation is technically justified and economically favourable.

Table 5-23 Pavement Recommendations

Operational Area	Type of Pavement
Container Stacking Area	Interlocking Block Pavement
Reefer Container	Interlocking Block Pavement
Hazardous Container Storage Area	Cast-in-Place Concrete
Empty Container Storage Area	Interlocking Block Pavement with gravel base
Terminal Internal Road Network	Asphalt Concrete Pavement
Gate and Truck and Car Parking Areas	Cast-in-Place Concrete
Terminal Access Roads	Asphalt Concrete Pavement
Fuel station and Repair & Maintenance Facilities	Cast-in-Place Concrete

Source: Sellhorn/HPC, 06/2014

Annex 4: Evidence of Consultation

1.0 STAKEHOLDER CONSULTATIONS AND PUBLIC INVOLVEMENT

The environmental/social feasibility study included stakeholder consultations. Key project stakeholders were identified for consultations and these included regulatory bodies and local government institutions. Stakeholder consultation is a process and should continue through the project feasibility and ESIA stages through to implementation.

1.1 Objectives

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

- To provide some information about the proposed project;
- To provide opportunities for stakeholders to discuss their opinions and concerns;
- To provide and discuss with stakeholders alternatives considered to reduce anticipated impacts;
- To identify and verify significance of environmental, social and health impacts; and
- To inform the process of developing appropriate mitigation and management options.

1.2 Public Consultations

Consultations have been held with 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. The stakeholders identified are as presented below. Official responses received are provided in **Table 1**. Consultations are ongoing to obtain official response from some of the stakeholders.

Project Proponent

- GPHA, Head Office, Tema

Project Contractors/Consultants

- Transtech (Road Consultants)
- JV Sellhorn Ingenieunurgesellschaft (Port Consultants)

Local Authorities

- Tema Metropolitan Assembly (TMA); and
- Tema Development Corporation.

Regulatory Institutions

- Environmental Protection Agency, Head Office, Accra.
- Ghana Maritime Authority;
- Ghana National Fire Service;
- Ghana Navy;
- Forestry Commission; and

- Fisheries Commission.

Other Stakeholders

- Ave Maria Resort;
- Sakumono Fishing Community;
- Tema Traditional Council; and
- Tema Community 3 Site A and Site B Residents Association.

1.3 Public Notices

A Scoping Notice, which aims at inviting public comments on the proposed project has been published, as required under the procedure for the conduct of EIA in accordance with Regulation 15 (1) of LI 1652. The publication was made page 56 of the March 12, 2014 edition of the Daily Graphic, a national newspaper. A copy of the notice is provided as **Annex 2**.

Table 1: Summary of Concerns Raised During Stakeholder Consultation

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
Project Implementers				
GPHA, Head Office, Accra	Project Engineer, Komla Ofori	Proponents	0244366587	Provided information on the project designs and alternatives considered.
Sellhorn Ingenieunurgesellschaft	Contract Administrator, Kwaku D Boateng		0244320855	
Local Political Authorities				
Tema Metropolitan Assembly	Taylor Appiah Assistant Development Planning Officer, Robert Tetteh	Administrator	0208113801 0279657268	• The Assembly has been informed of the project • Organise stakeholder meeting for the project. Write to the Assembly to officially inform and invite stakeholders for a meeting. Stakeholders include the DUR, GHA, TMA, Assemblymen, project affected persons/organisations concerned Chiefs, NGOs etc. Consult the MCE in scheduling the stakeholder meeting • Need to ensure that fishermen in the area are not affected by the proposed project • The proposed road expansion should be planned with the TMA and the TDC to avoid conflicts in development projects
Tema Development Corporation	Acting Estate Manager, Kwesi Darko Asare Acting Estate Manager (Lands), Sarah Donkor Estate Officer (Sales), Joyce Akpaachah	Administrator	 0244364583 0244627444	• TDC has had several informal meetings with the GPHA and TMA concerning the development of the metropolis • Synergies in plans of the three institutions Is vital. The TDC has initiated a redevelopment scheme of the Tema metropolis. The proposed project needs to be coherent with this. A consultant has been assigned to carry out the development of the plan. The proposed designs are with the Head of procurement • There are concerns with regards to noise levels, air quality, and accidents within developed areas on the proposed dedicated road • A 50 acre land has been provided to GPHA as a Terminal for trucks. This needs to be considered in the design of the proposed project. The land is located at the Ashaiman end of the Tema motorway.

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
				• Need to ensure that schools along the road expansion routes are not affected. Security and safety measures will have to be provided during construction and operational phase of the project to the student • Need to provide adequate compensation to all affected persons (sellers and property owners) • Consider construction at night and weekends near schools to protect the children • TDC can provide verification of ownership of all affected lands
Regulatory Institutions				
Ghana Maritime Authority	Deputy Director, Environment and Safety Standards, Capt. Inusah Abdul Nasir	Regulator (Maritime Services)	0244037367, inusahnash@yahoo.com	• The GMA is mandated to monitor, regulate and coordinate all activities in the maritime sector, with the backing of legislation. • GPHA superintends over the Ghana Maritime Security Act and the Shipping Act. • SOLAS and the ISPS code mandates every port to have a security plan to deal with maritime security threats. Both the Tema and Takorado Ports have security plans in place. The plans are however based on the current infrastructure, therefore the expansion works will necessitate the revision of the plan, as per the the Maritime Security Act. • MARPOL mandates every port receiving international ships to put in place Port Reception Facilities for oily discharges. GMA ensure the adequacy of the facilities. The expansion should take into account the capacity of the existing port reception facility, and provide additional if required. • Air pollution expected to increase with the expected increase in Port traffic • Ballast water from increased port traffic could increase the risk of introduction of harmful aquatic organisms and pathogens which could affect the port environment and health • Port State Control of the GMA inspects ships arriving at the port from oversees to ensure they are manned and operated safely in accordance with international maritime instrument. Port State Control also inspects treatment facilities for Ballast Water for compliance with international best practices. • Port State Control samples 15% of incoming ships. The proposed expansion works will require more resource and personnel of the GMA to achieve this. Current resources and personnel will be stressed and and capacity will need to be developed to meet the ineeds of the increased traffic

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
				• There could also be impact on ecotourism since the beach is an area for entertainment of tourists • The use of dredgers will increase ambient noise levels and air quality, as well as oil waste discharges • Need to ensure that the dredged materials are adequate for use for reclamation • Increased bunkering is expected so measures need to be put in place to prevent illegal bunkering • Vessels for dredging will require permits from the GMA to operate • Any changes in the port (extent of works, layout, etc.) should be communicated to the GMA for the necessary notices to mariners to be promulgated, as is safe and proper. The GMA is yet to receive official communication of the proposed Port Infrastructure Development from the port authorities.
Ghana National Fire Service	Regional Fire Commander, Gilford Tetteh Adams Regional Fire Inspector, Benjamin Abbey Regional Deputy Commander, Godwin Damale		0275577317 0244721465 0244819636	• The GNFS assists the GPHA Fire service in emergency situations • Provide drawings of the proposed project and incorporate the provision of emergency lanes within the port proposed roads as part of the project • The GNFS will assist and make recommendations to assist in the compliance with the fire regulations to ensure safety. The Tema Regional Coordinator should be involved in the assessment since the will be involved with the implementation of the recommendations
Forestry Commission	Services Manager (Wetlands Coordinator), C C Amankwah	Regulator (Sakuma Lagoon)	0244262467	• The proximity of the dedicated expressway to the Sakumono Lagoon, a designated RAMSAR site is of concern to the Forestry Commission. • A map, in an appropriate scale with grid lines, indicating the project road needs to be provided to aid in decision making on project impacts on the RAMSAR site for recommendation of appropriate mitigation measures.
Fisheries Commission	Deputy Director/Head of Marine Services, Matilda Quist	Regulator (Fisheries)		• There is a small fishing community at the Sakmono beach (constituting about 5% of the Fishermen in the Tema District). • There is the need to ensure that the fishermen at the Sakumo beach are not displaced to affect their livelihood • The Sakumo fishermen fish close to the shore and therefore it is important to ensure the proposed project does not affect negatively on their activities

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
				• Visit to the research unit of the Fisheries Commission for further information required.
Other Stakeholder				
Tema Traditional Council	Shipi, Stool Secretary, Nii Armaah Somponu II Development Control Chairman of the Traditional Council, Joseph Ashitey Larteh In attendance: Tema East Sub-Metropolitan Director, Mrs Rita Damani	Traditional Authorities	0244838635 0208178265 0244713328	• The community was resettled to the current location in Tema East during the construction of the Tema port, leading to the loss of their ancestral home and canoe landing beaches • Customary rites are performed at the Halcrow beach, near the Meridian, for initiation of priests. The rock has to be preserved during the construction and access provided for the performance of rites • The expansion could lead to increased traffic and deterioration of already damaged road in the area • There is an expected influx of people to Tema New town after the completion of the project. This will put pressure on their already strained resources and utilities • There is the need for extensive consultation of GPHA with the Traditional authority, prior to construction, for peaceful coexistence. Interbetton for instance, started some construction without consulting the traditional council. The project was not successful until consultation with the traditional authorities to perform rites. • The Sakumo II lagoon is heavily silted due to the narrow outlet provided. At present only water flows into the sea while silt settles behind it. It would be preferable to expand the outlet. • The fishermen in the Sakumo beach are predominantly from Ada, but the area is still under the jurisdiction of the traditional authority • The community has made several unheeded complaints about the fact that there is only one access road to the community. This could cause serious inconvenience if damaged • The existing roads have been damaged by port boundtrucks. The construction of a dedicated road should also incorporate repair of existing damaged roads • The stool receives no royalties from GPHA although they gave their land to GPHA. They Council is therefore contemplating court action since GPHA is operating commercially by leasing lands to private operators although the original of GPHA is to be a gateway to the world

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
				• Families have lost their lands to GPHA and artisanal canoes cannot compete with sophisticated trawlers at the Fishing Harbour
Sakumono Fishing Community	John Okantey Jacob Gbelegu Antie Tettey Fesah	Local fishermen	0246779957 - - 027689817	• There are five nets being operated at the beach. Each net reuires about 60 to 70 fishermen to operate. The nets are owned by five families (Ocantey family, Sogborgbor family, Teitsu family, Adamani family and Lomo family) • They have received some information about proposed project, and don't envisage any challenges from the proposed project on their activities • The proposed site for the reclamation and dredging is rocky and therefore the fishing activities are not carried out there, since there is a hisk of damage to the nets • Fishing activities occasionally extends close to the Sakumono beach ottlet •
Tema Community 3 residents Association (Site B)	President, Community 3, Site B residents/Member, Community 3 Residents Joint Committee, Reverend Vincent Addoquye Addo	Community	0244250819	• The residents of community 3 site A, Site B and Afko Area were invited to a meeting for presentation of the project by the project contractors for the proposed project for a dedicated road to the port. Mention was made of the main port infrastructure project. Regular meetings should be held with the community to assess the impact of the project • There is also a joint committee of the three communities that discuss issues of mutual interest • Workers that may undertake the proposed port expansion and road project are from different backgrounds and may introduce social vices, such as theft, robbery etc., to the community. Security measures will therefore need to be put in place • Noise nuisance from the project activities is expected during construction • Need to ensure that the internal roads at Sites A and B are not used as bypass roads during the construction phase. There is the need to rearrange transport routing to minimise impact on traffic • Dust emissions will have to be controlled • The residents will have to be compensated for disturbance through Corporate Social Responsibility e.g. provision of bus stop, security etc. • Youth form the community should be employed to keep their interest in the project and provide income

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Concerns Raised/ Information Received
Ave Maria Resort	Executive Director, Mrs Teresa Afua Ntim	PAP	0244531295	• Ave Maria Resort is a family owned business • The original owners of the resort were the Halcrow Beach Club, who were the British Consultants for the Harbour construction. It was used exclusively by the British, except the then President, Dr Kwame Nkrumah. The ownership reverted to Ghanaians after the overthrow of the President. • The place is unique because of its proximity to the Meridian Rock, signifying the location of the Greenwich meridian • She obtained a 25 year lease for the place from GPHA in 2002, although it was handed over to her by Halcrow in 1998. She was introduced to GPHA by Halcrow (Phil Davis). The terms of agreement with Halcrow was for her to renovate and use the place at no fee anin return provide free accommodation for Halcrow Personnel at the resort for life. • She was initially informed that the proposed project will not have any negative effect on her operations but rather benefit her as the place would be used as a cruise station. • She was however informed by the GPHA in March 2015 that the project designs had changed and the resort will affected. • GPHA also stated in the letter that the lease agreement will be terminated in September 2015. She was also assured that the property will be fully compensated at an agreed valuation cost • Ave Maria resort is open to relocation to a similar or better place within the area to operate • The resort has 15 rooms and there are plans to construct 92 more • The place has been developed in phases since 2003. More intensive work has been undertaken recently due to the expected utilisation from the expansion works

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Ghana National Fire Service

Date of Consultation: 5/3/2014 **Time:** 10:30am **Venue:** Tema Regional Office

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
① Gilford Tetteh Adams	Regional Fire Commander 0244721468 0244819636	0277577317/0243719681/0249911666 Regional Fire Inspector Divisional officer 4)
② Benjamin Asbey		
③ Godwin Damate		2IC Regional Deputy Commander

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
The GNFS assists the ~~Port~~ GPHA fire service in emergency situations. Hence the doing of the proposed project and in compliance the provision of emergency lanes as part of the project within the port and the proposed road. The GNFS will assess and make recommendations to assist	in the compliance with the fire regulations to ensure safety. The Tema Regional headquarters should be involved in the assessment of fire safety since they will be involved in the implementation of the recommendations.	

Signature: ..... THE REGIONAL FIRE OFFICER GHANA NATIONAL FIRE SERVICE HEADQUARTERS TEMA 5/8/2014.

Name: .....

Date: .....

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Tema Development Corporation

Date of Consultation: 13/05/2014 **Time:** 3:00pm **Venue:** Tema Development Corporation.

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited / Nana Ama Ansah (Trustech Consult)

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Kwesi Derko Asare Sarah Donkor Joyce Akpadah	 0244364583 0244627[illegible]	Acting Estate Manager Acting Estate Manager (Land) Estate officer (Sales)

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
① TDC has had a lot of informal meetings with GPHA and TMA to see the common development of the metropolis. See Corporate Planner for more information. ② Synergies in plans is vital, TDC has initiated a redevelopment scheme of the Tema metropolis. Proposed project needs to cohere with this. A consultant has been hired to carry the assignment. Designs with the head of Procurement. See the coordinator for Redevelopment for more information.	③ Concern with noise level, air quality, accident risk from the developed areas. along the proposed dedicated road. • A 50 acre land has been provided to GPHA as a terminal for trucks. This needs to be considered in the designs. The land is located the Ashaiman end of the motorway. ④ Need to ensure that schools along the proposed road expansion are not affected. Need to provide security and safety measures during construction and operation of the project.	⑥ Need to provide adequate compensation for affected persons (sellers, property owner) ⑤ Consider construction at night and weekends especially near schools to protect school children. ⑦ TDC can provide verification of the ownership of land for affected lands.

Signature: [signature]

Name: SARAH DONKOR

Date: 13/05/14

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Tema Metropolitan Assembly.

Date of Consultation: 5/03/2014 **Time:** 12:20pm **Venue:** Tema Metropolitan Assembly

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited / Esenam Fumador of SAL Consult

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
① Robert Tetteh	Ass Development Planning officers	~~0279655~~ 0279657268

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
Organise a broader stakeholder meeting for the project. The Director General has been to the Assembly to inform them of the project. Write to the Assembly to officially inform and invite to stakeholder meeting. Stakeholders - urban roads, TMA MCE, Assemblymen, affected properties/organisations, GHA, ~~[illegible]~~ Concerned chiefs (with info from the presiding member), NGOs	Need to ensure that fishermen are not affected by the project. Consult with the MCE in scheduling the stakeholder meeting.	

Signature: [signature]

Name: Robert Perez Tetteh

Date: 5/03/2014

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder:

Date of Consultation: **Time:** **Venue:**

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
John Okantey Jacob Gadegu Andie Tettey Fesah	0244779959 – – 0279689817	~~[illegible]~~ fisherman. Net repairer/Fisherman Fisherman.

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
There are five (5) nets being operated at the beach. Each net takes about 60 to 70 ~~[illegible]~~ fishermen. Fishing season is from October to May. Fishing is carried out at about 400 to 500yards from the shore. The fisher activities also occasionally extend the the outfall of Sakumo lagoon. The area after the Sakumo outfall is rocky and therefore fishing activities are not carried out there. Fear of damaging their nets. During the fishing season they can fish everyday.	They don't envisage any problem from the implementation of the project on their activities. Families (net owners) ① Ocansey family ② Sogborgor family ③ Teiten family ④ Adaman's family ⑤ ~~Batch family~~ ⑥ Lomo family The net is owned by the families.	

Signature:.. Date:..................................

Name:..

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed the Port Expansion Project, Port of Tema

Identified Stakeholder: Ghana Maritime Authority

Date of Consultation: **Time:** **Venue:**

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Mrs Theresa Efua Ntim	0244531795	Executive Director

Summary of Stakeholder Discussion, Comments and Concerns

Issue/Comments/Concerns/Suggestions/Recommendations	
Family own the land. Lease for 25 years to be renewed after ~~every~~ ~~25~~ the expiration of the 25 years. *She was initially informed that she will not be affected by the project and the place could be used as a Guest Station. *She was later informed that the plans has changed and that the lease agreement will be terminated after ~~25 years~~	September 2015. The letter was written in march 2015. The letter stated that the property will be fully compensated. *She has invested a lot in the project because she expected the plot to be used in the expansion project. *Open to relocation to a similar or better place within the area to be able to operate. *15 rooms and plans for expansion for additional 92 rooms. The has been continous developments ~~for~~ ~~Tema~~ over the years * It was developed in phases since 2003.

Signature: TEntim

Name: Teresa Efua Ntim

Date: 24/6/15

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed the Port Expansion Project, Port of Tema

Identified Stakeholder: Ghana Maritime Authority

Date of Consultation: **Time:** **Venue:**

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Mrs Teresa Afua N'Tsin	0244 531 795	Executive Director

Summary of Stakeholder Discussion, Comments and Concerns

Issue/Comments/Concerns/Suggestions/Recommendations	
The original owners were the Hailcrow Beach club, owned by the British Consulate to the Harbour. It was used exclusively by the British, except the President, Dr. Kwame Nkrumah. The place is unique because of its proximity to the meridian Route. The ownership reverted to Ghanaman after the overthrow of Dr. Kwame Nkrumah. *She was introduced to GPHA by the Hailcrow Beach Club's President (Phil Davis)	*Stand lease from GPHA in 2002. The place was however handed over to her by Hailcrow Beach club in 1998. The agreement with the Beach club was that they would use the club for life, while she uses and renovates the facilities free of charge.

Signature: T Ntsin

Name: Teresa Efua Ntsin

Date: 24/6/15

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed the Port Expansion Project, Port of Tema

Identified Stakeholder: Ghana Maritime Authority

Date of Consultation: 19/06/2015 **Time:** **Venue:** Head Office, GMA

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Capt. Inusah Abdul Nasir	0244037367 inusahnash@yahoo.com	Deputy Director, Environt & Safety Standards.

Summary of Stakeholder Discussion, Comments and Concerns

Issue/Comments/Concerns/Suggestions/Recommendations	
* Port State samples 15% of the incoming ships Resource/and personnel of the GMA to enforce the port state controls measures will be stretched More capacity will need to be built to meet the increased port traffic. * Impact on ecotourism since the beach is and area for entertainment. * Use of dredgers – noise, air pollution – discharge of oily waste, engine cooling water –	* Need to ensure that dredged material is adequate for use as refill material for land reclamation. * Increased bunkering, measures should be put in place to prevent illegal bunkering. * Vessels from dry dock will need permits to operate. * Any changes in the port (extent of works, layout etc) must be communicated to the maritime authority for the necessary notices to mariners to be promulgated, as it safe and proper. * GMA is yet to receive information on the proposed port development. * VTMIS Project

Signature:.....

Date: 19/06/2015

Name: CAPT. INUSAH A. NASIR

Interaction with Nana Yaw Otu of SAL.

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Ghana Maritime Authority

Date of Consultation: 19/06/2015 **Time:** **Venue:** Head Office, Ghana Maritime Authority

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Capt Inusah Abdul Nasir	0244037367 inusahnash@yahoo.com	Deputy Director, Environment & Safety Standards.

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
(1) mandated to monitor, regulate and coordinate all activities in the maritime sector, with the backing of legislation. GMA supervises also the Ghana Maritime Security act and the Shipping Act. - SOLAS and ISPS mandates Every port must have a security plan) to deal with maritime security threats. Tema has a security plan, as well as Takoradi Port. The plan based on current infrastructure the expansion will necessitate the reassignment of the port facility	and update the plans, as per the maritime security act. This will help curb social vices in the port. * Port Reception facilities MarPOL mandates every port State to have adequate reception facilities. GMA ensures adequacy of the reception facilities on the jetty for oily discharges. The expansion should take into account the suitability and adequacy of the facilities. Garbage reception facilities should also be provided.	* Air pollution expected with increase in traffic to the port area. * Ballast water from increased ships traffic, could introduce harmful aquatic organisms and pathogens which could affect the port environment and human health. Port State control of the GMA boards ships that visit the port from foreign countries to ensure that the ship is manned and operated safely in accordance with international maritime instruments. Inspect how Ballast water is being treated for compliance with best practice.

Signature:.....

Name: CAPT. INUSAH A. NASIR

Date: 19/06/15

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder:

Date of Consultation: **Time:** **Venue:**

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Matilda Quist.		Deputy Director. Head of Marine Fisheries

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
Fishermen • There is a small fishing community at the Salaamo beach (5% of the Fishy population of the Tema district). Need to ensure that the fishermen at the Salaamo beach are not displaced to affect their livelihood. Visit the research unit of the Fisheries Commission in Tema for further information.	Salaamo beach fishermen fish close to the shore and therefore it is important to ensure the proposed project activities do not impact negatively on their activities (eg. pollution). MQuist	

Signature: MQuist

Name: MATILDA QUIST

Date: 14/04/15

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Comm 3 residents.

Date of Consultation: 17/6/2015 **Time:** 13: **Venue:** Community 3, Site B.

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Reverend Vincent ~~A~~ Addotey Addo.	0244 250 814	President, Comm 3 Site B, residents Association

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
~~Need to ensure that~~ workers that are brought in for the Road Construction as well as the Main port expansion ~~work~~ are from different backgrounds and may introduce Social problems such as theft, robbery, etc. Security measures should be put in place. * These have to be checked. Noise means for the project will disturb the Community. * Ensure the county road is not	Used as a bypass during Construction. Need to rearrange the transport routing so that traffic congestion is not an issue. * Dust emissions will have to be controlled. * The residents will have to be compensated through Social responsibilities for the harm Caused (e.g. police post, bus stop, * Youth should also be employed in the Construction activities, ~~to~~ Keep their interest in the project and provide income.	* Regular meetings should be held to assess the impact of the project in the community; with the representative * The residents association of Community 3 Sites B, Site A and Afko area were invited to a meeting for presentation of the project by ~~GPHA~~ the project contractors. * Comm 3. residents formed committee. to oversee issues of common interest.

Signature: .....

Name: Rev. V. A. Addo

Date: 17/06/2015

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Tema Traditional Council

Date of Consultation: 17/6/2015 **Time:** 11:30am **Venue:** Tema East Sub-Metro office

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
① Nii Amaarh-Somponu II	0244838635	Shipi (Stool Secretary)
② Joseph Ashitey Kortey	0208178265	Development Control Chairman (Tema Traditional...)
③ Rita Damani (Mrs)	0244713328	Tema East Sub-Metro Director

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
There is the need for extensive consultation between GPHA and the traditional authorities to ensure peaceful coexistence. The traditional authorities will need to be consulted prior to constructions begins. For instance, Interbelton did some construction without consulting the traditional council. The project was not successful un they had to go back for the necessary rites to be performed.	The Sakumo II lagoon is heavily silted due to the outlet provided. At present only water flows into the Sea, no silt flows. It would be preferable for the outlet to be expanded. Land in the hinterland areas are be sold by GPHA, whereas the original aim was to provide a gateway to the country. Existing roads have been damaged by port operating	trucks, the construction of a dedicated should also take into account repair of existing roads that have been damaged. The traditional authority need to perform rites for pacification prior to the construct[ion] Fishermen in the Sakumo area are predominantly from Ada but still fall under their jurisdiction

Signature: [signature]

Name: Nii Amaarh Somponu II

Date: 17/06/2015

SAL CONSULT LIMITED STAKEHOLDER ENGAGEMENT FORM

Title of Project: ESIA Study for the proposed Upgrade and Expansion of the Tema Port, STMA, Greater Accra Region

Identified Stakeholder: Tema Traditional Council

Date of Consultation: 17/06/2015 **Time:** **Venue:** ~~Head Office~~, Tema East Sub-Metro Office, New Town

Interviewers: Nana Yaw Otu-Ansah of SAL Consult Limited

Stakeholder/Officer(s) Consulted		
Name	**Contact Number**	**Position**
Nii Amarh Sompunu II	0244838635	Shipi (Stool Secretary)
Joseph Ashitey Lartch	0208178265	Development Control Chairman (Traditional Council)
Rita Bimani (Mrs)	0244713328	Tema East Sub-Metro Director.

Summary of Stakeholder Discussion, Comments and Concerns

Issue	Comments/Concerns	Suggestions/Recommendations
The community was resettled in the current location in Tema East during the construction of the Tema Port, leading to the loss of ancestral home; canoe landing beaches. Customary rites are performed at the Afen beach when priests are being initiated. This is done at the meridian rock. The rock has to preserved during the construction. Access should be provided to the traditional	Authority for the performance of the necessary rites. The expansion could lead to increased traffic and impact on the road transport and social facilities. The community has made several complaints about a single access to the ~~port~~ New town but has not been heeded. The Community may not be prepared for impact of the expansion of the Tema port. The Stool receives no royalties from GPHA although they gave their land to the community.	The community is contemplating a court action since GPHA is operating commercially and must therefore receive royalties. There ~~no~~ will be influx of people to the area after the completion of the port, with its attendant industry. This will result in pressure on their already weak resources and utilities. Farmlands have been lost to industries. Artisanal canoes do not compete with sophisticated trawlers.

Signature: [signature]

Name: Nii Amarh Sompunu II

Date:..................................

Annex 5: GPHA Occupational Health and Safety Policy

GHANA PORTS AND HARBOURS AUTHORITY

OCCUPATIONAL HEALTH AND SAFETY POLICY

OCTOBER 2005

TABLE OF CONTENTS

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 6: World Bank's General Environmental Management Conditions for Construction Contracts as shown in.

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.

56The 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 7: Compensation Framework

1.0 Project Background

The preparation of a complete Resettlement Action Plan (RAP) for the proposed Port Infrastructure development for the Tema Port, is premature at the present time when the design of the coastline to be reclaimed is still ongoing. The principal Project-Affected-Persons (PAP)/structures identified at this stage is the Ave Maria Resort.. 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 has least impact 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 no impacts from land acquisition. Issues of land acquisition will not be an issue here since land required for the project are within the property of GPHA and securely shielded from intrusion.

Possible impacts from the project is analysed in **Table 1.**

Table 1: Project Impacts on Assets/Properties

Project Activity	Potential Impacts on Assets/ Properties		
	Land	*Structures*	*Livelihood*
Construction of breakwater	No acquisition required	No structures will be affected	No livelihood issues expected
Dredging and reclamation	No land acquisition required	Ave Maria Resort Potentially affected See (**Plates 1 and 2**)	Ave Maria Resort Potentially affected See (**Plates 1 and 2**)
Construction of quay walls	No acquisition required	No structures will be affected	No livelihood issues expected
Cargo handling and berthing	No acquisition	No structures will be	No livelihood issues

Project Activity	Potential Impacts on Assets/ Properties		
	Land	*Structures*	*Livelihood*
furniture at all the respective berths	required	affected	expected
Coastal reclamations and/or reformations	No acquisition required	Ave Maria Resort Potentially affected See (**Plates 1 and 2**)	Ave Maria Resort Potentially affected See (**Plates 1 and 2**)

Plate 1: View of the Ave Maria Resort

Plate 2: Aerial View of the Ave Maria Resort

3.1 Project Affected Persons

There will be the need to compensate the people who may be directly or indirectly affected by the project when survey works are completed, and the number of affected people has been identified. Information available indicate that the Ave Maria Resort is the principal affected party. The analysis of PAPs will be continuously be updated as to reflect any changes in the scope of the project.

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 (Ave Maria Resort) are potentially affected by a component of a sub-project, wherever practicable, the sub-project shall be redesigned to avoid any impact on such dwellings and to avoid displacement/relocation accordingly.
- Where the impact on the property is unavoidable, GPHA will seek the first option to relocate the affected property to a mutually agreed location and the necessary compensation paid.
- 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. These 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,
- The 1962 State Lands Act, which gives details on the processes and procedures required by compulsory acquisition of land.

6.0 Eligibility

In line with this compensation framework the following two categories of affected people will be eligible to project 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 assets/properties other than land (i.e. structures and crops).

7.0 Compensation

Compensation principles to be adopted will include:

- Compensation will be paid prior to destruction of structure/land entry; and
- Compensation will be at full replacement value or reinstatement cost.

In contrast with the depreciated or net value of a structure, the “replacement value” includes the full cost of materials and labour required to reconstruct a structure of similar surface and standing. In other words, the affected persons will be able to have their structures rebuilt in a different location or reinstated using the compensation paid for the old structure.

8.0 Entitlements

Entitlement matrix for compensation issues for the proposed Tema Port Infrastructure Development Project is presented in the **Table 3**.

Table 2: Entitlement Matrix

Property	Type of Impact	Entitled units	Eligibility criteria	Entitlement
Land	Loss of land/property	Land owner	Evidence of ownership (legal/customary)	Cash compensation
Structures	Destruction of permanent immoveable structures	Owner of property	Evidence of ownership of affected structure	Cash compensation at full replacement value of structures
	Temporary displacement of moveable structures	Owner	-	GPHA to bear cost of temporary displacement of structure and cost of moving structure back to project-affected location

9.0 Valuation and Compensation Rates

Methods used by the Land Valuation Board (LVB) to calculate rates cannot be disclosed and are kept confidential. Structures to be demolished will be assessed by professional valuers, either from the LVB or from private offices certified by the LVB. Structures will be valued at full replacement cost.

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 at the Head Office in Tema will handle this assignment. GPHA will seek relevant cooperation from competent agencies at the national and regional level, such as the regional office of the LVB where necessary.

10.2 Funds for Compensation

The initial budget estimate for compensation of the affected property is not determined at this stage. 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 compensation certificate together with GPHA authorised representative and the relevant 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 Tema Metropolitan Assembly representatives.

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 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 mechanism 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 are proposed to be implemented involves initial provision of basic information to potentially affected people on the project and 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:

- Ghana Ports and Harbours Authority;
- Environmental Protection Agency (EPA) (resource personnel); and
- Land Valuation Board (LVB) (resource personnel).

16.0 RAP Management Committee

A RAP management team is being proposed to oversee the implementation of the RAP in all the project affected areas. The team shall consist of a representative of the Metropolitan Assembly, and representatives of GPHA and LVB. 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.