



Republic of Ghana

## MINISTRY OF WORKS AND HOUSING

### GREATER ACCRA RESILIENT AND INTEGRATED DEVELOPMENT PROJECT (GARID )

### THE ENVIRONMENTAL IMPACT ASSESSMENT [EIA] STUDY FOR THE DREDGING IN THE ODAW BASIN



-  
**Final Report**



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## ACRONYMS AND ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
EA	Environmental Assessment
EAR	Environmental Assessment Regulation
EHSR	Environmental, Health and Safety Representative
EHS	Environmental, Health and Safety
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GARID	Greater Accra Resilient and Integrated Development Project
LI	Legislative Instrument
AMA	Accra Metropolitan Assembly
MSWR	Ministry of Sanitation and Water Resources
MWH	Ministry of Works and Housing
NEQG	National Environmental Quality Guidelines
OP	Operational Procedure
PPE	Personal Protective Equipment
PCU	Project Coordinating Unit
TQWR	Target Water Quality ranges
WB	World Bank
WRI	Water Research Institute

## EXECUTIVE SUMMARY

### Introduction

The Government of Ghana (GoG), through the Ministry of Works and Housing, has requested IBRD/IDA credit facility from the World Bank for investment in both structural works and nonstructural services towards improving flood and solid waste management in the Greater Accra Metropolitan Area. The works and services will be delivered through a proposed project– The Greater Accra Urban Resilience and Integrated Development (GARID) Project.

Phase I of the proposed project focuses on the Odaw river basin. The Odaw River and its tributaries Nima, Onyasias, Dakobi and Ado drain the major urbanized areas of Accra. This river basin has the highest population density in the country, containing 60% of entire Greater Accra Region population, and is affected by chronic flooding with an estimated 30% of the population at risk living in informal settlements subject to regular flooding.

### Objectives

The main objectives of the GARID Project are to (1) Strengthen flood and solid waste management; and (2) Improve the living conditions of the most vulnerable communities in the Odaw Basin in the Greater Accra Region.

### Project description

Four (4) typical sections will be dredged under the proposed project. The dredge areas will begin from the confluence between Onyasias and the Odaw channel (landmark Caprice) and slope downstream to the Korle –Lagoon into the sea. The length of the area to be dredged is about 10km with the average dredge depth ranging from 0.8 to 3m. Also, the total dredge volume is roughly estimated at 1,084,091m<sup>3</sup>. The exact volume and locations of dredging are yet to be fully identified or located based on detailed feasibility studies and the detailed design yet to be completed. The proposed areas include:

- 1) Caprice – Abossey Okai bridge : Lined section of Odaw River channel with high sedimentation rates and the most frequently flooded area.
- 2) Abossey-Okai bridge – Interception weir: Wider unlined section of the Odaw with fixed banks. The section runs through waste disposal areas and a large informal settlement called Old Fadema.
- 3) Interception weir – Sea: “Korle Lagoon” Area.
- 4) Main Odaw River tributaries: South Kaneshie (including Cemetery drain and Mataheko drain), Nima drain and Agbogbloshie drain.

The implementation of the project will be preceded and determined by a feasibility and design study. The study will assess the feasibility of deferred and routine maintenance dredging options from a technical, economic, financial, environmental and social perspective of the main Odaw River channel. The ESIA will be updated based on the feasibility study and detailed engineering design which are yet to be completed. The Feasibility Study and the ESIA will be interrelated as the Feasibility Study will build on outputs of the ESIA (e.g. Impacts, optimisation and mitigation measures, elaborate project definitions of selected options, etc.) and vice versa.

Detailed project activities will be determined from the feasibility and design studies. It is expected that the project scope will be more clearly defined when all these studies are finalized.

### Approach and Methodology

The approach and methodology for the environmental study involved the following:

- Desktop study and literature reviews;
- Reconnaissance visits and site inspections;
- Public/stakeholder consultations and meetings ;
- Baseline information gathering, including:
  - Climatological/weather study;;
  - Geology and Soil;
  - Topographic survey;
  - Socio-economic characteristics (demography, gender, employment, industry).
- Design and implementation of water and sediment data collection program
- Identification and Assessment of project impacts and mitigation measures; and
- Preparation of Environmental and Social Management Plan and Monitoring Plans

### Design and Implementation of water and Sediment data collection programme

Ten (10) sampling locations were identified and selected within the Odaw basin catchment taking into consideration the different basin activities comprising the location of settlements, cattle rearing, auto mechanics, markets etc. Thewater and sediment samples were analysed at the national research laboratory in Accra for metals, organic compounds, invertebrates etc. Standard methods were followed in the sampling and analysis.

### Relevant Policies, Legal and Administrative Frameworks

Relevant Policies, Legal and Administrative Frameworks are as follows:

National sector Policies		
1.	National Environmental Policy, 2013	National Health Policy, June 2007
2.	National Land Policy, 1999	National Water Policy, July 2006
3.	National Environmental Sanitation Policy, June, 2010	National Riparian Buffer Policy , 2011
4.	National Water Policy, July 2006	National Riparian Buffer Policy , 2011
5.	National Environmental Sanitation Strategic and Action Plan, 2010	National Urban Policy Framework
National Legal Framework		
6.	The Constitution of the Republic of Ghana, 1992	The Fees and Charges (Amendment Instrument), 2015 (LI 2228)
7.	The State Lands Act 1963, Act 125	Local Governance Act 2016 (Act 936)
8.	Environmental Protection Agency (EPA) Act 1994, Act 490	The Labour Act 2003, Act 651
9.	Lands Commission Act 767	Workmen's Compensation Law 1987
10.	Environmental Assessment Regulations 1999, LI 1652	Land Use and Spatial Planning Act (Act 924), 2016
Institutional Framework		
11.	Ministry of Works And Housing (MWRWH)	Environmental Protection Agency
12.	Metropolitan, Municipal and District Assemblies (MMDAs)	Hydrological Services Department
13.	Sub Metropolitan and Zonal Councils	Ministry of Local Government and Rural Development/ Ministry of Sanitation and Water Resources
14.	Department of Urban Roads (DUR)	Lands Commission

	<b>National sector Policies</b>	
15.	Water Resources Commission (WRC)	

### *World Bank Safeguard Policies*

Five (5) of the Safeguards Policies are determined to be triggered by the proposed project. These include:

- OP/BP 4.01 Environmental Assessment;
- OP/BP 4.04 Natural Habitat
- OP/BP 4.11 Physical Cultural Resources
- OP/BP 4.12 Involuntary Resettlement
- OP/BP 4.37 Safety of Dams

### **Alternative Considerations**

For the development of the proposed Project, a number of options are under consideration to present the most feasible alternatives. These options considered are in respect of:

- Dredging Methods
  - Mechanical
  - Hydraulic
- Quality of Dredge Material and handling
  - Clean/Non-Contaminated material
  - Slightly Contaminated material
  - Contaminated material
- Dewatering
- Disposal Options ;
  - Open water disposal
  - Capping and Contained water disposal
  - Confined Disposal Facilities
  - Strip Mine Reclamation/Landfill cover for solid waste
  - Fill Material
  - Habitat Restoration
- No Action Alternative

### **Baseline information**

The Odaw River runs through the Accra metropolis and flows through numerous communities into the Korle Lagoon and finally enters the Atlantic Ocean. The Odaw river and Korle lagoon are threatened by pollution from activities of densely populated settlements surrounding the drain/channel. Most sections of the drains are used as garbage dumping receptacles, especially in crowded and low-income areas where garbage-collecting basins are placed very close to open areas. Some sections are badly choked with weeds and bushes, and serious erosion has damaged drains and culverts in places. Stagnant foul waters are found in drains in the central part of the city where there are stores, markets and restaurants, as well as lorry parks. No maintenance is carried out to remove the garbage and silt in the industrial areas, causing flooding.

The major problem affecting the river is poor sanitation. The areas along the channel have been encroached and individuals openly dump rubbish/garbage and practice open defecation. The inadequate drainage and poorly designed channels in many parts of the Basin have given rise to serious flood problems as it impacts on increase surface water runoff and flooding in low lying areas. These are problems compounded by choked drains.

Dredging of the Korle lagoon is required to reduce flooding and provide improved flow in the existing channel system. The Odaw basin drainage channels have lost much of their potential natural hydraulic performance due to the build-up of sediments (about 1,084,091.42 m<sup>3</sup>) and solid waste materials over many years and with less than optimal dredging investments on an annual basis.

#### Project affected Persons

The Project Affected Persons (PAPs) for the Odaw Dredging project are mostly within the 50m reserved buffer on either side of the drain and around the lagoon area.. No major obstacles or activities are expected to hinder the movement of dredging equipment even though some few persons may have to be temporarily relocated and may suffer inconveniences or loss of livelihood. It is estimated that up to about 1000 people may be affected and will mostly be the automechanics and squatters around Avenor, Circle, Agbogloboshie (Sikkens) and mainly squatters along the banks of the lagoon at Old Fadama. Others may include the petty traders and cattle rearers located between Avenor and Graphic Road.

#### Characteristics of the Specific Disposal Sites

##### *Proposed Temporary Holding Site*

The proposed temporary holding area for dredge material is located on the western bank of the Odaw channel along the Ring Road West and shares boundaries with the Agbogloboshie scrap yard, all within the Odaw catchment area. The characteristics of the site have already been described above.

##### *Proposed Final Disposal Site*

The Kpone Landfill is a potential site for the final disposal of the residual dredge material (about 10% of the total dredge material) after the recovery of sand. It is located in Kpone, a suburb of Tema which is about 33 km from the dredge site and can be accessed by the Accra –Tema Highway. The site lies in the coastal savanna zone of Ghana and experiences dry equatorial climate with a mean annual rainfall ranging between 730mm to 790mm. The vegetation zones in the area are mainly shrub and grassland. The geology of the district is Precambrian rocks of the Dahomeyan formation ie : metamorphic rocks mainly consisting of granite, gneiss and schist have been derived from sedimentary layers.

The landfill was originally designed to serve the Tema Metropolitan Assembly however it currently serves a population of 1 million persons, accepting 95% of waste generated in the Greater Accra Metropolitan Area.

#### Sediment characteristics

The results show that the soil texture is mostly sandy (mostly over 90%) with particles ranging from very fine sand to a composite of medium sand. The dredge material is therefore less likely to be contaminated as sand material generally has a low capacity to retain pollution including heavy metals. This observation was confirmed by the results of the sediment analysis.

It is further inferred from the results of the laboratory analysis on both water and sediment that despite the poor sanitary conditions and visual quality of the water and sediments arising from the intensive land use activities within the catchment, the expected dredge materials are not contaminated with heavy metals and organic compounds. The sand component of the dredge material could therefore be recovered and considered for re-use.

### **Stakeholder Consultations**

Key stakeholders to the proposed Odaw dredging project were consulted in November 2018 and February 2019. These include regulatory bodies, local government institutions and community members. Stakeholder consultation is an on- going process and would continue throughout project implementation.

The stakeholders consulted are grouped under the following headings:

- Project proponents;
- Regulatory institutions; and
- Other stakeholders.

#### *Project Proponents*

- Ministry of Works and Housing ;
- Hydrological Services Division
- Ministry of Sanitation and Water Resources being represented by the Project Coordinating Unit (PCU)

#### *Regulatory Institutions*

- Environmental Protection Agency (EPA),
- Accra Metropolitan Assembly
- Water Resources Commission
- FC- Wildlife Division

#### *Other Stakeholders*

- Zoomlion- Dredge Masters
- Dredge International -KLERP
- Opinion Leaders of Beneficiary Communities
- Project Affected Persons (PAPs)

### **Key Issues of Concern by stakeholder**

Some key issues expressed by some of the main stakeholders which have contributed to the design of the mitigation and management plans for the project are summarized as follows:

1. The Assembly members emphasized the recurrent siltation of the channel/basin which results in floods is mainly due to lack of management and poor sanitation practices of inhabitants along the area. The government must develop a plan that allows for periodic dredge work and regular management Also, the project must collaborate with the Assembly and the government to remove the squatters along the drain.
2. The AMA Drains and maintenance unit also informed the consultant that the structural designs of some adjoining drains are poor eg. The Nima drain flows directly into the Odaw at a right angle

unlike other drains that flow slowly at different angles into the Odaw. This results in backflow from the Nima drains whenever there are heavy rains and causes the floods in the circle area

3. Project affected Persons complained about dredge material from previous dredge works which have been left at the banks of the drain. These materials flow back into the drain when washed by the rains. There were also concerns of possible relocation and if compensation will be paid to the affected persons.
4. According to previous Dredge Engineers there are no disposal sites provided by the Government of Ghana. This has been a major challenge that is yet to be fully resolved.

#### Disclosure of ESIA Document

Further to earlier discussions and recommendations from stakeholders, subsequent meetings were held to disclose the results of the assessment and to obtain the buy-in of stakeholders particularly, the Assembly members and traditional authorities. The ESIA will be disclosed on the Banks intranet website prior to appraisal.

#### **Evaluation of potential Impacts**

Potential Positive Impacts include

- Employment Generation;
- Flood mitigation; and
- Alternative Uses of dredge material

Potential Negative Impacts for the various project Phases are as follows

##### Pre- Dredging Phase

- Occupational Health and Safety; and
- Anxiety on the part of potentially affected persons

##### Dredging Phase

- Air quality deterioration
- Noise and Vibration
- Visual intrusion/Aesthetic impacts
- Water quality deterioration
- Generation and disposal of solid waste
- Public safety and traffic impacts
- Impacts on livelihood
- Occupational health and safety
- Impacts on cultural heritage

##### Post-Dredging Phase

- Public safety and traffic Impacts
- Occupational Health and Safety
- Impacts from dredge material disposal

## Mitigation and Monitoring Measures

Impact	Mitigation measure	Responsibility	Monitoring Indicators	Responsibility
<b>Dredging Phase</b>				
Air quality deterioration	<ul style="list-style-type: none"> <li>• Ensure effective communication strategy for dredging plan to communities e.g. Through assemblyman, radio advertisements , PA systems, etc</li> <li>• Stockpiles of exposed soil and unpaved access roads to be sprinkled with water to regulate dust levels during transport of equipment and dredge material.</li> <li>• Use of good quality fuel and lubricants in vehicles, equipment and machinery.</li> <li>• Ensure that heaped dredge material is not left to dewater in the open for long periods to prevent wind and water transport of soil particles into the communities and back into the drain</li> <li>• Regular scheduled maintenance and servicing to be carried out on all vehicles and equipment to minimize exhaust emissions</li> <li>• Engines of vehicles, machinery, and other equipment to be switched off when not in use to reduce emissions.</li> <li>• Dredge works to be phased out or controlled to reduce emissions from equipment and machinery in use</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>-Intensity of foul Odour</li> <li>-Observation of air borne particulates (dust) and exhaust fumes</li> <li>-Records of dampening of roads</li> <li>-Complaints from the general public on dust pollution</li> <li>-Air quality monitoring records</li> </ul>	Contractor
Noise and Vibration	<ul style="list-style-type: none"> <li>• Excavation activities to be carried out during daylight hours.</li> <li>• Excessively noisy dredge equipment to be located away from sensitive environmental receptors.</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>-Complaints on noise nuisance</li> <li>-Noise level monitoring records</li> </ul>	Contractor

	<ul style="list-style-type: none"> <li>Regular maintenance of equipment and machinery to reduce noise generation when in use.</li> <li>Engines of vehicles, equipment and machinery to be turned off when not in use.</li> <li>Residents, traders and communities to be notified in advance of the project before mobilization to site</li> </ul>			
Visual intrusion/Aesthetic impacts	<ul style="list-style-type: none"> <li>Dredge activities to be done in sections to reduce impacts of change and visual intrusions to the general public.</li> <li>The work sites to be hoarded off from public view.</li> <li>Good housekeeping measures, such as regular cleaning, to be maintained at the work camp site.</li> <li>Ensure an acceptable post-dredged site as per provisions in the contract.</li> </ul>	Contractor	Hoarding in place -Condition of areas around excavation sites	Contractor/ Supervising Engineer
Water Quality deterioration	<ul style="list-style-type: none"> <li>During dredging, the contractor should consider slower dredging speeds to reduce the amount of material entering the water column and associated impacts</li> <li>Works not to be executed under aggressive weather conditions such as rains or stormy conditions. Also change dredge schedules based on tide and natural/background turbidity levels to minimize effects from high turbidity levels</li> <li>No solid waste, fuels, or oils to be discharged into any section of the drain or waterway.</li> <li>Dredge works to be done in sections to minimize soil resuspension and associated impacts</li> <li>Temporary sediment barriers to be installed on slopes to prevent silt from entering water courses.</li> </ul>	Contractor	-Observable change in water quality (turbidity/ excessive resuspension of sediments ) -Observable waste bins at construction sites - Immediate transport of excavated material to temporary holding sites -Flooding at project site and environs	Contractor

	<ul style="list-style-type: none"> <li>Maintenance, fuelling and cleaning of vehicles and equipment to take place at off-site workshop with adequate leakage prevention measures</li> </ul>			
Generation and disposal of dredge material and solid waste	<ul style="list-style-type: none"> <li>Specify in the Performance-Based Contract the application of Reduce, Recycle, Reuse and Recover for waste management through the following actions:</li> <li>Ensure solid waste is salvaged first and/or separate solid waste from dredge materials.</li> <li>Recovery of sand from the dredge materials to reduce the volume of materials going to the final disposal site but to also generate income from the sand recovery</li> <li>Only dredge materials sans recovered sand and solid wastes will be disposed in dredge materials disposal areas. Solid waste will be disposed at approved engineered sanitary landfill sites</li> <li>Ensure that the excavated waste( i.e. plastics and metals)is not left on site but is readily disposed off.</li> <li>Dewatered material unsuitable for backfilling will be collected from the temporary disposal site for onward disposal to the approved disposal site in collaboration with the AMA .</li> <li>Provide bins on site for temporary storage of garbage such as lubricant containers, drinking water sachets and carrier bags/packaging materials.</li> <li>All metal scrap waste will be disposed of at sites approved by the AMA or sold to approved third party agents for use by metal companies.</li> <li>Contractor to work according to a prepared and agreed Dredge Material Recovery, Disposal and Management Plan</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>-Availability and use of bins/skips</li> <li>-Records on frequency and location of solid waste disposal</li> <li>-Records on collection of recyclable materials</li> </ul>	Contractor

Public safety and traffic impacts	<ul style="list-style-type: none"> <li>Contractor to prepare a code of conduct and ensure all employers adhere and abide by it.</li> <li>Contrator to ensure temporary area for holding dredge material is properly fenced off and well-maintained.</li> <li>Work areas to be hoarded off adequately to avoid inquisitive trespassers especially children</li> <li>Warning signs to be posted around work areas to discourage trespassers</li> <li>Contractors to maintain adequate security at dredging sites to avoid pilfering or vandalising of property</li> <li>Contractors to provide traffic management plans duly approved by relevant authorities</li> <li>Adequate alternative arrangements to be made to minimize impacts on motorists and pedestrians</li> <li>Works to be completed on time to minimize inconvenience to motorists and pedestrians</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>-Absence of unauthorized persons at construction site</li> <li>-Availability and use of warning signs and cautionary tapes around excavations/trenches</li> <li>-Records on frequency and type of incident/accidents involving public</li> <li>-Availability and use of diversion/road signs or trained persons directing traffic.</li> <li>-Records of parking at unauthorized places</li> </ul>	Contractor
Impacts on livelihood	<ul style="list-style-type: none"> <li>Consult affected property owners and seek their concern prior to commencement of works</li> <li>The Contractor to liase with the AMA to ensure the Public is well informed of the proposed project prior to contractor mobilizing to sites;</li> <li>Employment and other opportunities to be given to local communities as much as possible</li> </ul>	MWH/Assembly Members/Contractor	<ul style="list-style-type: none"> <li>-Records on consultations with PAPs</li> <li>-Records on affected persons</li> <li>- Records mitigation measures</li> <li>-Records on public complaints relating to disruption of livelihoods</li> </ul>	Contractor
Occupational health and safety	<ul style="list-style-type: none"> <li>Engage experienced workers for the proposed project</li> <li>All workers should be given proper induction/orientation on safety.</li> <li>The contractor will have a Health &amp; Safety Policy and procedures to guide the dredge activities</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>-Workers' awareness of Contractor's health and safety policy and programs</li> <li>-Availability and proper use of PPEs</li> <li>-Availability and proper use of warning signs</li> <li>-Availability of first aid kit</li> </ul>	Contractor

	<ul style="list-style-type: none"> <li>The contractor will ensure all workers adhere to the Code of Conduct</li> <li>Regularly service all equipment and machinery to ensure they are in good working condition.</li> <li>Ensure there are first aid kits on site and a trained person to administer first aid.</li> <li>Provide and enforce the use of appropriate personal protective equipment (PPE) such as safety boots, reflective jackets, hard hats, hand gloves, earplugs, nose masks, etc.</li> <li>Proof of competence for all equipment/machine operators will be required and established through inspection of valid drivers or operator's license or documents.</li> <li>Comply with all site rules and regulations.</li> <li>Apply sanctions where safety procedures are not adhered to.</li> <li>Site meetings should create awareness on OHS.</li> </ul>		<ul style="list-style-type: none"> <li>-Adherence to health and safety procedures</li> <li>-Records on frequency, type and source of illness/accident/injury</li> <li>-Records on non-compliances</li> </ul>	
Impacts on cultural heritage	<ul style="list-style-type: none"> <li>Traditional authority, Korle -We responsible for the sanctity of river gods should be consulted</li> <li>Necessary cultural rites agreed with community and performed prior to access to water bodies</li> </ul>	Contractor/Assembly members/Traditional Authorities.	-Records on engagements with Traditional Authorities	Supervising Consultant /MWH/GARID PCU
<b>Post – Dredging Phase</b>				
Public safety and traffic Impacts	<ul style="list-style-type: none"> <li>Encourage public reporting of illicit discharges and disposal of garbage into the drain by creating awareness among community members and also providing a means of reporting</li> <li>Regular inspection of the condition of drain structures and identifying areas that need repair or maintenance.</li> </ul>	Contractor/AMA – Drains and Maintenance Unit/MWH	<ul style="list-style-type: none"> <li>-Records of Dredge Material Recovery, Disposal and Management Plan /schedule communicated to the general public</li> <li>-Transport of dredge material during off peak traffic periods</li> </ul>	Contractor

	<ul style="list-style-type: none"> <li>Establish routine maintenance program, including: Development of an inventory of system components, with information including age, materials used/required, drainage areas served, elevations, etc.</li> <li>Regularly review previous maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure.</li> <li>Adequate alternative arrangements to be made to minimize impacts on motorist and pedestrians</li> <li>Excavated material will be appropriately disposed immediately where applicable to prevent health and sanitation risks for community member’s</li> </ul>		<ul style="list-style-type: none"> <li>-Good housekeeping practices within excavation area</li> <li>-Proper handling of waste material</li> <li>-No trespassers on active construction sites</li> <li>-Availability and use of warning signs and cautionary tapes around excavations and other dangerous areas</li> <li>-Records on frequency and type of incident/accidents involving public</li> <li>- Availability of bins at construction site</li> <li>-Proper and regular disposal of waste generated</li> </ul>	
Occupational Health and Safety	<ul style="list-style-type: none"> <li>Prepare and adhere to OHS Policy and procedures</li> <li>Maintain work areas to avoid accidents</li> <li>A safety and emergency response plan must be developed for all operations with due importance given to the protection of the environment</li> <li>Provide field workers with personal protective equipment, such as rubber gloves and overalls, and waterproof shoes;</li> <li>Provide workers with regular health checks</li> </ul>	Contractor	<ul style="list-style-type: none"> <li>Workers’ awareness of health and safety policy</li> <li>-Availability and proper use of PPEs</li> <li>-Availability and proper use of warning signs</li> <li>-Availability of first aid kit</li> <li>-Adherence to health and safety procedures</li> <li>-Records on frequency, type and source of illness/accident/injury</li> <li>-Records on non-compliances</li> <li>-Records on training and awareness creation on health and safety</li> </ul>	Contractor
Dredge material disposal	<ul style="list-style-type: none"> <li>The contractor will be required to prepare a Dredge Material Recovery, Disposal and Management Plan duly approved by the</li> </ul>	Contractor/MWH/AMA	<ul style="list-style-type: none"> <li>- Dredge Material Recovery, Disposal and Management Plan</li> </ul>	Cotractor

	<p>Project and based on the approved disposal options specified in this ESIA.</p> <ul style="list-style-type: none"> <li>• Ensure that a temporary area for storing dredge materials and sand recovery will be identified and selected by the contractor upon approval of the project</li> <li>• Excavated earth materials will, as much as possible, be re-used for back filling purposes to reduce waste</li> <li>• Contrator to ensure temporary area for holding dredge material is properly fenced off and well-maintained.</li> <li>• Dredged material will be tested and disposed of appropriately</li> <li>• Excavated materials and silt, which cannot be used will be disposed off at appropriate sites as per the Dredge Material Recovery, Disposal and Management Plan prepared by contractor and approved by the AMA. The rampant practice of heaping de-silted materials by banks which are later washed back into drains after rain events will be avoided</li> </ul>		<p>-Good housekeeping practices within excavation area</p> <p>-Proper handling of waste material</p> <p>- Proper records on waste disposal</p>	
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## **Environmental and Social Management Plan**

An Environmental and Social Management Plan (ESMP) is developed for the project in accordance with the Environmental Assessment Regulations of 1999, LI 1652 and OP 4.01 to assist the Odaw dredging project to be carried out in an environmentally safe and sustainable manner

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

- Development of a Dredge Material Recovery, Disposal and Management Plan
- Adoption of Environmental Health and Safety Plan
- Environmental, Health and Safety management Structuring
- Environmental Health and Safety Committee
- Contractors ESMP
- Workers' training and awareness creation
- Environmental and Social Monitoring Programmes
- Archaeological and Cultural Heritage chance find procedure
- Community Safety and Traffic Management Plan
- Public and community participation;
- Provisional Grievance Redress Mechanism
- Audits and Reviews; and
- Environmental and social management budgeting

The ESMP, including the Dredge Material Recovery, Disposal and Management Plan and all other environment and health & safety plans, will be implemented by the Dredge Contractor based on a performance-based contracting. The contractor will be supervised by the owner's Supervision Consultant under a close supervision by the PCU's Environmental and Social Specialists.

## **Institutional Arrangements**

This chapter discusses the institutional roles and responsibilities as well as training and capacity building requirements to ensure the successful implementation of environmental and social management measures for the Odaw dredging Project.

## **Disclosure of the ESIA Report**

The findings from the assessment were disclosed to the Assembly members/opinion leaders of the respective Electoral areas for their further appreciation of environmental and social safeguards being put in place to ensure a successful project. The World Bank will also disclose the ESIA on their website prior to the introduction of the project to the Bank's Board.

## **Conclusion**

MWH is committed to ensuring sustainable environmental management and safeguarding the health and safety of the general public in the implementation of the Odaw dredging project. MWH is committed to ensuring that the project complies with good international industry practice in environment and social sustainability as well as national environmental laws and regulations of Ghana. About USD 397,000.00 (excluding contractor budget) will be required for environmental management including reporting.

The environmental and social impacts outlined in this document as well as mitigation and monitoring measures will be implemented by the Contractor and monitored by the Supervising Consultant and MWH/GARID PCU to ensure effective implementation of the project.

## **1.0 INTRODUCTION**

### **1.1 Background**

The Odaw River and its tributaries Nima, Onyasias, Dakobi and Ado have a total catchment area of 270 km<sup>2</sup> and drain the major urbanized areas of Accra, including Accra Metropolitan Assembly, Ga East, Ga West and Adentan Municipal Assemblies further upstream. In terms of population and basin activities, the AMA is by far the most dominant Assembly with over 65% of the total population. The high population figure of the city, estimated at about 4.3 million within the GAMA is both an asset and source of worry. While the relatively high population serves as a huge and vibrant market for investors and traders, it also poses a problem of sanitation and waste management. (MWH, 2018)

The Government of Ghana (GoG), through the Ministry of Works and Housing, has requested IBRD/IDA credit facility from the World Bank for investment in both structural works and nonstructural services towards improving flood and solid waste management in the Greater Accra Metropolitan Area. The works and services will be delivered through a proposed project– The Greater Accra Urban Resilience and Integrated Development (GARID) Project.

The GARID project will span 10 to 12 years to provide long term solutions to flooding and associated challenges facing Greater Accra region. Phase I of the proposed project focuses on the Odaw river basin. The Odaw River and its tributaries Nima, Onyasias, Dakobi and Ado drain the major urbanized areas of Accra, including among others, Accra Metropolitan Assembly, Ga East, Ga West and Adentan Municipal Assemblies further upstream. This river basin has the highest population density in the country, containing 60% of entire Greater Accra Region population, and is affected by chronic flooding with an estimated 30% of the population at risk living in informal settlements subject to regular flooding.

### **1.2 Objectives of the Project**

The main objectives of the GARID Project are to (1) Strengthen flood and solid waste management; and (2) Improve the living conditions of the most vulnerable communities in the Odaw Basin in the Greater Accra Region.

This Environmental and Social Impact Assessment (ESIA) will assess the environmental and social risks and impacts of dredging, transport and disposal of dredged materials based on available information at hand and general knowledge of the project without the benefit of a feasibility study and detailed engineering design. The main focus of the ESIA will be to assess the quality and potential quantity of the sediments in the Odaw channel that will be dredged and its subsequent impacts and risks on environment and people. Various disposal and management options for the dredged materials will be studied and analyzed in this ESIA. The findings and recommendations of this ESIA will feed into a more comprehensive ESIA that will be conducted alongside the detailed feasibility study and the Performance-based contracting (PBC) approach that will engage a contractor to undertake the dredging activity based on pre-agreed performance standards, including disposal and management of dredged materials.

The Project has been classified as Category A in accordance with the World Bank's policy requirements. Therefore, an Environmental and Social Impact Assessment (ESIA) is required as a condition for Project financing. The Ghana Environmental Protection Agency (EPA) environmental assessment regulations also require environmental impact assessment of any undertaking which has the potential for negative impacts on both humans and environment.

### **1.3 Specific Objectives of the ESIA**

The objectives of this ESIA are to: (i) collect baseline data on physical characteristics of the Odaw basin, including different land uses, water and sediment quality of areas to be dredged and its area of influence and socio-economic data; (ii) analyze and characterize the sediment materials from a cross section of the basin maintaining representativeness of the Basin area from Caprice to the coast for physical, chemical, biological and engineering properties to inform the evaluation of dredge materials re-use and disposal options (iii) conduct an analysis of the disposal and management alternatives/options of dredge materials keeping in mind the impacts on the river flow from both upstream and downstream on how this would affect future sedimentation depending on the location of the dredging and impacts on communities within the transport routes of the dredge materials. Analysis of alternatives will include but will not be limited to: (a) dredging methods/techniques that will have least impact on environment and people; (b) disposal options based on characterization of the dredge materials; (c) transport system and route of dredge materials; (d) dredging and no dredging options.

### **1.4 Scope of the ESIA**

The Scope of the assignment comprise the following:

- Undertake field visits towards the collection of information and data for the environmental and social study.
- Hold interviews and consultations with Planning Officers of the MMDAs, Local Government Officials, key Government agencies and communities within the Odaw basin.

#### Environmental Assessment

The assessment included the following sets of activities:

- Collect surface water samples along various points of Odaw Channel for physico-chemical analysis;
- Collect and analyze sediment samples from various representative points and depths, where dredging is anticipated or planned, to determine the physio-chemical characteristics of the sediment, including but not be limited to heavy metals, hydrocarbons and other hazardous chemicals, which will be critical in determining disposal and management options of the dredged materials;
- Based on sediment quality, analyze various alternatives for the transport, disposal and management of dredged materials and their pros and cons, including cost, keeping in mind the health and safety of the communities living in the influence area of the anticipated dredged material disposal transport routes and sites and road safety and traffic constraints in Accra.
- Among the dredged materials disposal and management options to be looked into shall include but will not be limited to:
  - Dredged material should be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse

of uncontaminated, dredged material should be considered (e.g. for wetland creation or enhancements, habitat restoration, or creation of public access / recreational facilities);

- Use of submerged discharges should be considered for hydraulic disposal of dredged material;
  - Use of lateral containment in open water disposal should be considered. Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms;
  - Use of cap containment sediments with clean materials should be considered. Level bottom capping or a combination of borrow pits / dikes with capping reduces the underwater spread of contaminated material;
  - Confined disposal facilities should be used, either nearshore or upland, when open water disposal is not feasible or desirable. If dredge spoil is contaminated, confined disposal facilities should include liners or other hydraulic containment design options to prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) may be required prior to discharge. Site-specific discharge quality standards should be established depending on the type and toxicity of the effluents and the discharge location.
- Collect preliminary socio-economic data within the project area based largely on published records and secondary information.
  - Document the minutes of consultations, the issues raised and how these issues will be addressed in the ESIA.

## **1.5 Data Analysis and Reporting**

This Environmental and Social Impact Assessment Report evaluates issues in a manner which is consistent with their relative significance. The report is compliant with Ghana's EA and environmental requirements and the Bank's environmental policies and consistent with the following outline:

### **Executive Summary**

#### **Main Report:**

- General and Specific objectives
- Policy, Legal and Administrative Framework.
- Project Description (Focused on Dredging Operation).
- Baseline Data
  - Physical
  - Biological
  - Chemical
  - Socio-economic

The baseline includes an analysis of the quality of water and sediments that will be removed in order to know if the dredging material requires special treatment at the final disposal.

- Analysis of Alternatives (mainly on various disposal and management options of the dredged materials, disposal sites, dredging technologies, transport routes of the dredged materials, etc.
- Impact assessment of various options for dredge materials disposal

- Management measures and/or options for dredging, transport and disposal of dredged materials

c. **Appendices:**

- References;
- Other Appendices as Appropriate.

## 2.0 PROJECT DESCRIPTION

This chapter provides a general description of the proposed project area as well as some activities to be undertaken to implement the project.

### 2.1 Description of the Odaw channel/Basin

The Odaw River runs through the Accra metropolis and flows through numerous communities into the Korle Lagoon and finally enters the Atlantic Ocean. The major tributaries are the Onyasia River and the Nima Stream. The catchment covers an area of 270 km<sup>2</sup>. The Odaw River catchment is approximately 30km long. The widest part of the catchment is just over 10km wide. Korle Lagoon occupies a large portion of the lowest-lying area of the basin and stretches northwards about 1.5km. A more detailed description and Figures showing the project area is provided in the Baseline Environmental and Social Conditions in **Chapter 6**.

#### 2.1.1 Korle Lagoon

Three main waterways convey their flows into the Korle lagoon namely Odaw stream, Kaneshie stream and the Agbobbloshie stream. The Korle lagoon is divided into the Upper lagoon extending from the Klerp interceptor to the Guggisberg Bridge and the lower lagoon, which extends from the Guggisberg bridge southwards to the Winneba bridge with its outfall into the ocean (Gulf of Guinea). The total surface area of the lagoon is 243,292m<sup>2</sup> with a length of 1.422km and an average width of 195.70m.

### 2.2 Project Area /Areas to be dredged

Four (4) typical sections will be dredged under the proposed project. The dredge areas will begin from the confluence between Onyasia and the Odaw channel (landmark Caprice) and slope downstream to the Korle –Lagoon into the sea. The exact locations of dredging are yet to be fully identified or located based on detailed feasibility studies and the detailed design to be completed. The proposed areas (**See Table 2-1 and Figure 2-1**) include :

- 1) Caprice – Abossay Okai bridge : Lined section of Odaw River channel with high sedimentation rates and the most frequently flooded area.
- 2) Abossay-Okai bridge – Interception weir: Wider unlined section of the Odaw with fixed banks. The section runs through waste disposal areas and a large informal settlement called Old Fadema.
- 3) Interception weir – Sea: “Korle Lagoon” Area.
- 4) Main Odaw River tributaries: South Kaneshie (including Cemetery drain and Mataheko drain), Nima drain and Agbobbloshie drain.

Details of the proposed areas to be dredged are provided in **Table 2-1**.

**Table 2-1: Details of Proposed Areas to be dredged**

<b>Location</b>	<b>Length(m)</b>	<b>Average Width(m)</b>	<b>Average Depth (m)</b>	<b>Area (m<sup>2</sup>)</b>	<b>Volume (m<sup>3</sup>)</b>
Lower lagoon	770	166	2.5	190632.3	476580.7
Upper Lagoon	549	83	1.5	119059.9	178589.9
Island around Old fadama	419	127	3	42299.46	126898.38
Canal	1503	69	1.5	103707	155560.5
Odaw channel	3854	35	0.8	134890	107912.0
South kaneshie	1699	15	1	25485	25485.0
Agbogbloshie	871	15	1	13065	13065.0
<b>TOTAL</b>	<b>9,665</b>				<b>1,084,091.42</b>

### **2.2.1 Expected Dredge Volume**

It is estimated that 40,000m<sup>3</sup> of dredge material accumulates in the Odaw basin annually and must be removed. Currently, the accumulated silt to be removed from the basin is 1,084,091.42 m<sup>3</sup>.

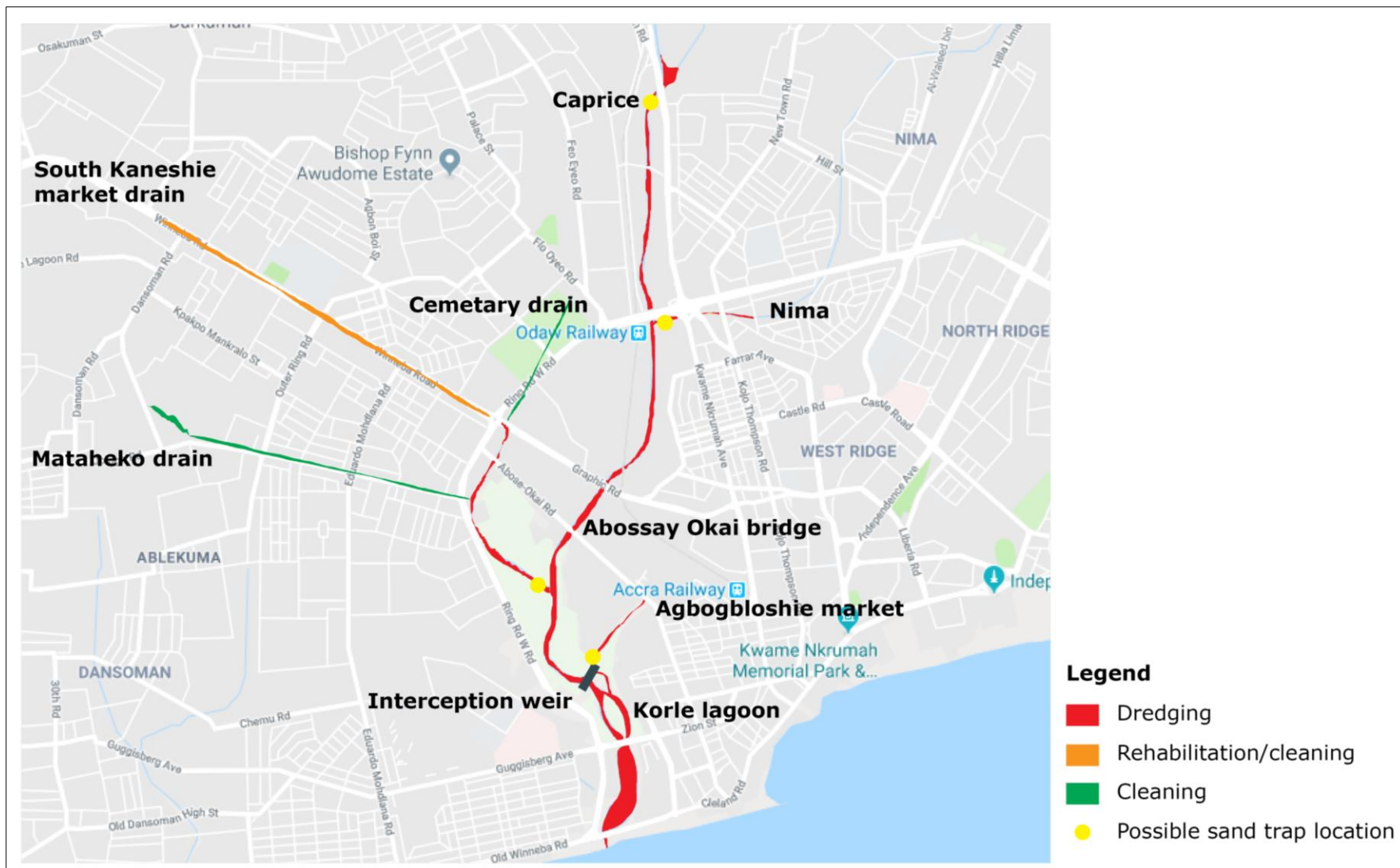


Figure 2-1:Project area with Proposed interventions (Source:Tender Document,2018)

## 2.3 Description of Project Activities

The Government of Ghana foresees the need to invest in flood protection infrastructure interventions in order to mitigate the effects of the heavy rainfall, flash floods during the wet season and the adverse impact of climate change on the country's development. The implementation of the project will be preceded and determined by a feasibility and design study. The study will assess the feasibility of deferred and routine maintenance dredging options from a technical, economic, financial, environmental and social perspective of the main Odaw River channel.

The feasibility study will include:

- Environmental water and dredged material analysis and survey of dredging loads
- An assessment of the needs and prioritization (based on modelling – where floods occur and their relative impact) for dredging, cleaning and rehabilitation
- Actual deferred dredging volume from the Korle lagoon and upstream channel plus the sections of tributaries within the proposed project area. Also, the estimated yearly accumulated re-sedimentation volume for the annual maintenance dredging period
- An assessment of suitable sand trap locations for sufficient sand storage capacity that will accumulate each year
- Possible temporary handling and/or final deposit areas.
- Assessment of possibilities to make the interception weir functional; and
- Analyze potential institutional set-ups for the approved sediment handling site(s) and sand traps

The ESIA will be updated based on the feasibility study and detailed engineering design that are yet to be completed. The Feasibility Study and the ESIA will be interrelated as the Feasibility Study will build on outputs of the ESIA, the ESIA will also build on outputs of the Feasibility Study e.g. Impacts, optimisation and mitigation measures, elaborate project definitions of selected options, etc.

Detailed project activities will be determined from the feasibility and design studies. It is expected that the project scope will be more clearly defined when all these studies are finalized.

### **3.0 BRIEF DESCRIPTION OF APPROACH AND METHODOLOGY FOR THE STUDY**

The approach and methodology for the environmental study involved the following:

- Desktop study and literature reviews;
- Reconnaissance visits and site inspections;
- Public/stakeholder consultations and meetings ;
- Baseline information gathering, including:
  - Climatological/weather study;;
  - Geology and Soil;
  - Topographic survey;
  - Socio-economic characteristics (demography, gender, employment, industry).
- Design and implementation of water and sediment data collection program
- Identification and Assessment of project impacts and mitigation measures; and
- Preparation of Environmental and Social Management Plan and Monitoring Plans

#### **3.1.1 Review of Available Literature**

The key documents identified and reviewed for the environmental study of the proposed dredging project include:

- Environmental and Social Management Framework (ESMF) for the GARID: This report defines the procedures for screening and further environmental assessment of sub-projects which includes the proposed dredging project. It provides the framework of principles as well as regulatory and institutional arrangements within which to mitigate negative environmental and social impacts of the project
- Some relevant local and international environmental assessment reports relating to dredging projects, such as:
  - Minnesota Pollution Control Agency, Managing Dredge Materials, 2014
  - Australian and New Zealand Guidelines for Fresh and Marine Water Quality released in 2000 (ANZECC/ARMCANZ, 2000).
  - ESIA for Tema LNG Terminal Project, August 2018 (included the dredging of the Tema Port) etc.
  - World Bank Industry and Sector Guidelines for Ports and Harbours (includes dredging)
- District Analytical Report, Accra Metropolitan Assembly, 2010 Population and Housing Census, October 2014;
- Relevant laws and other strategic planning documents at the national and sector levels;
- World Bank Group Operational Safeguard Policies and Environmental and Health Safety Guidelines;
- Relevant academic research work carried out within the project's area of influence (see Section 13 under bibliography); and
- Base maps of the project area.

#### **3.1.2 Site Inspections**

A reconnaissance visit was conducted on 16<sup>th</sup> October 2018 to identify the nature of the biophysical environmental media, possible environmental impacts and the probable geographical area of

influence of the Project. The pictures below show some areas along the Odaw channel within the project area.



Plate 3-1: From Avenor to Circle(left)and from Circle overhead to Graphic Road (Right)



Plate 3-2: From Agbogbloshe to Old Fadama (left) and from Old Fadama to the Korle (right)

### 3.1.3 Public/Stakeholder Identification and Consultations

Project stakeholders were engaged severally to understand the project scope, design and implementation and to obtain relevant project documents. Key stakeholders were consulted between November 2018 and February 2019 to obtain their comments and concerns on the proposed project with respect to the potential environmental and socio-economic issues. The stakeholders consulted include the following:

#### *Project proponents:*

Project Proponents include the following

- Ministry of Works and Housing
- Hydrological Services division (HSD)
- Ministry of Local Government and Rural Development being represented by the Project Coordinating Unit (PCU)
- Accra Metropolitan Assembly and
- Design engineers

#### *Regulatory Agencies*

- Environmental Protection Agency (EPA), Accra;
- Water Resources Commission;
- Environmental Sanitation Directorate of the Ministry of Local Government and Rural Development
- Accra Metropolitan Assembly– Drains Maintenance and Waste Management Unit

#### *Other Stakeholders*

- Project Affected Persons
- Farmers /Fishermen along Korle Outfall

### **3.1.4 Design and implementation of water and sediment data collection program**

#### **3.1.4.1 Sampling Locations**

The total number of sediment and water samples as well as the location of the sampling points within the Odaw basin were determined and agreed with the client at the start of the assignment, based on budgetary considerations.

Ten (10) sampling locations (from PT 1 to PT10) were identified and selected within the Odaw basin catchment taking into consideration the different basin activities comprising the location of settlements, cattle rearing, auto mechanics, markets etc. PT10 was the most upstream location which was chosen to represent background conditions within the channel. **Figure 3-1** shows the sediment and water sampling points selected for the assessment.

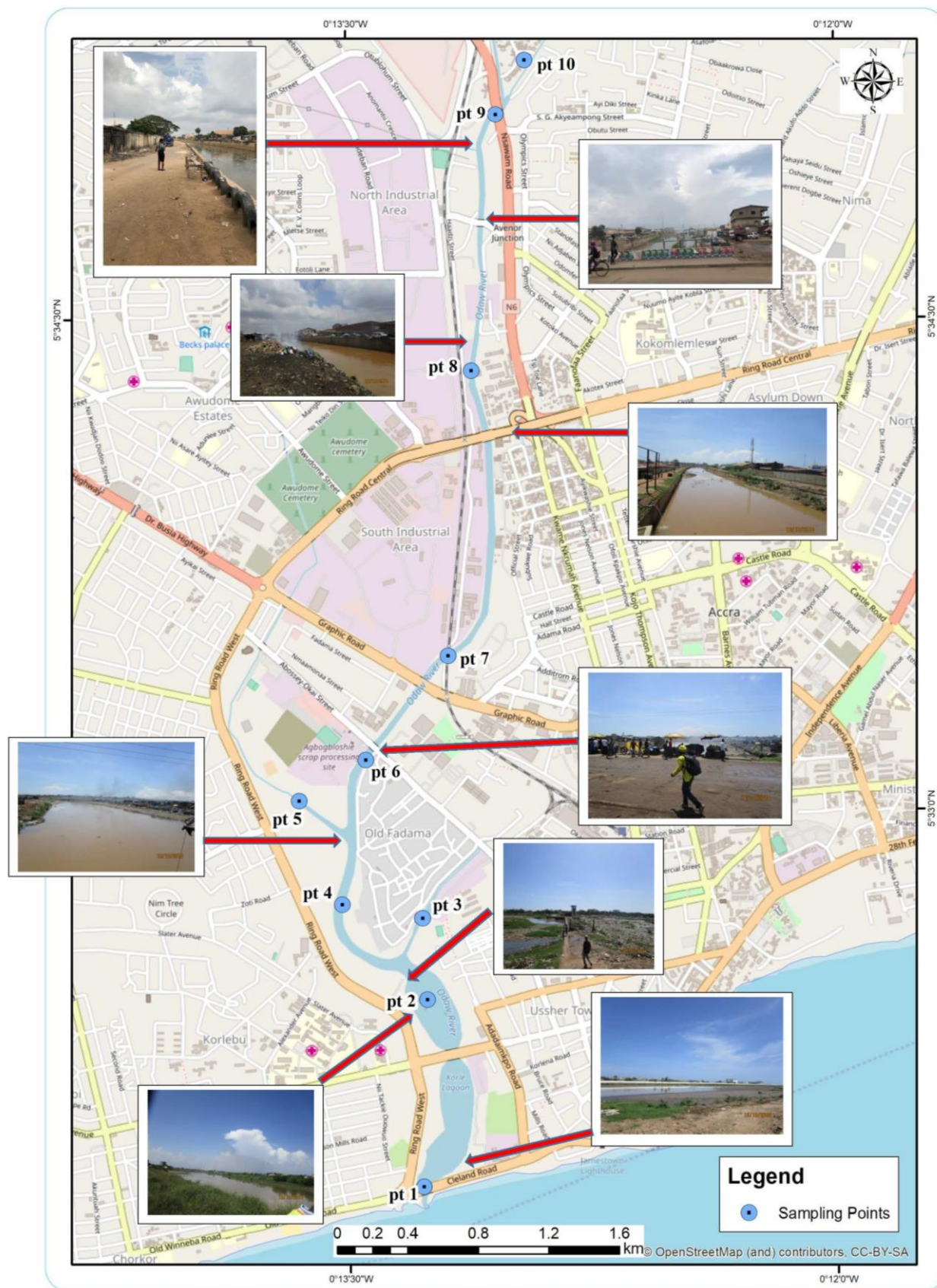


Figure 3-1: Location of Sampling Points

#### 3.1.4.2 Sampling Methodology

Sediment and water samples were collected in December 2018 to establish options for the subsequent treatment and use of this material. The samples were analysed at the Water Research Institute- CSIR which is a competent national research institution, and was subcontracted to participate in the sampling and analyses program. Special equipment (core borers, boat etc.) were mobilized for the sampling exercise. For sections of the drain where suitable, samples were obtained from the boat. The accredited laboratories used standard methods involving digestion and Atomic Absorption Spectrophotometry and Gas Chromatography for the analysis.

For the sediment samples, the core borer was hammered into position, usually to the bottom of the channel (mostly to about 1.5m) but lower at the lined sections of the drain. The sediments were emptied into a plastic bucket and finally into zip lock bags and taken to the laboratory for analysis. The samples were taken from the mid- channel.

Surface water samples were collected at each sampling point in 1 litre plastic bottles and sent to the laboratory for analysis.



Plate 3-3: Sampling along some sections of the channel.



**Plate 3-4: sampling from silted sections from Graphic road Bridge (left) and Circle (Right)**

#### **3.1.4.3 Sampling Challenges**

Challenges encountered during the sampling include

- Difficulty in the coring due to high plastic waste materials deposited within the stratum, and
- High solid waste on the water surface resulting in difficulty in navigation between sampling points with the canoe

#### **3.1.5 Laboratory analyses**

The samples were taken to the laboratories of the Water Research Institute (WRI) of the Council for Scientific and Industrial Research (CSIR) for analysis. Standard methods were followed in digesting the sediment samples and in the use of Atomic Absorption Spectrophotometry (AAS) for metals analyses and Gas Chromatography (GC) for organic compounds.

## 4.0 RELEVANT POLICIES, LEGAL AND ADMINISTRATIVE FRAMEWORKS

The Ministry of Works and Housing, under the Greater Accra Resilient and integrated Development project is committed to adhering to the requirements of all applicable policies and laws associated with the dredging of the Odaw basin. The relevant national and legal policies, institutional framework as well as World Bank safeguards policies to guide the implementation of the proposed dredging are described under this section. This is to ensure sustainable development and compliance with national and international regulations.

### 4.1 National and Sector Policies and Plans

The national and sector policies and plans identified to be relevant to the proposed Dredging Project have been discussed in **Table 4-1**.

**Table 4-1; Relevant Policy Framework**

	Policy and Key Compliance Requirements	Applicability to Proposed Project
16.	<b><u>National Environmental Policy, 2013</u></b> The ultimate aim of the Policy is to improve the surroundings, living conditions and the quality of life of the entire citizenry, both present and future. It seeks to promote sustainable development through ensuring a balance between economic development and natural resource conservation. The policy thus makes a high quality environment a key element supporting the country's economic and social development.	The proposed project seeks to promote sustainable development by including economic, social and environmental considerations.  The implementation of the project will conform to the environmental laws of the country, which includes registration with EPA, Preliminary Environmental and Social Assessment and obtaining an environmental permit prior to commencement.
17.	<b><u>National Land Policy, 1999</u></b> The key aspects of the policy relevant to the project include: <ul style="list-style-type: none"><li>• The use of any land in Ghana for sustainable development, the protection of water bodies and the environment and any other socioeconomic activity will be determined through national land use planning guidelines based on sustainable principles in the long-term national interest.</li><li>• Land categories outside Ghana's permanent forest and wildlife estates are available for such uses as agriculture, timber, and mining and other extractive industries, and human settlement within the context of a national land use plan.</li><li>• All land and water resources development activities must conform to the environmental laws in the country and where Environmental Impact Assessment report is required this must</li></ul>	The project site is not a protected area and does not lie in a forest or wildlife zone.

	Policy and Key Compliance Requirements	Applicability to Proposed Project
	be provided. Environmental protection within the 'polluter pays' principle will be enforced.	
18.	<p><b><u>National Environmental Sanitation Policy, June, 2010</u></b></p> <p>The policy is aimed at developing and maintaining a clean, safe and pleasant physical environment in all human settlements, to promote the social, economic and physical well-being of all sections of the population. It comprises a number of complementary activities, including the construction and maintenance of sanitary infrastructure, the provision of services, public education, community and individual action, regulation and legislation.</p>	The design and implementation of the proposed project will take into consideration measures to promote healthy sanitary measures as well as protect and maintain a clean and safe environment. It is aimed at improving drainage and flood management within Accra city.
19.	<p><b><u>National Health Policy, June 2007</u></b></p> <p>The National Health Policy document, which aims at creating wealth through health, among other things places emphasis on improvements in personal hygiene, immunization of mothers and children. The National Health Policy also argues that a healthy population could only be achieved if there were improvements in environmental hygiene and sanitation, proper housing and town planning, provision of safe water, safe food and nutrition and encouragement of regular physical exercise.</p>	The implementation of the proposed project will improve the flooding situation of areas within the Odaw –Korle Catchment
20.	<p><b><u>National Water Policy, July 2006</u></b></p> <p>The National Water Policy of Ghana provides a framework for the sustainable development of Ghana's water resources. It is targeted at all water users, water managers and practitioners, investors, decision-makers and policy makers within the central Governmental and decentralized (district assemblies) structures, non-Governmental organizations and international agencies</p>	The Odaw and Korle serve as main drains and flood management drains. The proposed project aims at improving conditions of the Odaw drain and Korle lagoon for effective flood water management as well as providing infrastructure for forecasting floods
21.	<p><b><u>National Riparian Buffer Policy , 2011</u></b></p> <p>The riparian buffer zone policy identifies encroachment of watercourses and wetlands as a major cause of flooding in Ghana. To remedy the situation, the policy sets out "to preserve or establish green spaces as riparian buffers along waterways in areas that are practically difficult for regeneration and reforestation of riparian vegetation as more Draft ESMF for the GARID_ March 2018 Page 74 efficient ways of preventing drinking water contamination and flooding". Measures outlined in the policy to support flood abatement are provision of minimum standards for delineating reservations for various types of water bodies, enforcement of a no development zones around water bodies and removal of unauthorized structures in reservations around water bodies</p>	The project proposes to improvements of drainage systems, and flood water management through upstream water conservation, development of green spaces and flood retention areas in Odaw drainage basin.

	Policy and Key Compliance Requirements	Applicability to Proposed Project
22.	<p><b><u>National Urban Policy Framework</u></b></p> <p>The goal of the National Urban Policy (NUP) is “to promote a sustainable, spatially integrated and orderly development of urban settlements with adequate housing, infrastructure and services, efficient institutions, and a sound living and working environment for all people to support the rapid socioeconomic development of Ghana. The policy identifies choked drains and frequent flooding as part of the key sources of environmental deterioration. The initiatives to achieve Objective 4: “Improving environmental quality of urban life”, includes to “Develop and implement a systematic programme of flood control measures in urban communities (Initiative 4.6)”.</p>	The project identifies the frequent flooding areas and choked drains i.e. the Odaw and proposes improvements.
23.	<p><b><u>National Environmental Sanitation Strategic and Action Plan, 2010</u></b></p> <p>The NESSAP is a response to the need to refocus attention on environmental sanitation in Ghana and provide clear strategies and action plans that will guide implementation by Metropolitan, Municipal and District Assemblies (MMDAs). It is a logical follow-up to the revision of the Environmental Sanitation Policy (1999) within the new framework of national planning that requires comprehensive sector policies and strategic plans and investment costs</p>	The Proposed project is in line with the strategy of systematic implementation of interventions for improving environmental sanitation infrastructure and services in Ghana following laid down planning processes as in the NESSAP.

## 4.2 National Legal Framework

The relevant regulatory obligations to guide this project from the conceptual stage through implementation and monitoring to decommissioning have been outlined in **Table 4-2** under this section.

**Table 4-2: Relevant legal Framework**

No.	Legal Framework and Key Compliance Requirements	Applicability to Proposed Project
1.	<p><b><u>The Constitution of the Republic of Ghana, 1992</u></b></p> <p>The Constitution includes some provisions to protect the right of individuals to private property, and also sets principles under which citizens may be deprived of their property in the public interest (described in Articles 18 and 20). Article 18 provides that “Every person has the right to own property either alone or in association with others.”</p>	MWH, being a public entity, will ensure that the project complies with relevant constitutional provisions. Damage to any property will receive appropriate reinstatement and or compensation payment in line with the constitution.
2.	<p><b><u>The State Lands Act 1963, Act 125</u></b></p> <p>The Act 125 vests the authority to acquire land for the public interest in the President of the Republic. It also gives responsibility</p>	The Odaw Channel/Drain has a mandatory drain reservation of about 50m on either side.

No.	Legal Framework and Key Compliance Requirements	Applicability to Proposed Project
	for registering a claim on the affected person or group of persons, and provides details of the procedure to do this. The State Lands Act, 1962 provides some details to be taken into consideration when calculating compensation such as definitions for (1) cost of disturbance, (2) market value, (3) replacement value, and so on.	
3.	<p><b><u>Environmental Protection Agency (EPA) Act 1994, Act 490</u></b></p> <p>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. The EPA is the responsible for issuing environmental permits for operations such as this project subject to EPA review.</p>	The implementation of proposed project will be in compliance with the Environmental Assessment (EA) procedures for approval of the EPA. An EPA permit will be obtained and the permitted conditions complied with during project implementation.
4.	<p><b><u>Lands Commission Act 767</u></b></p> <p>The Lands Commission Act 2008 re-establishes the Lands Commission to integrate the operations of public service land institutions in order to secure effective and efficient land administration to provide for related matters. The objectives of the Commission include among others to:</p> <ul style="list-style-type: none"> <li>• Promote the judicious use of land by the society and ensure that land use is in accordance with sustainable management principles and the maintenance of a sound eco-system; and</li> <li>• Ensure that land development is effected in conformity with the nation's development goals.</li> </ul>	The proposed project development is in line with the nations development Goals
5.	<p><b><u>Environmental Assessment Regulations 1999, LI 1652</u></b></p> <p>The Environmental Assessment Regulations 1999 (LI 1652) enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to commencement of the project. This regulation allows the EPA to place proposed undertakings at the appropriate level of environmental assessment.</p>	The development of the proposed project is being guided by LI 1652 including registering with the EPA and obtaining an environmental permit.
6.	<p><b><u>The Fees and Charges (Amendment) Instrument, 2015 (LI 2228)</u></b></p> <p>The Fees and Charges (Amendment) Instrument 2015 (L.I. 2228) provides comprehensive rates, fees and charges collectable by Ministries, Department and Agencies (MDAs), such as the Environmental Protection Agency, for goods and services delivered to the public.</p>	MWH, in obtaining an environmental permit from the EPA, will pay all necessary fees and charges as prescribed by LI 2228
7.	<p><b><u>Local Governance Act 2016 (Act 936)</u></b></p> <p>This Act establishes and regulates the local government system and gives authority to the RCC and the Metropolitan/Municipal/District Assembly to exercise political and administrative power in the Regions and District, provide guidance, give direction to, and supervise all other administrative authorities in the regions and district respectively. The Assembly is mandated to initiate</p>	Accra Metropolitan Assembly is the main Metropolitan Assembly with jurisdiction over the Project area

No.	Legal Framework and Key Compliance Requirements	Applicability to Proposed Project
	programmes for the development of basic infrastructure and provide municipal works and services as well as be responsible for the development, improvement and management of human settlements and the environment in the district.	
8.	<p><b><u>The Labour Act 2003, Act 651</u></b></p> <p>Section 118(1) of the Labour Act 2003 (Act 651) stipulates that it is the duty of an employer to ensure that every worker employed works under satisfactory, safe and healthy conditions.</p> <p>Act 651 contains a number of specific provisions relating to an employer's duty of care to its workers. These include providing and maintaining "at the workplace, plant and system of work that are safe and without risk to health" and taking "steps to prevent contamination of the workplaces by, and protect the workers from, toxic gases, noxious substances, vapours, dust, fumes, mists and other substances or materials likely to cause risk to safety or health".</p>	This Act requires MWH and the contractors to ensure the welfare of workers and ensuring the safety and health of workers by providing a safe working environment and providing the required apparatus and measures to mitigate impacts.
9.	<p><b><u>Workmen's Compensation Law 1987</u></b></p> <p>It is to provide for the payment of compensation to workmen for personal injuries caused by accidents arising out and in the course of their employment. The tenets of the law places a large share of the burden of supporting workers injured at the workplace on the shoulders of the employers.</p>	The Law enjoins MWH as an employer to ensure and be responsible for the safety of workers and ensure appropriate compensation is paid to workers for injuries arising in the course of work
10.	<p><b><u>Land Use and Spatial Planning Act (Act 924), 2016</u></b></p> <p>The Town and Country Planning Act 1945, CAP 84 seeks to ensure the orderly and progressive development of land, town and other areas whether urban or rural for conserving and developing resources and to preserve and improve amenities thereof, and for related matters. It is the principal legislation in force regulating the general planning and development of human settlements.</p>	The proposed area is a drainage basin with residential/commercial facilities along the channel. The development is thus in accord with the objectives of the Metropolitan assembly.

### 4.3 Institutional Framework

Table 4-3; Institutional Framework

No.	Institutional Framework and Key Compliance Requirements	Applicability to Proposed Project
1.	<p><b><u>Ministry Of Works And Housing(MWRWH)</u></b></p> <p>MWRWH has the overall responsibility for the initiation, the formulation, implementation and co-ordination of policies and programmes for the systematic development of the country's infrastructure requirements in respect of Works, Housing and Flood Control Systems to ensure efficiency of the sector. The Works Directorate and the Hydrological Services Department of the Ministry have direct responsibility for drainage and flood control measures.</p>	The MWRWH will coordinate the rehabilitation and maintenance of the Odaw dredging project.

No.	Institutional Framework and Key Compliance Requirements	Applicability to Proposed Project
	<p>The main objective of the Works Directorate is to facilitate the formulation of policies for the construction industry (building and drainage), and the protection of Ghana's coastline through the following:</p> <ul style="list-style-type: none"> <li>• Liaise with PPME Directorate in the development of sectoral policy;</li> <li>• To collate plans, programmes and projects emanating from policies and objectives of the sector as well as assist in the development of strategies for the determination of works priorities;</li> <li>• To programme and coordinate the construction, rehabilitation, maintenance and reconstruction of state properties i.e., public buildings and Government bungalows;</li> <li>• To programme and coordinate the construction, rehabilitation, maintenance and reconstruction of storm water drainage systems and coastal works;</li> <li>• To liaise with works sub-sector implementing Agencies to ensure that, their programmes are integrated into well-defined national and sectoral plans and priorities;</li> <li>• To prepare short, medium and long-term plans for the sub-sector to attract donor funding;</li> <li>• To monitor the implementation of all works related field programmes and <u>projects</u></li> </ul>	
2.	<p><b><u>Environmental Protection Agency</u></b></p> <p>The EPA is the body responsible for regulating the environment and ensuring the implementation of government policies on the environment. The functions of the Agency include:</p> <ul style="list-style-type: none"> <li>• ensuring compliance with any laid down environmental impact assessment procedures in the planning and execution of development projects, including compliance in the respect of existing projects;</li> <li>• promoting effective planning in the management of the environment;</li> <li>• imposing and collecting environmental protection levies in accordance with the Environmental Protection Agency Act 1994, Act 490 or regulations made under the Act; and</li> <li>• Acting in liaison and co-operation with government agencies, District Assemblies and other bodies and institutions to control pollution and generally protect the environment.</li> </ul>	<p>The project team will follow and abide by all EPA procedures in the implementation of the project.</p>
3.	<p><b><u>Hydrological Services Department</u></b></p> <p>The Hydrological Services Department is an agency of the Ministry has the responsibility of programming and the co-</p>	<p>The hydrological Services department is responsible for the monitoring and evaluation of project activities which</p>

No.	Institutional Framework and Key Compliance Requirements	Applicability to Proposed Project
	ordination of coastal protection works, the construction and maintenance of storm drains countrywide and the monitoring and evaluation of surface water bodies in respect of floods	include reviewing of reports submitted by all project consultants to the Ministry
4.	<p><b><u>Ministry of Local Government and Rural Development/Ministry of Sanitation and Water Resources</u></b></p> <p>The Ministry of Local Government and Rural Development is the supervisory authority over the Metropolitan Assemblies and has the mandate to promote the establishment and development of a vibrant and well-resourced decentralized system of local government for the people of Ghana to ensure good governance and balanced rural based development. The Ministry has oversight responsibility over the metropolitan, municipal and district assemblies in the country.</p> <p>The Ministry's functions include:</p> <ul style="list-style-type: none"> <li>• Formulating, implementing, monitoring, evaluating and coordinating reform policies and programmes to democratize governance and decentralize the machinery of government;</li> <li>• Reforming and energizing local governments to serve effectively as institutions for mobilizing and harnessing local resources for local national administration and development;</li> <li>• Facilitating the development of all human settlements through community and popular participation;</li> <li>• Facilitating the promotion of a clean and healthy environment;</li> <li>• Facilitating horticultural development;</li> <li>• Improving the demographic database for development planning and management; and</li> <li>• Promoting orderly human settlement development.</li> </ul> <p>The Ministry of Sanitation and Water Resources owns the project and has the mandate to;</p> <ul style="list-style-type: none"> <li>• Initiate, formulate and implement policies and programmes to enhance service delivery in the area of water and sanitation;</li> <li>• Provide, regulate and facilitate access to safe drinking water and sanitation;</li> <li>• Support the private sector in the provision of safe water and adequate improved sanitation services and infrastructure;</li> <li>• Support the creative and innovative research in the production and use of improved technologies and approaches for effective provision of water and sanitation services within the country;</li> </ul>	Ministry of Local Government and Rural Development,/Ministry of Sanitation and Water Resources will ensure smooth implementation and sharing of documentation

No.	Institutional Framework and Key Compliance Requirements	Applicability to Proposed Project
	<ul style="list-style-type: none"> <li>Co-ordinate, monitor and evaluate the efficiency and effectiveness of the performance; and</li> <li>Prepare Sector Medium Term Plan in consultation with the National Development Planning Commission (NDPC)</li> </ul>	
5.	<p><b><u>Metropolitan, Municipal and District Assemblies (MMDAs)</u></b></p> <p>Metropolitan, Municipal and District Assemblies (MMDAs) are responsible for the provision of water and sanitation services within their respective areas of jurisdiction, including the planning and implementation of projects where necessary. The legislative instruments which set them up charges them to ensure public safety, including public protection from the adverse impacts of floods, see Section 46 of the Local Government Act, 1993 (Act 462). The Assemblies serve as the planning authority responsible for the overall development of their areas of jurisdiction</p>	<p>The proposed interventions fall within the jurisdiction of the Accra Metropolitan Assembly. The assembly will ensure public safety including protection from adverse impacts in flood adaptation and waste management in their respective jurisdictions</p>
6.	<p><b><u>Sub Metropolitan and Zonal Councils</u></b></p> <p>The Metropolitan Assembly and Municipal Assemblies work through decentralized units comprising Sub-metropolitan and Zonal Councils respectively which have been created by various legislative instruments. The functions of these decentralized units include the day-to-day administration of the area under its jurisdiction. For example, the AMA has ten (10). They ensure regular inspection and monitoring of their respective localities to avoid conditions likely to be offensive or injurious to public health</p>	<p>The Sub-Metropolitan Zonal Councils within the project jurisdiction are Okaikoi South, Osu Klottey, Ayawaso Central and Ablekuma South.</p>
7.	<p><b><u>Department of Urban Roads (DUR)</u></b></p> <p>The responsibility for the construction of secondary and certain tertiary drains lies with the Department of Urban Roads (DUR), a civil service organization under the Ministry of Roads and Highways. While DUR funds, procures and supervises the execution of works, these responsibilities are gradually devolved to the MMDA. Thus, for the maintenance of secondary and tertiary drains in the MMDA, the Urban Roads Department (URD) is the first responsible entity</p>	<p>The department will be responsible for the long term improvements of the drainage systems ie widening of Odaw river mouth, rehabilitation of inoperable pump stations; lining of major drainage channels; and construction of selected secondary channels in the Accra Metropolitan</p>
8.	<p><b><u>Water Resources Commission (WRC)</u></b></p> <p>The WRC is responsible for granting licenses for any water use activity and the procedures as laid down in the WRC Act 1998 (Act 526) will be followed. The commission is also responsible for</p> <ul style="list-style-type: none"> <li>Planning for water resources development and management within river basins (catchments) as the natural units of planning</li> <li>Collating, storing and disseminating data and information on water resources in Ghana</li> </ul>	<p>All project activities requiring a license will receive assistance from the WRC and the Commission will therefore provide adequate guidance to ensure that the proper procedures are used.</p>

No.	Institutional Framework and Key Compliance Requirements	Applicability to Proposed Project
	<ul style="list-style-type: none"> <li>Monitoring and assessing activities and programmes for the utilization and conservation of water resources</li> </ul>	
9.	<p><b>Lands Commission</b></p> <p>The Land Valuation Division (LVD) is the statutory body ensuring that land required for projects are properly acquired and also transparent procedures are followed and fair and adequate compensation is paid. Though private firms may be invited to participate in the process, in case of disputes, the LVD would assist to ensure prompt settlement</p>	No new land will be acquired. The mandatory reservations on either side of the drain will be used. Where disposal will require land, the land will be properly acquired.

#### 4.4 World Bank Safeguard Policies

The World Bank (WB) has published policies/procedures to guide the safe development of projects they fund. Among the ten (10) WB Safeguards Policies, five (5) – **OP/BP 4.01 Environmental Assessment**, **OP/BP 4.04 Natural Habitat**, **OP/BP 4.11 Cultural resources**, **OP/BP 4.12 Involuntary Resettlement** and **OP/BP 4.47 Safety of Dams** are triggered by the proposed project. The WB safeguards policies and a summary of their core requirements are provided in the **Table 4-4**. In addition, the World Bank Group General Environmental Health & Safety Guidelines and Industry Sector Guidelines for Ports and Terminals specifically the dredging sections were also consulted and referred to.

**Table 4-4: 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	<b>OP 4.01 Environmental Assessment</b>	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 categorizes 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 ESIA is required
2	<b>OP 4.04: Natural Habitats</b>	Do not finance projects that degrade or convert critical habitats. Support projects that affect non-critical	Triggered	Dredging work at different locations may affect natural habitats

No	World Bank Safeguard Policy	Summary of core requirements	Potential for Trigger under proposed project	Remarks or recommendation for proposed project
		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).		within the channel. The ESIA will incorporate mitigation measures to reduce the impact on natural habitats.
3	<b>OP 4.11: Physical Cultural Resources</b>	Investigate and inventorize cultural resources potentially affected. Include mitigation measures when there are adverse impacts on physical cultural resources or avoid if possible	Triggered	The river is seen as a deity by the local people. A chance find procedure (see <b>section 10</b> ) will be developed to address issues of any cultural finds during dredge works.
4	<b>OP 4.12: Involuntary Resettlement</b>	Assist displaced persons in their effort to improve or at least restore their standards of living. Avoid or minimize resettlement where feasible. 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.	Triggered	Properties along the RoW of the basin may be affected during dredge work. This may affect livelihoods of individuals within the RoW along the channel.
5	<b>OP 4.09: Pest Management</b>	Support integrated approaches to pest management, identify pesticides that may be financed under the project and develop appropriate pest management plan to address this.	Not triggered	The project will not involve the use of pesticides.
6	<b>OP 4.10: Indigenous Peoples</b>	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

<b>No</b>	<b>World Bank Safeguard Policy</b>	<b>Summary of core requirements</b>	<b>Potential for Trigger under proposed project</b>	<b>Remarks or recommendation for proposed project</b>
7	<b>OP 7.60: Projects in Disputed Areas</b>	Ensure that claimants to disputed areas have no objection to proposed project.	Not triggered	No issues of land dispute has been identified.
8	<b>OP 4.36: Forest</b>	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.
9	<b>OP 4.37: Safety of Dams</b>	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.	Triggered	The proposed project does will involve the construction of small retention ponds for flood mitigation. Retention ponds will range in height 4.0 to 5.5m and are thus considered small dams
10	<b>OP 7.50: Projects on International Waterways</b>	Ascertain whether riparian agreements are in place, and ensure that riparian states are informed of and do not object to project interventions.	Not triggered	The proposed project does not involve international waters.

#### 4.5 Relevant Environmental Quality Guidelines

The guidelines provide for permissible levels for ambient air quality, noise levels and effluent quality guidelines for discharge into natural water bodies. The environmental guidelines adopted for this project include;

- National Ambient Noise Level Guidelines (NANLG); and
- National Effluent Quality Discharge Guidelines (NEQDG).
- World Bank Group Environmental Health and Safety Guidelines, and
- World Bank Industry and Sector Guidelines for Ports and Harbours (includes dredging)

Refer to **Annex 1** for the NANLG and NEQDG.

## 5.0 ALTERNATIVE CONSIDERATIONS

For the development of the proposed Project, a number of options are under consideration to present the most feasible alternatives. These options considered are in respect of:

- Dredging Methods
- Quality of Dredge Material and handling
- Dewatering
- Disposal Options ;
- No Action Alternative

### 5.1.1 Dredging Methods

The following dredging methods have been considered for the proposed project. Limitations and advantages for each type of dredge method have been assessed to help with the proper planning and design for the project.

#### 5.1.1.1 Hydraulic Dredging

Hydraulic dredges add water to the sediment and transport it as slurry through a pipeline to a placement site. It normally involves the use of a dredge head to dislodge the sediment from the bed where it mixes with water for transport through the pipeline. eg Cutter heads. This method has the ability to remove more fine materials such as silt and sand and produces a low percentage of suspended sediment. However, it is not suited for removing larger or coarser dredge materials. It requires more skill and experience to achieve the optimal suction setting for different bodies of water and types of sediment. It has lower equipment costs as well as for operation and maintenance. Depending on the site, may require longer dredge time as compared to the mechanical equipment.



Plate 5-1: Cutterhead Dredger

#### 5.1.1.2 *Mechanical dredging*

Mechanical dredges employ a bucket to remove sediment from the bed of the waterway, move the sediment up through the column, and place it in a haul vessel for transport and disposal. There are two major classes of mechanical dredges, based on how the bucket is deployed. The first uses a wire rope attached to a crane to lower the bucket to the bed and retrieve e.g. clamshell dredge. The second class deploys a bucket at the end of the arm of an excavator or backhoe and is referred to as an articulated fixed –arm dredge. This type of method produces high percentage of resuspended sediment, and allows for removal of debris. It is more mobile, can work tight areas and requires less time to do more work. It is efficient for disposal at long haul distances. However, it has higher equipment costs as well as operation, and maintenance.



**Plate 5-2; Articulated fixed –arm dredger**

##### 5.1.1.2.1 Selected Option

The most preferred dredging method would be the mechanical dredging method. Considering the unlined nature of some sections of the channel, this method will be much easier to operate to accomplish the task as it is more mobile and can work tight spaces. Also, the mechanical dredger does not generate slurry and the dredge material can be safely carted to an appropriate disposal site. It is efficient for disposal at long haul distances. Mechanical dredging is considered because it may require less time to complete works.

#### 5.1.2 *Quality of dredge material*

Before deciding on the method of disposal, the dredged sediments must be first classified according to their potential to contaminate the environment where they are due to be deposited. Sediments may be classified under one of three classes

##### 5.1.2.1 *Clean/ Non –contaminated Material*

Dredge material predominantly made up of sand, gravel or pebble is unlikely to be contaminated, as pollutants do not generally adhere to these types of particles. Non – contaminated materials can easily be excavated, placed in any type of disposal site and re-used.

#### 5.1.2.2 *Slightly Contaminated material*

When dredged materials are lightly contaminated, direct use may still be an option if the environmental risks are low, taking site-specific conditions into account. Slightly contaminated material are allowable for placing in specific disposal sites e.g. open water disposal sites but requiring careful placing

#### 5.1.2.3 *Contaminated material*

A relatively small percentage of dredged material is heavily contaminated. Contamination levels vary depending on the site, animal presence, and anticipated bioaccumulation. Some contaminants include;

- Organochlorine compounds such as DDT, dieldrin, and polychlorinated biphenyls (PCB's), which are man-made and not soluble in surface waters.
- "Oil and Grease," referring to natural and contaminant sediments that are fat soluble. These contaminants are often present due to spillage or chronic pollution from industrial and municipal causes.

Contaminated sediments present risk to human health and the environment and limit the uses of the water body. They may require differing degrees of treatment and careful consideration as to placement and reuse e.g. CDFs. Mostly they can be re-used, but some sediments may not be re – usable and will have to be confined.

##### 5.1.2.3.1 Selected Option

From the analysis of sediment and water samples for the project area (which are presented in later sections of this report), the expected dredge materials are "not contaminated/only slightly contaminated" despite the very poor aesthetic conditions observed within the basin.

### 5.1.3 *Dewatering*

After materials are dredged from the project site, it must be placed in an area that will facilitate efficient dewatering as the high water content of dredged material effectively prohibits its use in a productive manner. Dewatering reduces dredge volumes considerably to allow for easy transport to the final disposal site via haulage trucks. It is estimated that 40,000m<sup>3</sup> of dredge material accumulates in the Odaw basin annually. The accumulated silt in the basin is about 1,084,091.42 m<sup>3</sup>.

#### 5.1.3.1 *Mechanical Dewatering*

This option often allows the most rapid dewatering process, but is usually the most expensive. Utilizing mechanical dewatering equipment allows for the material to be dewatered and hauled off as it is being dredged. Typical mechanical dewatering equipment consists of belt presses, filter presses, hydro cyclones, shaker/vibratory screens, or a combination of all these products.

#### 5.1.3.2 *Open Air/Evaporation*

With this method the dredged material is deposited in heaps at a temporary holding site for a number of days prior to final disposal. The materials are left exposed to the sun and air. This option is less costly and does not require any machinery.

#### 5.1.3.2.1 Selected Option

The selected option would be the open air/Evaporation. This option does not require any machinery and is equally efficient. Dewatering during the dry season will provide ideal conditions. Temporary holding sites are readily available close to the project area for use, for example the GI site which is opposite the Fadama settlement.

### 5.1.4 ***Disposal Options***

#### 5.1.4.1 *Open Water Disposal*

Discharging into the seas, oceans, estuaries, bays, rivers and lakes is one of several alternative options for dealing with the dredged material. This type of disposal is only suitable for clean or slightly contaminated material as dumping may lead to the release of large amounts of contaminants such as heavy metals or hydrocarbons at the site. However, depositing large amounts of non-contaminated or low-contaminated sediment, may lead to physical and chemical changes in the water column as well as changes in bottom morphology. This may disrupt the balance inside and around dumping site. Dumping sediments into water columns has the potential to adversely impact on the environment. Dumping may influence food chain structures for inhabiting aquatic species.

#### 5.1.4.2 *Capping and Contained water Disposal*

Capping is the controlled placement of contaminated material at an open-water site followed by a covering or cap of clean isolating material. Capping is a control measure for the benthic contaminant pathway. Level bottom capping is a term used for capping without means of lateral containment. If some form of lateral containment is used in conjunction with the cap, the term contained aquatic disposal is used. Considerations in evaluating the feasibility of capping include site bathymetry, water Depth, currents, wave climate, physical characteristics of contaminated sediment and capping sediment, and placement equipment and techniques. Because long-term stability of the cap is of concern, capping is generally considered to be more technically feasible in low-energy environments. Precise placement of material is necessary for effective capping, and use of other control measures such as submerged discharge and lateral containment increase the effectiveness of capping.

#### 5.1.4.3 *Confined Disposal Facilities( CDF)*

This is the placement of a dredged material into a secure area where the sediment is physically contained. Confined disposal facilities (CDFs) are diked structures that have been built for the disposal of contaminated dredged material. A confined disposal facility may be constructed as upland sites, nearshore sites with one or more sides in water (sometimes called intertidal sites), or as island containment areas. The main objective for a Confined Disposal Facility is to retain dredge material solids which are not clean and allow the discharge of clean process water from the confined area. This maximizes the amount of solids that can be stored and the lifetime of the storage facility. Confined disposal Facilities are visible, which makes them relatively simple to monitor, but may disturb the aesthetics of the surrounding areas to the dismay of the public. (Illustrated in **Figure 5-1**)

##### 5.1.4.3.1 Upland Confined Disposal facility

An upland CDF is a facility constructed on dry land in which the dredged material is stored above the groundwater level, with an enclosing dike to confine the dredged material. Depending on the water table, a watertight liner may be necessary to prevent emissions into the groundwater.

#### 5.1.4.3.2 Island/Nearshore CDF

An island/nearshore CDF is also diked but constructed in water and the dredged material is at least partially stored under the water level. However, island and nearshore CDFs can be filled hydraulically which makes them less expensive to fill.

Availability of sufficient CDF capacity will continue to be a challenge because of the scarcity and the difficulty in finding suitable locations, CDFs should only be used for materials that cannot otherwise be relocated or treated for a subsequent use.

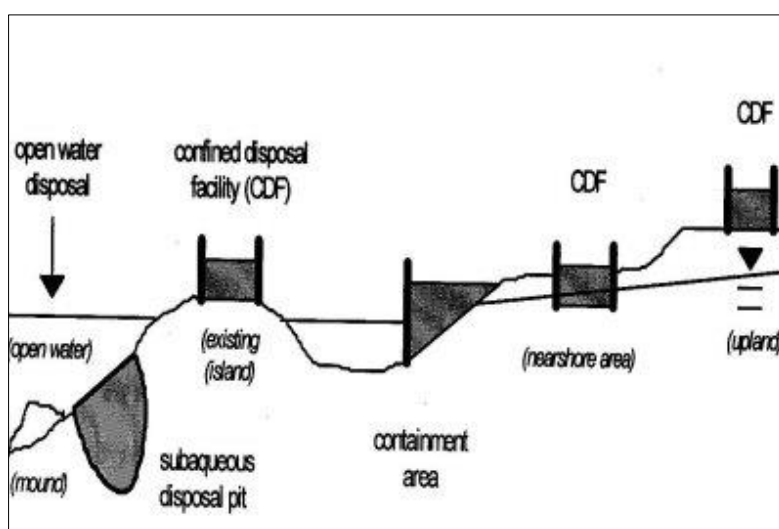


Figure 5-1; Open water disposal and types of confined disposal facilities

#### 5.1.4.4 *Strip Mine Reclamation /landfill cover for solid waste*

Dredged material can be used for the reclamation of abandoned strip mine sites that are too acidic for standard reclamation practices and the covering of solid waste landfills. Both uses would require large quantities of dewatered dredged material and would ultimately provide nonconsumptive vegetative cover to unsightly areas. For instance landfills are designed to contain pollutants and manage runoff, they have the added benefit of being able to accept certain materials deemed infeasible for unconfined aquatic disposal. These disposal sites provide greater protection against liability, since thorough waste testing and gate controls are required and enforced. Additionally, in most cases dredged material will replace the need to use clean soil or another non-waste source. Finally, because these sites are typically highly disturbed sites with limited natural resource values, the use of dredged materials is likely to impact the few existing natural resources. Strip mines along the Weija –Kasoa area may be explored. The G1 landfill along the Korle-Bu Road and Kpone Landfill site in Tema are potential disposal sites and may be explored.

#### 5.1.4.5 *Fill Material*

Dredged material can be used as fill material for construction/industry works after dewatering e.g. Road compacting, concrete aggregates, etc. This helps reduce overall project costs by not having to purchase off-site material for these purposes. This will allow large volumes of dewatered dredged material in holding areas to be used up which will make available more space at disposal sites for

subsequent disposal of material. This option however requires holding areas and depending on dredge volumes large areas will be required for storage of these materials until they are used. Over the years, about 400,000m<sup>3</sup> of sediments have accumulated in the basin which must be dredged. This is key as it will determine the size of any such holding area required.

#### 5.1.4.6 *Habitat Restoration/Enhancement*

Habitat development refers to the establishment and management of relatively permanent and biologically productive plant and animal habitats. Use of dredged material as the substrate for habitat development is one of the most common and most important beneficial use categories. The use of dredged material for habitat development offers a disposal technique that is an attractive and feasible alternative to more conventional disposal options. Within various habitats, several distinct biological communities may occur. For example, the development of a dredged material island may involve a wide variety of wetland, upland, island, and aquatic habitats. This option may be considered for restoration of wetlands under the Korle Lagoon Ecological Project.

##### 5.1.4.6.1 Selected Option

A preferred option would be the use of the dredge material as fill material. From the sediment analysis, the dredge material is predominantly non-contaminated sandy material. Dewatering will reduce volumes of the sludge available for disposal and also allow recovery of the sand for reuse. The sand can be used as construction material, reclaiming low lying areas, covering materials for capping old dumpsites eg. Kpone landfill. This will allow large volumes of the dewatered dredged material in holding areas to be disposed of and the remaining unusable material will require smaller areas for final disposal. There is an existing temporary holding area just on the western bank of the Odaw channel across from old Fadama along the Korle – Bu road used for earlier dredge works, and this should again be considered for use because of its close proximity to the dredge area. The ESIA which will accompany the feasibility study and detailed design for the dredging project will be more elaborate on the potential sites of the dredge material.

#### 5.1.5 **No Action Alternative**

For this option it implies the current challenges within the Odaw-Korle Drain will persist and probably get worse. The Odaw-Korle drain will remain silted and polluted and communities within the catchment will continue to experience flooding and its after effects during the rainy season. Existing facilities will remain underutilized. Also, jobs opportunities and the economic investment opportunity by MWH/GAMA under GARID will be lost. The aesthetic value of the area will remain bad and affect visitors' interest (tourism potential) in the Metropolis in general.

## **6.0 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS**

This chapter discusses the general bio-physical environmental and social conditions as well as demographic and socio-economic conditions within the project catchment area.

### **6.1 General Bio-Physical Environment**

#### **6.1.1 Climatic Conditions**

The basin lies in the coastal Savannah zone which has two rainy seasons. The average annual rainfall is about 730mm, which falls primarily during the two rainy seasons. The first begins in May and ends in mid-July. The second season begins in mid-August and ends in October. Rain usually falls in high intensity short duration storms and gives rise to local flooding where drainage channels are obstructed. The intensity of rainfall has been observed to increase over the years probably as a result of climate change. This coupled with increased runoff due to rapid urbanization has compounded the already precarious flooding situation within the basin.

There is very little variation in temperature throughout the year. The mean monthly temperature ranges from 24.7°C in August (the coolest) to 28°C in March (the hottest) with annual average of 26.8°C. As the area is close to the equator, the daylight hours are practically uniform throughout the year. Relative humidity is generally high varying from 65% in the mid-afternoon to 95% at night. The predominant wind direction in Accra is from the WSW to NNE. Wind speeds normally range between 8 to 16 km/hr. High wind gusts occur with thunderstorm activity, which pass in squall along the coast. The maximum wind speed recorded in Accra is 107.4 km/hr (58 knots). Strong winds associated with thunderstorm activity often because damage to property and mostly removing roofing materials.

#### **6.1.2 Vegetation In The Project Area**

The project area is highly urbanized and consists of mostly slums, with very little to no vegetation. The little vegetation observed within the project area include overgrown weeds along the sides of the drain and wetland vegetation surrounding the lagoon.

#### **6.1.3 Geology and Soils**

The geology of the basin consists of Precambrian Dahomeyan Schists, Granodiorites, Granites Gneiss and Amphibolite's to late Precambrian Togo Series comprising mainly Quartzite, Phillites, Phylitones and Quartz Breccias. Other formations found are the Palaeozoic Accraian Sediments - Sandstone, Shales and Interbedded Sandstone-Shale with Gypsum Lenses.(MWH, 2018)

The soils in the Metropolitan area can be divided into four main groups: drift materials resulting from deposits by windblown erosion; alluvial and marine mottled clays of comparatively recent origin derived from underlying shales; residual clays and gravels derived from weathered quartzites, gneiss and schist rocks, and lateritic sandy clay soils derived from weathered Accraian sandstone bedrock formations. In many low lying poorly drained areas, pockets of alluvial 'black cotton' soils are found. These soils have a heavy organic content, expand, and contract readily causing major problems with foundations and footings. In some areas, lateritic soils are strongly acidic and when saturated are prone to attack concrete foundations causing honeycombing.

#### **6.1.4 Surface water and Drainage**

The topography of the city is low lying coupled with encroachment of slum populations resulting in flood vulnerability. Accra has four main surface water resources. These are from the west of the city: the Densu River basin which drains into the Sakumo Lagoon and then into the sea (Gulf of Guinea); The Odaw River with its tributaries - Nima, Onyasia, Ado and Dakobi –which flows into the Korle and Chemu Lagoons to form the Odaw-Korle-Chemu catchment which passes through the middle of the city; the Kpeshie and Songo-Mokwe catchments or drainage systems to the far east of the city. All these catchments/drainage systems have their sources beyond the boundaries of Accra but their periodic overflows are a key cause of flood hazards.

The Odaw-Korle-Chemu catchment covers an area of 250 km<sup>2</sup> and passes through the most urbanised spaces of Accra. The Korle Lagoon is the major basin into which the greater proportion of the floodwaters of Accra flow before entering the sea. Being part of the Odaw-Korle-Chemu catchment, the Odaw River passes through the central part of Accra, drains into the Korle Lagoon near the central business district (CBD) to the west and then into the Gulf of Guinea. **See Figure 6-1.**

The Odaw-Korle basin, leading to the generation of substantial quantities of solid wastes, makes it: one of the most polluted water bodies on earth, serving as a cesspool for most of Accra's industrial and municipal wastes.(Amoako & Boamah, 2015)

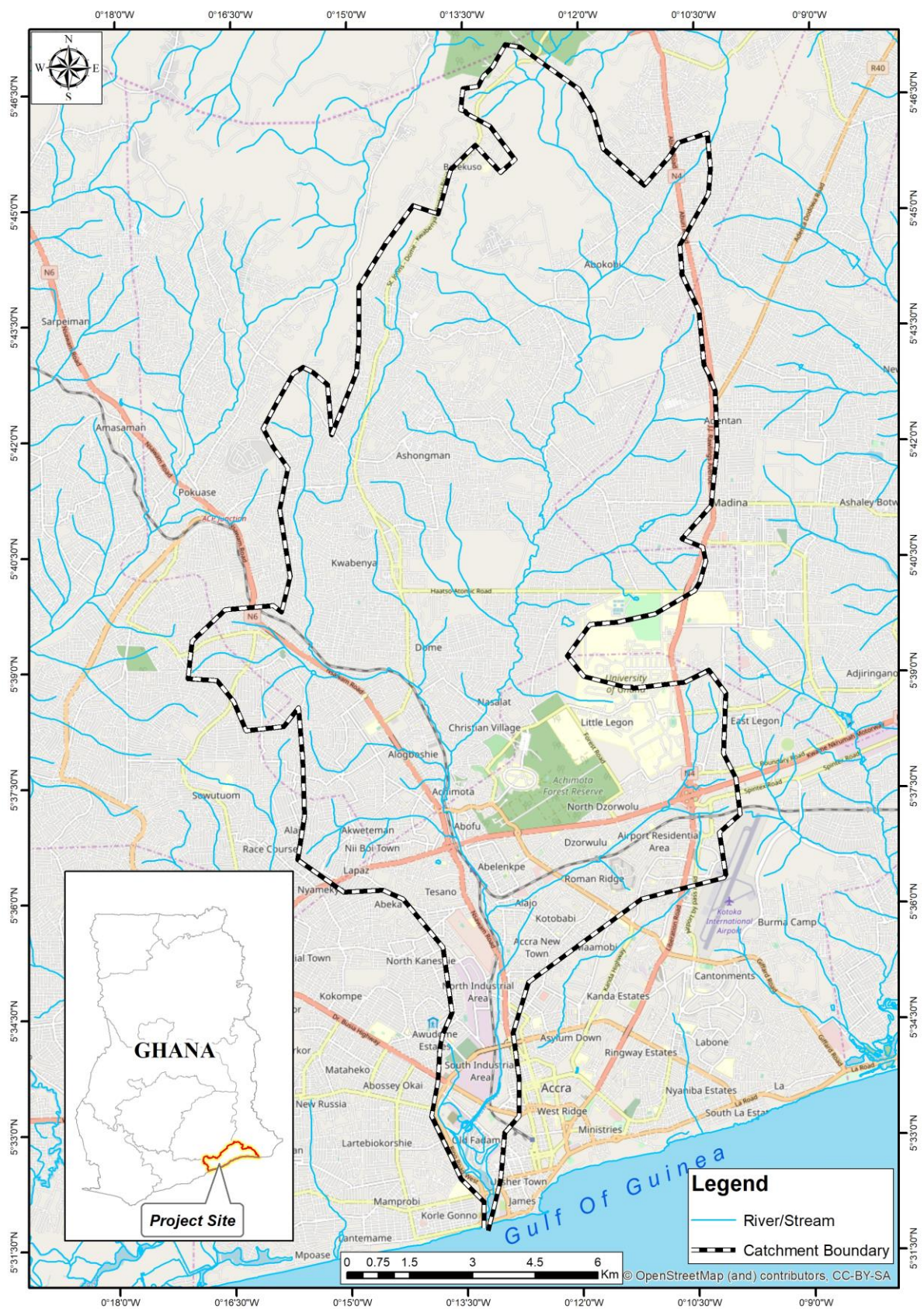


Figure 6-1; Surface water and Drainage of the Odaw Catchment

### **6.1.5 Culturally sensitive areas**

The Korle Lagoon is a highly polluted but culturally sensitive water body within the project catchment. The lagoon is believed to inhabit a god and as such it is for example, 'forbidden' to have any form of contact with the lagoon on Saturdays. In May every year, traditional rites are performed in the lagoon prior to the Homowo festival which is the annual festival of the local Ga tribe. The chief priests have been consulted about the dredging and will be informed prior to the start of the dredging works. If needed, ceremonies or rituals will be conducted prior to dredging works.



**Plate 6-1; The Korle Lagoon leading to the outfall into the Sea**

## **6.2 General Demographic, Socio-economic and Cultural Environment**

### **6.2.1 Size and boundary of the project Area**

The Accra Metropolitan Area is one of the 254 Metropolitan, Municipal and Districts in Ghana, and among the 26 districts in the Greater Accra Region. It covers a total land area of 139.674 Km<sup>2</sup>. and encompasses the Ablekuma Central, Ablekuma South, Ashiedu Keteke, Ayawaso Central, Okaikoi South, and Osu Klottey sub-metropolitan district councils. It is bounded to the North by Ga West Municipal, the West by Ga South Municipal, the South by the Gulf of Guinea, and the East by La Dadekotopon Municipal. The local authority of the district, the Accra Metropolitan Assembly. (Ghana Statistical Service, 2014)

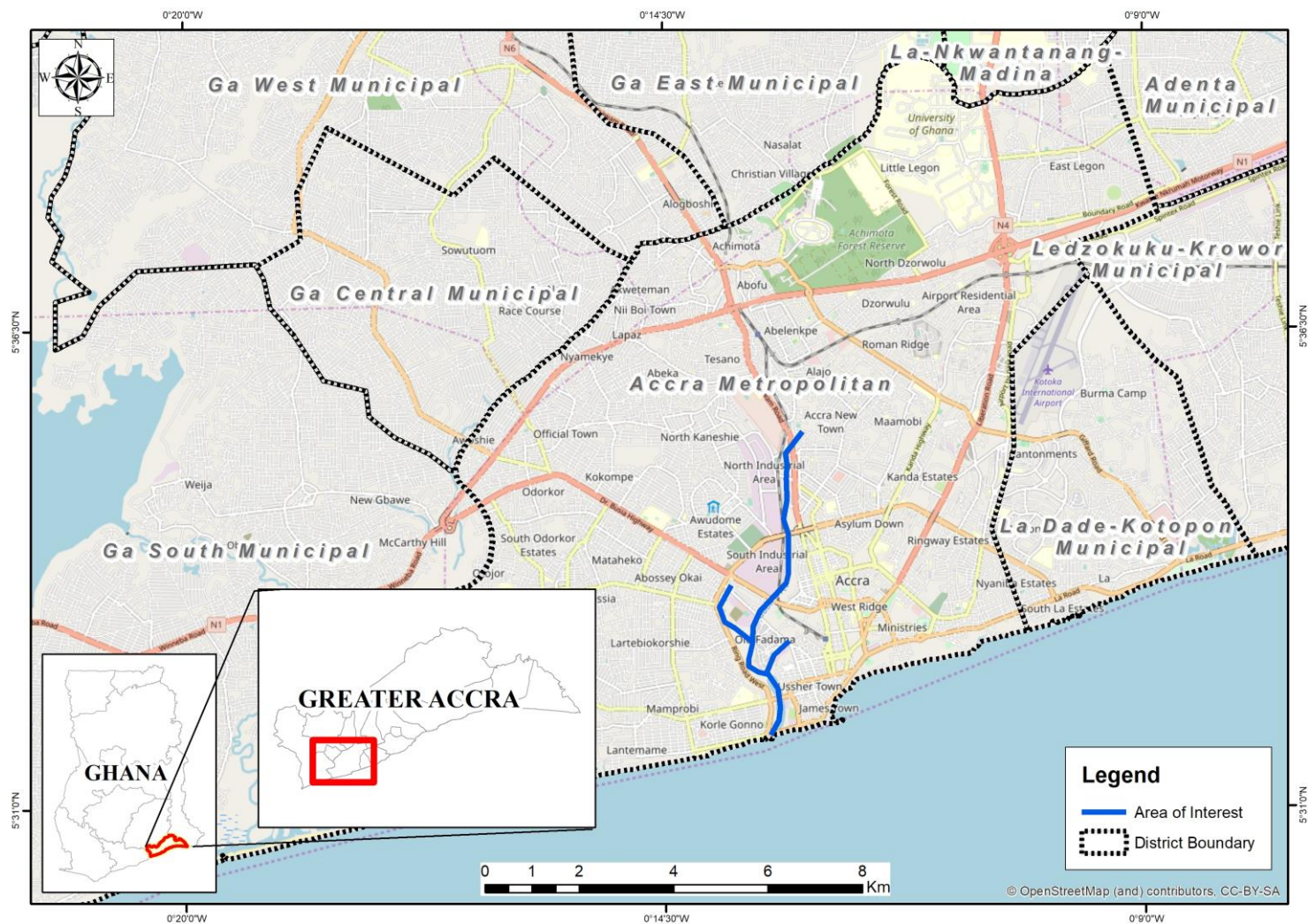


Figure 6-2; Location of the Accra Metropolitan Assembly (AMA)

### **6.2.2 Population/Demographic characteristics**

The AMA is by far the most dominant Assembly with over 65% of the total population. The high population figure of the city (4,337,542 persons) within the AMA is both an asset and source of worry to authorities. While the relatively high population serves as a huge and vibrant market for investors, it also poses problem of sanitation and waste management as well as traffic jam especially during the peak hours of the day. It is estimated that during the peak hours, Accra hosts about 25% of the national population and has influx population of about 1,000,000 on daily basis for economic activities aside the residential dimension captured by the National Population Census.

The primacy of Accra Metropolitan Area as an administrative, educational, industrial and commercial centre is the main factor for this and continues to attract people from all over Ghana, and outside, as its functional importance is on incremental ascendancy. Rural-urban migration accounts for over 35% of the population increase. The environmental sanitation situation within the Assemblies in the upper reaches of the basin is also generally poor. Despite the rapid population growth in recent years, development has been haphazard and waste management facilities are grossly inadequate therefore contributing to immense stress on the basin resource

According to the AMA, there are over 65 out of the 82 officially identified slums and shanty towns within the immediate environment of the Odaw-Korle catchment/basin

### **6.2.3 Existing conditions within the basin**

Drainage in Accra consists of natural drains and a few major storm water drains. A network of small drains known as gutters are in place to serve a dual purpose of storm water drain and conduit for domestic effluent. The course of the river is natural but constructed/lined at some sections (e.g. avenor to agbogbloshie for this project) while the remaining sections are yet to be lined. The principal outlet for water in this catchment is the Korle Lagoon, its auxiliary function as a central drainage system is emptying its contents into the sea. The existing drainage system is based on gravity flow with most of the drainage basins being open, this has resulted in it becoming shallow over time due to excess siltation and waste finding its way into the water body with runoff.

The Odaw River and Korle lagoon is threatened by pollution inflow from activities of densely populated settlements surrounding the drain/channel. Most sections of the drains are used as garbage dumping receptacles, especially in crowded and low-income areas where garbage-collecting basins are placed very close to open areas. Some sections are badly choked with weeds and bushes, and serious erosion has damaged drains and culverts in places. Stagnant foul waters are found in drains in the central part of the city where there are stores, markets and restaurants, as well as lorry parks. No maintenance is carried out to remove the garbage and silt in the industrial areas, causing flooding.

The channel/drain is in deplorable condition as a result of poor and, in some cases, lack of maintenance; dumping of refuse and human excreta( Open defecation is a common activity along the drain) , flow obstructions caused by service and utility lines; undersized culverts crossing roads and unauthorized structures located within the flow path. Portions of the channel need lining to check

scouring and to improve the carrying capacity. **Figure 6-3** illustrates identified activities along the Drain.

Apart from being densely populated, about 80% of all the industries in Accra are located in the lower drainage basin of Korle/Odaw complex which channel their waste through the Korle. Large amounts of untreated industrial waste emptied into the lagoon has led to severe pollution and excess load of nutrients leading to eutrophication, this has disrupted its natural ecology and has resulted in extinction of most aquatic life forms.



**Plate 6-2: Lined silted Section at Circle (left) and Unlined section at Old Fadama**

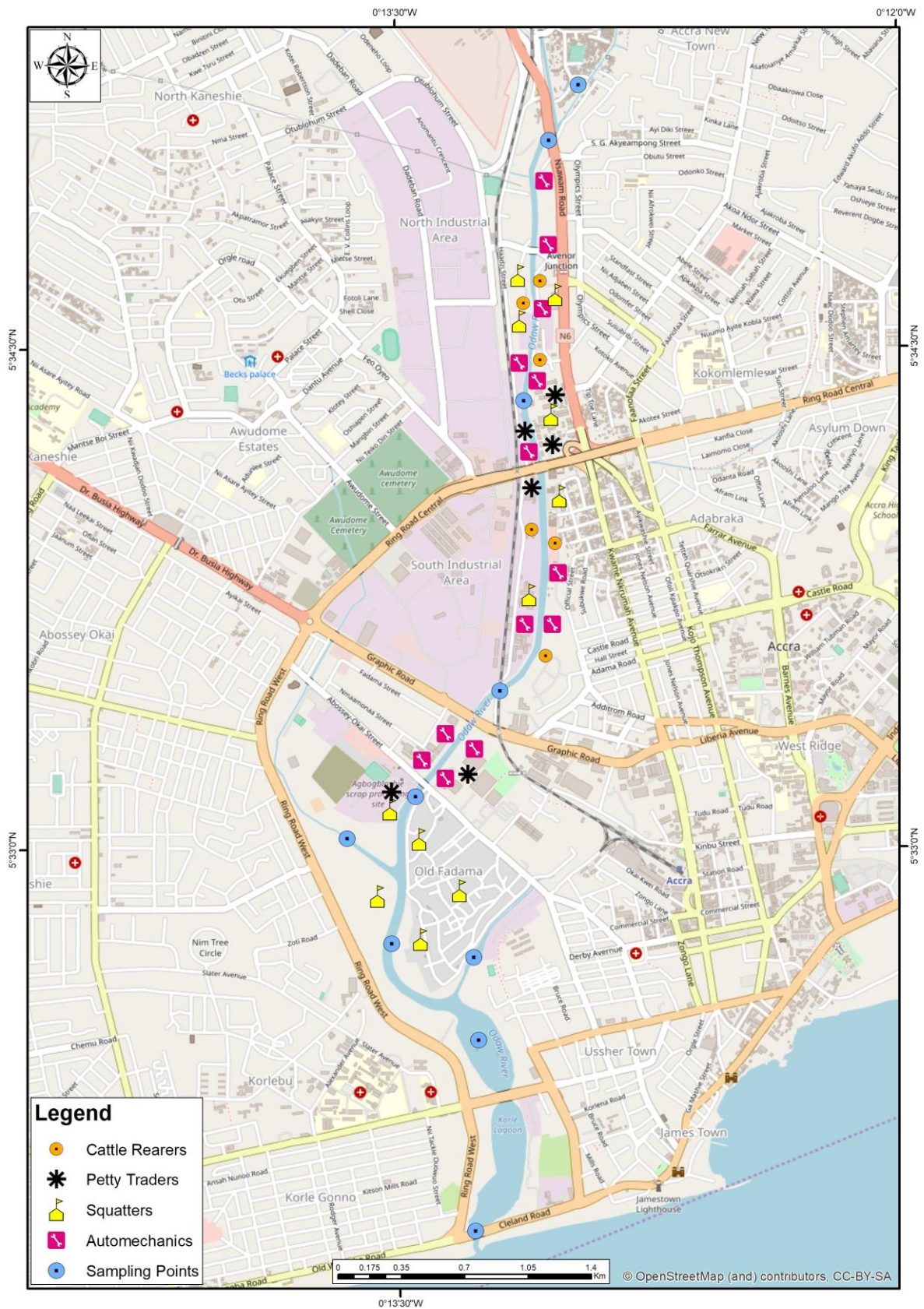


Figure 6-3: Identified activities along the Odaw drain

#### **6.2.4 Environmental sanitation challenges**

The major problems affecting the drainage channel is poor sanitation. The areas along the channel have been encroached and individuals openly dump rubbish/garbage and practice open defecation. The inadequate drainage and poorly designed channels in many parts of the Basin have given rise to serious flood problems as it impacts on increase surface water runoff and flooding in low lying areas. These are problems compounded by choked drains.

Dredging of the Korle lagoon is required to reduce flooding and provide improved flow in the existing channel system. The Odaw basin drainage channels have lost much of their potential natural hydraulic performance due to the build-up of sediments and solid waste materials over many years and with less than optimal dredging investments on an annual basis.



**Plate 6-3: Some silted and choked parts of the drain**

#### **6.2.5 Project Affected Persons**

The Project Affected Persons (PAPs) for the Odaw Dredging project are mostly within the 50m reserved buffer on either side of the drain and around the lagoon area. **Figure 6-3** shows some major activities along the channel. No major obstacles or activities are expected to hinder the movement of dredging equipment even though some few persons may have to be temporarily relocated and may suffer inconveniences or loss of livelihood. It is estimated that up to about 1000 people may be affected and will mostly be the automechanics and squatters around Avenor, Circle, Agbogbloshie (Sikkens) and mainly squatters along the banks of the lagoon at Old Fadama. Others may include the petty traders and cattle rearers located between Avenor and Graphic Road.

### **6.3 Characteristics of the specific disposal sites**

This section briefly describes the physical /social/ biological characteristics of the specific areas proposed for temporary holding and final disposal sites of dredge material.

#### **6.3.1 Temporary Holding Area –Western Bank of the Odaw Channel**

The proposed temporary holding area for dredge material is located on the western bank of the Odaw channel along the Ring Road West and shares boundaries with the Agbogloboshie scrap yard, all within the Odaw catchment area (**See Figure 6-4**). Currently, the area is used as an illegal waste dump site and usually there are scavengers found rummaging through the rubbish. The characteristics of the site have already been described in the earlier sections.

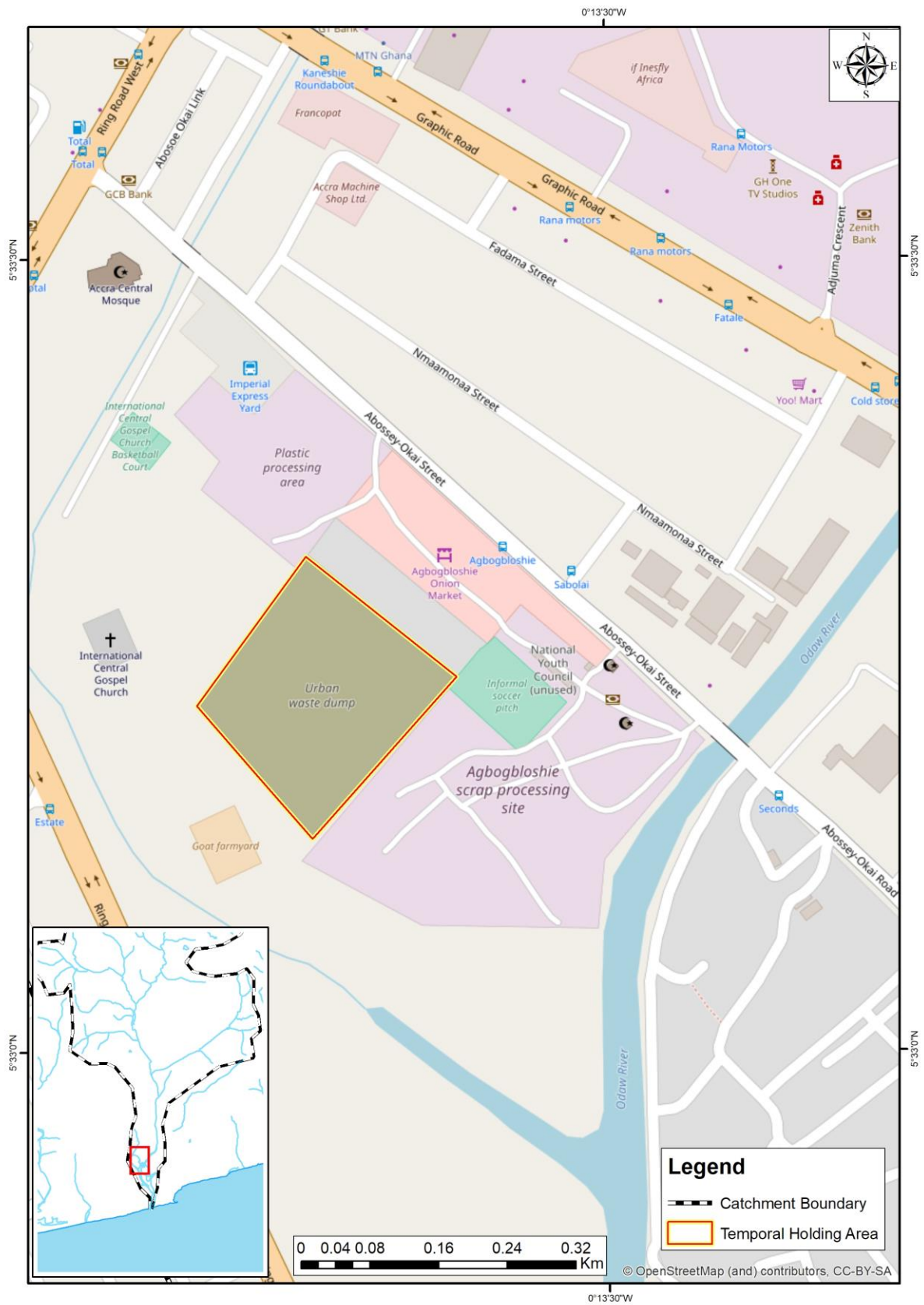


Figure 6-4: Location of proposed Temporary Holding site

### **6.3.2 Final Disposal Site – Kpone landfill**

The Kpone Landfill is a potential site for the final disposal of the residual dredge material (about 10% of the total dredge material) after the recovery of sand. It is located in Kpone, a suburb of Tema which is about 33 km from the dredge site and can be accessed by the Accra –Tema Highway. It is owned by the Tema Municipal Assembly and is managed by Zoomlion company.

The site lies in the coastal savanna zone of Ghana and experiences dry equatorial climate with a mean annual rainfall ranging between 730mm to 790mm. The vegetation zones in the area are mainly shrub and grassland. The geology of the district is Precambrian rocks of the Dahomeyan formation ie : metamorphic rocks mainly consisting of granite, gneiss and schist have been derived from sedimentary layers

The landfill was originally designed to serve the Tema Metropolitan Assembly however it currently serves a population of 1 million persons, accepting 95% of waste generated in the Greater Accra Metropolitan Area. The waste is mainly non-degradable plastic materials, organic waste which comprises cooked food, fruits, vegetables, faecal matter, animal slaughter waste, plant based materials and any item that can easily decay. The biggest challenge at the site is the sorting out of organic waste from others. Due to ignorance and lack of legislations of pre-sorting, majority of Ghanaians dump degradable and non-degradable waste into one container.



**Plate 6-4: Kpone Landfill Site**

## **6.4 Results of water and sediment analyses**

This section presents the results of the laboratory analysis to confirm the level of contamination of both water and sediment media analyzed.

### **6.4.1 Surface Water Quality Analysis**

The research laboratory used standard methods for the analysis consisting of Atomic Absorption Spectrophotometry. The summarized results from the analysis are presented in **Table 6-1** while the

certified laboratory results are provided in **Annex 2**. The results are compared with the available Canadian Environmental Quality Guidelines-Protection of Aquatic life and the *Target Water Quality Ranges (TWQR) of the Ghana Raw Water Quality Criteria and Guidelines (Volume 6): Protection of Aquatic ecosystems*. The guidelines donot cover all the parameters analysed by the laboratory.

#### Discussion of Results

The results are compared with to the CEQGs –Protection of aquatic life in Table **6-1**. It is observed that all samples were within guideline levels provided for the respective parameters analyzed.

The results compared with the TQWR (**Table 6-2**) show that Lead, Copper and Free Cyanide were within guideline levels for all samples. With the exception of Points 1, 2 and 8, all other sampling points were above the guideline limit of 2mg/l for Total Iron.

Table 6-1: Water Quality Results compared with CEQGs- Protection of aquatic life

Parameter	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	CEQGs-protection of aquatic life
pH (pH Units )	6.89	7.11	6.97	7.15	6.8	6.88	7.11	7.08	7.27	7.13	6.5 – 9.0
Apparent Colour (Hz)	7.50	10.0	188	30	37.5	30.0	20.0	30.0	20.0	20.0	-
TSS (mg/l)	17.0	69.0	2577	51.0	201	142	96.0	191	14.0	66	-
TDS(mg/l)	28.5	30.1	2300	790	965	721	750	672	610	595	-
Residual Chlorine(mg/l)	<0.005	0.020	<0.005	0.120	<0.005	0.270	0.160	0.170	0.060	<0.005	-
Ammonia (NH <sub>4</sub> -N, mg/l)	5.21	8.40	8.70	5.00	15.5	12.8	6.72	10.5	3.10	4.54	-
Nitrate (NO <sub>3</sub> -N, mg/l)	0.052	0.021	<0.001	0.054	0.087	<0.001	<0.001	0.057	0.011	<0.001	13
Phosphorous(mg/l)	0.274	0.128	0.537	0.844	1.69	0.326	0.667	0.422	0.174	0.109	-
Free Cyanide (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Fluoride (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	120
Sulphide (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Total Iron Mg/l	0.371	1.08	3.88	3.21	2.57	3.63	2.08	0.219	7.94	3.45	-
Zinc(mg/l)	0.110	0.055	0.157	0.047	0.098	0.129	0.051	0.031	0.122	0.064	7.0
Lead( mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
BOD(mg/l)	29.5	32.5	951	31.5	55.2	35.2	34.7	30.5	40.7	45.8	-
COD(mg/l)	105	156	3787	123	374	163	155	163	152	196	-
Oil/Grease (mg/l)	2.50	2.00	15.0	6.80	5.20	5.50	3.70	7.20	3.00	2.90	-
Arsenic (mg/l)	0.003	0.021	0.05	0.0011	0.013	0.008	0.005	0.017	0.042	0.034	5
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.026
Silver (mg/l)	0.247	0.064	0.044	0.047	0.059	0.026	0.018	0.011	0.051	0.042	0.25

<b>Cadmium (mg/l)</b>	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<b>0.09</b>
<b>Total Chromium(mg/l)</b>	0.024	0.010	0.038	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
<b>Copper (mg/l)</b>	<0.010	<0.010	0.013	<0.010	<0.005	<0.010	<0.050	<0.010	0.017	0.017	
<b>Selenium(mg/l)</b>	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<b>1</b>
<b>Nickel(mg/l)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
<b>Manganese</b>	16.3	0.416	2.57	2.08	0.271	0.198	0.186	0.025	0.239	0.251	-

Table 6-2: Results Compared with TQWR for protection of Aquatic Ecosystems

<b>Parameter</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>	<b>P5</b>	<b>P6</b>	<b>P7</b>	<b>P8</b>	<b>P9</b>	<b>P10</b>	<b>TWQR for protection of Aquatic Ecosystems</b>
<b>pH (pH Units )</b>	6.89	7.11	6.97	7.15	6.8	6.88	7.11	7.08	7.27	7.13	-
<b>Apparent Colour (Hz)</b>	7.50	10.0	188	30	37.5	30.0	20.0	30.0	20.0	20.0	-
<b>TSS (mg/l)</b>	17.0	69.0	2577	51.0	201	142	96.0	191	14.0	66	-
<b>TDS(mg/l)</b>	28.5	30.1	2300	790	965	721	750	672	610	595	-
<b>Residual Chlorine(mg/l)</b>	<0.005	0.020	<0.005	0.120	<0.005	0.270	0.160	0.170	0.060	<0.005	-
<b>Ammonia (NH<sub>4</sub> -N, mg/l)</b>	5.21	8.40	8.70	5.00	15.5	12.8	6.72	10.5	3.10	4.54	<b>7</b>
<b>Nitrate (NO<sub>3</sub> -N, mg/l)</b>	0.052	0.021	<0.001	0.054	0.087	<0.001	<0.001	0.057	0.011	<0.001	-
<b>Phosphorous(mg/l)</b>	0.274	0.128	0.537	0.844	1.69	0.326	0.667	0.422	0.174	0.109	-
<b>Free Cyanide (mg/l)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<b>0 -0.1</b>

Fluoride (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sulphide (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Total Iron Mg/l	0.371	1.08	3.88	3.21	2.57	3.63	2.08	0.219	7.94	3.45	<b>2 mg/l</b>
Zinc(mg/l)	0.110	0.055	0.157	0.047	0.098	0.129	0.051	0.031	0.122	0.064	-
Lead( mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<b>1.0</b>
BOD(mg/l)	29.5	32.5	951	31.5	55.2	35.2	34.7	30.5	40.7	45.8	
COD(mg/l)	105	156	3787	123	374	163	155	163	152	196	
Oil/Grease (mg/l0	2.50	2.00	15.0	6.80	5.20	5.50	3.70	7.20	3.00	2.90	
Arsenic (mg/l)	0.003	0.021	0.05	0.0011	0.013	0.008	0.005	0.017	0.042	0.034	
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<b>0.04</b>
Silver (mg/l)	0.247	0.064	0.044	0.047	0.059	0.026	0.018	0.011	0.051	0.042	
Cadmium (mg/l0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<b>0.4</b>
Total Chromium(mg/l)	0.024	0.010	0.038	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<b>0-1</b>
Chromium 6(mg/l)	-	-	-	-	-	-	-	-	-	-	-
Copper (mg/l)	<0.010	<0.010	0.013	<0.010	<0.005	<0.010	<0.050	<0.010	0.017	0.017	<b>&gt;0.14</b>
Selenium(mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Nickel(mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Manganese	16.3	0.416	2.57	2.08	0.271	0.198	0.186	0.025	0.239	0.251	-

#### 6.4.1.1 Aquatic Macroinvertebrate Analysis

Aquatic macroinvertebrates are good indicators of stream water quality because different types of macroinvertebrates tolerate different stream conditions and levels of pollution, their presence or absence is used to indicate clean or polluted water. The results for the macroinvertebrate analysis within the Odaw Channel is presented in **Table 6-3**.

**Table 6-3; Aquatic Macroinvertebrate in the Odaw Channel**

Sampling Point/Location	Taxa	Common Name	Total	% Occurrence
1	-			
2	<i>Atherix sp.</i>	Water snipe fly	1	50
	<i>Bellamyia unicolor</i>	freshwater snail	1	50
3	-	-		
4	<i>Eristalis sp</i>	hoverflies	1	50
	<i>Nais sp.</i>	water nymph crayfish	1	50
5	<i>Psychodidae (Pupa)</i>	Moth flies/Drain Flies/sewer Flies	1	100
6	<i>Psychodidae (Pupa)</i>	Moth flies/Drain Flies/sewer Flies	1	25
	<i>Psychodidae sp.</i>	Moth flies/Drain Flies/sewer Flies	3	75
7	<i>Psychodidae (Pupa)</i>	Moth flies/Drain Flies/sewer Flies	1	50
	<i>Eristalis sp</i>	hoverflies	1	50
8	<i>Diptera Pupa</i>		1	14.29
	<i>Psychodidae (Pupa)</i>	Moth flies/Drain Flies/sewer Flies	2	28.57
	<i>Psychodidae sp.</i>	Moth flies/Drain Flies/sewer Flies	2	28.57
	<i>Hydrobia accrensia</i>	Mud snails	2	28.57
9	<i>Diptera Pupa</i>	True Flies	2	66.67
	<i>Psychodidae sp.</i>	Moth flies/Drain Flies/sewer Flies	1	33.33
10	<i>Orthocladinae quadrifasciatus sp. CO2</i>	Orthoclads	1	7.14
	<i>Stictochironomus puripennis sp CC49</i>	Non –biting midges	6	42.86
	<i>Psychodidae sp.</i>	Moth flies/Drain Flies/sewer Flies	7	50

#### Analysis of Results

From **Table 6-3**, it can be observed that the moth flies, mud snails, freshwater snails, water snipe flies, water nymph crayfish, orthoclads and non-biting midges are present in the samples collected. The species with percentage occurrence above 50 include; the water snipe fly, freshwater snail, hover fly,

true fly and predominantly the moth flies. Moth flies usually breed in drains, sewers, septic tanks and soil that has been contaminated with sewage. Open defecation is mostly practiced upstream from Point 10 up till Point 5. The predominant occurrence of the moth flies is an indication of sewage within the channel. The water snipe fly, hover fly and freshwater snail are moderately tolerant of nutrient pollution/pollution - sensitive hence can survive in fair water quality. The presence of these organisms is an indication of some amount of nutrient pollution within the Odaw channel particularly in sampling areas upstream and mid stream.

#### 6.4.1.2 *Pesticides and Organic Pollutants (PCBs)*

The results of the pesticide analysis have been provided in **Table 6-4** and compared with WHO guideline levels. From the table all parameters measured were below detectable levels. This may be surprising considering the various activities within the catchment area and along the boundaries which may impact adversely on the quality of the water and sediment. Concentrations are very low and not detectable.

The results of the PCB analysis compared with Canadian Environmental Quality Guideline for sediment- Protection of aquatic life shows that all parameters measured were below the detectable limit.

Table 6-4: Results for Pesticides analysis in water samples

Parameter (µg/l)	PT1	PT2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	WHO GUIDELINE (µg/L)
Alpha BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Beta BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Gamma BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Delta BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Heptachlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.100
Aldrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Heptachlor Epoxide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Alpha-Endosulfan	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
4,4'- DDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Dieldrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Endrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.600
Beta –Endosulfan	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
4,4'DDD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Endosulfan Phosphate	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Endrin Aldehyde	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
4,4'-DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Endrin Ketone	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Methoxychlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	20.0

Table 6-5: Organic Pollutants (PBs) in water samples

Parameter (µg/kg)	PT1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	CEQGS
<b>PCB-52</b> <b>(2,2',5,5'-</b> <b>Tetrachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-138</b> <b>(2,2',3,4,4',5'-</b> <b>Hexachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-101</b> <b>(2,2',4,5,5'</b> <b>Pentachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-180</b> <b>(2,2',3,4,4',5,5'-</b> <b>Heptachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-153</b> <b>(2,2',4,4',5,5'-</b> <b>Hexachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-118</b> <b>(2,3',4,4',5-</b> <b>Pentachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>28 PCB -28</b> <b>(2,4,4'-Trichlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03

## 6.4.2 Sediment Quality Analysis

### 6.4.2.1 Granulometry

Grain size is one of the main factors that govern heavy metal contamination in the particulate fraction. For this analysis the Unified Soil Classification System (USCS) ISO3310-1:2000 was used. The analysis was aimed at measuring the individual grain sizes of sediment samples. Generally, fine particles have a higher ability to carry the heavy metals due to the increase of specific surface area, and due to the presence of clay minerals, organic matter, and Fe/Mn/Al oxides associated forming fine-sized aggregates.

Dredge material that is predominantly sand, gravel or pebble is unlikely to be contaminated, as pollutants do not generally adhere to these types of particles, and are therefore not incorporated into the sediment. (Agency Minnesota Pollution control, 2014). The results from the granulometry analysis are provided in **Table 6-6** below.

Table 6-6: Granulometry Results

Sample ID	Clay fraction (%)	Silt fraction (%)	Sand Fraction (%)	Gravel Fraction (%)	Soil Texture	Remarks
Point 1	2	2	95.82	0.31	Sandy	1.5 m depth cored with a composite of very fine sand at estuary
Point 2	4	5	90.91	0.41	Sandy	3m depth core to the earth storm drain with a composite of medium sand
Point 3	19	11	68.64	1.40	Sandy	Earth storm drain to 2.2 depth core with composite of fine sand
Point 4	1	2	96.65	1.10	Sandy	Earth storm drain to 2.8m depth cored with a composite of medium sand
Point 5	1	1	87.13	10.46	Sandy	2.7m depth core to the earth storm drain with a composite of medium sand
Point 6	17	16	65.84	0.60	Sandy	2.9m depth core to the earth storm drain with a composite of medium sand
Point 7	18	10	70.65	0.93	Sandy	1.6m depth core to the concrete storm drain liner with a composite of fine sand
Point 8	1	1	93.59	4.09	Sandy	1.2m depth core to the concrete storm drain liner with a composite of well graded sand

<b>Point 9</b>	0	0	82.51	17.04	Sandy	0.8m depth core to the concrete storm drain liner with a composite of medium sand
<b>Point 10</b>	1	1	96.79	1.47	Sandy	No sediment deposit, a scrapper was used to get sediment within a radius of 5m with a composite of medium sand

### *Discussion of Results*

The results show that the soil texture is mostly sandy with particles ranging from very fine sand to a composite of medium sand however Point 3, 6 and 7 showed increased percentages of clay and silt compared to the other sampling points. Point 7 was at the mouth of the concrete lined drain whereas points 3 & 6 were sampled at the earth drains hence the increment in silt and clay deposition. From the results, it may be speculated that the proposed dredge material sampled is less likely to be contaminated as sand material generally has a low capacity to retain pollution including heavy metals. Long-term exposure to silver in humans include low blood pressure, decreased respiration and argyria/argyriosis which is a form of irreversible pigmentation of the skin. Aquatic ecosystems are however revealed to be less prone to the toxic effects of the metal due to the assimilating capacity of the water and its dissolved contents.

#### **6.4.2.2 Heavy Metal Contaminants**

The results are illustrated in **Figure 6-5** and presented in **Table 6-7**. The results are compared with the revised Australian and New Zealand Guidelines for Fresh and Marine Water Quality released in 2000 (ANZECC/ARMCANZ, 2000). From the table Silver was the only metal above the guideline level. Primary sources of anthropogenic silver in surface waters include industrial and smelting wastes. Highest concentrations were recorded at Point 9 and the lowest concentration is at the most downstream location at Point 1.

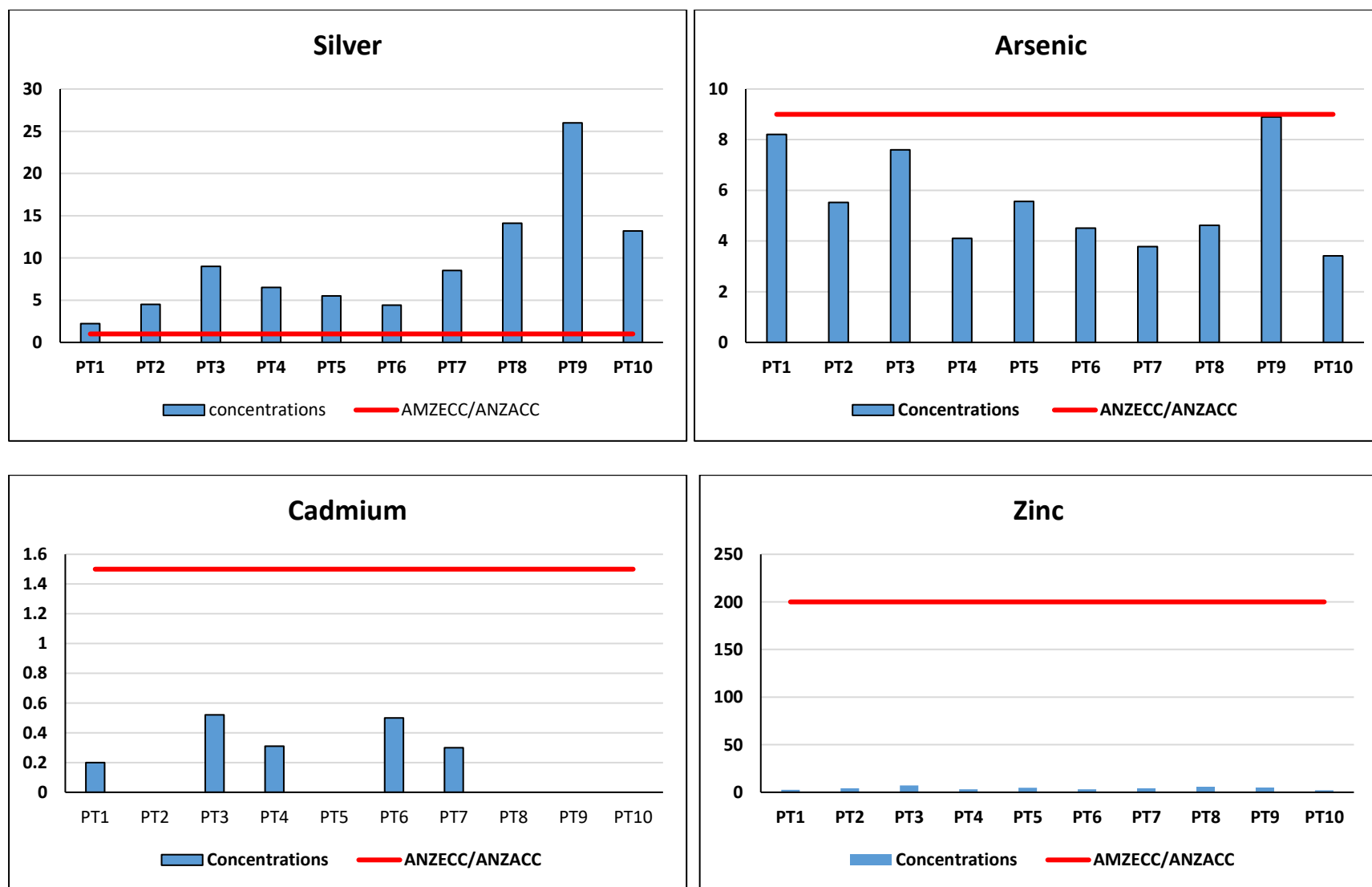


Figure 6-5: Illustrations of Silver, Arsenic, cadmium and lead Concentrations in the sediment,

Table 6-7: Heavy Metal Results

Parameter	PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9	PT10	ANZECC/ARMCANZ 2000
pH, (pH units)	8.11	7.95	7.05	7.53	8.23	7.51	7.79	8.02	8.38	7.76	-
Oil/Grease (mg/kg)	6.00	8.50	31.00	12.0	15.0	10.0	14.0	17.0	18.0	12.0	-
Total Iron (mg/kg)	21.0	34.0	52.0	42.0	25.0	55.0	41.0	62.0	75.2	61.0	-
Zinc (mg/kg)	2.62	4.12	7.21	3.12	4.61	3.00	4.12	5.70	5.10	2.10	<b>200</b>
Lead (mg/kg)	0.62	0.60	<0.5	<0.5	<0.5	0.780	<0.50	0.58	<0.50	<0.50	<b>50</b>
Arsenic (mg/kg)	8.21	5.52	7.60	4.10	5.56	4.51	3.78	4.62	8.90	3.42	<b>9.0</b>
Mercury (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<b>0.15</b>
Silver (mg/kg)	2.23	4.50	9.00	6.50	5.50	4.40	8.50	14.1	26.0	13.2	<b>1.0</b>
Cadmium (mg/kg)	0.20	<0.20	0.52	0.31	<0.20	0.50	0.30	<0.2	<0.20	<0.20	<b>1.5</b>
Total Chromium (mg/kg)	<0.50	<0.50	0.52	0.57	<0.50	0.70	0.78	<0.50	<0.50	<0.50	-
Copper (mg/kg)	4.50	2.10	2.40	3.10	2.00	3.50	2.50	2.00	1.00	4.50	<b>65</b>

<b>Selenium (mg/kg)</b>	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
<b>Nickel (mg/kg)</b>	0.54	0.57	0.62	0.51	0.70	0.54	0.58	0.54	0.61	0.54	<b>21</b>
<b>Manganese (mg/kg)</b>	15.8	24.0	25.0	19.0	13.5	22.5	17.0	27.0	63.0	18.0	-

#### 6.4.2.3 *Pesticides and Organic Pollutants in Sediment Samples*

The results for the pesticides analysis have been compared with WHO guideline levels and provided in Table 4-8. All parameters measured were below detectable levels. There is very little or no crop farming within the sections of the drain studied.

The results for organic pollutants/Polychlorinated biphenyls (PCBs) are compared with the Canadian Environmental Quality Guidelines for Sediment- Protection of Aquatic life and provided in **Table 6-8**. From the results PCB levels in the sediment within the project area were very low and not detectable despite the activities of the auto mechanic along the channel as well as the illegal e- waste processing activities around the Agbobloshie and Old Fadama areas.

Table 6-8: Pesticides in Sediment Samples

Parameter (µg/kg)	PT 1	PT2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	WHO GUIDELINE (µg/kg)
Alpha BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Beta BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Gamma BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Delta BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.0
Heptachlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.100
Aldrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Heptachlor Epoxide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Alpha-Endosulfan	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
4,4'- DDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Dieldrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Endrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.600
Beta –Endosulfan	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
4,4'DDD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Endosulfan Phosphate	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.030
Endrin Aldehyde	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
4,4'-DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.00
Endrin Ketone	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Methoxychlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	20.0

Table 6-9: Organic Pollutants in sediment (PCBs)

Parameter (µg/kg)	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	PT 7	PT 8	PT 9	PT 10	CEQGS
<b>PCB-52</b> <b>(2,2',5,5'-</b> <b>Tetrachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-138</b> <b>(2,2',3,4,4',5'-</b> <b>Hexachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-101</b> <b>(2,2',4,5,5'</b> <b>Pentachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-180</b> <b>(2,2',3,4,4',5,5'-</b> <b>Heptachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-153</b> <b>(2,2',4,4',5,5'-</b> <b>Hexachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>PCB-118</b> <b>(2,3',4,4',5-</b> <b>Pentachlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03
<b>28 PCB -28</b> <b>(2,4,4'-Trichlorobiphenyl)</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03

#### **6.4.3 General Assessment**

From the results of the laboratory analysis on both water and sediments from the Odaw basin, it can be inferred that despite the poor environmental conditions and visual quality of the water and sediments arising from the intensive land use activities within the catchment, the expected dredge materials are not contaminated with heavy metals and organic compounds. The sand component of the dredge material could therefore be recovered and considered for re-use.

## **7.0 STAKEHOLDER CONSULTATIONS**

Key stakeholders to the proposed Odaw dredging project have been consulted in November 2018 and February 2019. These include regulatory bodies, local government institutions and community members. Stakeholder consultation is an on-going process and would continue throughout project implementation.

### **7.1 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 information about the proposed project;
- To provide opportunities for stakeholders to discuss their opinions and concerns;
- To provide and discuss with stakeholders the 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.

### **7.2 Stakeholders Consulted**

The stakeholders consulted are grouped under the following headings:

- Project proponents;
- Regulatory institutions; and
- Other stakeholders.

#### Project Proponents

- Ministry of Works and Housing ;
- Hydrological Services Division
- Ministry of Sanitation and Water Resources being represented by the Project Coordinating Unit (PCU)

#### Regulatory Institutions

- Environmental Protection Agency (EPA),
- Accra Metropolitan Assembly
- Water Resources Commission
- FC- Wildlife Division

#### Other Stakeholders

- Zoomlion- Dredge Masters
- Dredge International -KLERP
- Opinion Leaders of Beneficiary Communities
- Project Affected Persons (PAPs)

### 7.3 Outcome of Stakeholder Consultations

A Summary of the consultations have been presented below in **Table 7-1**. Evidence of stakeholder consultations is provided in the **Annex 3**.

Table 7-1: Summary of Stakeholder Consultations.

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
<b>Institutions</b>					
Accra Metropolitan Assembly (AMA), Drains Maintenance and Waste Management Unit.	Graham Sarbah	Director, Drains Maintenance Unit	0202019170 0243235530	13/11/2018	<ul style="list-style-type: none"> <li>• The drains Maintenance and waste management unit is responsible for the management of the drains in the city.</li> <li>• Storm water drains which are supposed to be managed by the Ministry of Works and Housing, are also managed by the unit. This is however, one of the challenges of the unit.</li> <li>• The Odaw basin was last dredged in 2015.</li> <li>• Presently, there is no final disposal site for the materials and sediments that will be dredged out from the Odaw basin.</li> <li>• A final disposal site for the dredged materials must be made available, as it is not advisable to leave dredged out materials along the basin.</li> <li>• If dredged out materials are left along the basin, it serves as disposal sites for small “borla” taxis in the city.</li> <li>• There are also squatters living along the Odaw basin or channel.</li> <li>• AMA will inform squatters about the dredging activities, to enable them relocate before project activities starts.</li> <li>• There is no pool of funds available for the continuous maintenance of the Odaw basin after it has been dredged.</li> <li>• Silt traps can be constructed to prevent sediments and materials from other drains that flow into the Odaw basin.</li> <li>• Another challenge is with the Nima drain which flows directly into the Odaw basin (because it is at right-angle to the Odaw basin), unlike other drains that flow slowly at different angles into the Odaw. This result in a backflow from the Nima drains whenever there are heavy rains, which lead to floods in the Circle area.</li> <li>• This will only be resolved if the Nima drain is redirected to flow at an angle into the Odaw basin. This will allow the water from the drain to</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					flow slowly into the Odaw basin, thereby minimizing the occurrence of floods.
Hydrological Services Department, Accra	Seth Kudzordzi	Head, Drainage Department	0208186101	27/11/2018	<ul style="list-style-type: none"> <li>• The Ministry of Works and Housing (MoWH) is acting as the project lead with support from Ministry of Sanitation and Water Resources (MSWR) and Ministry of Local Government(MoLG).</li> <li>• The Department is however, handling the project with the MoWH, hence a major stakeholder of the project</li> <li>• The Department is responsible for the monitoring and evaluation of project activities which include reviewing of reports submitted by all project consultants to the ministry.</li> <li>• The project is grouped under three components, which are; <ul style="list-style-type: none"> <li>➤ Dredging of the Odaw basin</li> <li>➤ Construction of retention ponds and</li> <li>➤ Expansion of the Odaw channel</li> </ul> </li> <li>• Dredging consultants will be allowed to tender and bid for the dredging activities. The contract will be awarded to the winner.</li> <li>• The designs for the dredging of the Odaw are still ongoing</li> <li>• It is planned that two retention ponds will be constructed.</li> <li>• The final disposal sites for the dredge materials is currently the major challenge, however, discussions are underway to decide on the disposal sites before dredging.</li> </ul>
Dredge Masters(DM)	Capt. Ansar Ahmed Khan	Project Director	0302228080/ 0200385554	27/11/2018	<ul style="list-style-type: none"> <li>• The DM is a subsidiary of Zoomlion Ghana Ltd., a waste management company in Ghana.</li> <li>• The dredging of the Odaw river started in 2015 by DM and it is still an ongoing project.</li> <li>• The ongoing dredging was signed under the Accra Sanitary Sewer and Storm Water Drainage Elevation Project.</li> <li>• The project has halted due to financial constraints on the side of the government.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>• The dredge materials were dumped at the G1 landfill site because they were contaminated (no evidence received).</li> <li>• The government will help with evacuating the squatters along the Odaw channel before dredging activities began.</li> <li>• The rubbish and waste materials found in the channel poses a risk to water quality, national development and the entire dredging process. This was a major challenge during the 2015 dredging of the Odaw channel.</li> <li>• For the upcoming GARID project, additional or new landfill sites have to be proposed for the disposal of dredge materials.</li> <li>• The only solution to reducing floods caused by water bodies is, inflows and outflows of water should be balanced.</li> <li>• After the dredging activities, the Odaw channel can be widened but should not be lined.</li> </ul>
Previous Dredge Projects	Wise Ametefe	Engineer	0244384254	18/10/18	<ul style="list-style-type: none"> <li>• Has been involved in previous dredging projects on the Odaw as a consultant to Dredge Masters.</li> </ul> <p><u>Concerns on the proposed project</u></p> <ul style="list-style-type: none"> <li>• Dredging volumes have not yet been determined for the Odaw channel</li> <li>• It is advisable to collect samples at stream or major tributaries to the Odaw</li> <li>• It is important to sample existing dredge material for comparison. Existing dredged material left along the channel and the Klerp around Old Fadama.</li> <li>• Also it will be good to collect sediment from the island around the old Fadama stretch.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<u>Dredge Disposal</u> <ul style="list-style-type: none"> <li>The government has not yet identified disposal sites for dredged material, hence temporary disposal sites for previously dredged material have been created along the Odaw channel.</li> <li>The dredged material has to be drained. Bunds must be created to drain the water before haulage for onward disposal.</li> <li>There will be no hindrance to dredge works with respect to removal of structures along the channel.</li> </ul>
<b><i>Electoral areas</i></b>					
Odawna/ Sahara Electoral Area	Hon.Hendrick Noble Kinnah	Assembly member	0244662363	14/11/2018	<u>Concerns with previous dredging</u> <ul style="list-style-type: none"> <li>During the dredging of the Odaw basin or channel in 2015, the communities were not properly engaged.</li> <li>Also, dredged materials were left along the channel. This has led to increased flooding in certain communities in the area especially in the Odaw market, when there are heavy rains.</li> <li>The engineering of the drains system was not properly done. Hence, leading to floods in the area.</li> <li>Retention basins were not constructed at vantage points of the channel to hold storm water for a period of time. This will help sediments settle and also allow for the water to flow gradually into the channel, thereby reducing floods.</li> <li>People have been allowed to encroach along the channel.</li> </ul> <u>Expectations from the project</u> <ul style="list-style-type: none"> <li>The community leaders especially assembly members should be involved in the project activities. This will aid in the project implementation.</li> <li>The project timelines should be properly disseminated to the community leaders.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>• A buffer of 50m above and after the Odaw channel should be left and well vegetated. This will allow of future expansion of the channel as the city is developing.</li> <li>• The government should insist on the growing of greens (e.g. Trees) in the city and individual homes.</li> </ul>
Accra Metropolitan Assembly	Hon. Alfred Adjei	Presiding member/ Assembly member- Avenor Electoral Area	0244626622	21/11/2018	<ul style="list-style-type: none"> <li>• During the previous dredging in 2015, no major challenges were encountered. The community durbar was organized to sensitize the members before the project began.</li> <li>• However, the dredge materials were left on the along the Odaw river channel. This was collected after several months, creating an avenue for community members to dump rubbish into the channel as well as practice open defecation behind heaps of the dredge materials.</li> <li>• The assembly is responsible for making policies, hence, the law enforcement agencies should ensure that people are not allowed to encroach on the buffer areas along the river.</li> <li>• The project is a laudable idea but should be sustainable. A workable plan should be formulated to ensure the Odaw river is dredged at least every quarter or bi- annually.</li> <li>• The project will help reduce floods in the city.</li> </ul>
Amamomo Electoral Area	Hon. Musah Ziyad	Assembly member	0244286953	21/11/2018	<ul style="list-style-type: none"> <li>• There have been series of dredging done in the Odaw by Dredgemasters, a subsidiary of Zoomlion Company Ltd before the change of Government.</li> <li>• The last dredging activity done in 2015 led to the demolishing of some structures in the Old Fadama community. This resulted in confusion among community members. This was because, the community members were informed that the demolishing exercise would be done within 50m radius around the Odaw River, however it went beyond that.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>Most of the squatters along the river, especially the Sikkens area have only businesses there, few individuals actually squat there.</li> <li>The scrap dealers along the river also dump used appliances into the river.</li> <li>The community members including squatters along the river should be duly sensitized about the project.</li> </ul> <p><u>Challenges</u></p> <ul style="list-style-type: none"> <li>All the drains in the city are connected to the Korle Lagoon. This results in silt flowing into the Odaw basin.</li> <li>This has also contributed to the filth at our beaches because the outfall of the channels is situated in the sea.</li> <li>Dredging the Odaw basin is not the permanent solution to reducing floods in the city.</li> </ul> <p><u>Recommendations</u></p> <ul style="list-style-type: none"> <li>Silt traps should be constructed at the exit points of drains to prevent sediments from flowing into the Odaw basin and then eventually into the sea.</li> <li>Citizens must be sensitized as well as measures put in place to prevent them from dumping waste in the drains.</li> </ul>
Korle- Dudor Electoral Area	Kabiru Ashong Katai	Assembly member	0244026953	21/11/2018	<ul style="list-style-type: none"> <li>People have encroached around the Korle lagoon after the last dredging in 2015.</li> <li>This can lead to flooding in the area when there are heavy storms since the previous dredging helped to reduce flooding in the area.</li> <li>The dredging of the Odaw River should be done periodically, at least every quarter.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>The dredge materials should be disposed after the dredging is done. This will prevent the sediments from flowing back into the Odaw channel during heavy storms.</li> <li>The squatters must move to create access for the dredge machines when the project begins.</li> <li>The assembly member is willing to support in the project implementation if called upon.</li> </ul>
<b>Project Affected Persons (PAPs)</b>					
Avenor Electoral Area	Jonathan Addy (Rep)  Alex Addy (Rep)	Unit Committee Chairman Youth Organizer	0275565625  0249502731	26/11/18	<ul style="list-style-type: none"> <li>The level of floods in the area has minimized since the last dredging of the Odaw River in 2015.</li> <li>The dredge materials in the area were collected immediately after dredging.</li> <li>The members of the community were not duly informed before the previous dredging was done.</li> <li>No grievance redress mechanisms were put in place.</li> <li>After the dredging was done, the Unit Committee Chairman, records the water levels twice daily specifically at 6am and 6pm. A monthly report is prepared and submitted to the Regional Institute for Population Studies (RIPS) in Legon.</li> <li>Marks have been inscribed on the walls of the channel to help in the recording of the water levels daily.</li> <li>The water levels reduced to 40m after the previous dredging, but presently the minimum water level has increased to 110m. This is an indication that the amount of sand and sediments in the channel has increased.</li> <li>When the water level reaches an alarming height of 350m, community members living close to the channel are advised on the possible occurrence of floods. This is to enable them take needed precautions to prevent or avoid the occurrence of floods.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>The sediments in the Odaw channel are from adjoining gutters that flow into the channel during heavy storms.</li> <li>The gutters in the community are unable to handle the amount and rate of water flow during rains, hence, this causes a backflow which results into floods in the community.</li> <li>Some people dump rubbish and practice open defecation in parts of the channel.</li> <li>The dredge materials should be recycled instead of being disposed of.</li> <li>It is also assumed that, the backflow of water which causes floods, is as a result of part of the channel being destroyed.</li> <li>When there are heavy storms, the floods affected persons do not receive the needed help from National Disaster Management Organisation (NADMO).</li> <li>The community members should be duly informed before the project begins. This will help facilitate their cooperation and an easy project implementation.</li> </ul>
Awudu's Fitters Shop	Awudu Mohammed Ahaya Mohammed Moses Abukari	Mechanics along the drain at Avenor	0244923011 0265235532 0266396631	26/11/2018	<ul style="list-style-type: none"> <li>The only concern raised was to whether they will be duly compensated or an area will be allotted to them to enable them relocate there.</li> </ul>
Korle Dudor Electoral Area	Nana Yaw Sarfo	Opinion leader Chairman (Ghana Porters Union)	0275196003	27/11/18	<ul style="list-style-type: none"> <li>The scrap dealers and market women along the channel are responsible for the filth in the Odaw.</li> <li>Sanctions should be put in place to serve as punitive measures for anybody who sells or live within 50m away from the Odaw.</li> <li>The project is a laudable one, but if the squatters or people who live along the drain are allowed to come back after dredging, the cycle will continue.</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<ul style="list-style-type: none"> <li>The squatters will only vacate the place if only the authorities such as AMA, EPA, etc. speak to them. This is the only circumstance under which, they will cooperate to help in easy project implementation.</li> </ul>
Fishermen at the beach / outfall of the Odaw river	Francis Okoe Okansha Samuel Lartey	Fishermen representatives	0570218532	27/11/18	<ul style="list-style-type: none"> <li>These fishermen are not deep sea fisherman.</li> <li>The dredge materials should be collected immediately, because it's washed into the sea during heavy storms. This changes the colour of the sea water and makes fishing quite difficult.</li> <li>The project will benefit the fishermen greatly. This is because, the dredging of the Odaw River automatically increases the number of fishes that are harvested by the fishermen.</li> <li>Presently, fishing has become very difficult because, instead of fish they mostly harvest /catch rubbish in their nets</li> <li>Zoomlion Ghana helps sweep the beach on a daily basis.</li> <li>The fishermen at the beach where the outfall is located are into small scale fishing and they are four in number.</li> <li>The canoes at the outfall of the Odaw River belong to fishermen from Jamestown beach who only come to mend their nets and go back.</li> </ul>
<b>Second Round of Consultations</b>					
Accra Metropolitan Assembly	Hon. Alfred Adjei	Presiding member/ Assembly member- Avenor Electoral Area	0244626622	11/02/2019	<ul style="list-style-type: none"> <li>The Presiding Member is the Head of all Assembly Members under the AMA.</li> <li>The Hon Member confirmed all concerns had been adequately captured in the report and mitigation measures provided were good.</li> <li>Going through the report, he was very happy to be informed that there will be sand recovery from the dredge material and hopes this can generate some revenue for the assembly to be used for maintenance.</li> <li>At the next Assembly meeting the Hon Member will discuss the findings from the study and disclosure with other members who</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					are stakeholders under the project but could not be present at our meeting. The Draft ESIA report will be shared.
Ga Gbese Traditional Authority	Nuumo Ayitey Cobblah III	Korle – We High priest	0205933666	13/02/2019	<ul style="list-style-type: none"> <li>Nuumo Ayitey Cobblah III is the Highest Priest of the local tribe which is the Ga Gbese and the divinely chosen mouthpiece of the god of the Korle lagoon.</li> <li>The consultant discussed the project with the Highest priest and his elders and the priest expressed his joy and support for the upcoming project. He emphasized that the project was good and he and his people are in full support.</li> <li>He was emphatic that the project will only be successful if the required pacification rites are properly performed</li> <li>He mentioned that the Korle is not an ordinary water body; it is a god hence the spirits are to be consulted to prevent any untoward catastrophes to workers and machinery on site when/ if work begins. If the gods are not properly consulted, the work will not be successful. According to Nuumo Ayitey Cobblah III, rituals are usually performed every Friday, Saturday and Sunday; to seek guidance and protection from the Korle god.</li> <li>As the highest priest and the spiritual representative of the people, he is the only qualified leader who can perform the rites needed to pacify the gods before, during and after the project. No one else has the spiritual authority to do so and indeed his people will not even allow anyone else</li> <li>He is willing to assist the project by seeking the blessings of the gods to ensure a successful project especially at the start of the dredging</li> <li>He further elaborated on the source of the Korle and lamented the pollution challenges and their effects on the lagoon. He further</li> </ul>

Stakeholder/ Institution	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					<p>went on to explain that for the past 3 years all efforts to get funding to desilt the Korle have proved futile.</p> <ul style="list-style-type: none"> <li>There are other rivers that also drain into the Korle such as the Bubui River around the Obetsebi roundabout and Kane River, which passes through the Awudome cemetery. The Bubui River seems choked. The above-mentioned are actually river bodies with their respective gods who pay obeisance to the Korle.</li> </ul>

### 7.3.1 Key Issues from Consultation

The main environmental and social concerns raised during the stakeholder consultations are summarized in **Table 7-2**.

**Table 7-2: Summary of Key Issues of concern and responses**

Stakeholder	Key issues of concern	Response
Assembly Members	<ul style="list-style-type: none"> <li>The recurrent siltation of the channel/basin which results in floods is mainly due to lack of management and poor sanitation practices of inhabitants along the area. The government must develop a plan that allows for periodic dredge work and regular management</li> <li>The project must collaborate with the Assembly and the government to remove the squatters along the drain</li> </ul>	<p>-Dredging is quite costly, the concerns are well noted however the assembly members must also endeavor to educate community members on the impacts of their poor sanitation practices on the drain</p> <p>-The Ministry will liaise with the AMA to ensure affected persons are adequately informed and repositioned, if possible</p>
Drains Maintenance and Waste Management Unit	<ul style="list-style-type: none"> <li>The structural designs of some adjoining drains are poor eg. The Nima drain flows directly into the Odaw at a right angle unlike other drains that flow slowly at different angles into the Odaw. This results in backflow from the Nima drains whenever there are heavy rains and causes the floods in the circle area.</li> </ul>	<p>Sub – project activities must include civil works which aim at improving the flood situation and some engineering challenges along the Basin.</p>
Project Affected Persons	<ul style="list-style-type: none"> <li>Dredge material from previous dredge works have been left at the banks of the drain. These materials get back into the drain when washed by the rains</li> <li>Affected persons are concerned if they will be relocated and if they will receive compensation to that effect.</li> </ul>	<p>-There were challenges with disposal sites for previous dredge works, hopefully this should not re occur for this project</p> <p>-The consultant cannot confirm or deny relocation and compensation packages. But the final decision from project proponents will be officially communicated to affected persons after an assessment to determine a RAP/Alternative Livelihood plan implementation.</p>
Previous Dredge Engineers	<p>There are no disposal sites provided by the Government of Ghana. This has been a major challenge that has not been resolved</p>	<p>The Ministry is working effortlessly with the Government to resolve this problem.</p>

		Hopefully this will be finalized before the project begins
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#### 7.4 Disclosure of the ESIA Document

Further to earlier discussions and recommendations from stakeholders, subsequent meetings were held to disclose the results of the assessment and to obtain the buy-in of stakeholders particularly, the Assembly members and traditional authorities. The ESIA will be disclosed on the Banks intranet website prior to appraisal. Evidence of Consultations is illustrated in **Plate 7-1** and included as **Annex 3**.



**Plate 7-1: Disclosure of ESIA to Nuumo Ayitey Cobbla III (left) and Hon Alfred Adjei –AMA Presiding Member/Assembly Member for Avenor Electoral Area (Right)**

## **8.0 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACT IDENTIFICATION AND EVALUATION**

The identified potential environmental and social issues and impacts have been discussed based on the nature of the project, project area of influence, field inspections and observations, results of the sediment and water quality analyses, concerns from stakeholder consultations and issues from relevant literature search.

### **8.1 Project Area of Influence**

The project areas to be influenced have been grouped under:

- Geographical;
- Environmental;
- Socio-economic;
- Community level; and
- Institutional/organizational.

#### **8.1.1 Geographical Area of Influence**

The direct area of influence will consist of the area within the 50m buffer along the drain and within the Korle Lagoon catchment as well as the buffer area surrounding the temporary and final disposal sites for the dredge material. The indirect area of influence will consist of the sections of the route along the xxx transportation route from the project site to the final disposal site. The larger geographical area of influence is Accra Metropolitan Assembly of the Greater Accra Region of Ghana and the country as a whole.

#### **8.1.2 Environmental Media Influence**

The physical environmental media to be potentially influenced by the activities of the proposed project are land (landscape); air quality, ground water resources and the Ocean. The landscape features include soil, flora and fauna at the project site which will be impacted by the project activities. Air quality may also be impacted by dust and gaseous emissions from equipment and machinery used on the project site during the dredging stage. The Ocean serves as the receiving medium from the Korle Lagoon.

#### **8.1.3 Socio- economic Influence of the Project**

The socio-economic and cultural influence will include:

- Project affected businesses and affected livelihoods of individuals along the drain during dredging;
- Provision of improved drains for better flood adaptation for communities

#### **8.1.4 Institutional Influence**

The major institutions to be influenced or involved in the proposed project include:

- Ministry of Works and Housing
- Ministry of Local Government and Rural Development;

- Ministry of Sanitation and Water Resources;
- Hydrological Services Department
- Accra Metropolitan Assembly

## **8.2 Project Activities and Issues of Environmental and Social Concern**

### **8.2.1 Pre Dredging Phase**

The activities of environmental and social concern identified under the pre-dredging phase include but are not limited to;

- Feasibility studies, reconnaissance visits, confirmation of sediment volumes etc.
- Water and Sediment Sampling and analyses
- Identification of project affected persons and Stakeholder consultations;
- Identification and confirmation of disposal sites
- Statutory permitting activities including meetings with the EPA.

### **8.2.2 Dredging Phase**

Activities that will potentially create environmental, social and safety concerns during the dredging stages include:

- Mobilization and moving of dredge equipment to the site, recovery of sand, desilting and flushing of the drain
- Temporary holding facilities for wet dredge material and sand recovery
- Transport of dredge material to disposal sites
- Management of disposal sites
- Engagement of project affected persons

### **8.2.3 Post- Dredging Phase Activities**

The main project activities that will potentially create environmental, social and safety concerns during the Post-dredging stages include:

- Maintenance activities within the channel and along the basin
- Regular engagement of communities within the catchment area

## **8.3 Criteria of Impact Evaluation**

### **8.3.1 Duration of the Impact**

- A temporary impact can last days, weeks or months, but must be associated to the notion of reversibility.
- A permanent impact is often irreversible. It is observed permanently or may last for a very long term.

### 8.3.2 *Extent of the Impact*

- The extent is regional if an impact on a component is felt over a vast territory or affects a large portion of its population.
- The extent is local if the impact is felt on a limited portion of the zone of study or by a small group of its population.
- The extent is site-specific if the impact is felt in a small and well defined space or by only some individuals.

### 8.3.3 *Intensity of the Impact*

- The intensity of an impact is qualified as strong when it is linked to very significant modifications of a component.
- An impact is considered of average intensity when it generates perceptible disturbance in the use of a component or of its characteristics, but not in a way to reduce them completely and irreversibly.
- A weak intensity is associated with an impact generating only weak modifications to the component considered, without putting at risk some its utilization or its characteristics.

### 8.3.4 *Impacts Severity*

- Major Impact: repercussions on the environment are very strong and cannot easily be reduced.
- Moderate Impact: repercussions on the environment are substantial but can be reduced through specific measures.
- Minor Impact: repercussions on the environment are significant but subdued and may or may not require the application of mitigation measures.

## 8.4 **Evaluation of Potential Positive Impacts**

The potential positive impacts of the proposed dredging project are listed below and evaluated in **Table 8-1**.

- Employment Generation;
- Flood mitigation; and
- Alternative Uses of dredge material

**Table 8-1: Evaluation of potential positive impacts.**

No.	Impact	Key receptor(s)	Preliminary Evaluation
1.	Employment Generation	Community, third party contractors/consultants	<ul style="list-style-type: none"><li>• The project will provide employment opportunities throughout its entire duration.</li><li>• Employing skilled labour such as machine operations and unskilled labour locally (e.g. digging trenches, etc.) will improve household incomes and wellbeing.</li><li>• Given parts of the area have been encroached by informal settlers, there is limited working space for big machinery, more</li></ul>

No.	Impact	Key receptor(s)	Preliminary Evaluation
			<p>local manual labour will be required e.g. laying of pipes, digging trenches, etc.</p> <ul style="list-style-type: none"> <li>Employing community workers will further create a sense of ownership within the area and reduce chances of vandalism during the operational phase</li> <li>Local consultants whose services have been procured to carry out activities during the various stages of the project will generate revenue for such local firms.</li> </ul>
2.	Flood mitigation	Residents within the basin, General Public	<ul style="list-style-type: none"> <li>Desilting and channeling the drains will improve urban drainage and flood management in Odaw drainage basin through civil works, construction of sand traps, dredging, desilting, rehabilitation of drainage systems</li> </ul>
3.	Alternative uses of dredge material	Contractors, General Public	<ul style="list-style-type: none"> <li>The dredge material will be dewatered and the sand material recovered for re-use</li> <li>Recovery of sand from dredge materials can also create income to support the maintenance of the drain and reduce residual materials to be disposed of.</li> <li>Non- contaminated dredged material can be utilized as a source of fill material for various construction works, reclamation of low lying areas, composting and covering landfill sites.</li> <li>Non –contaminated dredge material can also be used as basin reclamation material for the reestablishment of plant and tree growth once the mining activities have been completed.</li> <li>Clean dredged material is an excellent source of material to create and/or restore aquatic, wetland and upland habitats. Native vegetation is often re-established and can provide large regions of natural areas for habitat applications.</li> </ul>

## 8.5 Summary of significant Adverse impacts

### 8.5.1 Pre- Dredging Phase

- Occupational Health and Safety; and
- Anxiety on the part of potentially affected persons

### 8.5.2 Dredging Phase

- Air quality deterioration
- Noise and Vibration
- Visual intrusion/Aesthetic impacts
- Water quality deterioration
- Generation and disposal of solid waste
- Public safety and traffic impacts
- Impacts on livelihood
- Occupational health and safety
- Impacts on cultural heritage

### 8.5.3 Post-Dredging Phase

- Public safety and traffic Impacts
- Occupational Health and Safety
- Impacts from dredge material disposal

## 8.6 Evaluation of Potential Adverse Impacts Associated Pre- Dredging Phase

The adverse environmental and social issues which could possibly arise from the planning phase activities, may include the following which are also evaluated in **Table 8-2**.

Table 8-2: Evaluation of adverse pre-dredging phase

S\N No.	Activity	Key receptor(s)	Preliminary Evaluation of Potential Impact	Likely impact Significance
1.	-Assessment of existing basin conditions - Reconnaissance and identification of sampling points	Field workers	<u>Occupational Health and Safety</u> <ul style="list-style-type: none"><li>• Field Workers including survey teams may be exposed to hazards (e.g. trips and falls, danger from possible contact with contaminated water during preliminary field assessments.</li><li>• This effect can be prevented or minimized by wearing appropriate personal protective equipment such as safety boots and gloves.</li><li>• The impact is temporary and lasting only during the preliminary phase.</li></ul>	• Minor
2.	Identification of affected persons	Potentially affected persons	<u>Anxiety on the part of potentially affected persons</u> <ul style="list-style-type: none"><li>• From the preliminary studies, squatters, mechanics ,petty trader and cattle rearers are the main occupants of the 50m buffer reserved at the banks of the drain on either side</li><li>• Project affected persons will be aggrieved if not consulted adequately ;</li><li>• Design engineers need to avoid/ minimize such impacts as much as possible.</li></ul>	• Moderate

## 8.7 Evaluation of Potential Adverse Impacts associated with Dredging Phase

The potential negative environmental and social impacts associated with dredging phase activities are listed below and evaluated in **Table 8-3**.

**Table 8-3: Evaluation of potential adverse dredging phase impacts**

	Impact	Activity	Key receptor(s)	Preliminary Evaluation of Impacts	Likely Impact Significance
1.	Air quality deterioration	Site Clearing Transport of equipment, dredging works , transport of dredge material	Public	<ul style="list-style-type: none"> <li>The areas along the channel ie Avenor, Circle , Agbogloboshie etc are already polluted with foul odour. Dredging may aggravate the intensity of the odour which will pose further nuisance to communities and persons working close to the site</li> <li>Site clearing at the various sections of channel for housing/ mounting dredge equipment may result in air quality deterioration.</li> <li>Transport of equipment to and from the site may release air emissions</li> <li>Exhaust emissions from heavy duty equipment and sediment loading trucks may result in air quality deterioration.</li> <li>The impact is intense, direct, and temporary and likely, lasting during the dredging phase; the impact is also local in extent i.e. limited to the project site and adjacent properties.</li> </ul>	Major
2.	Noise and Vibration	Dredge works	Public, fauna	<ul style="list-style-type: none"> <li>Noise and vibration from dredging equipment may pose a nuisance to persons around the dredging area</li> <li>Increased levels of noise and vibration from equipment may disturb Aquatic habitats and biota</li> </ul>	Minor
3	Visual intrusion/Aesthetic impacts	Removal of sediments	Public	<ul style="list-style-type: none"> <li>Temporary storage of dredge material on the banks of the drain may cause unsightly conditions</li> <li>The impact is direct, likely, temporary and local in extent. The scale may reduce if dredge works will be done in sections</li> </ul>	Major
4.	Water Quality deterioration	Dredge works	Water	<ul style="list-style-type: none"> <li>Fine particles resuspended during the dredging process can remain in the water column for many hours due to their low settling velocities. This material and any associated contaminants can be transported from the dredging area into the surrounding environment due to the effects of currents</li> <li>The associated re-suspension of sediment could further impact settling sediment. This impact, even though transient and localized to the dredge areas may be intense</li> </ul>	Major

5	Generation and disposal of solid waste	Clearing prior to dredge works		<ul style="list-style-type: none"> <li>Waste to be generated includes solid waste from communities as many communities use the Odaw River as an informal means of disposal of their solid wastes. Residents continue to indiscriminately dispose of their waste especially into the drain.</li> <li>Waste from the communities along the drain is also washed into the drain when it rains</li> <li>Vegetation/biomass from overgrown weeds within the drain will also generate waste</li> <li>The area around Old Fadama houses a slum which has also generated a huge rubbish dump site along the drain, also plastic waste accumulated at the non –functional Korle Lagoon Ecological Restoration Project (KLERP) contributes to the rubbish. These will have to be removed to make way for dredge works and will generate a large amount of waste</li> <li>The impact is direct, temporary and likely, lasting during the dredging phase; the impact is also local in extent i.e. limited to the project site and adjacent properties and disposal site, but major in scale</li> </ul>	Major
6	Public health, safety and traffic impacts	Transportation of waste, dredge material. Movement of dredge equipment , Dredge works along the drain	Communities along the drain	<p><u>Road Safety Impacts</u></p> <ul style="list-style-type: none"> <li>There are 5 major road crossings/bridges within the proposed project area from Avenor to Old fadama. Dredge equipment cannot go under these bridges but will require access via the roads leading to the various communities. Moving dredge Equipment from section to section may hinder traffic movement and cause delays along these already congested routes</li> <li>Also movement of disposal trucks to and from the dredge areas to the temporary holding sites and finally disposal sites may induce traffic along these routes</li> </ul> <p><u>Spread of HIV/AIDS and other Sexually Transmitted Diseases (STDs)</u></p> <ul style="list-style-type: none"> <li>Dredging aactivities may result in the movement of workers to the different project areas and people from other communities in search of job opportunities.</li> </ul>	Major

				<ul style="list-style-type: none"> <li>Influx of people during the period may enhance irresponsible sexual behaviour which could lead to teenage pregnancies, HIV/AIDS and other STD infections. The impact may be permanent or irreversible in nature.</li> </ul> <p><u>Public health issues</u></p> <ul style="list-style-type: none"> <li>The existing practice in the area is open defecation. However, poor sanitation conditions may further pollute the environment and ultimately the Korle lagoon if adequate toilet facilities are not provided for workers.</li> <li>The presence of workers along the channel may interfere with the use of the place for open defecation.</li> <li>This impact on public health is long term and severe but probability of occurrence depends on the number of workers expected.</li> <li>The impact is likely, direct and indirect, temporary and permanent depending upon injury/hazard, lasting during or beyond the dredge phase; the impact is local and the impact scale from moderate to major.</li> </ul>	
7	Impacts on livelihood	Dredge works and temporary disposal	Project affected persons	<ul style="list-style-type: none"> <li>The 50m reservation along the drain from Avenor to Agblogbloshie (Sikkens area) is occupied by squatters, auto mechanics, and petty traders and cattle rearers.</li> <li>These unauthorized inhabitants may have to be moved to allow for effective dredge works to take place. This may affect the livelihoods of occupants of the area</li> <li>The impact is indirect, the duration could be short or long term. The extent is local.</li> </ul>	Major
8	Occupational health and safety	Dredge works	Workers	<ul style="list-style-type: none"> <li>Workers will be exposed to risks during dredge works. The risks include hazards from operation of machinery/ equipment, inhalation of dust and fumes, drowning and accidents from falling objects, etc.</li> </ul>	Major

				<ul style="list-style-type: none"> <li>• Unhygienic working conditions, discriminatory practices, engagement of child labour could bring about social and labour conflicts</li> <li>• Risk of accidents from the materials management at the work camps, including accidents from poorly managed workspace and fire from fuel storage facilities</li> <li>• The impact is direct, temporary and likely, lasting during the dredge phase; the impact is local and may also involve foreign nationals as well. The scale could range from moderate to severe</li> </ul>	
9	Impacts on cultural heritage	Dredge works		<p>Dredging activities will affect the Korle Lagoon which is polluted and almost silted.</p> <p>Erosion of excavated material during dredge works may further add to siltation challenges of the lagoon.</p> <p>The impact is indirect, temporary and likely, lasting during the dredge; the impact is also local in extent, extending to nearby streams/lagoon, and moderate in scale</p>	Moderate

## 8.8 Evaluation of potential adverse Post-Dredging Phase

The potential adverse impacts related to the operational and maintenance phase of the proposed rehabilitation project are stated below and evaluated in **Table 8-4**.

**Table 8-4: Evaluation of Adverse Post -Dredging Phase impacts.**

No.	Impact	Activity	Key r receptor(s)	Preliminary Evaluation	Likely impact Significance
1	Public safety and traffic Impacts	Maintenance works , Disposal of dredge material	Public	<ul style="list-style-type: none"> <li>Disposal of dredge material via trucks to disposal sites may result in public health risks when not properly handled</li> <li>Leaving dredged material on the banks of the drains for long periods to allow for dewatering may pose health and sanitation risks to communities surrounding the area</li> <li>The impact is likely, direct and indirect, temporary and permanent, lasting during or beyond the post dredging phase; the impact is local and the impact scale from minor to moderate.</li> </ul>	Major
2	Occupational Health and Safety	Transport Disposal of dredge material , maintenance activities	Workers	<ul style="list-style-type: none"> <li>Occupational health and safety issues associated with the proposed post- dredging operation include.</li> <li>Risk of injury from slips, falls and drowning during maintenance activities.</li> <li>The impact is direct, possible, on-site, and could be minor to severe in scale due to level of injuries or fatalities.</li> <li>The duration of impact could be temporary or long-term or permanent.</li> </ul>	Moderate
3	Dredge material disposal	Transport and Disposal of dredge material	Environment	<ul style="list-style-type: none"> <li>Waste to be generated include, solid waste ie plastics and metals, vegetative biomass and sediments.</li> <li>Estimated volume of dredge material from the basin is 1,084,091 m<sup>3</sup></li> <li>Sediments are not contaminated with heavy</li> </ul>	Major

No.	Impact	Activity	Key receptor(s)	Preliminary Evaluation	Likely impact Significance
				metals, pesticides and hydrocarbons. <ul style="list-style-type: none"> <li>The impact is direct, likely, long-term, local in extent due to disposal and moderate in scale</li> </ul>	

## 9.0 IMPACT MITIGATION AND MANAGEMENT MEASURES

Mitigation and management measures for the potential adverse impacts have been proposed in **Table 9- 1** to ensure that the project impacts are managed within reasonable and acceptable limits. The general rules followed in designing the mitigation measures are listed below:

- a) Avoidance of major impacts: major impacts are impacts where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resources/receptors;
- b) Reduction of major and moderate impacts: moderate impacts are impacts 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; 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.

### 9.1 Type of Mitigation Measures

The mitigation measures adopted may be categorized as:

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

#### 9.1.1 Preventive Measures

These are measures adopted during the pre –dredging phase. The measures are aimed at avoiding or minimizing potential major impacts at source. Avoiding or reducing an impact at source is essentially ‘designing’ the project so that a feature causing an impact is designed out (e.g. site selection to avoid sensitive areas) or altered (e.g. working at night where necessary) or avoided (e.g. community sensitization programmes to avoid conflicts or confrontations).

#### 9.1.2 Control Measures

These are measures adopted to abate or remedy the impacts occurring during dredging and post – dredging phases. Impacts can be abated on site or at receptor end. Repair or remedy of impacts involves unavoidable damage to a resource, e.g. vegetation clearing during land preparation. In this case repair essentially involves re-vegetation of the affected parts.

#### 9.1.3 Compensatory Measures

Where other mitigation measures are not possible or fully effective, compensation, when required, will be provided in accordance with the national standards as set forth by the relevant entities such as the Water Resources Commission.

### 9.2 Mitigation Measures for Significant Potential Adverse Impacts

The mitigation measures for the identified adverse impacts are summarised in **Table 9-1** below.

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Table 9-1; Proposed Mitigation measures

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
<b>Dredging Phase</b>				
Air quality deterioration	Site Clearing Excavations Transport of equipment	<ul style="list-style-type: none"> <li>• Ensure effective communication strategy for dredging plan to communities e.g. through assemblymen, radio advertisements, PA systems, etc.</li> <li>• Ensure that stock piles of dredge material left to dewater at the temporary holding areas is not abandoned for long periods to prevent wind transport of soil particles into the environment</li> <li>• Dredge material should not be left at the banks but immediately sent to temporary holding sites (e.g. the proposed Site G1 which is opposite the old Fadama settlement) to reduce odour intensity for surrounding inhabitants</li> <li>• Unpaved access roads to be sprinkled with water to regulate dust levels during transport of equipment and dredge material.</li> <li>• Use of good quality fuel and lubricants in vehicles, equipment and machinery.</li> <li>• Regular scheduled maintenance and servicing to be carried out on all vehicles and equipment to minimize exhaust emissions</li> <li>• Engines of vehicles, machinery, and other equipment to be switched off when not in use to reduce emissions.</li> <li>• Dredge works to be phased out or controlled to reduce emissions from equipment and machinery in use</li> </ul>	Contractor	As part of duties of Contractor
Noise and Vibration	Dredge works	<ul style="list-style-type: none"> <li>• Dredging activities to be carried out during daylight hours.</li> <li>• Excessively noisy dredge equipment to be located away from sensitive environmental receptors.</li> <li>• Regular maintenance of equipment and machinery to reduce noise generation when in use.</li> <li>• Engines of vehicles, equipment and machinery to be turned off when not in use.</li> <li>• Residents, traders and communities to be notified in advance of the project before mobilization to site</li> </ul>	Contractor	As part of duties of contractor

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
Visual intrusion/Aesthetic impacts	Removal of sediments	<ul style="list-style-type: none"> <li>Dredge activities to be done in sections to reduce impacts of change and visual intrusions to the general public.</li> <li>The work sites to be hoarded off from public view.</li> <li>Good housekeeping measures, such as regular cleaning, to be maintained at the work camp site.</li> <li>Ensure an acceptable post-dredged site as per provisions in the contract.</li> </ul>	Contractor	70,000
Water Quality deterioration	Dredge works	<ul style="list-style-type: none"> <li>During dredging, the contractor should consider slower dredging speeds to reduce the amount of material entering the water column and associated impacts</li> <li>Works will not be executed under aggressive weather conditions such as rains or stormy conditions. Also change dredge schedules based on tide and natural/background turbidity levels to minimize effects from high turbidity levels</li> <li>No solid waste, fuels, or oils to be discharged into any section of the drain or waterway.</li> <li>Dredge works to be done in sections to minimize soil resuspension and associated impacts</li> <li>Temporary sediment barriers to be installed on slopes to prevent silt from entering water courses.</li> <li>Maintenance, fuelling and cleaning of vehicles and equipment to take place at off-site workshop with adequate leakage prevention measures</li> </ul>	Contractor	As part of duties of contractor
Generation and disposal of dredge material and solid waste	Clearing prior to dredge works	<ul style="list-style-type: none"> <li>Specify in the Performance-Based Contract the application of of Reduce, Recycle, Reuse and Recover for waste management through the following actions:</li> <li>Ensure solid waste is salvaged first and/or separate solid waste from dredge materials.</li> <li>Recovery of sand from the dredge materials to reduce the volume of materials going to the final disposal site but to all generate income from the sand recovery.</li> </ul>	Contractor	25,000

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
		<ul style="list-style-type: none"> <li>Only dredge materials sans recovered sand and solid wastes will be disposed in dredge materials disposal areas. Solid waste will be disposed of at approved engineered sanitary landfill sites</li> <li>Ensure that the excavated waste (i.e. plastics and metals) is not left on site but is readily disposed of.</li> <li>Dewatered material unsuitable for backfilling will be collected from temporary disposal sites for onward disposal to the approved final disposal site in collaboration with the AMA.</li> <li>Provide bins on site for temporary storage of garbage such as lubricant containers, drinking water sachets and carrier bags/packaging materials.</li> <li>All metal scrap waste will be disposed of at sites approved by the AMA or sold to approved third party agents for use by metal companies.</li> <li>Contractor to work according to a prepared and agreed Solid Waste Management Plan</li> </ul>		
Public health, safety and traffic impacts	Transportation of waste, dredge material. Movement of dredge equipment, Dredge works along the drain	<ul style="list-style-type: none"> <li>Contractor to prepare a Contractors ESMP as well as ensure all employers adhere strictly to code of conduct</li> <li>Work areas to be hoarded off adequately to avoid inquisitive trespassers especially children</li> <li>Warning signs to be posted around work areas to discourage trespassers</li> <li>Contractors to maintain adequate security at dredging sites to avoid pilfering or vandalising of property</li> <li>Contractors to provide traffic management plans duly approved by relevant authorities</li> <li>Adequate alternative arrangements to be made to minimize impacts on motorists and pedestrians</li> <li>Works to be completed on time to minimize inconvenience to motorists and pedestrians</li> </ul>	Contractor	50,000
Impacts on livelihood	Dredge works and temporary disposal	<ul style="list-style-type: none"> <li>The contractor should consider reducing the amount of space required within the 50m buffer along the channel to minimize/avoid resettlement impacts on the PAPS</li> </ul>	MWH/Assembly Members/Contractor	5,000

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
		<ul style="list-style-type: none"> <li>Consult affected property owners and seek their concern prior to commencement of works</li> <li>The Contractor to liaise with the AMA to ensure the Public is well informed of the proposed project prior to contractor mobilizing to sites;</li> <li>Employment and other opportunities to be given to local communities as much as possible</li> </ul>		
Occupational health and safety	Dredge works	<ul style="list-style-type: none"> <li>Engage experienced workers for the proposed project</li> <li>All workers should be given proper induction/orientation on safety.</li> <li>The contractor will have a Health &amp; Safety Policy and procedures to guide the dredge activities</li> <li>The contractor will ensure all workers adhere to the Code of Conduct</li> <li>Regularly service all equipment and machinery to ensure they are in good working condition.</li> <li>Ensure there are first aid kits on site and a trained person to administer first aid.</li> <li>Provide and enforce the use of appropriate personal protective equipment (PPE) such as safety boots, reflective jackets, hard hats, hand gloves, earplugs, nose masks, etc.</li> <li>Proof of competence for all equipment/machine operators will be required and established through inspection of valid drivers or operator's license or documents.</li> <li>Comply with all site rules and regulations.</li> <li>Apply sanctions where safety procedures are not adhered to.</li> <li>Site meetings should create awareness on OHS.</li> </ul>	Contractor	10,000
Impacts on cultural heritage	Dredge works	<ul style="list-style-type: none"> <li>Consult the Traditional authority, <b>Korle –We</b> responsible for the sanctity of river gods</li> <li>Necessary cultural rites agreed with community and performed prior to access to water bodies</li> </ul>	Contractor/Assembly members/Traditional Authorities.	3,000
<b>Post – Dredging Phase</b>				

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
Public safety and traffic Impacts	Maintenance works , Disposal of dredge material	<ul style="list-style-type: none"> <li>• Transport dredge material During off peak traffic periods along transport routes</li> <li>• Ensure the public is well informed of dredge plan at every phase of the project</li> <li>• Encourage public reporting of illicit discharges and disposal of garbage into the drain by creating awareness among community members and also and providing a means of reporting</li> <li>• Regular inspection of the condition of drain structures and identifying areas that need repair or maintenance.</li> <li>• Establish routine maintenance program, including: Development of an inventory of system components, with information including age, materials used/required, drainage areas served, elevations, etc.</li> <li>• Regularly review previous maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure.</li> <li>• Adequate alternative arrangements to be made to minimize impacts on motorist and pedestrians</li> <li>• Excavated material will be appropriately disposed immediately where applicable to prevent health and sanitation risks for community member’s</li> </ul>	Contractor/AMA – Drains and Maintenance Unit/MWH	As part of duties of Contractor
Occupational Health and Safety	Transport Disposal of dredge material , maintenance activities	<ul style="list-style-type: none"> <li>• Prepare and adhere to OHS policy and procedures</li> <li>• Maintain work areas to avoid accidents</li> <li>• A safety and emergency response plan must be developed for all operations with due importance given to the protection of the environment</li> <li>• Provide field workers with personal protective equipment, such as rubber gloves and overalls, and waterproof shoes;</li> <li>• Provide workers with regular health checks</li> </ul>	Contractor	As part of duties of Contractor
Dredge material disposal	Transport and Disposal of dredge material	<ul style="list-style-type: none"> <li>• The contractor will be required to prepare a Dredge Material Recovery, Disposal and Management Plan duly approved by the Project and based on the approved disposal options specified in this ESIA</li> </ul>	Contractor/MWH/AMA	As part of duties of Contractor

Environmental and Social Impact	Activity	Proposed Mitigation Measure	Responsibility	Cost (US\$)
		<ul style="list-style-type: none"> <li>Excavated earth materials will, as much as possible, be re-used for back filling purposes to reduce waste.</li> <li>Dredged material will be tested and disposed of appropriately</li> <li>There is an existing temporary holding area just on the western bank of the Odaw channel across from old Fadama along the Korle –Bu road used for earlier dredge works, and this should again be considered for use because of its close proximity to the dredge area before final disposal.</li> <li>Excavated materials and silt, which cannot be used will be disposed of at appropriate sites as per the Dredge Material Recovery, Disposal and Management Plan prepared by contractor and approved by the AMA. The rampant practice of heaping de-silted materials by banks which are later washed back into drains after rain events will be avoided.</li> </ul>		
<b>TOTAL</b>			<b>163, 000 for entire project duration</b>	

## **10.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN**

An Environmental and Social Management Plan (ESMP) is developed for the project in accordance with the Environmental Assessment Regulations of 1999, LI 1652 and OP 4.01 to assist the odaw dredging project to be carried out in an environmentally safe and sustainable manner. The ESMP outlines management commitment and the required training programmes for the sustainable implementation of the proposed project. An estimated budget for the PESMP is also included in this section.

### **10.1 Objectives of the EMP**

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

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

### **10.2 Programme to meet Requirements**

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

- Development and Implementation of a Dredge Materials Recovery, Disposal and Management Plan
- Adoption of Environmental Health and Safety Plan;
- Environmental, Health and Safety management Structuring
- Environmental Health and Safety Committee
- Contractors ESMP
- Workers' training and awareness creation
- Environmental and Social Monitoring Programmes
- Archaeological and Cultural Heritage Chance find procedure
- Community Safety and Traffic Management Plan
- Public and community participation;
- Provisional Grievance Redress Mechanism
- Audits and Reviews; and
- Environmental and Social management budgeting

#### ***10.2.1 Development and Implementation of a Dredge Materials Recovery, Disposal and Management Plan***

MWH will require bidders for dredge works to develop and implement a Dredge Materials Recovery, Disposal and Management Plan. This requirement will be spelled out in the dredge contract, which is performance-based. The plan will include dredging schedule, sand recovery and the disposal and

management of remaining materials to the final disposal site approved by the MWH. As sediments are not contaminated disposal options will be landfill covering materials and filling materials

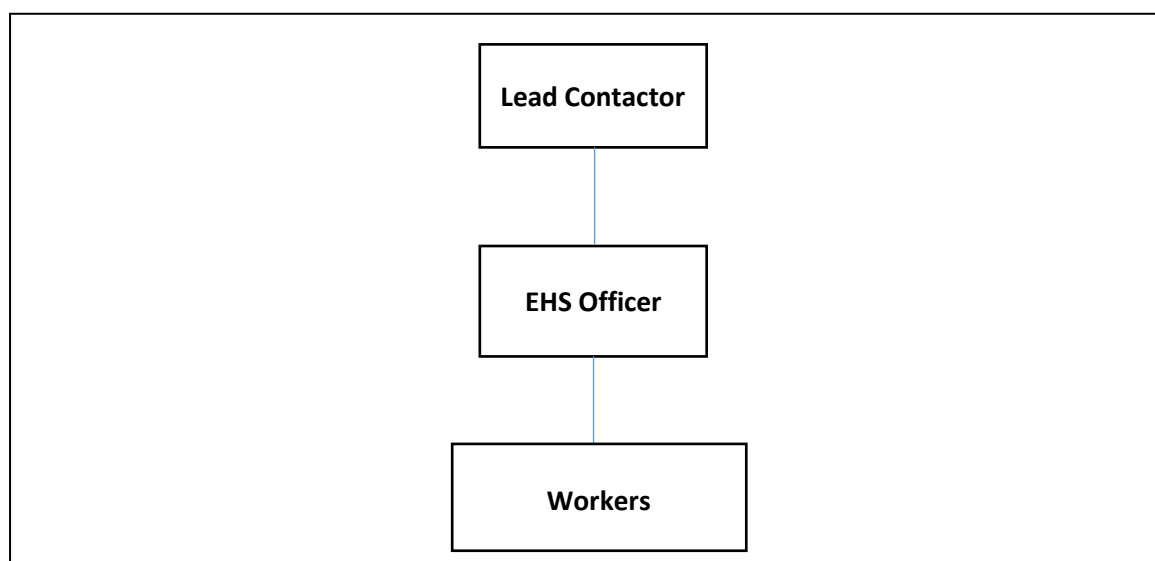
### **10.2.2 Adoption of Environmental, Health and Safety Plan**

The Contractor shall develop an environmental, health and safety plan to guide the sustainable implementation of the project. WMH shall ensure that the contractor implements the EHS Plan. The plan should include standard operational procedures will serve to guide the workers in their daily activities and also serve as a training manual for in-service training as well as induction of new workers engaged on the project.

### **10.2.3 Environmental, Health and Safety (EHS) Management Structuring**

The Lead Contractor shall appoint a qualified Environment, Health and Safety (EHS) Officer for the proposed dredge works. The EHS Officer will be responsible for the day-to-day management of the environment, health and safety of the project phases. The EHS Officer shall report directly to the top management of the Lead Contractor. The responsibilities of the EHS Officer will include the following:

- Lead the implementation of environmental, health and safety policies and programs of the construction works, as well implementation of the ESMP and environmental permit conditions.
- Ensuring adequate training is provided for all staff, including EHS induction for all workers.
- Organize and coordinate tool box meetings.
- Liaising with the Lead Contractor to ensure all required PPE, first aid, waste bins, temporary toilets and other logistics are provided for the BSP construction.
- Enforcing adherence to environmental, health and safety requirements including the use of PPE, waste bins, etc. and taking disciplinary actions against non-compliant workers.
- Liaising with the Lead Contractor and Supervising Engineer to resolve grievance issues reported at the project site.
- Reporting on environmental, health and safety issues, including grievance issues during monthly meetings.



**Figure 10-1: EHS Management Structure**

#### **10.2.4 Environment, Health and Safety Committee**

The EHS committee will comprise the (1) Contractor's EHS officer, (2) the supervising engineer's EHS officer, (3) a representative from the Accra Metropolitan Assembly and (4) the Safeguards representative from the Ministry of Works and Housing. The EHS Committee shall have monthly meetings to discuss and deliberate on environmental, health and safety issues. The safeguards representative from the Ministry shall head the EHS Committee and chair all meetings.

The functions of the Environmental, Health and Safety Committee shall among other things include:

- Supervising the implementation of the Environmental, Health and Safety Policies formulated for the Project;
- Ensuring the implementation of the environmental permit conditions and mitigation, monitoring and management measures in the ESIS;
- Engaging the services of Consultant(s) where necessary to assist with the preparation and implementation of Environmental, Health and Safety Policies and environmental permit conditions;
- Identifying appropriate training programmes for staff;
- Reviewing data collated on environmental management and workers' health and safety issues;
- Assisting to address environmental, health and safety complaints and concerns of staff and affected communities; and
- Ensuring disciplinary actions against staff who do not comply with health and safety procedures

#### **10.2.5 Contractors ESMP**

The contractor will prepare a Contractors ESMP to be approved by the MWH prior to the commencement of dredge works. This EMP will be used for the implementation of the various environmental actions regarding the dredging works.

The ESMP will include detailed information on site camps, storage of equipment, final design implementation methods, labour conditions, employee code of conduct, social risks such as gender based violence among others and mitigation measures to prevent any adverse effects of these project activities.

#### **10.2.6 Workers Training and Awareness Creation**

The contractor will ensure effective dissemination of information to all staff on the project. Training programmes will be regularly organized on environmental, health and safety. These will include formal in-service trainings, practical trainings and induction for new staff. The trainings will include the following:

- Worker Code of Conduct
- EHS policies and procedures;
- Standard operational procedures;
- Machine/equipment handling and operation;
- Road safety and traffic regulations;
- Public health and sanitation;

- Emergency response; and
- First aid.

#### **10.2.7 Environmental and Social Monitoring Programmes**

Comprehensive monitoring programmes will be developed based on the monitoring plan provided in **Section 12** for relevant environmental and social monitoring parameters.

#### **10.2.8 Archaeological and Cultural Heritage Chance Find Procedure**

In the unlikely event of an archaeological or cultural heritage chance find during dredge work, the following steps and reporting procedure will be followed:

- All construction activity in the area will cease immediately;
- The find location will be recorded and necessary steps taken to secure/protect the area;
- The find will be reported to the Supervising Engineer
- The Supervising Engineer for the dredge works will inform the MWH;
- MWH will engage an archaeologist/cultural heritage expert from The Ghana Museums and Monuments Board which is the legal custodian of Ghana's material cultural heritage (movable and immovable heritage under the National Museum Act 1969 (NLCD387).
- The expert will assess the finding and advise on further necessary steps.

#### **10.2.9 Community Safety and Traffic Management Plan**

The dredge works will involve transport of dredge equipment and material to the temporary and final disposal sites. The area around the dredge site is urbanized and it is recommended that a community safety and traffic management plan should be developed by the Contractor after identifying adequate access and evacuation routes as well as work camp locations. The contractor must also develop a camp management plan inclusive of a code of conduct for workers. The traffic management plan should be developed based on the assessment of sensitive receptors along the routes eg schools, clinics etc to minimise traffic congestion and related impacts.

#### **10.2.10 Public and community participation**

The offices of the Ministry will welcome any complaints, constructive suggestions and advice on environmental, health and safety issues of concern during project implementation.

Local hotline numbers will be available to the general public for communicating all grievances and complaints related to the dredging works. Aggrieved individuals or communities can also make or submit all complaints or concerns to their respective Assemblymen, the Environmental Health and Sanitation Unit (EHSU) at AMA or at the Client Service/Front Desk of AMA for redress. It is envisaged that public involvement will help reduce conflict through early identification of grievances.

#### **10.2.11 Provisional Grievance Redress Mechanism**

The objective of the Grievance Redress Mechanism (GRM) is to provide an effective, transparent and timely system that would give aggrieved persons redress, minimize bad publicity, avoid/minimizes delays and avoid litigation in execution of the Odaw dredging project. This ensures public health and safety, and sustainability of the project. The GRM will provide all affected stakeholder's avenues

through which they can express their concerns and receive the needed corrective actions in an appropriate and timely manner.

The contractor will make public the GRM through public sensitization, particularly to the project affected persons and communities. The sensitization on the GRM will be done in the local languages of the area in addition to English Language to enable all stakeholders understand the content. This will ensure that approaches, ways and contact information for all stages of the GRM are clearly spelt out.

The GRM will consist of a four-tier resolution arrangement as follows:

- Local (project site) level;
- Metropolitan Assembly level grievance resolution;
- Ministry-level grievance resolution; and
- National legal level.

The general process is that a project affected person and/or other stakeholders should first raise a grievance at the project site office. If unresolved, it is referred to Drains and Maintenance Unit of the AMA. Beyond this level, the issue will be referred to the Grievance and Redress Committee (GRC). If this proves unsuccessful in resolving the grievance, the complainant may seek legal redress at the law court to resolve the issue. The levels of the GRM are explained as follows and the redress form attached as **Annex 4**.

#### **Local (project site) level**

A complaint made to the project site office shall be received by an assigned officer from the Supervising engineer. The procedure shall be as follows:

- A complaint form shall be filled, dated and signed, a copy of the same shall be deposited in the Supervising engineer's office and a copy sent to the Ministry of works and Housing.
- An acknowledgement of complaint form shall also be filled, signed and given to the complainant.

The contractor shall resolve the grievance or rectify the anomaly within two (2) weeks of receipt of complaint. The Contractor's monthly project report will contain the complaint, the solution proffered, and the results of follow-up to determine whether the complainant is satisfied with the outcome. The location shall also be listed as a site to be inspected during the next site inspection that precedes monthly site meeting.

The Supervising engineer will ensure that contractor provides adequate information to affected communities in respect of names, telephone numbers, and office locations where questions and complaints can be directed. The Supervising engineer will also ensure that the contractor makes these information available by appropriate means including signboards, leaflets, community meetings, etc.

#### **Metropolitan Assembly-level Grievance Resolution**

A written, email, or verbal complaint shall be delivered to AMA- Drains Management and Maintenance Unit. This shall be recorded, dated and signed to acknowledge receipt. An acknowledgement of complaint form shall be sent by post to the complainant within two (2) weeks. Within this timeframe, the Drains and Maintenance Head shall liaise with the Project Director or Manager to investigate the issue with the Supervising engineer and ensure that the proffered solution is communicated to the

contractor through a site instruction. The monthly site report for the month in question shall report on the complaint and what has been done to remedy the situation. A visit to the location of the problems shall be included in areas to be visited during the monthly site inspections that precedes the monthly site meeting. The site inspection shall be attended by staff to verify confirmation of the resolution to the issue(s). When a solution is reached, the complainant shall be informed verbally and/or in writing within one (1) week thereafter. A written record of the proposed resolution shall be made. The solution proffered shall be recorded and dated.

#### **Ministry-level Grievance Resolution**

For issues that could not be resolved either directly with the Contractor on-site or through lodging of complaint at the AMA level, a project level Grievance Committee (GC) will be set at the Ministry of Works and Housing to handle such cases. The committee will include the following:

- A representative of the Ministry;
- The local Assembly Person;
- Representative of Supervising Engineer;
- Representative of affected stakeholder/stakeholder group within the project area; and
- A valuer or a quantity surveyor who shall sit on the committee for resettlement and compensation issues.

The GC will be chaired by the representative of the Ministry. Membership of the GC will be made known to the public/stakeholders as part of the sensitization on the GRM. The GC shall provide a response within three (3) weeks of receiving formal notification of a grievance. In cases where further site visits, investigations or discussions with the aggrieved stakeholder are deemed necessary in order to arrive at an amicable resolution, a date shall be planned with the complainant for the follow-up visit which will fall within the mandated three (3) weeks. The entire process shall be within three (3) weeks of receipt of complaint and the solution reached shall be communicated to the complainant.

#### **National legal level**

If the aggrieved stakeholder is not satisfied with the outcome of the Ministry-level intervention in resolving the grievance, the stakeholder will be advised to seek redress through the appropriate legal system/law court.

#### ***10.2.12 Audits and Reviews***

Quarterly environmental, health and safety audits and reviews will be conducted to assess the performance of the environmental, health and safety policies and operational procedures implemented. The monitoring programme will form the basis for effective auditing and reviews. The outcome of the annual audits and reviews will underpin the periodic update of the ESMP of the proposed project.

#### ***10.2.13 Environmental and social management budgeting***

The environmental and social management plans described above require detailed cost analysis after project development to determine the budget needed for implementation. About US\$204,000.00 (excluding contractor budget) will be required for environmental management including reporting as shown in **Table 10-1**. This amount is subject to review following confirmation from cost studies to be carried out after project development.

**Table 10-1: Environmental and social management budget**

<b>No.</b>	<b>Programme</b>	<b>Cost/year (US\$)</b>
1.	Implementation of mitigation measures (refer to <b>Table 9-1</b> )	163,000.00 +-
2.	Training/Capacity Building (refer to <b>Table 11-2</b> )	68,000.00
3.	<u>Environmental Auditing and Reporting</u> <ul style="list-style-type: none"> <li>Quarterly environmental, health and safety audits</li> <li>Returns of Monitoring Reports to EPA (in line with LI 1652)</li> <li>Preparation of Environmental and Social Management Plan in three year cycles (in line with LI 1652)</li> </ul>	10,000.00
4.	Environmental And Social monitoring Plan (refer to <b>Table 12-1</b> )	131,000.00
5.	Implementation of Grievance Redress mechanism	10,000.00
6.	Preparation and Implementation of emergency response plan	15,000.00
<b>Total</b>		<b>397,000.00</b>

## 11.0 INSTITUTIONAL ARRANGEMENTS

This chapter provides the roles and responsibilities of the various institutions involved in the proposed Odaw dredging project.

### 11.1 Institutional Arrangements for project Implementation

The institutional roles and responsibilities to ensure the successful implementation of environmental and social management measures for project activities are outlined in **Table 11-1**

**Table 11-1: Institutional Roles/Responsibilities**

Institution	Responsibility	Phase of Implementation
Ministry of Works and Housing /GARID Project Coordinating Unit(PCU)	<ul style="list-style-type: none"> <li>- Overall responsibility for the design and implementation of the project</li> <li>-Implementation, management, oversight, and monitoring of the Compact.</li> <li>Enter into contracts with Consultants including the ESIA Consultant and Design Consultant.</li> <li>-Ensure all design measures proposed in the ESIA are incorporated in the project design and implemented.</li> <li>-Ensure all necessary environmental reports, permits and approvals such as ESIA, environmental permits, etc. are prepared/ obtained for the project.</li> <li>- Ensure that all measures during preparatory phase are addressed by the PCU and design consult</li> <li>- GARID PCU will hire Environmental Specialist and Social Development Specialist to supervise contractor.</li> <li>- Managing political processes and related reporting, and public/community relations.</li> </ul>	Project lifespan (design and implementation)
Hydrological services division/ MSWR/MoLG	Responsible for the monitoring and evaluation of project activities which include reviewing of design and other reports submitted by all project consultants to the ministry	Project lifespan (design and implementation)
Design Consultant/Supervising Engineer	<ul style="list-style-type: none"> <li>-Responsible for the design and overall supervision of construction works and conduct of the contractor.</li> <li>-Ensure environmental and social management considerations in the project design are implemented during construction.</li> </ul>	Dredging /Post-Dredging Phase
Contractor	<ul style="list-style-type: none"> <li>Ensure all environmental and social management measures in the project designs and ESIA are implemented during construction.</li> <li>-Responsible for environmental and social management of the project during construction.</li> <li>-Responsible for developing and implementing a Dredge Materials Recovery, Disposal and Management Plan reviewed and approved by the PCU and Supervision Consultant</li> </ul>	Dredging /Post-Dredging Phase

Institution	Responsibility	Phase of Implementation
	-Responsible for health and safety and welfare of workers and communities during construction.	
AMA	-Collaborate and partner with the MWH/GARID Project for the development and delivery of socio-economic infrastructure and services - Collaborate with various consultants to manage communication and information dissemination with the public during the project duration - Assist with community sensitization/ engagements -Play role in grievance resolution.	Entire project duration

## 11.2 Training/Capacity Building for Environmental, Health and Safety Management

The training

and capacity building requirements to ensure successful environmental, health and safety management of the Odaw dredging project is provided in **Table 10-2**.

**Table 11-2: Training/Capacity requirements**

No.	Activity	Target Group/ Participants	Timeline/Duration	Proposed Facilitator	Estimated Cost/(US\$)
1.	Training Workshop on ESIA, grievance redress mechanism, code of conduct for contractor and his workers, public health and safety issues, Permitting, Triggered World Bank Safeguards Policy and environmental management	-GARID Project Coordinating Unit -Supervising Engineer -Contractor -AMA	Prior to commencement of dredge works	MWH/ GARID Project Coordinating Unit/ ESIA Consultant	35,000.00
2.	Induction on occupational and traffic public health and safety requirements of the dredge works and environmental management	Contractors workers	Prior to commencement of dredge works	Contractor/ Supervising Engineer	18,000.00
3.	Public sensitization on GRM	-General public	Throughout project duration	MWH/AMA	15,000.00
<b>TOTAL COST</b>					<b>68,000.00</b>

## 12.0 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

Environmental and social monitoring is an essential component of a post project review phase following Environmental and Social Assessment. The monitoring of various environmental and social parameters will also help to confirm any predicted impact or otherwise and address the effectiveness of the implementation of the mitigation measures.

A comprehensive monitoring plan has been developed in **Table 12-1** for all the potential adverse environmental and social impacts identified in earlier section of the report. The monitoring plan includes identification of the responsible institutions or persons and estimated budget/cost requirements. Detailed cost analysis from prospective consultants and experts to be engaged as part of the monitoring programme will be needed to confirm cost requirements.

Table 12-1: Environmental and Social Management Plan

No.	Environmental/ Social Component/ Issue	Monitoring Parameters	Monitoring Site	Measurements	Frequency/ Period	Responsibility	Budget(USD)
<b>Pre Dredging Phase</b>							
1.	Identification of affected persons	-Records on consultations with PAPs -Records on affected persons and compensation paid (where applicable) -Records on public complaints relating to disruption of livelihoods	-Project Catchment Area	Stakeholder engagement	Design implementation phase	MWH	24,000
<b>Dredging Phase</b>							
2	Air quality deterioration	-Intensity of Foul Odour -Observation of air borne particulates (dust) and exhaust fumes -Records of dampening of roads -Complaints from the general public on dust pollution -Air quality monitoring records	Project Area/catchment	-observation - Hand-held dust samplers (TSP, PM <sub>10</sub> )/ diffusion tubes (NO <sub>x</sub> , So, CO) - Record keeping and analysis	During dust generating activities (e.g. movement of trucks on untarred roads, Dredging	Contractor	6,000
3.	Noise and Vibration	-Complaints on noise nuisance -Noise level monitoring records	Project Area and surroundings	Hand held integrated noise level machines -Record Keeping and analysis	To verify complains of noise	Contractor	2,000

No.	Environmental/ Social Component/ Issue	Monitoring Parameters	Monitoring Site	Measurements	Frequency/ Period	Responsibility	Budget(USD)
4.	Visual Intrusion/Aesth etic Impacts	Hoarding in place -Condition of areas around excavation sites	Project Area	Observation	Continuous	Contractor/ Supervising Engineer	8,000
5.	Water Quality deterioration	-Observable change in water quality (turbidity/ excessive resuspension of sediments ) -Observable waste bins at construction sites - Immediate transport of excavated material to temporary holding sites -Flooding at project site and environs	-Project area /Sea	Observation	Daily Bi- weekly	Contractor	-
6.	Generation and disposal of solid waste	-Availability and use of bins/skips -Records on frequency and location of solid waste disposal -Records on collection of recyclable materials	-Project Area -Disposal Routes	Record keeping and analysis	Monthly	Contractor	10.000
7.	Public safety and traffic impacts	-Absence of unauthorized persons at construction site -Availability and use of warning signs and cautionary tapes around excavations/trenches -Records on frequency and type of incident/accidents involving public -Availability and use of diversion/road signs or trained persons directing traffic. -Records of parking at unauthorized places	-Communities along the Channel -Project/ Stakeholder meetings	Record keeping and analysis	Monthly and during project/ stakeholder engagement meetings	Contractor	12,000

No.	Environmental/ Social Component/ Issue	Monitoring Parameters	Monitoring Site	Measurements	Frequency/ Period	Responsibility	Budget(USD)
8.	Impacts on livelihood	<ul style="list-style-type: none"> <li>-Records on consultations with PAPs</li> <li>-Records on affected persons</li> <li>- Records mitigation measures</li> <li>-Records on public complaints relating to disruption of livelihoods</li> </ul>	-Communities along the Odaw drain up till the Korle	Record keeping and analysis	stakeholder engagement meetings	Contractor	5,000
9.	Occupational health and safety	<ul style="list-style-type: none"> <li>-Workers' awareness of Contractor's health and safety policy and programs</li> <li>-Availability and proper use of PPEs</li> <li>-Availability and proper use of warning signs</li> <li>-Availability of first aid kit</li> <li>-Adherence to health and safety procedures</li> <li>-Records on frequency, type and source of illness/accident/injury</li> <li>-Records on non-compliances</li> </ul>	Project Area	Health & Safety records, audit and review	Daily	Contractor	10,000
10	Impacts on cultural Heritage	-Records on engagements with Traditional Authorities	Korle Lagoon	Record Keeping	Prior to commencement of the project	Supervising Consultant /MWH/GARID PCU	-
11	Influx of workers	<ul style="list-style-type: none"> <li>-Records on community sensitization programs</li> <li>-Health records on pregnancy, HIV/AIDS and other STDs</li> <li>-Records on public complaints relating to non-conformity to societal norms by workers and migrants</li> </ul>	-Communities around project site Stakeholder meetings	<ul style="list-style-type: none"> <li>Record keeping and analysis</li> <li>-Health records</li> </ul>	Monthly and during stakeholder engagement meetings	Contractor	5,000

No.	Environmental/ Social Component/ Issue	Monitoring Parameters	Monitoring Site	Measurements	Frequency/ Period	Responsibility	Budget(USD)
12	Public Complaints /Grievances	-Type and nature of complaints and concerns; -Complaint records (Record of grievance and number resolved/unresolved) -Management and Stakeholder Meetings	-Communities in the project area -Project/ Stakeholder meetings	Record keeping and analysis	Weekly	Contractor	7,000
13	Environmental compliance	-Environmental, health and safety audits -Quarterly returns of Monitoring Reports to EPA (in line with LI 1652) -Preparation of Environmental and Social Management Plan in three year cycles (in line with LI 1652)	-Project Area	Analysis of monitoring reports/ Environmental Assessment Regulations, LI 1652	Quarterly	MWH safeguards Officer	10,000
<b>Post –Dredging Phase</b>							
1	Public safety and traffic Impacts	-Records of Dredge plan/schedule communicated to the general public -Transport of dredge material during off peak traffic periods -Good housekeeping practices within excavation area -Proper handling of waste material -No trespassers on active construction sites -Availability and use of warning signs and cautionary tapes around excavations and other dangerous areas -Records on frequency and type of incident/accidents involving public - Availability of bins at construction site	-Project site -Transport routes for equipment and waste disposal	Health, safety and traffic records; audit and review	Daily	Contractor	7,000

No.	Environmental/ Social Component/ Issue	Monitoring Parameters	Monitoring Site	Measurements	Frequency/ Period	Responsibility	Budget(USD)
		-Proper and regular disposal of waste generated					
2	Occupational Health and Safety	Workers' awareness of health and safety policy -Availability and proper use of PPEs -Availability and proper use of warning signs -Availability of first aid kit -Adherence to health and safety procedures -Records on frequency, type and source of illness/accident/injury -Records on non-compliances -Records on training and awareness creation on health and safety	Construction site Disposal sites	Health & Safety records, audit and review	Daily	Contractor	10,000
3.	Dredge material disposal	- Dredge Material Recovery, Disposal and Management Plan -Good housekeeping practices within excavation area -Proper handling of waste material - Proper records on waste disposal	Project area Final Disposal Site	Observation, Waste management Plan records	Weekly	Contractor	15,000
<b>TOTAL</b>							<b>131,000.00</b>

### **13.0 CONCLUSION**

MWH is committed to ensuring sustainable environmental management and safeguarding the health and safety of the general public in the implementation of the Odaw dredging project. MWH is committed to ensuring that the project complies with good international industry practice in environment and social sustainability as well as national environmental laws and regulations of Ghana.

The environmental and social impacts outlined in this document as well as mitigation and monitoring measures will be implemented by the Contractor and monitored by the Supervising Consultant and MWH/GARID PCU to ensure effective implementation of the project.

The Odaw dredging project when completed will improve flood alleviation and reliability in and around the Odaw channel.

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## **ANNEXES**

ANNEX 1: NAAQG, NANLG AND NEQDG AND TWQR

ANNEX 2: CERTIFIED LABORATORY RESULTS

ANNEX3: EVIDENCE OF STAKEHOLDER CONSULTATIONS

ANNEX 4: GRIEVANCE REDRESS FORM

## ANNEX 1:NAAQG, NANLG And NEQDG And TWQR

### National Ambient Air Quality Guideline Values

The guideline provides for permissible guideline values for a variety of air pollutants as shown in the table below:

**National Ambient Air Quality Guideline Values**

Substance	Time Weighted Average (TWA)		Averaging Time
Sulphur Dioxide (SO <sub>2</sub> )	900 µg/m <sup>3</sup>	Industrial	1 hr
	700 µg/m <sup>3</sup>	Residential	1 hr
	150 µg/m <sup>3</sup>	Industrial	24 hr
	100 µg/m <sup>3</sup>	Residential	24 hr
	80 µg/m <sup>3</sup>	Industrial	1 yr
	50 µg/m <sup>3</sup>	Residential	1 yr
Nitrogen Oxides (measured as NO <sub>2</sub> )	400 µg/m <sup>3</sup>	Industrial	1 hr.
	200 µg/m <sup>3</sup>	Residential	1 hr.
	150 µg/m <sup>3</sup> 60 µg/m <sup>3</sup>	Industrial Residential	24 hr 24 hr
Total Suspended Particulate	230 µg/m <sup>3</sup>	Industrial	24 hr
	150 µg/m <sup>3</sup>	Residential	24 hr
	75 µg/m <sup>3</sup>	Industrial	1 yr
	60 µg/m <sup>3</sup>	Residential	1 yr
PM <sub>10</sub>	70 µg/m <sup>3</sup>		24 hr
Smoke	150 µg/m <sup>3</sup>	Industrial	24 hr
	100 µg/m <sup>3</sup>	Residential	24 hr
	50 µg/m <sup>3</sup>	Industrial	1 yr
	30 mg/m <sup>3</sup>	Residential	1 yr
Carbon Monoxide	100 mg/m <sup>3</sup>		15 min
	60 mg/m <sup>3</sup>		30 min
	30 mg/m <sup>3</sup>		1 hr
	10 mg/m <sup>3</sup>		8 hr
Hydrogen Sulphide	150 µg/m <sup>3</sup>		24 hr
Mercury	1 µg/m <sup>3</sup>		1 yr
Lead	2.5 µg/m <sup>3</sup>		1 yr
Cadmium	10 - 20 ng/m <sup>3</sup>		1 yr
Manganese	1 µg/m <sup>3</sup>		24 hr
Dichloromethane (Methylene Chloride)	3 mg/m <sup>3</sup>		24 hr
1,2-Dichloroethane	0.7 mg/m <sup>3</sup>		24 hr
Trichloroethane	1 mg/m <sup>3</sup>		24 hr
Tetrachloroethene	5 mg/m <sup>3</sup>		24 hr
Toluene	8 mg/m <sup>3</sup>		24 hr
Arsenic	30 ng/m <sup>3</sup>	Industrial	24 hr
	15 ng/m <sup>3</sup>	Residential	24 hr
Fluoride	10 µg/l		24 hr

### National Ambient Noise Level Guideline (NANLG)

The guideline provides for permissible night and day noise levels for variety of settings ranging from residential areas with negligible or infrequent transportation to predominantly heavy industrial areas as shown in the table below.

#### **National Ambient Noise Quality Guideline Values**

ZONE	DESCRIPTION OF AREA OF NOISE RECEPTION	PERMISSIBLE NOISE LEVEL IN dB(A)	
		DAY 0600 - 2200	NIGHT 2200 - 0600
<b>A</b>	Residential areas with low or infrequent transportation	55	48
<b>B1</b>	Educational (school) and health (hospital, clinic) facilities	55	50
<b>B2</b>	Areas with some commercial or light industry	60	55
<b>C1</b>	Areas with some light industry, places of entertainment or public assembly, and places of worship located in this zone	65	60
<b>C2</b>	Predominantly commercial areas	75	65
<b>D</b>	Light industrial areas	70	60
<b>E</b>	Predominantly heavy industrial areas	70	70

### National Effluent Quality Guidelines

The national effluent quality discharge guideline levels as administered by the EPA are as provided in the table below.

#### **General Effluent Quality Guidelines for Discharge into Natural Water Bodies- Maximum Permissible Levels**

Parameter	EPA Recommended Guideline Value
pH	6 – 9
Temperature Increase	<3oC above ambient
Colour	200 TCU
Turbidity	75 NTU
Conductivity	1500 uS/cm
Total Suspended Solids	50 mg/l
Total Dissolved Solids	1000 mg/l
Oil/Grease	5.0 mg/l
Sulphide	1.5 mg/l
Total Phosphorus	2.0 mg/l
Biochemical Oxygen Demand (BOD <sub>5</sub> )	50 mg/l
Chemical Oxygen Demand (COD)	250 mg/l
Nitrate	50 mg/l
Ammonia as N	1.0 mg/l
Alkalinity as CaCO <sub>3</sub>	150 mg/l
Phenol	2.0 mg/l
Mercury	0.005 mg/l
Total Arsenic	1.0 mg/l
Soluble Arsenic	0.1 mg/l

Lead	0.1 mg/l
Total Pesticides	0.5 mg/l
Fluoride	10 mg/l
Chloride	250 mg/l
Sulphate	200 mg/l
Total Coliforms	400 MPN/100ml
E. coli	0 MPN/100ml
Cadmium	0.1 mg/l
Chromium (+6)	0.1 mg/l
Total Chromium	0.5 mg/l
Copper	5.0 mg/l
Nickel	0.5 mg/l
Selenium	1.0 mg/l
Zinc	10.0 mg/l
Silver	5.0 mg/l
Tin	5.0 mg/l
Aluminum	5.0 mg/l
Antimony	5.0 mg/l
	0.05 mg/l

(Source: Environmental Protection Agency, Accra 1997)

#### Target Water Quality Ranges Volume 6:Protection of Aquatic Ecosystems

Constituent	TWQR	Norm	Remarks
<b>Ammonia</b> (µg/l)	7	Chronic and acute toxic effects of on aquatic organisms	Un-ionised ammonia
<b>Cadmium</b> (µg/l)	0.15	Chronic and acute toxic effects of on aquatic organisms	Soft water
	0.25		Medium water
	0.35		Hard water
	0.4		Very hard water
<b>Calcium</b> (mg/l)	0-100	Scaling in domestic appliances; impairment of soap lathering	If Ca-Mg ratio is < 1, adverse health effect on shell organism may occur.
<b>Chromium</b> (mg/l)	0-7	Chronic and acute toxic effects of on aquatic organisms	Chromium (IV)
	12		Chromium (III)
<b>Copper</b> (mg/l)	0-0.3	Chronic and acute toxic effects of on aquatic organisms	Soft water
	0.4-0.8		Medium water
	0.9-1.2		Hard water
	>1.4		Very hard water
<b>Cyanide</b> (mg/l)	0-0.1	Chronic and acute toxic effects of on aquatic organisms	
<b>Dissolved Oxygen</b> (% Saturation)	80-120	Chronic and acute physiological effects and behaviour of aquatic biota	
<b>Iron</b>	-	Chronic and acute toxic effects of on aquatic organisms	Should not vary by more than 10% of the background concentration.
<b>Lead</b> (µg/l)	0.5		Soft water

	0.5	Chronic and acute toxic effects of on aquatic organisms	Medium water
	1.0		Hard water
	1.2		Very hard water
<b>Magnesium</b> (mg/l)	0-100	Scaling in domestic appliances; impairment of soap lathering	
Mercury (µg/l)	0.04	Chronic and acute toxic effects of on aquatic organisms	Should not vary by more than 15% of local un-impacted concentration.
<b>Nitrogen-Inorganic</b> (mg/l)	-	Changes in trophic status	
<b>Pesticides</b> (mg/l):		Chronic and acute toxic effects of on aquatic organisms	
<b>Aldrin</b>	0.01		
<b>DDT</b>	0.0015		
<b>Dieldrin</b>	0.005		
<b>Dursban</b>	0.001		
<b>Endosulfan</b>	0.003		
<b>Endrin</b>	0.002		
<b>Heptachlor</b>	0.005		
<b>Lindane</b>	0.015		
<b>2,4-dichlorophenol</b>	4.0		
<b>pH</b>	-	Acute and chronic physiological effects; changes in ecosystem structure and function	Should not vary by more than 5% of local background conditions.
<b>Temperature</b> (°C)	-	Acute and chronic physiological effects; changes in ecosystem structure and function	Should not vary by more than 10% of local background conditions.
<b>Total Dissolved Solids</b>	-	Acute and chronic physiological effects; changes in ecosystem structure and function	Should not vary by more than 15% of local background conditions.
<b>Total Hardness</b> (mg/l CaCO <sub>3</sub> )	500	Acute and chronic physiological effects; changes in ecosystem structure and function	
<b>Total Suspended Solids</b> (mg/l)	-	Acute and chronic physiological effects; changes in ecosystem structure and function	Should not vary by more than 10% of local background conditions.
<b>Zinc</b> µg/l)	2	Chronic and acute toxic effects of on aquatic organisms	

## **ANNEX 2: CERTIFIED LABORATORY RESULTS**

### **ANNEX 3 EVIDENCE OF STAKEHOLDER CONSULTATIONS**

## ANNEX 4 GRIEVANCE REDRESS FORM

**GRIEVANCE FORM-**  
**ODAW DREDGING PROJECT UNDER GREATER ACCRA RESILIENCE AND INTEGRATED DEVELOPMENT (GARID PROJECT)**

<b>Reference No:</b>		<b>Date of submission:</b>	
<b>Name of Grievant:</b>  <input type="checkbox"/> I wish to raise my grievance anonymously <input type="checkbox"/> I request not to disclose my identity without my consent		<b>Work Phone:</b> <b>Home Phone:</b> <input type="checkbox"/> Send documents to external representative <b>Email:</b>	
<b>Postal Address:</b> <b>P.O. Box:</b> <b>City:</b>		<b>Residential Address:</b> <b>Street:</b> <b>City:</b>	
Date, time and place of event leading to grievance:		Date you became aware of the event, <i>(if different)</i> :	
<b>Frequency of Occurrence</b> <input type="checkbox"/> One time incident/grievance (date _____) <input type="checkbox"/> Happened more than once (how many times? _____)			
Detailed description of grievance including names of other persons involved, if any (What happened? Where did it happen? Who did it happen to? What is the result of the problem?)			
Proposed solution to grievance:			
<b>Grievant: File a copy of this form with your immediate supervisor and retain a copy for filing at the next step or steps if necessary. If you do not receive a response within 5 working days or disagree with the action taken, you may file a copy of the grievance at the next step.</b>			
<b>Step</b>	<b>Grievance Filed With</b> <i>(Please Print Name)</i>	<b>Date</b>	<b>GRIEVANT'S SIGNATURE</b>
<b>1</b>	Contractor		

<b>2</b>	AMA – Drains and Maintenance Unit			
<b>3</b>	MWH/GARID PCU			