

**Federal Republic of Nigeria**



**ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN  
(ESMP)**

**FINAL Draft REPORT**

**For**

**THE RECLAMATION, CHANNELLING AND REMEDIATION  
WORKS AT OGISO-OSUNDE STREET FLOOD AND EROSION  
GULLY SITE, IKPOBA OKHA LOCAL GOVERNMENT AREA OF  
EDO STATE**

**NIGERIA EROSION AND WATERSHED MANAGEMENT PROJECT  
(NEWMAP)**



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## **LIST OF ABBREVIATIONS AND ACRONYMS**

|                    |                                               |
|--------------------|-----------------------------------------------|
| ALARP              | As Low As Reasonably Practicable              |
| BOD                | Biochemical Oxygen Demand                     |
| BP                 | Bank Policy                                   |
| CBO                | Community Based Organization                  |
| CDD                | Community Driven Development                  |
| CEC                | Cation Exchange Capacity                      |
| CSO                | Community Support Organizations               |
| DO                 | Dissolved Oxygen                              |
| ECEC               | Effective Cation Exchange Capacity            |
| ESMP               | Environmental and Social Management Plan      |
| EA                 | Environmental Assessment                      |
| EAR                | Environmental Audit Report                    |
| EIA                | Environmental Impact Assessment               |
| EDWMB              | Edo State Waste Management Board              |
| ESA                | Environmentally Sensitive Areas               |
| ESIA               | Environmental & Social Impact Assessment      |
| ESMF               | Environmental and Social Management Framework |
| FGN                | Federal Government of Nigeria                 |
| FME <sub>env</sub> | Federal Ministry of Environment               |
| FRDP               | Federal Roads Development Project             |
| GIS                | Geographic Information System                 |
| HCW                | Healthcare waste                              |
| HCF                | Healthcare facility                           |
| HSE                | Health Safety and Environment                 |
| IDA                | International Development Association         |
| IPM                | Integrated Pest Management                    |
| JHA                | Job Hazard Analysis                           |
| LB                 | Land Bureau                                   |
| LFN                | Laws of the Federation of Nigeria             |
| LGA                | Local Government Area                         |
| MDAs               | Ministries, Departments & Agencies            |
| MDG                | Millennium Development Goals                  |



|        |                                                      |
|--------|------------------------------------------------------|
| MEPU   | Ministry of Environment and Public Utilities         |
| NSPCU  | National Project Coordinating Unit                   |
| MIGA   | Multilateral Guarantee Agency                        |
| MOE    | State Ministry of Environment                        |
| MoH    | State Ministry of Housing                            |
| N/A    | Not Applicable                                       |
| NEEDS  | National Economic Empowerment & Development Strategy |
| NEWMAP | Nigeria Erosion and Watershed Management Project     |
| NGO    | Non-Governmental Organization                        |
| NIWA   | National Inland Waterways Authority                  |
| NS     | Not Specified                                        |
| OD     | Operational Directives (of the World Bank)           |
| OHS    | Occupational Health and Safety                       |
| OP     | Operational Policy                                   |
| PFM    | Public Financial Management                          |
| PMU    | Project Management Unit                              |
| PDO    | Project Development Objectives                       |
| PAP    | Project Affected Persons                             |
| PPE    | Personal Protective Equipment                        |
| RPF    | Resettlement Policy Framework                        |
| PSP    | Private Sector Partners                              |
| SACA   | State Action Committee on Aids/HIV/STIs              |
| SD     | Standard Deviation                                   |
| SEPA   | State Environmental Protection Agency                |
| SMENV  | State Ministry of Environment                        |
| SPM    | Suspended Particulate Matter                         |
| SPMU   | State Project Management Unit                        |
| SWM    | Solid Waste Management                               |
| TDS    | Total Dissolved Solids                               |
| THC    | Total Hydrocarbon Content                            |
| TOR    | Terms of Reference                                   |
| TSP    | Total Suspended Particulate                          |
| TSS    | Total Suspended Solids                               |

WB World Bank  
 WHO World Health Organization

**LIST OF ABBREVIATIONS AND ACRONYMS, Cont'd**

| <u>UNITS OF MEASUREMENT</u> |                                    | <u>CHEMICAL ELEMENTS AND COMPOUNDS</u> |                      |
|-----------------------------|------------------------------------|----------------------------------------|----------------------|
| %                           | Percentage                         | C                                      | Carbon               |
| µg                          | Microgramme                        | Ca                                     | Calcium              |
| µm                          | micrometre                         | CaCO <sub>3</sub>                      | Calcium Carbonate    |
| µS                          | micro Siemen                       | CCl <sub>4</sub>                       | Carbon Tetrachloride |
| cfu/ml                      | Colony forming unit per millilitre | Cd                                     | Cadmium              |
| cm                          | Centimetre                         | Cl                                     | Chloride             |
| dBA                         | Decibel                            | CO                                     | Carbon Monoxide      |
| ft                          | Feet                               | CO <sub>2</sub>                        | Carbon Dioxide       |
| g                           | Gramme                             | Cr                                     | Chromium             |
| g/cm                        | Gramme per Centimetre              | Cu                                     | Copper               |
| k                           | Kilogramme                         | Fe                                     | Iron                 |
| Km                          | Kilometre                          | H                                      | Hydrogen             |
| m                           | Meter                              | H <sub>2</sub> O                       | water                |
| m/s                         | Meter per Second                   | H <sub>2</sub> S                       | Hydrogen Sulphide    |
| m <sup>3</sup>              | Meter Cube                         | Hg                                     | Mercury              |
| meq                         | Milliequivalent                    | K                                      | Potassium            |
| mg                          | Milligramme                        | Mg                                     | Magnesium            |
| mg/Kg                       | Milligramme per Kilogramme         | Mn                                     | Manganese            |
| mg/l                        | Milligramme per Litre              | N                                      | Nitrogen             |
| ml                          | Millilitre                         | Na                                     | Sodium               |
| mm                          | Millimetre                         | Na <sub>2</sub> PO <sub>4</sub>        | Sodium phosphate     |
| NTU                         | Turbidity Unit                     | NaOH                                   | Sodium hydroxide     |
| ‰                           | Parts per thousand                 | NH <sub>3</sub>                        | Ammonia              |
| oN                          | Degree North                       | NH <sub>4</sub> <sup>+</sup>           | Ammonium ion         |
| PH                          | Hydrogen ion concentration         | NH <sub>4</sub> F                      | Ammonium flouride    |
| ppb                         | parts per billion                  | Ni                                     | Nickel               |
| ppm                         | parts per million                  | NO <sub>2</sub> <sup>-</sup>           | Nitrite ion          |
| ToC                         | Temperature in degrees Celsius     | NO <sub>3</sub> <sup>-</sup>           | Nitrate ion          |
|                             |                                    | NO <sub>x</sub>                        | Nitrogen Oxides      |
|                             |                                    | O <sub>2</sub>                         | Oxygen               |
|                             |                                    | P                                      | Phosphorus           |
|                             |                                    | Pb                                     | Lead                 |
|                             |                                    | PO <sub>4</sub>                        | Phosphate            |
|                             |                                    | SiO <sub>2</sub>                       | Silicate             |
|                             |                                    | SO <sub>2</sub>                        | Sulphur dioxide      |
|                             |                                    | SO <sub>4</sub>                        | Sulphate ion         |
|                             |                                    | V                                      | Vanadium             |
|                             |                                    | Zn                                     | Zinc                 |

## **EXECUTIVE SUMMARY**

### ***ES1.0 Project Background***

Gully erosion is one of the major environmental challenges facing Nigeria. Erosion has led to the degradation of watershed with devastating effects on the biophysical environment, health and socio-economic lives of the people. The present state of gully affairs undermines economic growth and poses a threat to the developmental programmes of the Federal Government of Nigeria including the currently pursued “*Transformation Agenda*” and “*Vision 20-2020*”.

Consequently, the Federal Government of Nigeria (FGN) has sought the support of the World Bank to tackle this age-long and worsening problem of erosion and degraded watershed in southern Nigeria. The support is sought through “The Nigeria Erosion and Watershed Management Project”, NEWMAP. The Government of Nigeria is currently implementing the multi-sectoral Nigeria Erosion and Watershed Management Project (NEWMAP), being financed by the World Bank, Global Environment Facility, the Special Climate Change Fund, and the Government of Nigeria. NEWMAP, an 8-year multi-sectoral and multi-scale program, finances activities implemented by States and activities implemented by the Federal government. The project currently includes 19 states, namely Anambra, Abia, Cross River, Edo, Enugu, Ebonyi, Imo, Akwa Ibom, Bauchi, Borno, Delta, Gombe, Kano, Katsina, Kogi, Nasarawa, Plateau, Oyo and Sokoto.

The proposed Ogiso-Osunde intervention project involving reclamation, channelling and remediation works at Edo College flood and gully erosion Site by Edo State NEWMAP is meant to bring succour to the threatened communities and Edo College in particular. In the process of executing this project, there are bound to be adverse impacts on the biophysical environment and the socio-economic and health conditions of the people.

Consequently, there is the need to assess the Environmental and Social Impacts of this intervention project by the Edo NEWMAP. Considering the category of the proposed project and the environment, infrastructure and population of the affected people, the development of an Environmental and Social Management Plan (ESMP) by the Edo State NEWMAP SPMU in Benin City becomes a desideratum.

In consonance with its mandate of ensuring the adequate management of environmental and social impacts, the Edo State NEWMAP has embarked on preparing this Environmental and Social Management Plan (ESMP) for possible mitigation and management of adverse environmental and social impacts triggered in the cause of project implementation. This ESMP was prepared in accordance with the World Bank’s Performance Standards and the

requirements of applicable Nigerian legislation and international environmental policies. The report covers the associated and potential adverse impacts, mitigation measures, environmental management/monitoring plans, implementation cost, and institutional actions to be taken before, during and after implementation to either eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable limits. It also addresses the adequacy of the monitoring and institutional arrangements and cost implications for the intervention project. The ESMP will be utilized by the contractors commissioned by Edo State NEWMAP for the project and will form the basis of site-specific management plans that will be prepared by the contractors as part of their construction methodology prior to works commencing. The ESMP will ensure that the policies of the Federal Government of Nigeria and the World Bank on environmental and social safeguards assessment are met and all subprojects undertaken are environmentally and socially sound and sustainable.

### ***ES 1.1 Description of the Ogiso-Osunde Gully Erosion Site and the proposed Intervention Activities***

Ogiso-Osunde is a location in the Ikpoba-Okha districts to the south-east of the centre of Benin City (Latitude 60 20' 0"N and Longitude 50 38' 0"E). The drainage systems upstream of the gully and possible ways of stabilising the gully have previously been examined in the Stormwater Master Planning and Concept Design Study. The problem at the Ogiso-Osunde site relates to inadequate and poorly maintained urban drainage systems. The lower end of Osunde Street has been severely undermined by erosion and has totally collapsed. Inspection of the catchment area and drainage systems reveals that most of the runoff being directed to the Ogiso-Osunde Street system is from the catchment to the west of Murtala Mohammed Way (MM Way). This runoff is concentrated and channelled along the MM Way before being released onto the Ogiso-Osunde Street where the drainage system is unable to cope.

The aims of the Ogiso-Osunde project are:

- To route the runoff from the sub-catchments through various conduits so as to avoid the concentration of flow at Osunde Street;
- To provide facilities with sufficient capacity to convey the flows;
- To safely discharge the storm water into an underground conduit in the moat;
- To connect the system in the moat to an existing conduit which discharges to the Ikpoba River;
- To accommodate excess flows during major rain events in an open concrete channel which serves as a roadway at other times, and
- To rehabilitate the damaged streets.

Specifically, the intervention programme details at the Ogiso-Osunde gully erosion site will involve:

- Reconstruction of the upper portion of Osunde Street, with new underground conduits
- that will divert flows into a new box culvert that will be provided under the floor of the existing moat;
- Reconstruction of Aigbekaen Street and provision of a new drainage channel that will divert some of the flow from Murtala Mohammed Way;
- Reconstruction of Akugbe Street and provision of a second new drainage channel that will divert more flow from Murtala Mohammed Way;
- Construction of a new articulated concrete block lined channel to take flows from the upper portion of Murtala Mohammed Way;
- Provision of a concrete lined overland flood escape route down Omusi Street that will also provide vehicular access except when flooding occurs, and
- Dredging of a portion of the Ikpoba River

The design for safety and risk primarily consists of open canals, box culverts, manholes and inlet structures. The open channels will be protected with handrails and pedestrian crossings where necessary.

### ***ES 1.2 Rationale for the ESMP***

The **Environmental and Social Management Plan (ESMP)** is a management tool that specifies the strategies and procedures for managing potential environment and social impacts associated with a proposed project. The ESMP contain a set of mitigation, monitoring, and institutional actions to be taken before and during implementation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

This Environmental and Social Management Plan (ESMP) is developed to identify the environmental and social management and mitigation actions required to implement project activities at the erosion gully site, in accordance with the requirements of the World Bank and applicable Nigerian local and national legislations. This ESMP provides an overview of the environmental and social baseline conditions in the project area, summarizes the potential

impacts associated with the project activities at the proposed gully intervention site and sets out the management measures required to mitigate any potential impacts.

### **ES 1.3 Need for the ESMP**

The benefits envisaged in conducting this ESMP include:

- The management of environmental and social performance throughout the life of the project.
- Protection of the environment and minimizing adverse social impacts via consultative process; and
- Lower overall project cost in the long term (reduced probability of environmental disasters, costly clean-up, host communities interference, etc.);
- Effective community engagement, opportunity for enhanced public confidence and good public relations and
- Support for displaced persons in their efforts to restore their livelihoods and living standards and compensation for any loss of livelihood or assets;

### **ES 1.4 Scope of Work**

The objective of the consulting service is to prepare Environmental and Social Management Plan (ESMP) for OGISO OSUNDE EROSION GULLY SITE IN EDO STATE intervention site. The ESMP is site-specific and consists of a well-documented set of mitigation, monitoring, and institutional actions to be taken before and during implementation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. Each ESMP also includes the measures needed to implement these actions, addressing the adequacy of the monitoring and institutional arrangements for the upper and lower watersheds in the intervention site.

The consultant will work in close collaboration with the engineering design consultants and NEWMAP State Project Management Unit's (SPMU) safeguards team, and with other actors as directed by the SPMU. In that respect the sequencing of the technical/feasibility studies and the ESMP will be critical. The consultant will have to receive the draft technical/feasibility studies in order to take into account the technical variants of the proposed activities and also in return inform the technical design consultants of any major constraint that may arise due to the social and environmental situation on the ground.

At the intervention site, the consultant will visit the full sub-watershed as delimited in the given gully stabilization design. The consultant will take into account the proposed civil engineering designs, vegetative land management measures and other activities aimed at reducing or managing runoff that would be carried out within the sub-watershed. The

consultant will assess natural resources and infrastructure potentially affected during project implementation and operation and selects the management strategies needed to ensure that environmental risks are appropriately mitigated.

Tasks of the consultant include the following:

- a) Describe biophysical and social environment including the existing status of the sub-watershed (Upper/Lower) and gullies;
- b) Identify the potential environmental and social issues/risks associated with the intervention;
- c) Drawing on the feasibility and engineering report and site design, appropriate baseline indicators (for example, m<sup>3</sup>/sec of runoff collected in the sub-watershed during a heavy hour-long rainfall).
- d) Develop a plan for mitigating environmental and social risks associated with construction and operation in the gully intervention in consultation with the relevant public and government agencies;
- e) Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels;
- f) Develop a time-bound plan for mitigating environmental and social risks associated with the specific intervention in the designated sub-watershed management in consultation with the relevant public and government agencies;
- g) Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels;
- h) Identify monitoring objectives and specifies the type of monitoring, with linkages to the impacts assessed and the mitigation measures described above (in a-e);
- i) Provide a specific description of institutional arrangements: the agencies responsible for carrying out the mitigation and monitoring measures (e.g., for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting, and staff training) and the contractual arrangements for assuring the performance of each implementing agency;
- j) Define technical assistance programs that could strengthen environmental management capability in the agencies responsible for implementation;
- k) Provide an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and
- l) Provide the expected capital and recurrent cost estimates and sources of funds for implementing the ESMP and inform accordingly the design consultants so that these costs are duly taken into consideration in the designs.
- m) Other tasks:

n) The consultant shall assist the SPMU to:

(i) Register the ESMP with the environmental assessment (EA) departments at Federal and State levels; and

(ii) Disclose the finalized ESMP at National, State, LGA and Community levels.

### ***ES 2.0 Institutional and Legal Framework for Environmental Management***

The requirement for an Environmental and Social Management Plan is in compliance with the Federal Republic of Nigeria's (FRN) laws and World Bank Safeguard policies that are geared towards achieving sustainable development goals through proper and adequate care for the environment, health and safety, and social well-being of her citizens.

ESMF and RPF are the existing safeguard instruments that address the four triggered safeguards policies of the World Bank, namely: Environmental Assessment (EA) (OP 4.01), Natural Habitats (OP 4.04), Forest (OP 4.36) and Involuntary Resettlement (OP 4.12). The main elements of World Bank Safeguard policies triggered by NEWMAP and Nigeria's EA requirements were harmonized as far as possible, making this ESMP responsive to the objectives of good environmental practice for sustainable development, guarded by all relevant legal requirements.

### ***ES 2.1 Institutional Framework***

NEWMAP involves many federal and state Ministries, Departments and Agencies (MDAs), local governments, communities, and the civil society. This is because effective implementation of projects requires inter-ministerial and inter-state coordination, collaboration, and information sharing. Thus, each component, subcomponent and activity is to be implemented through relevant federal and state MDAs. The various MDAs include those responsible for planning, economy and finance, works, agriculture, water resources, forests, transport, power, emergency response, as well as those focused on climate and hydrological information or watershed/ basin regulation. The investments for Edo College gully site is being made through the Edo NEWMAP. However, the Edo State has the primary responsibility for land management and land allocations of the project site.

The Federal Ministry of Environment (FMEnv) is the lead implementing agency for NEWMAP. The Federal Project Management Unit (FPMU) headed by a Federal Coordinator hosted by FMEnv is responsible for the overall coordination. The Edo State Project Management Unit (Edo-SPMU) headed by the State Coordinator and hosted by the Edo State Ministry of Environment and Public Utility is responsible for the coordination in Edo State. Thus, he is directly responsible for coordinating activities of the Edo College Gully



Erosion Site intervention, including the implementation of this ESMP. Both the Federal and State levels Coordinating Units have environmental officers responsible for the mainstreaming of environmental issues into the NEWMAP projects. The Edo State Environmental Officer is directly responsible for coordinating the implementation of this ESMP for Edo College Gully Erosion Site on behalf of the State Project Coordinator. At the community level, the Edo College Gully Erosion Site Monitoring Committee will participate effectively in ensuring full compliance during all phases of the project implementation activities.

### ***ES 3.0 Biophysical Environment***

The assessment of biophysical environment of the study area covers general climate and meteorology, air quality and noise level soil, land use and tenure system, hydrology, geology/hydrogeology, surface water quality, vegetation and biodiversity. Most parameters measured were in conformity with local and international standards and mitigation measures were provided where potential adverse environmental impacts were detected.

### ***ES 4.0 Socio-Economic Characteristics, Public Consultations and Grievance Redress Mechanism***

The socio-economic characteristics of the project area reveal that;

- All respondents interviewed were vulnerable to the threat posed by the gully;
- Gully erosion affected the roads, landed property, buildings and farmland
- Most of the respondents are of the working class age-group (18-45 years), educated, with a good knowledge of the area, and thus have a sound perception of the gully history;
- A high proportion of respondents were employed with average monthly income of N31,000 – 100,000;
- Zinc and aluminium roof best described the house types, making rain harvesting feasible;
- Wastes are dumped in the gully, making it clogged;
- The community is peaceful and are ready to cooperate with NEWMAP project;
- There have been several erosion control efforts by the community members especially youths.
- High proportion of respondents are not aware of gully control methods, and
- Malaria and typhoid are the predominant ailment suffered by the respondents.

#### ***ES 4.1 Public Consultation and Concerns***

The project community has also significantly spelt out their desires for the project, calling for better drainage system and more access roads to enhance their socio-economic life. They are however weary over possibility of delay in project execution due to past experience. In

all, the proposed intervention project is a welcomed development by the affected community and is therefore recommended for timely execution.

#### **ES 4.2 Grievance Redress Mechanism**

A Grievance Redress Mechanism (GRM) has been designed by the Project and will be operational during ESMP implementation. The main objective of the GRM is to investigate charges of irregularities and complaints received by the Contractors and Edo NEWMAP SPMU, and provide an early, transparent and fair resolution.

The GRM will be communicated widely, both among the communities living close to the project site through the use of Community Liaison Officer (CLO) for the project, among other stakeholders. The Project Coordinator will be the final authority in this case and will communicate a final decision to the complaint within 15 days.

Complaints will be lodged and tracked through a tracking number. A complaint record will be maintained and the progress of GRM will be shared with World Bank on a monthly basis. Edo State PMU will also maintain an inquiry helpline which will enable stakeholders to obtain information on a range of issues including employment, contracting, procurement, supply and machinery hiring procedures.

A Grievance Procedure that will include the following components:

- Anyone may contact the Project, in person, by email, or by telephone to submit a grievance;
- Contacts about grievances may be by the affected person or through an agreed local liaison committee;
- All complaints will be documented by Edo State NEWMAP and tracked to resolution, and information on the status will be available to the person making the complaint;

### **ES 5.0 Summary of Impacts of the Project**

#### **Alternatives**

##### **ES 5.1 Impacts**

The NEWMAP gully erosion intervention project will be an effective way of controlling flood and erosion, and the consequent environmental damage, loss of life and property ravaging Ogiso-Osunde Gully Erosion site. The project will likely trigger impacts (positive and negative) on the biophysical and cultural components of the study area. Most negative adverse potential impacts, especially during the construction phase will be on air quality, soil,

water quality and socio-economic life of the people. These adverse potential impacts are summarized as follows (Table 01):

**Table 01: Potential Adverse Impacts during Different Project Phases**

| Description of impact                                                      | Project Phases |              |                           |
|----------------------------------------------------------------------------|----------------|--------------|---------------------------|
|                                                                            | Mobilization   | Construction | Operation/<br>Maintenance |
| Movement of heavy equipment to work sites which may pose danger to public  | X              | X            |                           |
| Increase in potential for road traffic Volume and risk of accidents/injury | X              | x            |                           |
| Influx of people, leading to Alteration in age-sex distribution            | X              | x            |                           |
| Increase in local population                                               | X              | x            |                           |
| Pressure on existing infrastructure                                        | X              | x            |                           |
| Increase in communicable diseases ( including STIs)                        | X              | x            |                           |
| Increase in cost of living/Inflation                                       | X              | x            |                           |
| Increase in social vices/awareness                                         | X              | x            |                           |
| Stress on existing security Structures                                     | X              | x            |                           |
| Injury/fatalities in workforce/Communities                                 | X              | x            |                           |
| Alteration/destruction of ecosystem                                        | X              | x            |                           |
| Reduction in air quality                                                   | X              | x            |                           |
| Increase in noise nuisance                                                 | X              | x            |                           |
| Emotional disturbances                                                     | X              | x            |                           |
| Potential for increased community agitation                                | X              | x            |                           |
| Loss of medicinal plants and economic trees                                |                | X            |                           |
| Reduction in biodiversity/Loss of Flora Fauna                              |                | X            |                           |
| Decreased quality of run-off water                                         |                | X            |                           |
| Increase in breeding grounds For disease vectors                           |                | X            | x                         |
| Alteration of soil fauna community                                         |                | X            |                           |
| Soil degradation                                                           |                | X            |                           |
| Loss of employment (after commissioning)                                   |                |              | x                         |

The adverse impacts of the intervention project include air quality impairment from trucks and machinery emissions and increase in suspended particulate matter, noise nuisance, traffic disturbance and accidents/injuries, waste generation, possible land acquisition for camps and construction facilities, soil impact, land use issues arising from displaced community members, pressure on public facilities and infrastructure due to population influx, soil and water contamination from river dredging activities.

### **ES 6.0 Environmental and Social Management Plan (ESMP)**

The identified adverse impacts were generally short-term and can be prevented, reduced, ameliorated, or controlled if the recommended mitigation measures are implemented. Mitigation measures were proffered to reduce the magnitude of identified adverse impacts, to a level as low as reasonably practicable (ALARP). These mitigation measures are incorporated in the Environmental and Social Management/ Environmental Monitoring Plan developed specifically for the Ogiso-Osunde gully erosion Site.

The Environmental and Social Management Plan (ESMP) has been developed to identify the environmental and social management and mitigation actions required to implement the NEWMAP gully erosion intervention project in Ogiso-Osunde in accordance with the World Bank's Performance Standards and the requirements of applicable Nigerian legislation and environmental policies. It summarizes the potential impacts associated with the project, with the mitigation measures required to ensure that adverse impacts are eliminated or reduced to As Low As Reasonably Practicable (ALARP) levels. It also sets out the management measures required at all phases of project development.

Therefore, the objectives of the ESMP include but not limited to the following:

- Achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;
- Avoid, where practicable, and reduce impacts on terrestrial and aquatic habitats and specific habitat features of ecological importance;
- Minimize, contain, transport, handle and dispose of solid and liquid wastes arising from project construction activities in such a manner as to minimize impacts to human health and the environment;
- Minimize potential air emission impacts on receptors;
- Minimize potential effects on water resources and associated receptors (i.e. rivers, streams, drainage channels, ponds, groundwater resources and associated users and specific flora and fauna);
- Prevent risk and resulting adverse impacts of the contractors activities on the health, safety and wellbeing of individuals and the community;
- In the event that damage or harm is caused, take action to repair and return to condition comparable to pre-impact condition;
- Implement a system to maintain communication with the community and raise awareness of proposed construction activities and the potential impacts that they may represent.
- Identify the roles and responsibilities of the environmental and social management organization of the project; and
- Ensure compliance with existing legislation.

The ESMP provides specific description of the impacts identified, mitigation measures as well as the institutional arrangements, i.e. who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting and staff training). It is to be implemented throughout the project life-cycle.

This intervention project could be implemented sustainably without serious adverse environmental impact if the recommended mitigation measures are strictly adhered to.

### E.S. 7.0 Training Plan

The project proposes to train the SPMU staff, contractors staff and the community representatives on environmental safeguards.

### E.S 8.0 Gender Based Violence, Labour Influx and Child Labor

The project may face an influx of non-local labor and working conditions issues as skilled laborers might not be available in the project sites. The project shall take concrete measures to mitigate potential labor influx-related risks such as workers' sexual relations with minors and resulting in pregnancies, presence of sex workers in the community.

### E.S. 9.0 Budget

The Budget covers the mitigation measures and each of the activities identified for each of the phases of the Ogiso-Osunde Gully Rehabilitation project. The total cost estimate for implementation of the ESMP is fifteen million, five hundred thousand naira only (i.e. \$43,055, at N360.00 to \$).

**Table 0.2: Budget /Cost Analysis of the Proposed Project ESMP Implementation**

| <b>S/N</b> | <b>MITIGATION IMEASURES</b>                                                                                                                                    | <b>COST ESTIMATES (N)</b> |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1          | Re-vegetation of unwanted/un-used area                                                                                                                         | <b>200,000.00</b>         |
| 2          | Contractor to ensure that nose masks and earmuffs are worn by workers during excavation                                                                        | <b>550,000</b>            |
| 3          | Water to be sprayed at work site especially in dry season<br>Air quality and noise in three locations (Ogiso-osunde Upper and Lower Watershed, and community   |                           |
| 4          | Edo NEWMAP to encourage sex education and awareness of transmission of HIV.AIDS, other communicable diseases<br>Community health                               | <b>400,000</b>            |
| 5          | Contamination of soils, surface and ground water bodies<br><br>Soil, Ground and surface water at three locations.                                              | <b>850,000</b>            |
| 6          | Potential increase in erosion,<br>Contamination of surface water bodies and loss of agricultural land<br>Microbial studies of water and sediments (2 locations | <b>450,000</b>            |

|   |                                                                                    |                   |
|---|------------------------------------------------------------------------------------|-------------------|
| 7 | Investment in soil erosion management                                              | <b>400,000</b>    |
| 8 | Sustaining livelihoods and protecting biodiversities                               | <b>400,000</b>    |
| 9 | <b>Training plan</b>                                                               | <b>4,000,000</b>  |
|   | <b>Total Budget for ESMP implementation</b>                                        | <b>3,250,000</b>  |
|   | <b>Additional cost of engaging an External Monitor for the ESMP implementation</b> | <b>5,000,000</b>  |
|   | <b>TOTAL BUDGET</b>                                                                | <b>15,500,000</b> |

#### E. S.10.0 Disclosure

After a review and clearance by the World Bank, the ESMP will be disclosed at the FMEnv, SME and the host LGA offices as well as at the World Bank website

## CHAPTER ONE

### INTRODUCTION

#### 1.1 BACKGROUND

Gully erosion is one of the major environmental challenges facing Nigeria. Erosion has led to the degradation of watershed with devastating effects on the biophysical environment, health and socio-economic lives of the people. The present state of gully affairs undermines economic growth and poses a threat to the developmental programmes of the Federal Government of Nigeria including the currently pursued “*Transformation Agenda*” and “*Vision 20-2020*” (Adger *et al.*, 2003).

The Government of Nigeria is implementing the multi-sectoral Nigeria Erosion and Watershed Management Project (NEWMAP), which is financed by the World Bank, Global Environment Facility, the Special Climate Change Fund, and the Government of Nigeria. NEWMAP, an 8-year multi-sectoral and multi-scale program, finances activities implemented by States and activities implemented by the Federal government. The project currently includes 19 states, namely Anambra, Abia, Cross River, Edo, Enugu, Ebonyi, Imo, Akwa Ibom, Bauchi, Borno, Delta, Gombe, Kano, Katsina, Kogi, Nasarawa, Plateau, Oyo and Sokoto.

The lead agency at the Federal level is the Federal Ministry of Environment (FME), Department of Erosion, Flood and Coastal Zone Management. State and local governments, local communities and CSOs are or will be involved in the project given that the project is a multi-sector operation involving MDAs concerned with water resources management, public works, agriculture, regional and town planning, earth and natural resources information, and disaster risk management.

The Edo State Government through the World Bank Assisted Project on The Nigeria Erosion and Watershed Management Project (NEWMAP) is financing the age-long gully erosion hazards in the State through the intervention of prioritized gully erosion sites.

The development objective of NEWMAP is: *to rehabilitate degraded lands and reduce longer-term erosion vulnerability in targeted areas*. At State level, NEWMAP activities involve medium-sized civil works such as construction of infrastructure and/or stabilization or rehabilitation in and around the gullies themselves, as well as small works in the small watershed where gullies form and expand. It is envisaged that the project will promote improved vegetative land management practices and ultimately contribute to retaining or increasing forest cover and carbon storage, while also preventing or reducing erosion impacts

through activities such as watershed scale planning, establishing vegetation corridors/set asides, and afforestation or natural regeneration measures. These works trigger the World Bank's Safeguard Policies including Environmental Assessment OP 4.01; Natural Habitats OP 4.04; Cultural Property OP4.11 ; Involuntary Resettlement OP 4.12, Safety of Dams OP 4.37; Pest Management Safeguard Policy OP 4.09; and Projects on International Waterways OP 7.50.

The specific objective of the intervention project is to reduce the vulnerability to soil erosion in targeted sub-watersheds. This innovative, multi-sectoral programme will finance State-led interventions to prevent and reverse land degradation on a demand-driven basis, initially focusing on gully erosion sites that threaten infrastructure and livelihoods in ready south-eastern States.

The project's strategic approach to intervention sites in the southern parts of the country is to:

- a. Start with "damage control" to slow the expansion of a targeted set of existing aggressive gullies, thereby reducing loss to property and infrastructure and helping to cultivate community ownership;
- b. Leverage the gully intervention to support integrated watershed management<sup>1</sup> and move towards greater adoption of sustainable land and water management practices by local people in the sub-watershed where the gully is located;
- c. Improve or protect rural livelihoods in the sub-watershed and carefully implement local Resettlement Action Plans;
- d. Strengthen disaster risk reduction and preparedness at state, local, and community levels; and
- e. Underpin these efforts by strengthening relevant institutions and information services, including urban storm water drainage management planning.

There are four essential components in the NEWMAP comprehensive detailed elements. These are:

- I. Erosion and Watershed Management Investments;
- II. Erosion and Watershed Management Institutions and Information Services;
- III. Climate Change Agenda Support; and
- IV. Project Management.



NEWMAP interventions are designed to operate at three stages of sub-watershed level, creating conditions for gully and watershed rehabilitation and livelihood development, including community sensitization. These include;

- Social mobilization and capacity building to ensure ownership and a strong foundation for subsequent interventions;
- Implementation of sub-watershed management plans including disaster response, and livelihoods development; and
- Continuing financial and technical support for gully and sub-watershed rehabilitation and livelihood activities as well as monitoring, while phasing out civil engineering activities.

The civil engineering activities will involve the use of low, medium and heavy duty equipment including but not limited to Loader, Grader, Vibration Roller, Bulldozer, Generator, Impact Drill, Mixer, Concrete Pump, and Pneumatic Hammer. The project activities will include;

- Refilling part of the gully to rehabilitate existing roads by carrying out complete or partial reclamation on the gully;
- Construction of collector drains along the main roads overlooking the intervention area in order to prevent further run off concentration along secondary roads;
- Provision of proper interceptor drains to safely discharge water through chutes and stilling basins or baffled aprons. The transverse chutes are positioned at appropriate points adjacent the interceptor drains to prevent the occurrence of erosion next to the lined concrete channel;
- Provision of concrete channels in infrastructure areas and check dams at suitable intervals at gully bed of the main gully;
- Reconstruction of a new rectangular channel in place of the existing damaged trapezoidal one; and
- Provision of vegetation measures following construction of the engineering measures.

### **1.1.1 Description of the Ogiso-Osunde Gully Erosion Site and the proposed Intervention Activities**

Ogiso-Osunde is a location in the Ikpoba-Okha districts to the south-east of the centre of Benin City (Latitude 60 20' 0"N and Longitude 50 38' 0"E) (Fig. 1.1). The drainage systems upstream of the gully and possible ways of stabilising the gully have previously been examined in the Stormwater Master Planning and Concept Design Study. The problem at the Ogiso-Osunde site relates to inadequate and poorly maintained urban drainage systems.

The lower end of Osunde Street has been severely undermined by erosion and has totally collapsed (Plate 1.1). Inspection of the catchment area and drainage systems reveals that most of the runoff being directed to the Ogiso-Osunde Street system is from the catchment to the west of Murtala Mohammed Way (MM Way). This runoff is concentrated and channelled along the MM Way before being released onto the Ogiso-Osunde Street where the drainage system is unable to cope.

The aims of the Ogiso-Osunde project are:

- To route the runoff from the sub-catchments through various conduits so as to avoid the concentration of flow at Osunde Street;
- To provide facilities with sufficient capacity to convey the flows;
- To safely discharge the storm water into an underground conduit in the moat;
- To connect the system in the moat to an existing conduit which discharges to the Ikpoba River;
- To accommodate excess flows during major rain events in an open concrete channel which serves as a roadway at other times, and
- To rehabilitate the damaged streets.

Specifically, the intervention programme details at the Ogiso-Osunde gully erosion site will involve:

- Reconstruction of the upper portion of Osunde Street, with new underground conduits
- that will divert flows into a new box culvert that will be provided under the floor of the existing moat;
- Reconstruction of Aigbekaen Street and provision of a new drainage channel that will divert some of the flow from Murtala Mohammed Way;
- Reconstruction of Akugbe Street and provision of a second new drainage channel that will divert more flow from Murtala Mohammed Way;
- Construction of a new articulated concrete block lined channel to take flows from the upper portion of Murtala Mohammed Way;
- Provision of a concrete lined overland flood escape route down Omusi Street that will also provide vehicular access except when flooding occurs, and
- Dredging of a portion of the Ikpoba River

The design for safety and risk primarily consists of open canals, box culverts, manholes and inlet structures. The open channels will be protected with handrails and pedestrian crossings where necessary.

These intervention activities will have adverse environmental and social impacts. Consequently, there is the need to assess the Environmental and Social Impacts of this intervention project by the Edo NEWMAP. Considering the category of the proposed project, and the environment, infrastructure and population of the affected

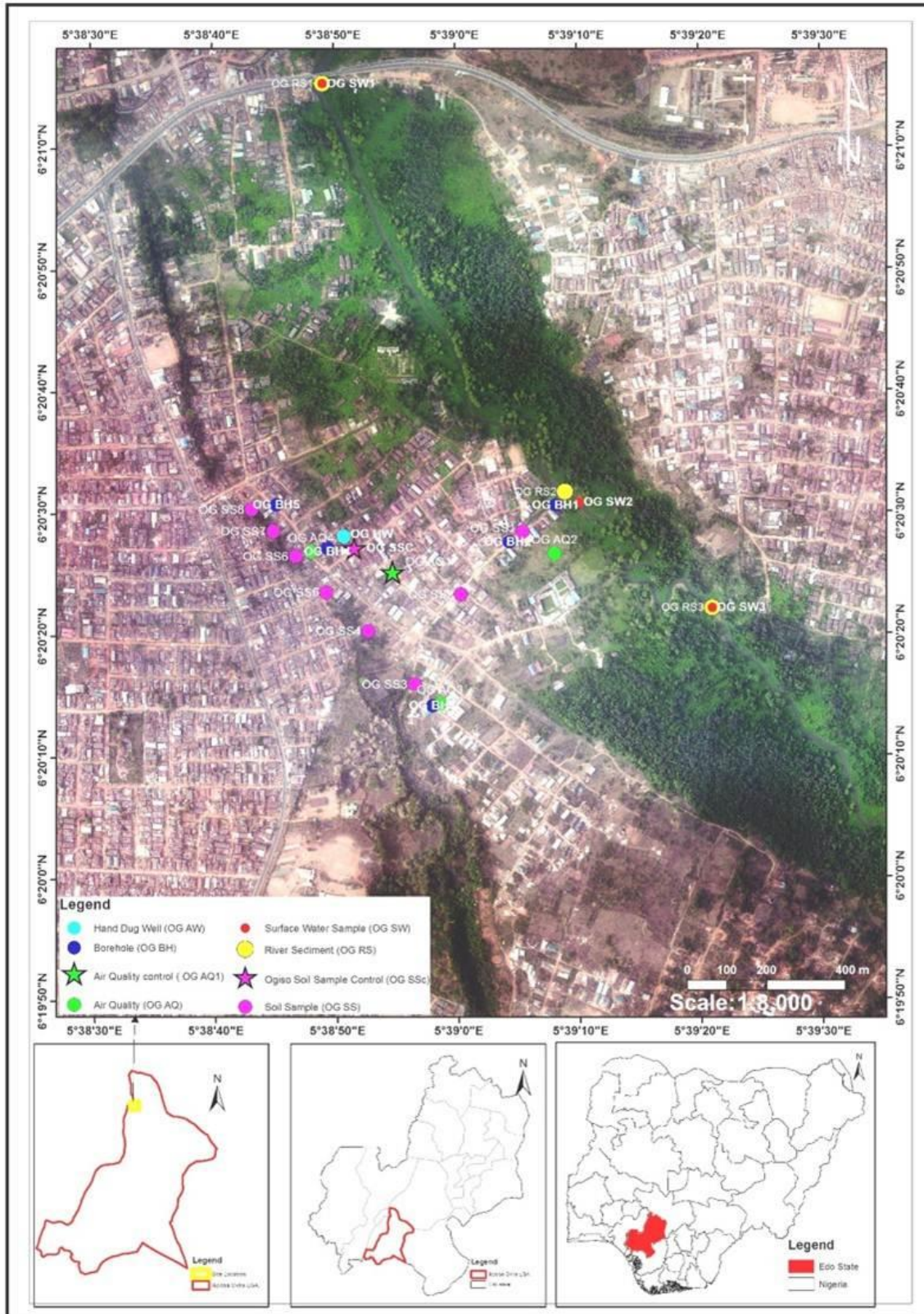


Fig. 1.1a: High Resolution Digital Imagery Map of Ogiso-Osunde Gully Erosion Site showing the Soil, Air Quality, Surface Water and Borehole sampling points



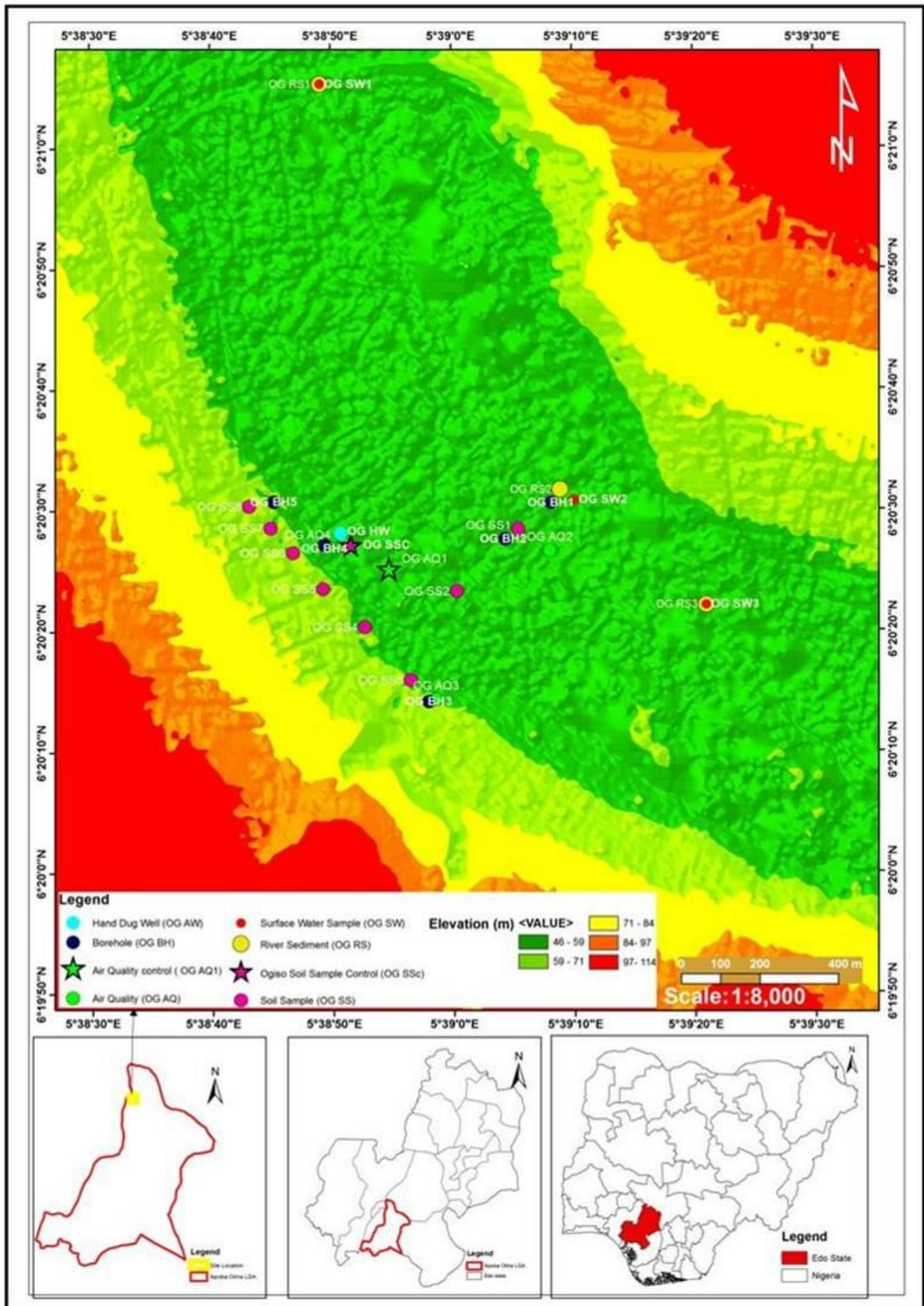


Fig. 1.1b: 3D High Resolution Digital Imagery Map of Ogiso-Osunde Gully Erosion Site



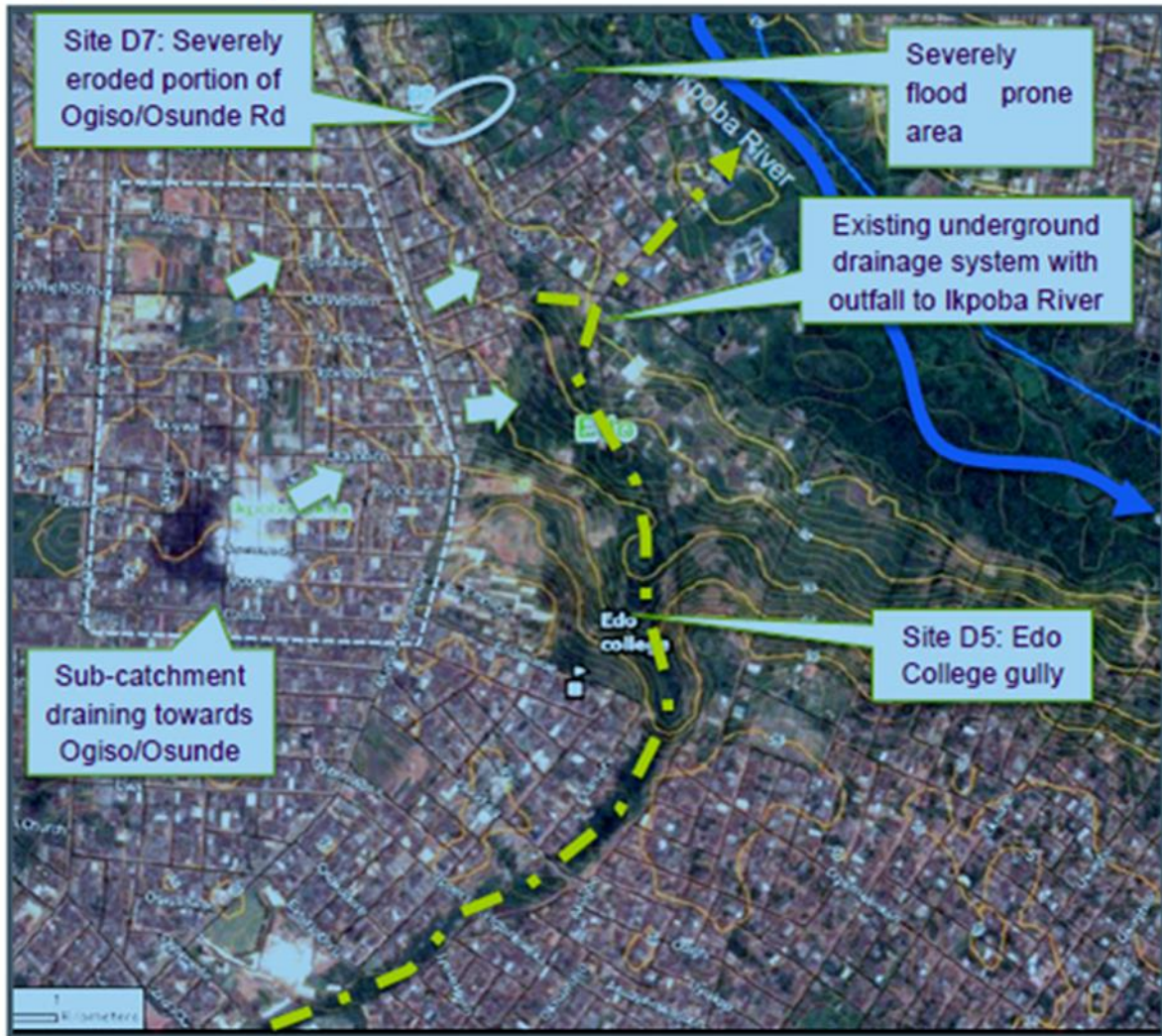


Fig. 1.2: The relative location of the Ogiso-Osunde Gully Site



**Plate 1.1: Collapsed Lower end of Osunde Street severely undermined by erosion**

people, the development of an Environmental and Social Management Plan (ESMP) by the Edo State NEWMAP SPMU in Benin City (NEWMAP, 2012a; NEWMAP, 2012b; NEWMAP, 2012c) becomes a desideratum.

This report presents the Environmental and Social Management Plan (ESMP) for the proposed intervention project at Ogiso-Osunde Gully Erosion Site in Benin City, Edo State under the Edo State Nigeria Erosion and Watershed Management State Project Management Unit (Edo NEWMAP-SPMU). The report covers the associated and potential adverse impacts, mitigation measures, environmental management/monitoring plans, implementation cost, and institutional actions to be taken before, during and after implementation to either eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable limits. It also addresses the adequacy of the monitoring and institutional arrangements and cost implications for the intervention project. The ESMP will be utilized by the contractors commissioned by Edo State NEWMAP for the project and will form the basis of site-specific management plans that will be prepared by the contractors as part of their construction methodology prior to works commencing. The ESMP will ensure that the policies of the Federal Government of Nigeria and the World Bank on environmental and social safeguards assessment are met and all subprojects undertaken are environmentally and socially sound and sustainable.

## **1.2 Rationale for the ESMP**

The **Environmental and Social Management Plan (ESMP)** is a management tool that specifies the strategies and procedures for managing potential environment and social impacts associated with a proposed project. The ESMP contain a set of mitigation, monitoring, and institutional actions to be taken before and during implementation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

The development of an Environmental and Social Management Plan (ESMP) includes establishing an environmental and social impact assessment (if none exists) and management process framework that incorporates the following elements:

- Regulatory policies;
- Identification of risks and impacts;
- stakeholder consultation/engagement
- Management programs that includes emergency preparedness and response;
- Monitoring and review.

This Environmental and Social Management Plan (ESMP) is developed to identify the environmental and social management and mitigation actions required to implement project activities at the erosion gully site, in accordance with the requirements of the World Bank and applicable Nigerian local and national legislations. This ESMP provides an overview of the environmental and social baseline conditions in the project area, summarizes the potential impacts associated with the project activities at the proposed gully intervention site and sets out the management measures required to mitigate any potential impacts. There has been no previous baseline study conducted in the area as at the time of this survey. Consequently, the potential impacts and associated mitigation measures and management procedures presented in this ESMP are based on the baseline information and assessments established through literature research and a single season field data gathering/laboratory analysis in November 2017. The established baseline conditions and stakeholder/community concerns have been incorporated into this document (See Chapters 3 and 4). Also presented in the ESMP are the management procedures to be used for community engagement, dissemination of project information and grievance management.

The benefits envisaged in conducting this ESMP include:

- The management of environmental and social performance throughout the life of the project.
- Protection of the environment and minimizing adverse social impacts via consultative process; and
- Lower overall project cost in the long term (reduced probability of environmental disasters, costly clean-up, host communities interference, etc.);
- Effective community engagement, opportunity for enhanced public confidence and good public relations and
- Support for displaced persons in their efforts to restore their livelihoods and living standards and compensation for any loss of livelihood or assets;

This ESMP will be utilized by the Edo State NEWMAP project monitoring unit (SPMU) and her commissioned contractors and will form the basis of site-specific management plans that will be prepared by the contractors. All contractors and subcontractors shall comply with the



ESMP requirements as applicable to the tasks they are employed to undertake. It is recognized that practical implementation of many of the measures may rest with contractors and subcontractors and consequently Edo State NEWMAP SPMU will require a robust review/audit mechanism, as described in this ESMP, to ensure that it is executed on her behalf. This ESMP should be regarded as a live document that should be reviewed and updated as new technologies and regulatory regimes emerge and impacts become apparent during the project life cycle.

### **1.3 Scope of the Work**

The objective of the consulting services is to prepare an Environmental and Social Management Plan (ESMP) for the proposed Edo State NEWMAP Emu gully erosion intervention site in Edo State Nigeria.

The specific tasks are to:

- Describe the biophysical and social environment including the existing status of the sub-watershed;
- Identify the potential environmental and social issues/risks associated with the intervention;
- Draw on the feasibility and engineering report and site design, appropriate baseline indicators (for example, m<sup>3</sup>/sec of runoff collected in the sub-watershed during a heavy hour-long rainfall);
- Develop a plan for mitigating environmental and social risks associated with construction and operation in the gully intervention in consultation with the relevant public and government agencies;
- Identify the feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels;
- Develop a time-bound plan for mitigating environmental and social risks associated with the specific intervention in the designated sub-watershed management in consultation with the relevant public and government agencies;
- Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels;
- Identify monitoring objectives and specify the type of monitoring, with linkages to the impacts assessed and the mitigation measures described above;
- Provide a specific description of institutional arrangements: the agencies responsible for carrying out the mitigation and monitoring measures (e.g., for operation, supervision, enforcement, monitoring of implementation, remedial action, financing,

reporting, and staff training) and the contractual arrangements for assuring the performance of each implementing agency;

- Define technical assistance programs that could strengthen environmental management capability in the agencies responsible for implementation;
- Provide an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and
- Provide the expected capital and recurrent cost estimates and sources of funds for implementing the ESMP and inform accordingly the design consultants so that these costs are duly taken into consideration in the designs.
- Register the ESMP with the environmental assessment (EA) departments at Federal and State levels; and
- Disclose the finalized ESMP at the National, State, LGA and Community levels.
- Subject the disclosed ESMP and RAP to Technical Review Exercise and other regulatory requirements that will culminate to issuance of Environmental Impact Statement (EIS) and the Certificate

This ESMP report, together with a separate report providing a Resettlement Action Plan (RAP) for the project Emu gully rehabilitation site will be used by the NEWMAP in Edo State.

#### **1.4 Approach and Methodology**

This ESMP was prepared in accordance with the World Bank safeguard policies and the Nigerian environmental assessment guidelines and procedures. The preparation of the ESMP was guided by NEWMAP ESMF and PAD alongside other relevant NEWMAP documents at both the federal and state levels.

The methodology used entails: Literature Review / Desktop studies, Field studies, Public consultations and Preparation of ESMP Report.

#### **1.5 Map of the Project Area**

The high resolution digital imagery for the Ogiso-Osunde Project Site is shown in Figures 1.1 and 1.2.

### **1.6 Summary of the Report**

The ESMP outlines the environmental and social management processes and procedures applicable to the project and includes the topics which are common to all environmental and social disciplines. Supporting documents are provided as annexures.

The ESMP is structured as follows:

Chapter 1 – Introduction (Description of the proposed intervention, Rationale for ESMP, Map)

Chapter 2 – Institutional and Legal Framework for Environmental Management;

Chapter 3 – Biophysical Environment (Description of the area of influence and environmental baseline conditions).

Chapter 4 – Socio-Economic Characteristics and Consultation with Stakeholders;

Chapter 5 – Assessment of Potential Adverse Impacts and Analysis of Alternatives

Chapter 6 – Environmental and Social Management Plan; and

Chapter 7 – Summary, Recommendations and Conclusion.

## CHAPTER TWO

### INSTITUTIONAL AND LEGAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

#### 2.1 World Bank Safeguards Policies triggered by NEWMAP and the proposed activity

The World Bank Environmental and Social Safeguard Policies (10+2) constitute a set of instruments to ensure that the bank-supported lending operations minimize any adverse impacts on local people and the environment. The policies are designed to avoid, mitigate or minimize the adverse environmental and social impacts of development projects supported by the World Bank, and improve decision making.

The intervention project activities at the Ogiso-Osunde gully erosion site and the associated overall development of the watershed trigger four out of the World Bank safeguard policies (Annexure 2) as indicated in Table 2.1.

**Table 2.1: Safeguard Policies Triggered by NEWMAP Project at Ogiso-Osunde**

| Safeguard Policies                    | Triggered by NEWMAP Project                                         | Triggered by Ogiso-Osunde gully erosion intervention | Reason                                                                                                                                                               |
|---------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environmental Assessment (OP/BP 4.01) | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Yes                                                  | Project activities including reclamation, channelling and remediation will have adverse effect on the environment.                                                   |
| Natural Habitats (OP/BP 4.04)         | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Yes                                                  | The activities outlined above in project description require the significant conversion of significant areas of natural habitats especially downstream of the gully. |
| Involuntary Resettlement (OP/BP 4.12) | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Yes                                                  | Homestead farms and residential areas will likely be affected                                                                                                        |
| Forests (OP/BP 4.36)                  | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Yes                                                  | Civil works will extend to forest area around the gully.                                                                                                             |

### **2.1.1 Relations between World Bank Safeguards Policies and Extant Laws in Nigeria**

The Nigerian EIA Act and the World Bank Safeguard Policies are similar; designed to help ensure that projects proposed for Bank financing are environmentally and socially sustainable, and thus improve decision-making.

In order to make the ESMP responsive to the objectives of good practice, the Nigeria's *EIA* requirements and World Bank Environmental Assessment were harmonised as far as possible.

The principles inherent in the environmental and social standards of the World Bank Safeguard on Environmental Assessment are in tandem with the FME<sub>Env</sub> EIA procedures and processes.

The Nigerian Environmental Impact Assessment Act (No. 86 of 1992) requires that all development projects be screened for their potential impacts. Based on the screening, a full, partial, or no Environmental impact assessment may be required.

According to the guidelines issued in the 1995 EIA screening process:

- **Category I** projects require a full EIA. Such projects include large-scale activities like agriculture development on 500 hectares or more, land reclamation of 50 hectares or more, fisheries that establish land based aquaculture of 50 hectares or more, forestry projects that converts more than 50 hectares, etc.
- **Category II** projects require only a partial EIA that focuses on mitigation and environmental planning measures, unless the project is located near an environmentally sensitive area, in which case a full EIA is required.
- **Category III** projects are those considered to have “essentially beneficial impacts” on the environment and for which the Federal Ministry of the Environment will prepare an Environmental Impact Statement, but which do not need an EIA.
- With regard to EA, the World Bank categorized projects into:
- **Category A:** These projects are those whose impacts are sensitive, diverse, and unprecedentedly, felt beyond the immediate project environment and are potentially irreversible over the long term. Such projects require full EA.
- **Category B:** These are projects that involve site specific and immediate project environment interactions. Specifically, they do not significantly affect human populations, alter natural systems and resources, consume much natural resources

(e.g., ground water) or have adverse impacts that are not sensitive, diverse, unprecedented and are mostly reversible. Category B projects will require partial EA, and environmental and social action plans.

- **Category C:** These are projects that are mostly benign in nature and are likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required, although some may require environmental and social action plans.
- **Category FI:** A proposed project is classified as Category FI, if it provides funds through a financial intermediary to subprojects that may result in adverse environmental impacts. Here the financial intermediary is responsible for setting up an Environmental and Social Management Framework that supervises the establishment of EIAs in line with the World Bank System.

The World Bank Categorization (A, B, & C) corresponds in principle with the Nigeria EIA requirements of Category I, II and III as both use the level of impacts associated with a given project as triggers for the required environmental assessment. However, in the event of divergence between the two with regard to the proposed intervention on Ogiso-Osunde Gully Erosion Site, the more stringent safeguard policy shall take precedence. There are significant similarities between World Bank Safeguards Policies and the EIA Act of Nigeria. However, in the event of dissonance between World Bank Safeguards Policies and the EIA Act and or any other extant laws in Nigeria, the World Bank Safeguards Policies shall supersede.

Thus, for the Ogiso-Osunde Gully Erosion Site intervention, the Nigeria's EIA requirements and World Bank operational procedures both apply and require:

- Early consideration of environmental and social issues (starting at the screening stage);
- Identification and early consultation with stakeholders;
- Prevention of adverse impacts through the consideration of feasible alternatives; and
- Incorporation of mitigation measures into planning and (engineering) design.

## **2.2 Relevant Federal and Local Policy, Legal, Regulatory, and Administrative Frameworks**

A number of national and local environmental guidelines are applicable to the operations of the NEWMAP. A brief discussion of these is provided below:

### **2.2.1 The Federal Ministry of Environment**

The Act establishing the Ministry places on it the responsibility of ensuring that all development and industrial activities, operations and emissions are carried out within the limits prescribed in the National Guidelines and Standards. The Ministry is therefore responsible for ensuring compliance with relevant regulations for environmental pollution management in Nigeria. To fulfil this mandate a number of regulations/instruments are available (See section on National Legal Instruments on Environment). However, the main instrument for ensuring that environmental and social issues are mainstreamed into developmental projects is the Environmental Impact Assessment (EIA) Act No. 86 of 1992.

With this Act, the FMEEnv prohibits public and private sectors from embarking on major developmental projects or activities without due consideration, at early stages, for environmental and social impacts. The Act, in performing this role, thus, makes an EIA mandatory for any development project, and prescribes the procedures for conducting and reporting EIA studies.

As part of the effective utilization of the EIA tool, the Ministry has produced sectorial guidelines detailing the necessary requirements of the EIA process from each Sector.

One of these guidelines, which applies to the proposed intervention project, is the sectorial guidelines on infrastructure development. The relevant National Legal Instruments on Environment are explained as follows:

### **2.2.2 The National Policy on Environment (NPE) of 1989**

The National Policy on the Environment (1989) (revised 1999) provides for “a viable national mechanism for cooperation, coordination and regular consultation, as well as harmonious management of the policy formulation and implementation process which requires the establishment of effective institutions and linkages within and among the various tiers of government that is, federal, state and local government”. The objective of the policy is to achieve sustainable development in Nigeria pertaining to:

- Securing a quality environment adequate for good health and wellbeing;
- Conserving the environment and natural resources for the benefit of present and future generations;

- Raising public awareness and promoting understanding of the essential linkages between the environmental resources and developments and encouraging individual and community participations in environmental improvement efforts;
- Maintaining and enhancing the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity; and
- Co-operating with other countries, international organizations and agencies to achieve optimal use and effective prevention or abatement of trans-boundary environmental degradation.

### ***2.2.3 Environmental Impact Assessment Act No. 86, 1992 (FME<sub>Env</sub>)***

This Act provides guidelines for regulating activities of development projects for which EIA is mandatory in Nigeria. The Act also stipulates the minimum content of an EIA as well as a schedule of projects that require mandatory EIAs.

### ***2.2.4 The National Guidelines and Standards for Environmental Pollution Control in Nigeria***

This was launched on March 12th 1991 and represents the basic instrument for monitoring and controlling industrial and urban pollution.

### ***2.2.5 The National Effluents Limitations Regulation***

This instrument makes it mandatory for industrial facilities to install anti-pollution equipment, make provision for further effluent treatment, prescribe maximum limit of effluent parameters allowed for discharge, and spell out penalties for contravention. It also provides that all industries in Nigeria should be operated on the basis of Best Available Technology (BAT).

### ***2.2.6 The NEP (Pollution Abatement in Industries and Facilities Generating Waste)***

#### ***Regulations***

Restrictions are imposed, through this instrument, on the release of toxic substances and requirements of Stipulated Monitoring of pollution to ensure that permissible limits are not exceeded; Unusual and accidental discharges; Contingency plans;

Generator's liabilities; Strategies of waste reduction and safety for workers.



### **2.2.7 The Management of Solid and Hazardous Wastes Regulations**

These regulate the collection, treatment, and disposal of solid and hazardous waste for municipal and industrial sources and give the comprehensive list of chemicals and chemical waste by toxicity categories.

### **2.2.8 National Guidelines on Environmental Management Systems (1999)**

These guidelines establish the requirements for an Environmental Management System (EMS) in all organizations/facilities in Nigeria. They also state that this EMS should be audited annually or as deemed necessary.

### **2.2.9 National Guidelines for Environmental Audit**

These are designed to serve as references for compliance with the environmental audit requirements of the FMEEnv. The guideline states that it is mandatory for a company to carry out an audit every 3 years or at the discretion of the Hon. Minister of the Environment.

### **2.2.10 National Policy on Flood and Erosion Control 2006 (FMEEnv)**

This policy addresses the need to combat erosion in the country by utilizing the procedures outlined in the National Action Plan for Flood and Erosion Control and Technical Guidelines, developed by the WIC Environmental Committee, which was set up to plan an operational platform for these issues. This particular policy has a direct bearing on the NEWMAP project activities.

### **2.2.11 National Air Quality Standard Decree No. 59 of 1991**

The FMEH is the regulatory agency charged with the enforcement of ambient air quality standards in Nigeria. The World Health Organization (WHO) air quality standards were adopted in 1991 as the national standards by the FMEH. These standards define the levels of air pollutants that should not be exceeded in order to protect public health.

### **2.2.12 The National Environmental Standards and Regulations Enforcement Agency Act 2007 (NESREA Act)**

With the repealing of the Federal Environmental Protection Act of 1988, the NESREA Act, 2007 became the major statutory regulation or instrument guiding environmental matters in Nigeria. It specially makes provision for solid waste management and its administration and prescribes sanctions for offences or acts, which run contrary to proper and adequate waste disposal procedures and practices.

### **2.2.13 The National Oil Spill Detection and Response Agency Act 2005 (NOSDRA ACT)**

This statutory regulation makes adequate regulations on waste emanating from oil production, exploration and its potential consequences to the environment.

## **2.3 Other Relevant Acts and Legislations at the Federal Level**

### **2.3.1 Land Use Act of 1978**

The Land-Use Act of 1978 states that, "It is in the public interest that the rights of all Nigerians to use and enjoy land in Nigeria and the Natural fruits thereof in sufficient quality to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved". This implies that acts that could result in the pollution of the land, air, and waters of Nigeria negate this decree, and is therefore unacceptable.

Furthermore, the Land Use Act of 1978 (modified in 1990) remains the primary legal means to acquire land in the country. The Act vests all land comprised in the territory of each state in the federation in the governor of the State and requires that such land shall be held in trust and administered for the use and common benefit of all Nigerians in accordance with the provisions of this Act.

According to the Act, administration of land area is divided into urban land, which will be directly under the control and management of the Governor of each State; and non-urban land, which will be under the control and management of the local government. State governors are given the right to grant statutory rights of occupancy to any person or any purpose; and the local government will have the right to grant customary rights of occupancy to any person or organization for agricultural, residential and other purposes.

### **2.3.2 Forestry Act of 1958 and National Agricultural Policy of 1988**

This Act provides for the preservation of forests and the setting up of forest reserves. It is an offence, punishable with up to 6 months imprisonment, to cut down trees over 2ft in girth or to set fire to the forest except under special circumstances. Nigeria is at present a wood-deficit nation. In order to ameliorate the situation, the policy on forest resources management and sustainable use is aimed at achieving self-sufficiency in all aspects of forest production using sound forest management techniques as well as the mobilization of human and material resources. The overall objectives of forest policy are to prevent further deforestation and to recreate forest cover, either for productive or for protective purposes, on already deforested fragile land.

In order to make adjustments towards new developments, the Forest Policy was subsumed into The National Agricultural Policy of 1988. The following provisions were put forward in the NAP;

- Consolidation and expansion of the forest estate in Nigeria and its management for sustained yield;
- Regeneration of the forests at rates higher than exploitation;
- Conservation and protection of the environment viz: forest, soil, water, flora, fauna and the protection of the forest resources from fires, cattle grazers and illegal encroachment;
- Development of Forestry industry through the harvesting and utilisation of timber, its derivatives and the reduction of wastes; and
- Wildlife conservation, management and development through the creation and effective management of national parks, game reserves, tourist and recreational facilities, etc.

### **2.3.3 Criminal Code**

The Nigerian Criminal Code makes it an offence punishable with up to 6 months imprisonment for any person who:

- Violates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carry on business in the neighbourhood, or passing along a public way: or
- Does any act which is, and which he knows or has reason to believe to be likely to spread the infection of any disease dangerous to life, whether human or animal.

### **2.3.4 Inland Waterways Authority (NIWA) of 1997**

The Nigeria Inland Water Authority (NIWA) Act 13 of 1997 established NIWA whose functions are among others are to:

- Provide regulations for inland navigation;
- Ensure the development of infrastructural facilities for a national inland waterways network connecting the creeks and the rivers with the economic centres using the river-ports as nodal points for inter model exchange;
- Ensure the development of indigenous technical and managerial skill to meet the challenges of modern inland waterways transportation; and
- Carry out environmental impact assessment of navigation and other dredging activities within the inland water and its right-of-ways.

## **2.4 Legislations at the State Level**

Some of the functions of the State Ministries of Environment include:

- Liaising with the Federal Ministry of Environment, FMEnv to achieve a healthy or better management of the environment via the development of National Policy on Environment;
- Co-operating with FMEnv and other National Directorates/Agencies in the performance of environmental functions including environmental education/awareness to the citizenry;
- Responsibility for monitoring waste management standards;
- Responsibility for general environmental matters in the State; and
- Monitoring the implementation of ESIA studies and other environmental studies for all development projects at the State level.

However, it must be stated that the supervisory ministry of the NEWMAP project at the federal level is the Ministry of Environment. Thus, the Edo State Ministry of Environment is the supervisory ministry in Edo State.

### **2.4.1 Edo State Legislations**

Structurally, the meditation of environmental authority centres on the principle of cooperative leadership by the Federal Government. This identifies immediately for the establishment of a Federal Ministry of Environment, and similar States Ministry of Environment at the State levels. The State Ministry of Environment and Public

Utility gives an administrative umbrella under which the managements of different phases of the environment are coordinated. In order to maximize the collaboration of the public, the traditional power structure of the Oba (paramount chiefs and community leaders) are also involved in the conception and implementation of environmental planning. Citizen participation through neighbourhood groups are also involved.

The administrative arrangements to handle environmental problems in Edo State include the Town Planning Division, which enforces building and housing codes and land use regulations; and the Task Force on Environmental Sanitation, responsible for solid waste management. Effective environmental planning administration adopts a holistic approach, which recognizes the need for a comprehensive environmental planning and a concentration of environmental authority. This is based on the premise that environmental issues are the responsibility of one agency but an obligation for all.

Worthy of special mention is the Edo State Sanitation and Pollution Control Law No.5 of 2010 that was recently passed into law. The law empowers the Ministry in the area of Environmental Impact Assessment (EIA) and related matters and supports the Environmental Auditing of facilities in order to ensure compliance with environmental standards under the supervision of the Federal Ministry of Environment.

#### **2.4.2 Edo State Ministry of Environment and Sustainability (EDSME&S)**

This is the legally authorized body exclusively responsible for the management of issues pertaining to the environment. Specifically, the agency is responsible for waste management, flood and erosion control, forest depletion and degradation and general environmental and atmospheric pollution. It should be noted that the ME&S changed from the Edo State Environmental Protection Board (EDSEPB) to a full-fledged Ministry in respect to the national realignments of the year 2000.

This ministry is made up of five departments and a board. The participation of the Department of Environment (DoE) is of particular importance to the Project. EDSMEPU's functions also consist of the formulation of policies for environmental protection and control (Nigerian Government, 2011).

#### **2.4.3 Edo State Waste Management Board (EDSWMB)**

The EDSWMB is an agency under the direct supervision of the Edo State Ministry of Environment and Public Utilities (EDSMEPU). The Board's functions embrace the compilation, transport, processing, recycling or disposal and monitoring of waste materials. Waste materials include solid, liquid and gaseous substances.

Other responsibilities include the development of guidelines, standards and regulations for pollution control and waste management as well as examination and compliance monitoring of industrial facilities (Nigerian Government, 2011).

Finally, it is essential to affirm that the World Bank categorisation (A, B, & C) corresponds in principle with the Nigeria EA requirements of Categories I, II and III, which in actual practice is done with regard to the level of impacts associated with a given project. However, in the event of any divergence between the two, the World Bank safeguard policy shall take precedence over Nigeria EA laws, guidelines and or standards. For the same reason, the Federal laws overrule the Edo State policy in any case of conflict.

#### ***2.4.4 Edo State Ministry of Lands and Surveys***

The Ministry has the mandate to manage all lands in Edo State, survey, map and chart all real estates in the State. To acquire value and allocate public real property for public projects and gazettes such acquisitions by the State with the ministry. The policy objectives of the Ministry are to process all instruments evidencing ownership and possession of real estate in the state, and, to keep in custody all real estate instruments, records, and their management.

#### ***2.4.5 Edo State Ministry of Energy and Water Resources***

The Ministry of Energy and Water Resources is saddled with the responsibility of providing Light and Water to all nooks and crannies of the State.

#### ***2.4.6 Edo State Ministry of Local Government Chieftaincy Affairs***

The Ministry of Local Government is, amongst other things, charged with the responsibility of:

- Co-ordinating the activities of Local Government Councils;
- Resolving Local Government and Communal Boundary Disputes;

- Maintenance of Law and Order in Local Government Areas in collaboration with Law Enforcement Agencies;

This ESMP is prepared in compliance with existing Federal, State and local laws of Nigeria as well as the World Bank's Environmental and Social Management Framework (ESMF) safeguards instruments prepared for NEWMAP at the beginning of the project. Several laws, policies, safeguards instruments and international conventions at various levels have been reviewed.

## **2.5 International Conventions and Agreements**

The World has signed several international regulations, protocols, treaties and conventions aimed at halting environmental degradation and thus protecting human health against possible adverse effects. Nigeria subscribes to a number of this International Regulations and Conventions relating to Environmental Protection.

Some of the guidelines/conventions/treaties to which Nigeria is a signatory are outlined below:

- Both the Vienna convention for the protection of the Ozone Layer and the Montreal protocol for Control of Substances that deplete the ozone layer;
- Basel convention on the prevention of trans-boundary movement of hazardous wastes and their disposal;
- Convention on the prevention of the international trade in endangered species (CITES);
- Convention on Biodiversity;
- Convention on climate change;
- Convention on Desertification;
- Convention on Persistent Organic Pollutants;
- World Health Organization (WHO) Health and Safety Component of EIA, 1987.

## **2.6 Institutional Framework**

NEWMAP involves many Federal and State Ministries, Departments and Agencies (MDAs), Local Governments, communities, and the civil society. This is because effective implementation of projects requires inter-ministerial and inter-state coordination, collaboration, and information sharing. Thus, each component, subcomponent and activity is to be implemented through relevant federal and state MDAs. The various MDAs include

those responsible for planning, economy and finance, works, agriculture, water resources, forests, transport, power, emergency response, as well as those focused on climate and hydrological information or watershed/ basin regulation. The investments for Ogiso-Osunde gully site is being made through the Edo NEWMAP. However, the Edo State has the primary responsibility for land management and land allocations of the project site.

The Federal Ministry of Environment (FMEnv) is the lead implementing agency for NEWMAP. The Federal Project Management Unit (FPMU) headed by a Federal Coordinator hosted by FMEnv is responsible for the overall coordination. The Edo State Project Management Unit (Edo-SPMU) headed by the State Project Coordinator and hosted by the Edo State Ministry of Environment and Sustainability is responsible for the coordination in Edo State. Thus, he is directly responsible for coordinating activities of the Ogiso-Osunde Gully Erosion Site intervention, including the implementation of this ESMP. Both the Federal and State levels Coordinating Units have environmental officers responsible for the mainstreaming of environmental issues into the NEWMAP projects. The Edo State Environmental Officer is directly responsible for coordinating the implementation of this ESMP for Ogiso-Osunde Gully Erosion Site on behalf of the State Project Coordinator. At the community level, the Ogiso-Osunde Gully Erosion Site Monitoring Committee will participate effectively in ensuring full compliance during all phases of the project implementation.



## CHAPTER THREE

### BIOPHYSICAL ENVIRONMENT

This chapter presents the baseline environmental conditions of the project location and area of influence, particularly those elements of the environment that may be impacted upon by the project and which should be included in the monitoring programme. The environmental conditions include the climate/meteorology, air quality/noise, soil, land use and tenure system, hydrology, geology/hydrogeology, surface and groundwater quality, vegetation and biodiversity.

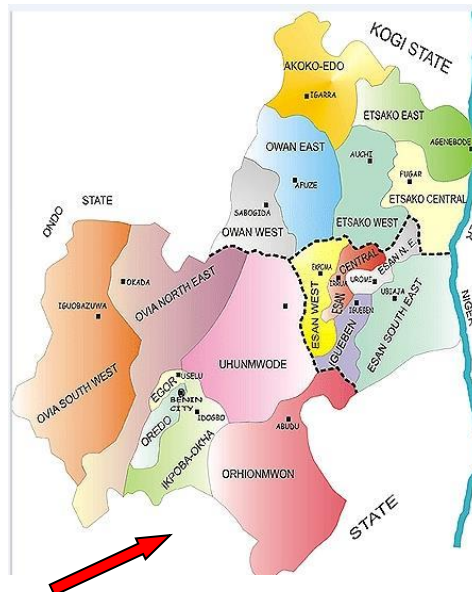
#### 3.1 Description of the Ogiso-Osunde Project Site

##### Location and Extent

Ogiso-Osunde is a location in the Ikpoba-Okha districts to the south-east of the centre of Benin City (Latitude 60 20' 0"N and Longitude 50 38' 0"E) (Figs. 3.1a, b, Figs. 1.1a,b). The drainage systems upstream of the gully and possible ways of stabilising the gully have previously been examined in the Stormwater Master Planning and Concept Design Study. The problem at the Ogiso/Osunde (D7) site relates to inadequate and poorly maintained urban drainage systems. The lower end of Osunde Street has been severely undermined by erosion and has totally collapsed. Inspection of the catchment area and drainage systems reveals that most of the runoff being directed to the Ogiso/Osunde Street system is from the catchment to the west of Murtala Mohammed Way (MM Way). This runoff is concentrated and channelled along the MM Way before being released onto the Ogiso/Osunde Street where the drainage system is unable to cope.



**Fig. 3.1a: Map of Nigeria Showing Edo State**



**Fig. 3.1b: Map of Edo State Showing Ikpoba-Okha Local Government Area**

A large portion of the residential area at the lower end of Ogiso-Osunde Street is severely flood-prone as indicated on Figure 1.2. The runoff from Ogiso-Osunde Road is channelled through the area between embankments or “dykes”. The residential area is clearly at a lower level than that of the watercourse. Should the channel overflow or the dykes breach, the residential area would be flooded.

### **3.2 Assessment of Baseline Conditions**

#### **3.2.1 Meteorology, Air Quality and Noise**

Climatic conditions show spatial and temporal variability and this is expected in the project area. The variability in climatic conditions influence will have influence on the project activities, particularly at the microclimatic level as seen in temperature, relative humidity, rainfall, wind speed and direction, and sunshine hours.

#### ***Temperature and Relative Humidity***

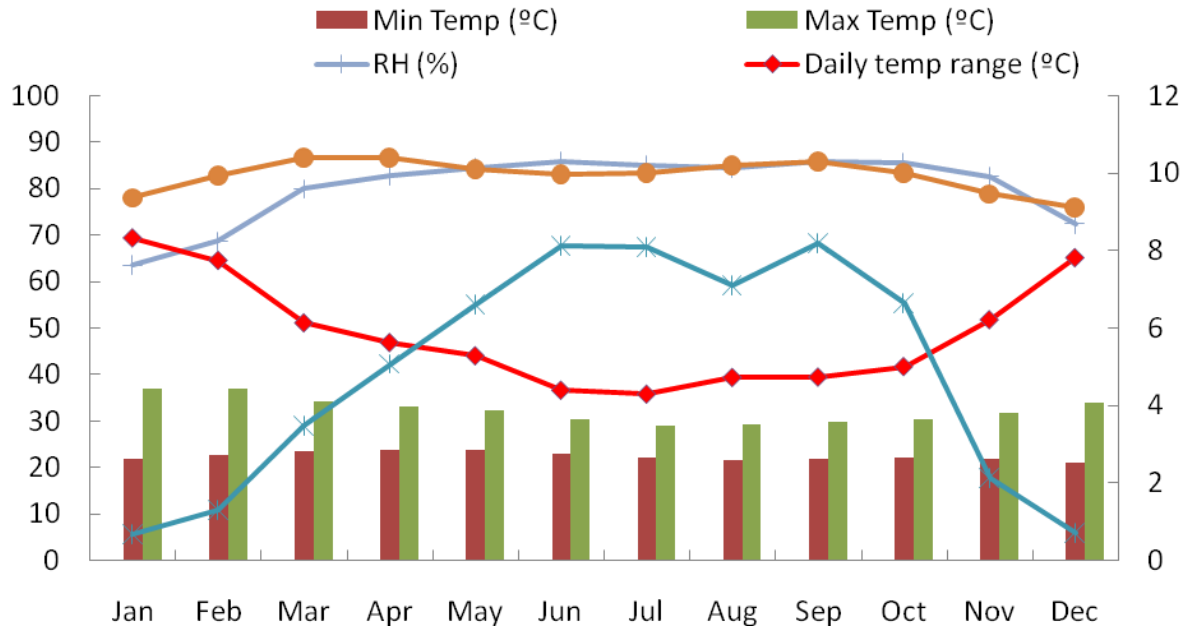
The average climatic conditions for the project area are summarized in Table 3.1 (Geoba.se database, 2016). On a regional scale, the 22-year data from NASA SSE presented in Figure 3.2 shows the general meteorology of Edo State. The average temperature for the year 2016 is (26.4°C). The warmest month, on average, is February with an average temperature of (28.3°C). The coolest month on average is August, with an average temperature of (25°C). The highest temperature is 29.0°C, recorded in February and March while the lowest recorded temperature is 24.0°C, which was recorded in August.

**Table 3.1: Summary of average temperature and precipitation in Benin City, 2016.**

| <b>Temperature – Precipitation</b> | <b>Annual</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>June</b> | <b>July</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|------------------------------------|---------------|------------|------------|------------|------------|------------|-------------|-------------|------------|------------|------------|------------|------------|
| Average Temp                       | 26            | 27         | 28         | 28         | 28         | 27         | 26          | 25          | 25         | 25         | 26         | 27         | 27         |
| Average high in °C                 | 27            | 28         | 29         | 29         | 28         | 28         | 27          | 26          | 25         | 26         | 26         | 27         | 28         |
| Average low in °C                  | 26            | 27         | 27         | 27         | 27         | 26         | 25          | 25          | 24         | 25         | 25         | 26         | 26         |
| Av. precipitation - mm             |               | 10         | 50         | 103        | 159        | 180        | 250         | 360         | 293        | 344        | 238        | 59         | 28         |

**Source:** Geoba.se, Copyright 2016 CantyMedia, [www.weatherbase.com/weather/weatherall.php3](http://www.weatherbase.com/weather/weatherall.php3)

Humidity remains high at about 84.5% and only drops in Dec/Jan to about 65%. The normal bimodal distribution of rainfall is clearly noted in the precipitation curve with a peak of about 8 mm/day during the months of Jun/Jul/Sept. Insolation of the atmosphere averages at about 10 kW/m<sup>2</sup>/day which just doubles the value at the earth's surface of about 5 kW/m<sup>2</sup>/day. The daily maximum and minimum temperature are also depicted in the Figure.



**Fig. 3.2: General meteorological parameters of Benin City from 1996 – 2015 (NASA SSE)**

During this study, four (4) monitoring sites were selected within and around the field, while one of the sites was selected at remote locations along the up-wind direction from the facilities, to serve as control. The parameters were measured in the locations described in Figure 1.1a, b.

Fieldwork data showed that the temperature ranged from 30.1°C to 33.3°C with a mean of 31.9°C. Relative humidity ranged from 58.6% to 73.8% with a mean of 66.6% (Table 3.2).

**Table 3.2: Monitoring Sites for Meteorology, Ogiso-Osunde (Nov 2017)**

| Sample Location | Northing | Easting | Air Temp. | Hum. | Wind Speed | Wind Direct. |
|-----------------|----------|---------|-----------|------|------------|--------------|
|                 |          |         | °C        | %    | m/s        |              |

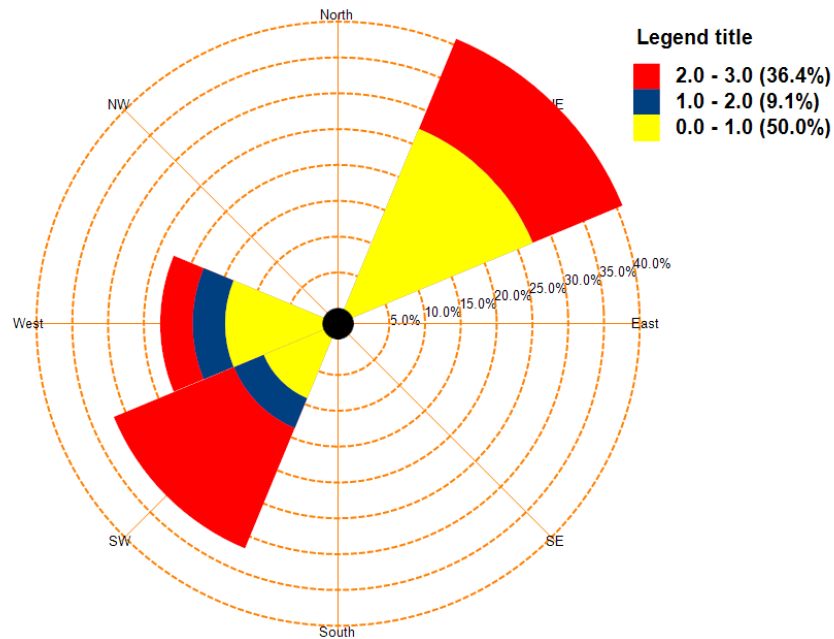
|       |            |             |      |      |     |    |
|-------|------------|-------------|------|------|-----|----|
| AQ C1 | 06°20.419' | 005°38.909' | 30.1 | 71.6 | 2.0 | NE |
| AQ 2  | 06°20.443' | 005°39.131' | 33.3 | 58.6 | 1.1 | NE |
| AQ 3  | 06°20.236' | 005°38.981' | 33.3 | 62.5 | 1.0 | E  |
| AQ 4  | 06°20.447' | 005°38.797' | 30.9 | 73.8 | 0.8 | NE |

SOURCE: Fieldwork 2017

**Wind speed and direction**

Analysis of climatic data obtained from Warri synoptic stations showed that the South Westerly is predominant between March and October which roughly coincides with the rainy season. On the other hand, the North Easterlies are rather frequent between November and February during the dry season. The South Easterlies and North Westerly are more evenly distributed throughout the year.

During the period of the study, the mean wind speeds in the study area ranged from 0.8 – 2.0 m/s (Table 3.2.) The prevailing direction was North Easterly to South Westerly as shown by the Wind Rose (Fig. 3.3).

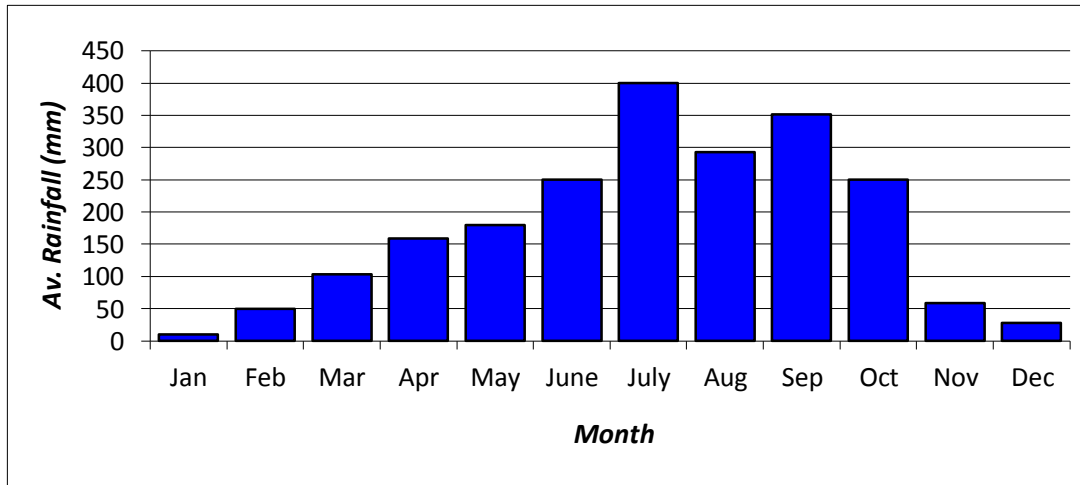


Windrose for the project area

**Fig. 3.3: Wind Rose for the project area and its receiving Environment**

**Rainfall**

The project area is located within the equatorial belt that experiences rainfall for most of the year. The State experiences both wet and dry seasons; the wet season lasting from April to November while, the dry lasts from December to March.



**Fig. 3.4: Rainfall (mm) Distribution Pattern for Benin** (Source: NIMET)

Rainfall in the area has a typical bimodal distribution which peaks in July, drops slightly in August rises again in September and drops off, as observed from the twenty- year data from the Benin synoptic station (Fig. 3.4). The annual mean rainfall averaged over a twenty (20) year period indicated that Benin had 2,147.36 mm. The state is however not homogeneous with respect to local climate. The rainfall distribution pattern ranges from 2900 mm per year in the south to as low as 350 mm per year in the north.

### **Noise and Air Quality**

Tables 3.3a and b shows that for all the air quality and noise parameters monitored, either the concentrations were not detected or were below FME<sub>env</sub>/DPR limits. Apart from the potential contribution of the project to the global atmospheric warming through generation of CO<sub>2</sub>, no other climatic parameter is likely to be affected by the proposed project. The Nigerian Ambient Air Quality Standards are given in Table 3.4. The WHO Guidelines on maximum permissible exposure to major pollutants and some possible effects of exceeding the limits are given in Table 3.5. To give a sense of order of magnitude and have appreciation for temporal evolution/activity changes, Table 3.6 has been included.

**Table 3.3: Air Pollutants/Noise Levels in Ogiso-Osunde Site ( Nov, 2017)**

| Sample Location                    | CO  | NO <sub>2</sub> | SO <sub>2</sub> | NH <sub>3</sub> | LEL | SPM               |
|------------------------------------|-----|-----------------|-----------------|-----------------|-----|-------------------|
|                                    | Ppm |                 |                 |                 | %   | µgm <sup>-3</sup> |
| AQ1 (Control)                      | 1.0 | ND              | ND              | ND              | ND  | 0.083             |
| AQ2                                | 0.5 | ND              | ND              | ND              | ND  | 0.071             |
| AQ3                                | ND  | ND              | ND              | ND              | ND  | 0.034             |
| AQ4                                | 0.6 | ND              | ND              | ND              | ND  | 0.052             |
| <b>FME<sub>env</sub> Standards</b> | 10  | 0.06            | 0.01            |                 |     | 250               |
| <b>WHO Limits</b>                  | 10  |                 |                 |                 |     | 150               |

Source: Field Survey Nov (2017) ND = Not Detected, NS = Not Specified

### Noise

The baseline outdoor noise levels within and around the project area and its environ are shown in **Tables 3.3.b** Noise level measurements were made at the same points as air quality. A mean noise range of 48.8 – 63.7 dB(A) was measured. The measured noise levels around the project environment were typical of rural communities in Nigeria (50 – 62 dBA). The highest noise level of 63.7 dB(A) was in AQ1Control. The Ambient Air Quality Standards are provided in Annexures 10.1 – 10.4.

*Table 3.3b: Noise Levels – (Nov 2017)*

| Sample Location | Noise |
|-----------------|-------|
|                 | dbA   |
| AQ1 (Control)   | 63.7  |
| AQ2             | 50.1  |
| AQ3             | 50.7  |
| AQ4             | 48.8  |
| FEnv Limits     | 90    |

### 3.2.2 Soil and Land use

#### **Soil Physico-Chemical Properties and Quality**

Six soil samples including a control station were collected within the project area to represent the main gully and samples of the connected gully fingers. Each of the samples collected were based on the soil profile indicating the top soil and the lower layers. Figure 1.1a,b shows the sampling locations while the summary of the

physicochemical properties of the soils, heavy metal concentrations and microbiological properties alongside their mean concentration values are as presented Table 3.8. The detailed results are given in Annexure 5.1.

The soils in this area were predominantly sandy in the entire fraction, with high occurrences of sandy clay loam and loamy sand in both the top (0-15 cm and bottom (15-30 cm layers. The results from the present study revealed high amount of sand in the soil implying well drained soil conditions and better soil aeration which would increase soil pH (reduce acidity. The pH of the entire soils was slightly acidic (5.8 - 6.9). This is typical of the soils of southern Nigeria. This is associated with the poor aeration property of the soils due to periodic inundation and poor drainage. The oxygen is generally depleted while there is more accumulation of hydrogen ions in the soil matrices.

The concentration of the anions (Chloride, Phosphate, Ammonium nitrogen, Sulphate and Nitrate) were generally low. These concentrations further indicate that the soils are well drained with low retention capacity for soluble salts and compounds of nitrate, chloride and sulphate.

**Table 3.4: Summary of Soil Physico-chemistry in Ogiso-Osunde Site**

| Parameter                                | Soil level | MIN  | MAX  | MEAN    | SD      | Acceptable Limits (DPR) |
|------------------------------------------|------------|------|------|---------|---------|-------------------------|
| pH                                       | 0-15cm     | 5.8  | 6.9  | 6.317   | 0.387   | NA                      |
|                                          | 15-30cm    | 5.5  | 6.9  | 6.133   | 0.476   | NA                      |
| Elect. Cond. ( $\mu\text{S}/\text{cm}$ ) | 0-15cm     | 251  | 688  | 371.500 | 160.103 | NA                      |
|                                          | 15-30cm    | 240  | 640  | 347.500 | 147.624 | NA                      |
| Organic Matter (%)                       | 0-15cm     | 0.62 | 2.56 | 1.623   | 0.756   | NA                      |
|                                          | 15-30cm    | 0.42 | 1.98 | 1.195   | 0.656   | NA                      |
| Organic Carbon (%)                       | 0-15cm     | 0.36 | 3.2  | 1.277   | 1.018   | NA                      |
|                                          | 15-30cm    | 0.22 | 3.1  | 1.038   | 1.059   | NA                      |
| Total Nitrogen (%)                       | 0-15cm     | 0.09 | 0.55 | 0.242   | 0.165   | NA                      |
|                                          | 15-30cm    | 0.04 | 0.22 | 0.143   | 0.076   | NA                      |
| Exchangeable Acidity (EA)                | 0-15cm     | 0.2  | 1.6  | 0.717   | 0.549   | NA                      |

|                                            |         |      |       |        |        |    |
|--------------------------------------------|---------|------|-------|--------|--------|----|
| (meq/100g)                                 |         |      |       |        |        |    |
|                                            | 15-30cm | 0.1  | 1.3   | 0.617  | 0.483  | NA |
| Sodium Na <sub>+</sub>                     | 0-15cm  | 0.34 | 1.15  | 0.615  | 0.285  | NA |
|                                            | 15-30cm | 0.2  | 0.91  | 0.397  | 0.269  | NA |
| Potassium K <sub>+</sub>                   | 0-15cm  | 0.03 | 0.38  | 0.128  | 0.128  | NA |
|                                            | 15-30cm | 0.01 | 0.15  | 0.070  | 0.051  | NA |
| Calcium Ca <sup>++</sup>                   | 0-15cm  | 1.41 | 5.29  | 2.743  | 1.400  | NA |
|                                            | 15-30cm | 0.9  | 3.52  | 2.043  | 1.010  | NA |
| Magnesium Mg <sup>++</sup>                 | 0-15cm  | 0.71 | 2.3   | 1.233  | 0.681  | NA |
|                                            | 15-30cm | 0.43 | 1.62  | 0.820  | 0.479  | NA |
| Cation Exchange Capacity CEC <sup>++</sup> | 0-15cm  | 2.51 | 9.12  | 4.720  | 2.377  | NA |
|                                            | 15-30cm | 1.55 | 5.78  | 3.330  | 1.590  | NA |
| ECEC <sup>++</sup>                         | 0-15cm  | 2.71 | 10.12 | 5.120  | 2.652  | NA |
|                                            | 15-30cm | 1.85 | 6.38  | 3.798  | 1.635  | NA |
| Clay (%)                                   | 0-15cm  | 4.3  | 6.5   | 5.250  | 0.846  | NA |
|                                            | 15-30cm | 4.3  | 6.8   | 5.433  | 0.871  | NA |
| Silt (%)                                   | 0-15cm  | 1.3  | 3.8   | 2.733  | 0.956  | NA |
|                                            | 15-30cm | 2    | 2.6   | 2.333  | 0.242  | NA |
| Sand (%)                                   | 0-15cm  | 89.8 | 94.3  | 92.017 | 1.577  | NA |
|                                            | 15-30cm | 88.9 | 93.9  | 91.183 | 2.008  | NA |
| Available P. (mg/kg)                       | 0-15cm  | 1.98 | 14.2  | 7.518  | 4.622  | NA |
|                                            | 15-30cm | 1.76 | 11.6  | 5.502  | 3.610  | NA |
| Ammonium, NH <sub>4</sub> N <sup>++</sup>  | 0-15cm  | 0.85 | 7.6   | 2.732  | 2.553  | NA |
|                                            | 15-30cm | 0.64 | 3.11  | 1.663  | 1.102  | NA |
| NO <sub>2</sub> <sup>++</sup>              | 0-15cm  | 0.27 | 2.43  | 1.115  | 0.867  | NA |
|                                            | 15-30cm | 0.19 | 1.64  | 0.842  | 0.631  | NA |
| NO <sub>3</sub> <sup>++</sup>              | 0-15cm  | 3.14 | 19.3  | 10.637 | 6.498  | NA |
|                                            | 15-30cm | 2.89 | 15.8  | 8.770  | 5.274  | NA |
| SO <sub>4</sub> <sup>++</sup>              | 0-15cm  | 0.45 | 3.13  | 1.193  | 0.979  | NA |
|                                            | 15-30cm | 0.38 | 1.14  | 0.683  | 0.277  | NA |
| Cl <sup>++</sup>                           | 0-15cm  | 41.8 | 109.4 | 60.400 | 24.959 | NA |



|       |         |       |       |         |        |         |
|-------|---------|-------|-------|---------|--------|---------|
|       | 15-30cm | 39.7  | 106.7 | 56.800  | 25.140 | NA      |
| Fe “  | 0-15cm  | 100.8 | 273.1 | 171.617 | 64.707 | NA      |
|       | 15-30cm | 91.2  | 265.7 | 153.833 | 62.907 | NA      |
| Mn “  | 0-15cm  | 11.5  | 32.4  | 19.700  | 9.092  | NA      |
|       | 15-30cm | 10.3  | 29.6  | 16.600  | 7.512  | NA      |
| Zn “  | 0-15cm  | 24.6  | 47.8  | 34.867  | 10.248 | 140-720 |
|       | 15-30cm | 22.9  | 39.5  | 29.783  | 6.473  | 140-720 |
| Cu “  | 0-15cm  | 1.58  | 10.1  | 6.293   | 3.744  | 36-190  |
|       | 15-30cm | 1.39  | 8.08  | 5.170   | 2.920  | 36-190  |
| Cr “  | 0-15cm  | 0.36  | 2.64  | 1.642   | 1.003  | 100-380 |
|       | 15-30cm | 0.28  | 1.82  | 1.128   | 0.670  | 100-380 |
| Cd “  | 0-15cm  | 0.54  | 5.21  | 1.665   | 1.770  | 0.8-12  |
|       | 15-30cm | 0.48  | 3.11  | 1.130   | 1.013  | 0.8-12  |
| Pb “  | 0-15cm  | 0.49  | 2.13  | 1.370   | 0.574  | 85-530  |
|       | 15-30cm | 0.37  | 1.78  | 1.078   | 0.486  | 85-530  |
| Ni “  | 0-15cm  | 0.11  | 1.42  | 0.532   | 0.541  | 35-210  |
|       | 15-30cm | 0.07  | 0.76  | 0.272   | 0.256  | 35-210  |
| V “   | 0-15cm  | 0.06  | 0.59  | 0.262   | 0.241  | NA      |
|       | 15-30cm | 0.02  | 0.5   | 0.192   | 0.184  | NA      |
| THC “ | 0-15cm  | 0.09  | 2.1   | 0.590   | 0.759  | NA      |
|       | 15-30cm | 0.05  | 0.55  | 0.275   | 0.188  | NA      |

The mean concentrations of heavy metals in the entire soils were low and typical of unpolluted soils. Iron, manganese, zinc and copper usually occur in relatively higher amounts in soil, since they are essential micronutrient elements for plant growth and development. The present values are consistent with previous findings and are within permissible and acceptable thresholds in soils.

The results of microbial load of soil samples are presented in Table 3.5. The total heterotrophic bacterial (THB) and Total fungal (TF) population in the studied area was generally in the order of  $10^4$  cfu/g.

Hydrocarbon utilizing bacteria (HUB) was nil, an observation which indicates no petroleum hydrocarbon input in the environment. The predominant isolated bacterial genera were *Bacillus*, *Micrococcus* and *Enterobacter*. No hydrocarbon degrading fungi were recorded. *Aspergillus* and *Penicillium* were the predominant fungal isolates.

**Table 3.5: Summary of Soil Microbiology Parameters (cfu/g) in Ogiso-Osunde Site**

| Parameter               | Ogiso (SS1)                                     | SS2 | SS3 | SS4 | SS5 | Ogiso (SS6)                                     | Acceptable limits (DPR) |
|-------------------------|-------------------------------------------------|-----|-----|-----|-----|-------------------------------------------------|-------------------------|
| THB (x10 <sup>4</sup> ) | 4.1                                             | 3.9 | 3.4 | 4   | 4.7 | 4.5                                             | NA                      |
| HUB (x10)               | 0                                               | 0   | 0   | 0   | 0   | 0                                               | NA                      |
| Bacterial isolates      | <i>Bacillus</i> sp., <i>Enterobacter</i> sp.    |     |     |     |     | <i>Bacillus</i> sp., <i>Enterobacter</i> sp.    |                         |
| THF (x10 <sup>4</sup> ) | 3.2                                             | 2.9 | 3.1 | 3.7 | 2.4 | 3.4                                             | NA                      |
| HUF (x10)               | 0                                               | 0   | 0   | 0   | 0   | 0                                               | NA                      |
| Fungal isolates         | <i>Aspergillus</i> spp., <i>Penicillium</i> sp. |     |     |     |     | <i>Aspergillus</i> spp., <i>Penicillium</i> sp. |                         |

### **Land Use and Agriculture**

Land Use refers to the various uses to which land is put. In the study area, a significant portion of the land which belongs to Ogiso-Osunde is put into housing, infrastructural development and agricultural use for homestead farming, plantain and cocoyam plantations. Other significant sections of the land support forest growth and fallow lands.

Land use in the entire area comprises small scale farm lands used for the cultivation of cassava, maize, plantain, cocoyam, yam, pepper, pawpaw, garden egg and oil palm. These are mainly subsistence agriculture.

### **3.2.3 Geology and Hydrogeology**

Benin City is situated in the southern part of Nigeria and lies within Longitudes 5°27'E and 5°45'E and Latitudes 6°6'N and 6°30'N. Geologically, the Benin region is underlain by Benin Formation, Alluvium, Drift/Top sands and Azagba Ogwashi Ogwashi Asaba Formations (Fig. 3.5).

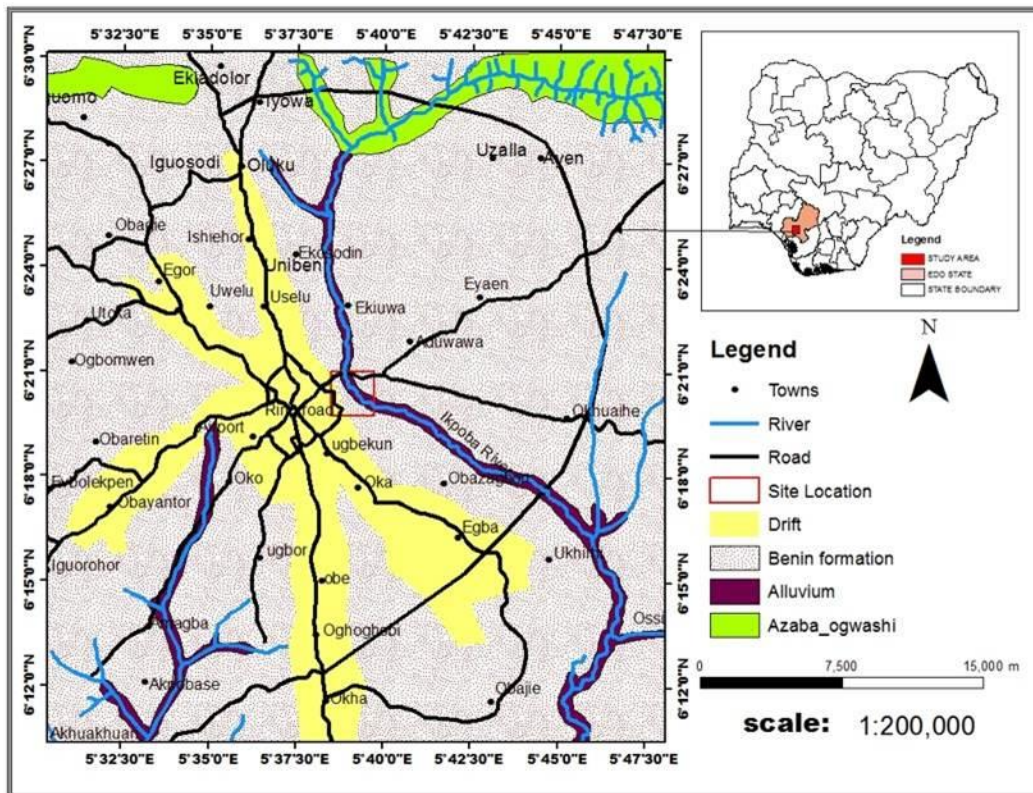


Fig. 3.5: Geological Map of Benin City modified after Akujieze, 2004

### Benin Formation

The Benin Formation was described by (Short and Stauble, 1967). The Benin Formation covers about 95% of the region. The Benin Formation is made up of top reddish clayey sands capping highly porous fresh water bearing loose pebbly sands. The formation has local thin shales and clays. Sands, sandstones and clays vary in colour from reddish brown to pinkish yellow in weathered surfaces and white in deep fresh surfaces. Limonitic coatings are believed to be responsible for the reddish brown colour. The Benin Formation is generally highly porous, permeable and prolific in water yield (Akujieze, 2004). The Benin Formation, also referred to as Coastal Plain Sands has been assigned Oligocene to Recent age (Short and Stauble, 1967).

### Alluvium

These are found along Ikpoba and Ovia flood plains. They are made up of dirty-white to yellowish-white sands, silts, clayey sands, gravels and wood-plant materials. Ogiso WS1, WS2 and WS3 river sediment samples, collected as part of field sampling for this study, are believed to be part of the recent alluvium deposit.

### Drift/Top Soil

They are made up of light brown-yellowish silt, mud and sands derived from the weathering of the parental Benin Formation. Drifts are washed down by fluvial agents especially the storms and floods dominating the wet season of the region. Drifts vary from very thin veneers to up to 0.55 m. Where the drifts are stabilized soil profile formation is developed.

### Azagba-Ogwashi Formation

Azagba-Ogwashi Formation (formally Ogwashi-Asaba Formation), consists of clays, sands and grits and seams of lignite alternating with gritty clays. It grades upwards into the Benin Formation. The Azagba-Ogwashi Formation is exposed in stream channels at the northern parts of the Benin Region, west of Ekiadolor, east of Utekon and north of Uzalla, (Akujeze, 2004)

### Groundwater Quality

Groundwater samples for physico-chemical and microbiological analysis were taken from four bore holes at different locations as shown in Figure 3.6. The results of the physico- chemical and microbial quality of groundwater are summarized in Table 3.10.

The results were compared with the FME<sub>env</sub> limits as well as the World Health Organization WHO standards maximum permissible levels, in order to determine the groundwater suitability for domestic use.

**Table 3.6a: Summary of Groundwater physico-chemical properties, Ogiso-Osunde Site**

| Sample Code        | MIN   | MAX   | MEAN    | SD      | FME <sub>env</sub> Limit |
|--------------------|-------|-------|---------|---------|--------------------------|
| pH                 | 4.1   | 6.1   | 4.760   | 0.802   | 6.5-8.5                  |
| EC (µS/cm)         | 235   | 650   | 329.600 | 179.522 |                          |
| Sal. (g/l)         | 0.106 | 0.293 | 0.149   | 0.081   |                          |
| Col. (Pt.Co)       | 0     | 0     | 0       | 0       |                          |
| Turb. (NTU)        | 0     | 0     | 0       | 0       |                          |
| TSS (mg/l)         | 3.8   | 3.8   | 3.800   | 0       |                          |
| TDS „              | 112   | 321   | 157.400 | 91.544  |                          |
| DO „               | 6.8   | 6.8   | 6.800   | 0       | 7.5                      |
| BOD <sub>5</sub> „ | 4.4   | 4.4   | 4.400   | 0       | 0                        |

|                          |       |       |        |        |            |
|--------------------------|-------|-------|--------|--------|------------|
| COD ,,                   | 4.2   | 44    | 13.980 | 16.848 | 0          |
| HCO <sub>3</sub> ,,      | 43.1  | 84.2  | 54.620 | 16.848 | 200        |
| Na ,,                    | 0.26  | 1.26  | 0.658  | 0.390  | 200        |
| K ,,                     | 0.1   | 0.31  | 0.186  | 0.083  |            |
| Ca ,,                    | 2.18  | 6.05  | 3.202  | 1.614  |            |
| Mg ,,                    | 0.49  | 2.34  | 1.028  | 0.753  |            |
| Cl ,,                    | 72.2  | 141.8 | 92.440 | 28.341 | 250        |
| P ,,                     | 0.01  | 0.5   | 0.160  | 0.202  | <5         |
| NO <sub>2</sub> ,,       | 0.004 | 0.031 | 0.019  | 0.011  | 0.1        |
| NO <sub>3</sub>          | 0.51  | 1.3   | 0.872  | 0.291  | 10         |
| NH <sub>4</sub> N (mg/l) | 0.074 | 0.074 | 0.074  | 0      | <1.0       |
| SO <sub>4</sub> ,,       | 0.33  | 0.55  | 0.444  | 0.093  | 200-400    |
| Fe ,,                    | 0.21  | 0.63  | 0.416  | 0.155  | 1          |
| Mn ,,                    | 0.027 | 0.027 | 0.027  | 0      | (0.05-0.5) |
| Zn ,,                    | 0.07  | 0.52  | 0.220  | 0.176  | 5          |
| Cu ,,                    | 0.003 | 0.017 | 0.010  | 0.005  | 0.1        |
| Cr ,,                    | 0.002 | 0.002 | 0.002  | 0      | 0.05       |
| Cd ,,                    | 0.004 | 0.004 | 0.004  | 0      | 0.01       |
| Ni ,,                    | 0     | 0     | 0      | 0      | 0.05       |
| Pb ,,                    | 0.006 | 0.006 | 0.006  | 0      | 0.05       |
| V ,,                     | 0     | 0     | 0      | 0      | 0.01       |
| THC ,,                   | 0.03  | 0.03  | 0.030  | 0      |            |

The groundwater samples are colourless with slightly acidic pH range of 4.1 to 6.1. The *in-situ* groundwater temperatures ranges from 27.3 to 28.0°C which falls below the permissible limit of <40°C. Turbidity was not detected in any of the groundwater samples. The TDS, electrical conductivity, and total solids are all within the FMEnv and WHO permissible levels for drinking water.

The heavy metal concentrations are generally low in the ground water samples. With the exception of Fe, Mn, Zn and Cu which occurred in very low concentrations, all other heavy metals including Total Hydrocarbon Content THC were below detection limit. No elevated concentrations of heavy metals and hydrocarbons are recorded in the groundwater samples. This implies that the groundwater samples in the area were not polluted at the time of survey. The slightly acidic pH appears to be a general phenomenon in all groundwater samples in Benin City. The water needs liming to increase the pH values to acceptable levels 6.5-8.5 for potable water.

The results of microbial load of boreholes are hereby presented in Table 3.3.8b. The total heterotrophic bacterial (THB) and Total fungal (TF) population in the studied area was generally in the order of  $1 \times 10^4$  cfu/ml.

The total heterotrophic bacterial (THB) counts of the borehole water samples range from  $2.0 - 2.8 \times 10^4$  cfu/ml for BH1 and the Hand Dug Well (HDW) respectively. Hydrocarbon utilizing bacteria (HUB) was nil, an observation which indicates no petroleum hydrocarbon input in the environment. The predominant isolated bacterial genera were *Enterobacter* and *Bacillus*.

From this study, it was observed that the total coliform ranged from 4 – 6 MPN/100ml and there was complete absence of faecal coliform. Water standards from World Health Organization (WHO) and United States Environmental Protection Agency (USEPA), defines water quality on the basis of its usage, but water meant for human consumption must be free from coliform bacteria.

**Table 3.6b: Summary of groundwater microbiological properties, Ogiso-Osunde Site**

| SAMPLE CODE                | Ogiso BH1                                       | Ogiso BH2 | Ogiso BH3 | Ogiso BH4 | Ogiso Hand Dug Well                             |
|----------------------------|-------------------------------------------------|-----------|-----------|-----------|-------------------------------------------------|
| THB (x10) cfu/ml           | 2                                               | 2.7       | 2.4       | 2.2       | 2.8                                             |
| Total Coliform (MPN/100ml) | 4                                               | 6         | 3         | 5         | 4                                               |
| HUB (x10) cfu/ml           | 0                                               | 0         | 0         | 0         | 0                                               |
| E.coli counts/100ml        | 0                                               | 0         | 0         | 0         | 0                                               |
| Bacterial isolates         | <i>Bacillus</i> sp.,<br><i>Enterobacter</i> sp. |           |           |           | <i>Bacillus</i> sp.,<br><i>Enterobacter</i> sp. |
| THF (x10) cfu/ml           | 0                                               | 0         | 0         | 0         | 0                                               |
| HUF (x10) cfu/ml           | 0                                               | 0         | 0         | 0         | 0                                               |
| Fungal isolates            | Nil                                             | Nil       | Nil       | Nil       | Nil                                             |

Considering the above data, the bore-hole water from this location should be treated in order to meet the standard limit for potable water, especially if the water is meant for human consumption.

### 3.2.4 Surface Water Studies

#### 3.2.4.1 Surface Water Quality

A summary of the physico-chemical characteristics for the study stations, presenting the mean, minimum and maximum values, and allowable limits set by regulatory agencies is provided in Table 3.7a. The detailed results of field and laboratory analysis of water quality samples recorded in all the stations are presented in Annexure 5.3.

The water bodies sampled in the project area had moderately high colour, turbidity and low dissolved solids. The water had slightly acidic pH (mean of 5.37), low conductivity (mean of 77  $\mu$ S/cm), and moderate level of dissolved oxygen and BOD<sub>5</sub>.

The waters were fresh (very low salinity) and oligotrophic (low nutrient status). The parameters were all within the normal range for aquatic life. This is characteristic of water bodies that have not been grossly impacted by human activities.

The heavy metals were very low in concentration and this indicates no serious pollution from petroleum and other anthropogenic activities.

**Table 3.7a: Summary of Physico-chemical characteristics of surface water, Ogiso-Osunde Gully erosion Site (November 2017)**

| Parameter           | MIN   | MAX   | MEAN   | SD     | FME <sub>Env.</sub> standard for Aquatic life |
|---------------------|-------|-------|--------|--------|-----------------------------------------------|
| Col. (Pt.Co)        | 7.3   | 15    | 10.100 | 3.375  | 15                                            |
| Turb. (NTU)         | 6.6   | 9.1   | 7.667  | 1.290  | NS                                            |
| TSS (mg/l)          | 11.3  | 22.1  | 17.500 | 5.575  | NS                                            |
| TDS ,,              | 38    | 65    | 50.667 | 13.577 | NS                                            |
| pH                  | 4.9   | 5.9   | 5.367  | 0.503  | 6.0-9.0                                       |
| EC( $\mu$ S/cm)     | 67    | 89    | 77.000 | 11.136 | NS                                            |
| Sal.(g/l)           | 0.034 | 0.054 | 0.045  | 0.010  |                                               |
| DO ,,               | 5.5   | 9.2   | 7.300  | 1.556  | 6.8                                           |
| BOD <sub>5</sub> ,, | 3.7   | 4.5   | 4.075  | 0.330  | 4.0                                           |
| COD ,,              | 22.2  | 32.2  | 28.000 | 5.188  | NS                                            |
| HCO <sub>3</sub> ,, | 12.2  | 22.1  | 17.800 | 5.076  | NS                                            |
| Na ,,               | 0.55  | 0.82  | 0.653  | 0.146  | NS                                            |
| K ,,                | 0.08  | 0.22  | 0.150  | 0.070  | NS                                            |
| Ca ,,               | 0.59  | 1.51  | 1.153  | 0.494  | NS                                            |
| Mg ,,               | 0.45  | 0.82  | 0.687  | 0.206  | NS                                            |

|                          |        |       |        |        |        |
|--------------------------|--------|-------|--------|--------|--------|
| Cl <sub>2</sub>          | 35.5   | 75.6  | 55.400 | 20.052 | NS     |
| P                        | 0.24   | 0.57  | 0.377  | 0.172  | NS     |
| NO <sub>2</sub>          | 0.058  | 0.089 | 0.073  | 0.016  |        |
| NO <sub>3</sub>          | 1.06   | 1.56  | 1.270  | 0.259  | NS     |
| NH <sub>4</sub> N (mg/l) | 0.111  | 0.154 | 0.132  | 0.022  |        |
| SO <sub>4</sub>          | 0.12   | 0.39  | 0.223  | 0.146  | NS     |
| Fe                       | 1      | 1.92  | 1.535  | 0.407  | 1.0    |
| Mn                       | 0.038  | 0.063 | 0.048  | 0.013  |        |
| Zn                       | 0.03   | 1.13  | 0.618  | 0.463  | 0.03   |
| Cu                       | 0.004  | 0.034 | 0.020  | 0.013  | 0.004  |
| Cr                       | 0.002  | 0.029 | 0.015  | 0.011  | 0.002  |
| Cd                       | 0.002  | 0.055 | 0.028  | 0.022  | 0.002  |
| Ni                       | 0.005  | 0.15  | 0.044  | 0.071  | 0.15   |
| Pb                       | 0.0017 | 0.049 | 0.023  | 0.020  | 0.0017 |
| V                        | 0.005  | 0.018 | 0.013  | 0.007  |        |
| THC                      | 0.01   | 0.22  | 0.107  | 0.106  | NS     |

### Surface Water Microbiology

Table 3.7b shows the results of microbial population of the surface water. The heterotrophic bacterial and fungal counts the surface water samples were found to be in the order of  $1 \times 10^6$ , ranging from  $2.9 \times 10^6$  cfu/ml at SW1 (upstream) to  $3.7 \times 10^6$  cfu/ml at SW2, the outfall from existing 2.4m diameter conduit draining the flood water into the Ikpoba River.

The results showed that there was no petroleum hydrocarbon utilizing bacteria and fungi respectively, recording nil in both counts. These findings are pointers to the fact that the studied surface waters had not been exposed to petroleum contaminants. Total coliform bacterial counts of the surface water range from 4 – 12 MPN/100 ml; with no faecal contamination, as the results for *E.coli* counts (MPN/100 ml) were all nil.

Most predominant bacterial isolates were species of *Bacillus* spp., and *Enterobacter aerogenes*. The predominant fungal isolates were *Penicillium* spp., and *Aspergillus* spp.

The relatively high counts of total heterotrophic bacteria and fungi in SW2 samples indicate levels of organic contaminants from the flood and waste discharge into the river. The above findings indicate that these studied surface waters do not contain petroleum hydrocarbon and human faecal contaminants.



**Table 3.7b: Summary of microbiological characteristics of surface water, Ogiso-Osunde Gully erosion Site (November 2017)**

| <b>SAMPLE CODE</b>         | <b>Ogiso SW1</b>                      | <b>Ogiso SW2</b> | <b>Ogiso SW3</b>       |
|----------------------------|---------------------------------------|------------------|------------------------|
| THB (x10) cfu/ml           | 2.9                                   | 3.7              | 3.2                    |
| Total Coliform (MPN/100ml) | 9                                     | 17               | 12                     |
| HUB (x10) cfu/ml           | 0                                     | 0                | 0                      |
| E.coli counts/100ml        | 0                                     | 0                | 0                      |
| Bacterial isolates         | <i>Bacillus sp., Enterobacter sp.</i> |                  |                        |
| THF (x10) cfu/ml           | 1.0                                   | 1.6              | 1.0                    |
| HUF (x10) cfu/ml           | 0                                     | 0                | 0                      |
| Fungal isolates            | Nil                                   | Nil              | <i>Aspergillus sp.</i> |

### **Sediment Quality**

A summary of the sediment characteristics, presenting the mean, minimum and maximum values, is provided in Table 3.8a. The sediment was moderately acidic, with a pH value ranged from 5.8 – 6.4 and mean values of 6.03. Mean electrical conductivity was 144 ( $\mu\text{S}/\text{cm}$ ). The nutrient concentrations were higher in the sediment than in the surface water. The earth metals (cations) were low in concentration, with sodium and calcium dominating. This is typical of fresh water environment. The sediment was dominantly sandy (>94%) in all stations. This was a result of sand and silt deposition from surface run off due to erosion from the immediate catchment. The heavy metals were found in very low concentrations in the sediments. Heavy metals such as chromium, nickel and vanadium were not detected. The significantly higher concentrations of metals in the sediment samples correlates with the trends in surface water and soil, showing that they may have been mobilized from crustal rocks by natural geochemical processes. Flocculation of these metals by adsorption to particulates is a source of incorporation into sediments. Thus leaching of soil particles from land into the aquatic environment as run-off could have contributed to the increase.

It is evident from the foregoing, that the water and sediment of the study area have not been adversely affected by anthropogenic activities.

**Table 3.8a: Summary of the characteristics of sediment samples from the study area**

| Sample Code                    | SED 1 | SED 2 | SED 3 | MIN   | MAX  | MEAN    | SD     |
|--------------------------------|-------|-------|-------|-------|------|---------|--------|
| pH                             | 6.4   | 5.8   | 5.9   | 5.8   | 6.4  | 6.033   | 0.321  |
| EC ( $\mu\text{S}/\text{cm}$ ) | 150   | 180   | 102   | 102   | 180  | 144.000 | 39.345 |
| Org.M. (%)                     | 0.59  | 0.67  | 0.44  | 0.44  | 0.67 | 0.567   | 0.117  |
| Org. C (%)                     | 0.22  | 0.38  | 0.14  | 0.14  | 0.38 | 0.247   | 0.122  |
| T. N. (%)                      | 0.11  | 0.21  | 0.19  | 0.11  | 0.21 | 0.170   | 0.053  |
| EA (meq/100g)                  | 0.9   | 0.9   | 0.15  | 0.15  | 0.9  | 0.650   | 0.433  |
| Na meq/100g                    | 0.37  | 0.39  | 0.24  | 0.24  | 0.39 | 0.333   | 0.081  |
| K meq/100g                     | 0.06  | 0.04  | 0.10  | 0.04  | 0.1  | 0.067   | 0.031  |
| Ca meq/100g                    | 1.09  | 1.5   | 1.11  | 1.09  | 1.5  | 1.233   | 0.231  |
| Mg meq/100g                    | 0.24  | 0.38  | 0.35  | 0.24  | 0.38 | 0.323   | 0.074  |
| CEC meq/100g                   | 1.76  | 2.31  | 1.8   | 1.76  | 2.31 | 1.957   | 0.307  |
| ECEC meq/100g                  | 2.66  | 3.21  | 1.95  | 1.95  | 3.21 | 2.607   | 0.632  |
| Clay(%)                        | 3.9   | 3.8   | 3.5   | 3.5   | 3.9  | 3.733   | 0.208  |
| Silt (%)                       | 1.9   | 1.1   | 1.7   | 1.1   | 1.9  | 1.567   | 0.416  |
| Sand (%)                       | 94.2  | 95.1  | 94.8  | 94.2  | 95.1 | 94.700  | 0.458  |
| Av. P (mg/kg)                  | 0.82  | 0.95  | 0.7   | 0.7   | 0.95 | 0.823   | 0.125  |
| NH <sub>4</sub> N (mg/kg)      | 0.21  | 0.46  | 0.24  | 0.21  | 0.46 | 0.303   | 0.137  |
| NO <sub>2</sub> (mg/kg)        | 0.17  | 0.07  | 0.19  | 0.07  | 0.19 | 0.143   | 0.064  |
| NO <sub>3</sub> (mg/kg)        | 1.1   | 1.28  | 1.2   | 1.1   | 1.28 | 1.193   | 0.090  |
| SO <sub>4</sub> (mg/kg)        | 0.26  | 0.3   | 0.24  | 0.24  | 0.3  | 0.267   | 0.031  |
| Cl (mg/kg)                     | 32.6  | 55    | 35.5  | 32.6  | 55   | 41.033  | 12.182 |
| Fe (mg/kg)                     | 70    | 82.2  | 77.3  | 70    | 82.2 | 76.500  | 6.139  |
| Mn (mg/kg)                     | 5.23  | 3.87  | 6.62  | 3.87  | 6.62 | 5.240   | 1.375  |
| Zn (mg/kg)                     | 17.1  | 21.3  | 18.9  | 17.1  | 21.3 | 19.100  | 2.107  |
| Cu (mg/kg)                     | 0.45  | 0.64  | 0.44  | 0.44  | 0.64 | 0.510   | 0.113  |
| Cr (mg/kg)                     | ND    | ND    | ND    | 0     | 0    |         |        |
| Cd (mg/kg)                     | 0.09  | 0.07  | 0.04  | 0.04  | 0.09 | 0.067   | 0.025  |
| Pb (mg/kg)                     | 0.019 | 0.16  | 0.11  | 0.019 | 0.16 | 0.096   | 0.071  |
| Ni (mg/kg)                     | ND    | ND    | ND    | 0     | 0    |         |        |
| V (mg/kg)                      | ND    | ND    | ND    | 0     | 0    |         |        |
| THC (mg/kg)                    | ND    | ND    | ND    | 0     | 0    |         |        |

### Sediment Microbiology

Microbial data from the investigation of sediments showed that the heterotrophic bacterial and fungal counts low (Table 3.8b). The hydrocarbon utilizing bacteria and fungi counts recorded nil, which implies that no possible petroleum hydrocarbon pollution of the study

area. Most predominant bacterial isolates were the species of *Bacillus*, *Citrobacter*, *Micrococcus* and *Enterobacter* while the fungal isolates were *Aspergillus* and *Penicillium*

**Table 3.8b: Microbiological analysis of Sediment**

THB = Total Heterotrophic Bacterial Counts , THUB = Total Hydrocarbon Utilizing Bacterial Counts, BD = Bacterial Degraders, TC = Total Coliform count, TE = Total *E. coli* count, THF = Total Heterotrophic fungal Counts, THUF = Total Hydrocarbon Utilizing fungal counts, FHD = Fungal hydrocarbon Degraders,

| Sample code | THB | THUB ( x 10 cfu/g) | % BD | Predominant Bacterial isolates                                              | THC (x 10 cfu/g) | THUF ( x 10 cfu/g) | % FHD | Predominant fungal isolates                     |
|-------------|-----|--------------------|------|-----------------------------------------------------------------------------|------------------|--------------------|-------|-------------------------------------------------|
| SED 1       | 3.5 | 0                  | 0    | <i>Citrobacter</i> sp., <i>Bacillus</i> sp., <i>Micrococcus</i> sp.         | 1.0              | 0                  | 0     | <i>Aspergillus</i> spp., <i>Penicillium</i> sp. |
| SED 2       | 4.2 | 0                  | 0    | <i>Enterobacter aerogenes</i> , <i>Bacillus</i> sp., <i>Micrococcus</i> sp. | 1.5              | 0                  | 0     | <i>Aspergillus</i> spp.                         |
| SED 3       | 4.2 | 0                  | 0    | <i>Enterobacter aerogenes</i> , <i>Bacillus</i> sp., <i>Micrococcus</i> sp. | 0.6              | 0                  | 0     | <i>Aspergillus</i> spp.                         |

### 3.2.4.2 Aquatic Ecology

#### Introduction

Ecological studies of the aquatic ecosystem are concerned with the species composition, community structure and diversity of the biotic or living components (phytoplankton, zooplankton, benthic invertebrates and fisheries) of the environment, their interactions amongst themselves and their relationships with the abiotic or Physico-chemical components of the environment. The results of field and laboratory investigations of the ecological communities of are presented below:

#### Phytoplankton

The phytoplankton or phytoplankters are unicellular (exceptionally multicellular) microscopic algae which are filamentous, solitary or colonial, and whose movements are dependent on water currents and waves. They represent primary producers in the aquatic ecosystem, since they are autotrophs, fixing solar energy for photosynthesis, and using carbon dioxide, water and mineral nutrients to produce organic matter and oxygen. A great diversity of phytoplankton exists in both fresh and brackish/marine

water. The types commonly found in the fresh and brackish waters include members of the division Bacillariophyta (diatoms), Chlorophyta (green algae), Cyanophyta (blue-green algae or Cyanobacteria) and the Euglenophyta (the euglenoids).

### Distribution and abundance of Phytoplankton

The phytoplankton from the three study stations of the Ikpoba River comprised of 30 species belonging to the divisions Bacillariophyta (12), Chlorophyta (14) and Cyanophyta (4) (Table 3.9). The division Bacillariophyta contributed the highest percentage to the total phytoplankton density, followed by Chlorophyta (Fig. 3.6).

**Table 3.9: The composition, density and distribution of Phytoplankton in Ogiso-Osunde Gully Erosion Site, November 2017**

|                                    | SW 1 | SW 2 | SW 3 |
|------------------------------------|------|------|------|
| <b>BACILLARIOPHYTA</b>             |      |      |      |
| <i>Actinoptychus splendens</i>     | 10   | 10   |      |
| <i>Aulocosira granulate</i>        | 30   | 20   | 10   |
| <i>A. granulata angustissima</i>   | 30   | 10   | 20   |
| <i>Coscinidiscus centralis</i>     | 10   |      | 10   |
| <i>Cyclotella sp.</i>              | 10   | 20   |      |
| <i>Fragillaria javanica</i>        | 30   | 40   | 20   |
| <i>Hyloidiscus scoticus</i>        | 30   | 20   | 40   |
| <i>Melosira granulata</i>          | 50   | 30   | 20   |
| <i>Nitzschia obtuse</i>            | 10   | 10   | 30   |
| <i>Pinnularia cardinaliculus</i>   | 20   | 10   | 20   |
| <i>Tabellaria feriestrata</i>      | 10   |      | 10   |
| <i>Thalassionema nitzschioides</i> | 30   | 10   |      |
| <b>CHLOROPHYTA</b>                 |      |      |      |
| <i>Closterium ehrenbergii</i>      |      | 20   | 10   |
| <i>Closterium rostratum</i>        | 30   |      | 20   |
| <i>Cosmarium askensyi</i>          | 10   | 20   | 30   |
| <i>Eudorina elegans</i>            | 60   |      | 20   |
| <i>Eudorina splendens</i>          | 30   | 10   |      |
| <i>Hylothoea disiliens</i>         | 20   | 30   | 10   |
| <i>Micrasterias foliaceae</i>      | 40   | 20   | 30   |

|                                                  | SW 1          | SW 2          | SW 3          |
|--------------------------------------------------|---------------|---------------|---------------|
| <i>Pandorina sp</i>                              | 10            |               | 20            |
| <i>Pediastrum duplex</i>                         | 20            | 10            |               |
| <i>Scenedesmus quadricauda</i>                   | 30            | 20            | 10            |
| <i>Spirogyra communis</i>                        | 60            | 10            | 20            |
| <i>Spirogyra dubia</i>                           | 50            | 10            | 10            |
| <i>Staurastrum asterias</i>                      | 20            | 20            | 10            |
| <i>Stauroidesmus glabus</i>                      | 10            |               | 20            |
| <b>CYANOPHYTA</b>                                |               |               |               |
| <i>Anaebena sp</i>                               |               | 70            | 10            |
| <i>Navicula sp</i>                               | 10            | 10            |               |
| <i>Coelosphaerium sp.</i>                        |               | 20            | 10            |
| <i>Oscillatoria sp</i>                           | 10            | 50            |               |
| <b>Density (x 10<sup>2</sup>/ m<sup>3</sup>)</b> | <b>680</b>    | <b>500</b>    | <b>410</b>    |
| <b>Total No. of Species</b>                      | <b>27</b>     | <b>24</b>     | <b>23</b>     |
| <b>Species Richness (d)</b>                      | <b>3.986</b>  | <b>3.701</b>  | <b>3.657</b>  |
| <b>Diversity (H')</b>                            | <b>3.116</b>  | <b>2.986</b>  | <b>3.033</b>  |
| <b>Evenness (E)</b>                              | <b>0.9454</b> | <b>0.9397</b> | <b>0.9673</b> |

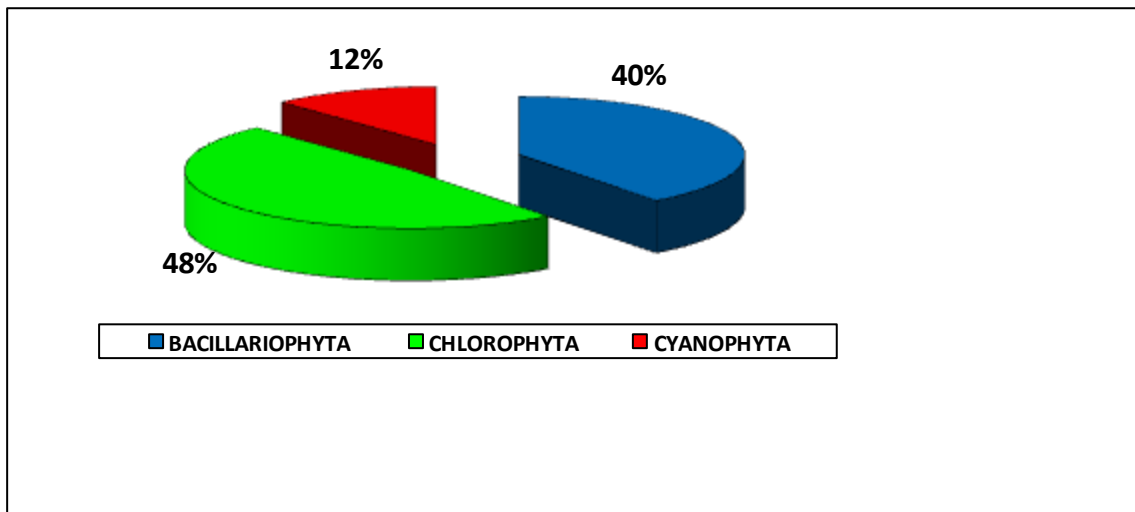


Figure 3.6: Contributions of phytoplankton divisions to the total density

### **Diversity and Evenness Indices for Phytoplankton**

Diversity indices are mathematical expression of the relationship between the number of species and their abundance. According to Wilhm and Dorris (1968), diversity values less than one (<1) are typical of heavily polluted zones, values of 1 to 3 for zones of moderate pollution and values of more than 3 for unpolluted water.

The phytoplankton diversity is fairly high and indicates a stable environment. The species diversity was high (3.12 in Station 1 to 3.03 in Station 3) in the study area. The range reported indicates moderate pollution to clean water (Ravera, 1979). Where dominance is high, equitability is low and consequently, diversity is low and the community becomes ecologically unstable. The phytoplankton encountered in this water body reflects average to good ecological condition and therefore, they may be used as indicators of water quality.

### **Zooplankton**

Zooplankton are microscopic animals found mainly in the pelagic zone of water bodies where they depend on water currents and waves for motion. Zooplankton communities in the tropics consist of the Rotifera, Cladocera, Copepoda and meroplanktonic larvae of benthic and nektonic organisms (Egborge, 1994; Ogbeibu & Egborge, 1995, Arazu and Ogbeibu, 2016). They are good biological indicators of water quality. Their sensitivity to environmental factors, both natural and artificial, makes them of considerable significance in pollution and environmental impact assessment studies.

The zooplankton community is subdivided according to its life history patterns as follows:

- Holoplankton: Those that spend their entire life cycle as zooplankton, e.g. copepods, rotifers.
- Meroplankton: Those that spend part of their life cycle as plankton, e.g. larvae forms of fish, shrimp, crabs, molluscs etc.

The zooplankton community of the study stations of the Ikpoba River comprised 18 species made up of 4 cladocerans, 6 copepods, 1 ostracod and 7 rotifers (Table 3.10). The cladocerans, dominated by *Alona affinis*, *A. rectangula* and *Chydorus sphaericus* were the most abundant taxonomic group among the zooplankton (Fig. 3.7).

**Table 3.10: The composition, density and distribution of zooplankton in Ogiso-Osunde Gully Erosion Site, November 2017**

| ZOOPLANKTON                     | SW 1 | SW 2 | SW 3 |
|---------------------------------|------|------|------|
| ARTHROPODA                      |      |      |      |
| CRUSTACEA                       |      |      |      |
| CLADOCERA                       |      |      |      |
| Family Chydoridae               |      |      |      |
| <i>Alona affinis</i>            | 20   | 10   | 20   |
| <i>A. rectangula</i>            | 10   |      | 30   |
| <i>Chydorus sphaericus</i>      |      | 20   | 10   |
| DAPHNIDAE                       |      |      |      |
| <i>Ceriodaphnia cornuta</i>     | 50   | 10   | 40   |
| MOINIDAE                        |      |      |      |
| <i>Moina micrura</i>            | 20   | 10   | 10   |
| <i>Moinadaphnia macleayi</i>    | 10   |      | 10   |
| SIDIDAE                         |      |      |      |
| <i>Diaphanosoma excisum</i>     | 20   | 20   | 20   |
| Family Macrothricidae           |      |      |      |
| <i>Macrothrix sp</i>            | 20   | 10   | 10   |
| COPEPODA                        |      |      |      |
| Cyclopoida                      |      |      |      |
| <i>Eucyclops macrurus</i>       | 20   | 10   |      |
| <i>Thermocyclops crassus</i>    | 30   | 10   | 20   |
| <i>Tropocyclops prassinus</i>   | 40   | 20   | 40   |
| Calanoida                       |      |      |      |
| <i>Thermodiaptomus yabensis</i> |      | 10   | 10   |
| OSTRACODA                       |      |      |      |
| <i>Cytheridella tepida</i>      |      | 40   | 10   |
| PHYLUM ROTIFERA                 |      |      |      |

| ZOOPLANKTON                                          | SW 1          | SW 2          | SW 3          |
|------------------------------------------------------|---------------|---------------|---------------|
| Family Brachionidae                                  |               |               |               |
| <i>Brachionus angularis</i>                          | 30            | 20            | 20            |
| Family Euchlanidae                                   |               |               |               |
| <i>Euchlanis dilatata</i>                            | 20            |               | 10            |
| <i>Dipleuchlanis propatula</i>                       |               | 10            | 10            |
| Family Lecanidae                                     |               |               |               |
| <i>Lecane leontina</i>                               | 40            | 10            | 30            |
| <b>Density (No. x 10<sup>3</sup>/ m<sup>2</sup>)</b> | <b>330</b>    | <b>210</b>    | <b>300</b>    |
| <b>Total No. of Species</b>                          | <b>13</b>     | <b>14</b>     | <b>16</b>     |
| <b>Species Richness (d)</b>                          | <b>2.069</b>  | <b>2.431</b>  | <b>2.63</b>   |
| <b>Diversity (H')</b>                                | <b>2.465</b>  | <b>2.516</b>  | <b>2.627</b>  |
| <b>Evenness (E)</b>                                  | <b>0.9609</b> | <b>0.9535</b> | <b>0.9475</b> |

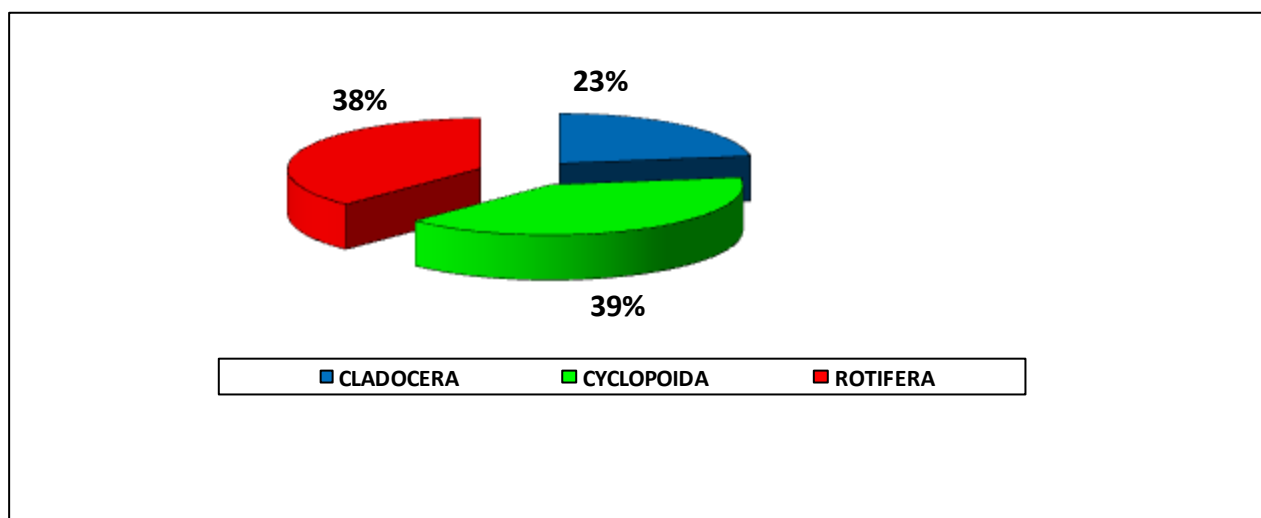


Figure 3.7: Contributions of zooplankton taxonomic groups to the total density.



### Diversity and Evenness Indices for Zooplankton

The zooplankton diversity is fairly high and indicates a stable environment. The species diversity was moderately high (2.52 in Station 2 to 2.63 in Station 3). The range reported indicates moderate pollution according to the classification of Ravera (1979).

### Macrobenthic Invertebrate Fauna

Macrobenthic invertebrates are bottom dwelling animals over 1.0 mm in size. They are classified either as **infauna** i.e. living wholly or partially buried in soft/hard substrates e.g. bottom dwelling annelids (segmented worms) or **epifauna** i.e. living on the surface, either crawling (mobile benthic fauna) or attached to hard substrates, roots of floating plants. Examples are crabs, barnacles, littorinids and oysters (Egborge, 1994). In Nigerian inland waters, the major benthic components include the Oligochaeta (Annelida), the water mites (Hydrachnellae), insect larvae/nymphs (Diptera, Coleoptera, Ephemeroptera, Hemiptera, Odonata and Trichoptera) and few molluscs and decapod crustaceans (Ogbeibu, 1991; Ogbeibu & Egborge, 1995; Edogun and Ogbeibu, 2016). The coastal brackish and marine benthic fauna comprise mainly the Polychaeta (Annelida), Crustacea (crab and prawns), Mollusca (mostly bivalves and gastropod periwinkles) and echinoderms.

### Species Composition, Density and Distribution

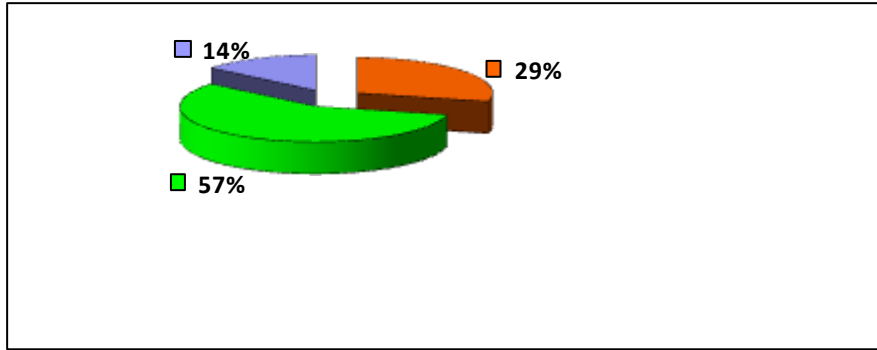
The macrobenthic invertebrates were represented by 30 species spread among the oligochaetes (3) and insects (19) and other arthropods (arachnids and decapods) 8 as presented in Table 3.11. The group Insecta dominated the macrobenthos in both stations (Fig. 3.8).

**Table 3.11: The composition, density and distribution of Macrobenthic Fauna in Ogiso-Osunde Gully Erosion Site, November 2017**

| TAXA              | SW 1 | SW 2 | SW 3 |
|-------------------|------|------|------|
| PHYLUM NEMATODA   |      |      |      |
| Class Secernantea |      |      |      |
| Order Tylenchida  |      |      |      |

| TAXA                          | SW 1  | SW 2  | SW 3  |
|-------------------------------|-------|-------|-------|
| Dorylaimidae                  |       |       |       |
| <i>Dorylaimus</i> sp          | 4     | 16    | 4     |
| PHYLUM ANNELIDA               |       |       |       |
| CLASS OLIGOCHAETA             |       |       |       |
| Family Naididae               |       |       |       |
| <i>Nais communis</i>          | 56    | 16    | 8     |
| <i>Dero limnosa</i>           | 44    | 36    |       |
| PHYLUM ARTHROPODA             |       |       |       |
| CLASS INSECTA                 |       |       |       |
| Order Coleoptera              |       |       |       |
| <i>Hydrophilus</i>            | 8     | 4     | 4     |
| <i>Philhydrus</i> sp.         | 8     | 4     |       |
| <i>Promoresia</i> sp          |       |       | 4     |
| Order Collembola              |       |       |       |
| <i>Isotoma</i> sp.            | 32    |       | 8     |
| Order Diptera                 |       |       |       |
| Family Chironomidae           |       |       |       |
| <i>Corynoneura</i> sp.        | 32    | 4     | 4     |
| Order Ephemeroptera           |       |       |       |
| Family Baetidae               |       |       |       |
| <i>Baetis</i> sp.             | 56    |       | 8     |
| <i>Cloeon cylindroculum</i>   | 32    | 16    | 16    |
| Order Odonata                 |       |       |       |
| Anisoptera                    |       |       |       |
| <i>Sympetrum</i> sp           | 4     |       | 4     |
| <i>Somatochlora metallica</i> | 8     | 8     | 8     |
| Zygoptera                     |       |       |       |
| <i>Coenagrion pulchellum</i>  | 28    | 12    | 4     |
| CLASS ARACHNIDA               |       |       |       |
| ORDER HYDRACHNELLAE           |       |       |       |
| FAMILY ARRENURIDAE            |       |       |       |
| <i>Arrenurus damkohleri</i>   | 4     | 8     | 8     |
| <i>A. geniculatus damasi</i>  | 4     | 8     |       |
| DECAPODA                      |       |       |       |
| FAMILY ATYIDAE                |       |       |       |
| <i>Caridina africana</i>      | 12    | 4     | 4     |
| <i>Caridina gabonensis</i>    | 8     | 12    | 6     |
| Density (No/ m <sup>2</sup> ) | 340   | 148   | 90    |
| Total No. of Species          | 16    | 13    | 14    |
| Species Richness (d)          | 2.412 | 2.336 | 2.532 |

| TAXA           | SW 1   | SW 2   | SW 3   |
|----------------|--------|--------|--------|
| Diversity (H') | 2.573  | 2.401  | 2.889  |
| Evenness (E)   | 0.8698 | 0.9109 | 0.9594 |



**Fig. 3.8: Contributions of macrobenthic invertebrate taxonomic groups to the total density.**

**Diversity and Evenness Indices for Macrobenthic invertebrates**

The benthic invertebrate diversity is fairly high and indicates a stable environment. The species diversity was moderately high (2.57 in Station 1 to 2.89 in Station 3). The range reported indicates moderate pollution according to the classification of Ravera (1979).

**Fisheries**

Fisheries involve the utilization of harvestable aquatic organisms and represent complex interactions between the population of organisms being harvested, the population of fishermen, and environmental conditions. Fisheries studies investigated the population in fisheries in the study communities, fisheries activities, fishing gears/methods, catch composition, fish species composition in the study area, fish landing, sales and price, spawning grounds, migration routes and patterns, productivity and pathology.

The study area is primarily a freshwater ecosystem, and fishing is carried out mainly by few artisanal fishermen from the riparian communities. The fishing techniques utilized include such basic gears as gill nets, cast net, long lines and traps. Fisheries involve the utilization of harvestable aquatic organisms in fresh, brackish and marine waters; it

represents complex interaction between the population of organisms being harvested, the population of fishermen, and the prevailing environmental conditions.

### Fisheries Activities

Fisheries activities in this area, according to response from fishermen was very low. Fishing is done mainly for subsistence purpose using gears like gill nets, bamboo traps and hook.

### The Checklist of Fish Species

Table 3.12 shows the checklist of commercially important fish species recorded during the study. This was based on data from direct sampling and secondary information from fisher folk in the riverine community. The list shows a total of 26 species in 11 families of fish. Cichlidae to which most of the tilapia species belong, appeared extensively in the catches. *Hemichromis*, *Oreochromis*, *Chromidotilapia* and *Tilapia* spp. were dominant. The Bagridae were represented by *Chrysichthys* and *Auchenoglanis* spp. Clariidae were well represented, with *Clarias gariepinus* being the most abundant. Characidae and Polypteridae were dominated by *Brycinus longipinnis* and *Erpetoichthys calabaricus* respectively.

**Table 3.12: Checklist of fish species in the study area of the Ikpoba River. (+ Low Abundance, ++ Moderate Abundance, +++ High Abundance)**

| SPECIES                            | Common Name           | Relative Abundance | Weight (g) | Total Length (cm) | Condition Factor (Kf) |
|------------------------------------|-----------------------|--------------------|------------|-------------------|-----------------------|
| BAGRIDAE                           |                       |                    |            |                   |                       |
| <i>Chrysichthys nigrodigitatus</i> | Silver cat fish       | ++                 | 148.9      | 37.25             | 0.3                   |
| <i>Auchenoglanis occidentalis</i>  | "                     | +                  | 120        | 30                | 0.4                   |
| <i>Auchenoglanis monkey</i>        |                       | ++                 | 71.6       | 23.6              | 0.5                   |
| CICHLIDAE                          |                       |                    |            |                   |                       |
| <i>Tilapia mariae</i>              | Cichlid fish, tilapia | ++                 | 30         | 13                | 1.4                   |
| <i>Tilapia zilli</i>               |                       | +++                | 16.4       | 10                | 1.6                   |
| <i>Tilapia dageti</i>              |                       | +                  | 19         | 11                | 1.4                   |
| <i>Tilapia guineensis</i>          |                       | +                  | 57         | 14.4              | 1.9                   |

| SPECIES                              | Common Name              | Relative Abundance | Weight (g) | Total Length (cm) | Condition Factor (Kf) |
|--------------------------------------|--------------------------|--------------------|------------|-------------------|-----------------------|
| <i>Hemichromis bimaculatus</i>       |                          | +++                | 39         | 11                | 2.9                   |
| <i>Hemichromis fasciatus</i>         |                          | +++                | 29.5       | 10.65             | 2.4                   |
| <i>Oreochromis aureus</i>            |                          | +                  | 25         | 11                | 1.9                   |
| <i>Oreochromis niloticus</i>         |                          | +++                | 71.5       | 14.9              | 2.2                   |
| <i>Chromidotilapia guentheri</i>     |                          | +++                | 213        | 24                | 1.5                   |
| CHANNIDAE                            |                          |                    |            |                   |                       |
| <i>Parachanna africana</i>           | Snakehead                | +                  | 119        | 24                | 0.9                   |
| <i>Parachanna obscura</i>            | "                        | +                  | 83         | 21.6              | 0.8                   |
| CHARACIDAE                           |                          |                    |            |                   |                       |
| <i>Brycinus longipinnis</i>          |                          | +++                | 63         | 24                | 0.5                   |
| <i>Brycinus nurse</i>                |                          | ++                 | 54         | 23                | 0.4                   |
| CLARIIDAE                            |                          |                    |            |                   |                       |
| <i>Clarias anguillaris</i>           | Mudfish, clariid catfish | +                  | 65         | 19.5              | 0.9                   |
| <i>Clarias gariepinus</i>            | "                        | +++                | 185        | 48                | 0.2                   |
| <i>Clarias buthopogon</i>            | "                        | ++                 | 128        | 30.28             | 0.5                   |
| CYPRINIDAE                           |                          |                    |            |                   |                       |
| <i>Epiplatys sexfasciatus</i>        | African carp             | ++                 |            |                   |                       |
| MALAPTERURIDAE                       |                          |                    |            |                   |                       |
| <i>Malapterurus electricus</i>       | Electric cat fish        | ++                 | 108.5      | 12.1              | 6.1                   |
| MOCHOKIDAE                           |                          |                    |            |                   |                       |
| <i>Synodontis nigrita</i>            | Catfish                  | +                  | 67         | 18                | 1.1                   |
| <i>Synodontis schall</i>             | "                        | +                  | 45         | 14.9              | 1.4                   |
| MORMYRIDAE                           |                          |                    |            |                   |                       |
| <i>Hyperopisus bebe occidentalis</i> | Elephant Snout fish      | +                  | 24         | 16.25             | 0.6                   |
| NOTOPTERIDAE                         |                          |                    |            |                   |                       |
| <i>Papyrocranus afer</i>             |                          | +                  | 75         | 24.6              | 0.5                   |
| POLYPTERIDAE                         |                          |                    |            |                   |                       |
| <i>Erpetoichthys calabaricus</i>     | Bichirs                  | +++                | 28         | 30                | 0.1                   |
| Total number of species = 26         |                          |                    |            |                   |                       |

The health status of the fish community was assessed by computing the Fulton's condition factor, Kf (equivalent to the Body Mass Index, BMI in humans). A condition factor equal to or greater than 1.0 implies that the fish species is healthy.

The average catch per unit effort is low in the study area. Interview with fishermen indicate that sometimes, the day's effort can be fruitless without any catch. Because of the low catch from the cast net gear, the some locals resort mainly to the use of fenced seine nets and traps and hooks for littoral bank edge fishes, which ensure more yields. The net can stay up to 6 hrs in the water. Fish catch however depends on the time, season and the type of net.

### Heavy Metal Contents in Fish Species

Fish tissue analysis was done for selected commercially important fish species. They were *Tilapia dageti*, *Auchenoglanis monkei*, *Malapterurus electricus* and *Clarias gariepinus*. The results of the heavy metal concentrations in these fish species throughout the study period and the FAO standards for heavy metal contents in fish is given in Table 3.13.

**Table 3.13: Heavy Metal Comparison in the Different Fish Species**

| Heavy metal | <i>Tilapia dageti</i> (X±SE)    | <i>Auchenoglanis monkei</i> (X±SE) | <i>Malapterurus electricus</i> (X±SE) | <i>Clarias gariepinus</i> (X±SE) | P-value | Sign.  | FAO LIMITS |
|-------------|---------------------------------|------------------------------------|---------------------------------------|----------------------------------|---------|--------|------------|
| Fe          | 221.05± 45.18<br>(106.1- 315.4) | 156.7±37.84<br>(85.8-245.1 )       | 172.6±37.15<br>(74.8 - 254.5)         | 247.8±45.96<br>(118.2 -334.2)    | 0.416   | P>0.05 | 50-150     |
| Zn          | 54.93± 14.42<br>(26.5 -93.6 )   | 40.23±22.1<br>(22.1 -64.8 )        | 44.800±9.74<br>(28.2 -67.2 )          | 52.38±13.25<br>(15.8 -77.3 )     | 0.805   | P>0.05 | 75.00      |
| Mn          | 1.46±0.27<br>(0.95 - 2.10 )     | 1.57±0.47<br>(0.70 -2.86 )         | 1.31± 0.33<br>(0.62 -2.22 )           | 2.013±0.70<br>(0.45 -3.74 )      | 0.750   | P>0.05 | 1.0        |
| Cu          | 0.73±0.41<br>(0.112 -1.920 )    | 0.57±0.297<br>(0.014 -1.290 )      | 0.35±0.12<br>(0.098 -0.660 )          | 1.25±0.74<br>(0.164-3.320 )      | 0.568   | P>0.05 | 20.00      |
| Pb          | 0.02±0.011<br>(0-0)             | 0.02±0.005<br>(0- 0)               | 0.01±0.006<br>(0-0)                   | 0.04±0.017<br>(0-0)              | 0.192   | P>0.05 | 1.5        |
| Cr          | 0.00±0.004<br>(0-0)             | 0.00±0.002<br>(0-0)                | 0.00±0.000<br>(0-0)                   | 0.00±0.003<br>(0-0)              | 0.763   | P>0.05 | 0.15       |
| Cd          | 0.01±0.006<br>(0.01-0.006)      | 0.00±0.005<br>(0-0)                | 0.00±0.004<br>(0-0)                   | 0.02±0.009<br>(0-0)              | 0.509   | P>0.05 | 0.2        |

**NOTE:** All values are in mg/kg unless otherwise stated; P>0.05 indicates no significant difference; Minimum and maximum in bracket

The laboratory results indicate that apart from Fe and Mn which exceeded the FAO limits in the fish species, all other metals were within the regulatory limits for safe consumption. Statistical analysis using the Single Factor Analysis of Variance (ANOVA) revealed that the heavy metal accumulation in all the fish species were not significantly different ( $P > 0.05$ ).

### 3.2.5 Vegetation

#### Plant Species composition and Diversity

A total of twenty-six 26 plant species was listed in the study area Table 3.14. The crops on the farms include scanty cassava, yams, plantain and cocoyams. Weeds found on the farms consisted mainly of herbaceous types such as *Panicum maximum*, dominating the riverine vegetation, *Chromolaena odorata*, *Mitracapus villosus*, and *Aspilia africana*. Trees such as bamboo *Bambusa vulgaris* oil palm *Elaeis guineensis* were recorded in low density around the Ikpoba River course.

#### Vegetation Structure and Health Status

The vegetation generally has two strata. The vegetation within the study site has an open canopy. Populations of fast growing pioneer tree species such as *Alchornea cordifolia* and *Albizia zygia* were common in bush fallow areas surrounding the river.

The vegetation within the project area is generally luxuriant. There were however some cases of cassava plants that were affected by the mosaic virus disease which is characterized by wrinkled/twisted leaves.

**Table 3.14: Plant Species Composition, Habit and Utility within the Study Area.**

| S/No | Scientific name                | Common English name | Habit    | Utility/Economic importance |
|------|--------------------------------|---------------------|----------|-----------------------------|
| 1    | <i>Albizia zygia</i>           | Albizia             | Tree     | Timber                      |
| 2    | <i>Alchornea cordifolia</i>    | Christmas tree      | Shrub    | Yam stake                   |
| 3    | <i>Anthocleista vogelli</i>    | Cabbage tree        | Tree     | Timber Float                |
| 4    | <i>Anthonotha macrophylla</i>  |                     | Shrub    | Yam stake                   |
| 5    | <i>Aspilia Africana</i>        | Haemorrhage plant   | Herb     | Medicinal                   |
| 6    | <i>Bambusa vulgaris</i>        | Bamboo              | Herb     | Yam stake                   |
| 7    | <i>Baphia nitida</i>           | Cam wood            | Tree     | Dye                         |
| 8    | <i>Calapogonium mucunoides</i> | Calapo              | Creepers | fertilizer                  |
| 9    | <i>Chromolaena odorata</i>     | Siam weed           | Herb     | Green manure                |
| 10   | <i>Commelina spp.</i>          | Tropical spiderwort | Herb     | Weed                        |
| 11   | <i>Dacryodes edulis</i>        | African pear        | Tree     | Edible fruit                |

| S/No | Scientific name             | Common English name       | Habit   | Utility/Economic importance |
|------|-----------------------------|---------------------------|---------|-----------------------------|
| 12   | <i>Dioscorea rotundata</i>  | Yam                       | Vine    | Staple food                 |
| 13   | <i>Elaeis guineensis</i>    | Oil palm                  | tree    | Edible oil                  |
| 14   | <i>Ficus exasperate</i>     | Fig tree                  | tree    | Sand paper                  |
| 15   | <i>Hevea brasiliensis</i>   | Rubber tree               | tree    | Rubber                      |
| 16   | <i>Musa sp.</i>             | Plantain                  | tree    | Food/fruit                  |
| 17   | <i>Musanga cecropioides</i> | Rain tree                 | tree    | Float for timber            |
| 18   | <i>Panicum maximum</i>      | Guinea grass              | herb    | Forage grass                |
| 19   | <i>Pennisetum purpureum</i> | Elephant grass            | herb    | Fodder                      |
| 20   | <i>Smilax kraussiana</i>    | West African sarsaparilla | climber | Medicinal                   |
| 21   | <i>Talinum triangulare</i>  | Water leaf                | herb    | Leafy vegetable             |
| 22   | <i>Trema guineensis</i>     |                           | tree    | Medicinal                   |
| 23   | <i>Vernonia cineria</i>     | Iron weed                 | herb    | Weed                        |
| 24   | <i>Carica papaya</i>        | Pawpaw                    | Tree    | Edible fruit                |
| 25   | <i>Magnifera indica</i>     | Mango                     | Tree    | Edible fruit                |
| 26   | <i>Dioscorea esculenta</i>  | White yam                 | Vine    | Staple food                 |

### Vegetation Structure, physiognomy and Health Status

The vegetation structure of the study area is depicted in Plate 3.1 (A – E). The vegetation generally has two strata, and very luxuriant around the Ikpoba River system. The elephant grass (*Pennisetum purpureum*) and bamboo (*Bambusa vulgaris*) were dominant. Around residential houses were cocoyams, plantains, garden eggs, mango and pears. The large leaves of plantain usually provide a close canopy covering the moat. The lower stratum below the plantains and cassava is colonised by weeds.

The bush fallow areas were characterized by light loving fast growing species such as *Alchornea cordifolia*, *Anthocleista vogelli* and *Albizia zygia*. Weeds such as *Chromolaena odorata* (Siam weed), *Pennisetum purpureum* and *Aspilia africana* were abundant in the bush fallows. All the vegetation types within the study area are secondary as most of the primary vegetation had been removed.





**Plate 3.7: Typical vegetation structure at the Upper (C) and Lower watershed (A,B,D) of the Ogiso-Osunde Gully site**

### 3.2.6 Biodiversity/ Wildlife

The characteristic fauna of the project area as recorded through direct sighting of wildlife, observation of burrows, faecal pellets/droppings, hairs, foot prints/tracks, devoured cassava and yam tubers and oil palm fruits as well as trampled/disturbed vegetation and oral interview are presented in Table 3.15. The result as presented indicate the presence of 46 species representing 5 mammals, 20 birds, 3 reptiles, 3 amphibians, 3 molluscs, 9 arthropods and 3 worms/annelids. Among the mammals, the great cane rat or cutting grass *Thryonomys swinderianus* and the giant rat *Cricetomys emini* were of the highest abundance and were the most frequently trapped “bush meat” in the area. Other small mammals of the families Muridae rats and mice and Soricidae Squirrels were well represented. The squirrels are dominated mainly by two arboreal species, viz: the sun squirrel and the giant forest squirrel which are fond of oil palm trees and *Raphia* palm leaves, respectively.



**Table 3.15: Checklist of wildlife and other invertebrate fauna common in the study area**

| PHYLUM/CLASS                    | ORDER/FAMILY                 | SCIENTIFIC NAME                  | COMMON NAME                      | Relative abundance       | Conservation Status IUCN |  |
|---------------------------------|------------------------------|----------------------------------|----------------------------------|--------------------------|--------------------------|--|
| PHYLUM<br>CHORDATA:<br>MAMMALIA | Order Rodentia               |                                  |                                  |                          |                          |  |
|                                 | Family Scuridae<br>Squirrels | <i>Paraxerus poensis</i>         | Small Green Squirrel             | ++                       |                          |  |
|                                 |                              | <i>Xerus</i> sp                  | Ground Squirrel                  |                          |                          |  |
|                                 | Family Muridae               | <i>Cricetomys emimi</i>          | Giant Rat                        | +++                      |                          |  |
|                                 |                              | <i>Rattus rattus</i>             | Black Rat                        | +++                      |                          |  |
|                                 | Family Thryonomidae          | <i>Thryonomys swinderianus</i>   | Greater cane rat cutting grass   | +++                      |                          |  |
|                                 | AVES                         | Family Ardeidae                  | <i>Butorides striatus</i>        | Green backed Heron       | +                        |  |
|                                 |                              |                                  | <i>Egretta egretta</i>           | Little egret             | +++                      |  |
|                                 |                              | Family Accipitridae              | <i>Haliaetus vocifer</i>         | West African River Eagle | ++                       |  |
|                                 |                              | Family Alcedinidae               | <i>Ceys picta</i>                | Pigmy Kingfisher         | ++                       |  |
| Family Bucerotidae              |                              | <i>Bycanistes subcylindricus</i> | Black and White Casqued Hornbill | ++                       |                          |  |
|                                 |                              | <i>Tockus fasciatus</i>          | Black and White Tailed Hornbill  | ++                       |                          |  |
| Family Charadriidae             |                              | <i>Pluvialis squatarola</i>      | Grey plover                      | +                        |                          |  |

| PHYLUM/CLASS    | ORDER/FAMILY        | SCIENTIFIC NAME                     | COMMON NAME               | Relative abundance | Conservation Status IUCN |
|-----------------|---------------------|-------------------------------------|---------------------------|--------------------|--------------------------|
|                 | Family Cuculidae    | <i>Centropus leucogaster</i>        | Black throated Coucal     | ++                 |                          |
|                 |                     | <i>Centropus sensgaliensis</i>      | Senegal coucal            | +++                |                          |
|                 |                     | <i>Pycnonotus harbatus</i>          | Graden bulbuls            | +++                |                          |
|                 | Family Laridae      | <i>Sterna hirundo</i>               | Common Tern               | ++                 |                          |
|                 | Family Falconidae   | <i>Milvus migrans</i>               | Black Kite                | ++                 |                          |
|                 |                     | <i>Kaupifalco monogrammicus</i>     | Lizard Buzzard            | +                  |                          |
|                 | Family Micropopidae | <i>Cypsiurus parvus</i>             | African Palm Swift        | ++                 |                          |
|                 |                     | <i>Apus affinis</i>                 | Little Swift              | ++                 |                          |
|                 | Family Ploceidae    | <i>Plesiositagra cucullatus</i>     | Village Weaver            | +++                |                          |
|                 |                     | <i>Cinnamopteryx costaneofuscus</i> | Chestnut and Black Weaver | ++                 |                          |
|                 |                     | <i>Hyphanturgus brachpterus</i>     | Speckled Weaver           | +++                |                          |
|                 |                     | <i>Vidua macroura</i>               | Pin-tailed Whydah         | +                  |                          |
|                 | Family Strigidae    | <i>Ptilopsis leucotus</i>           | White-faced Owl           | +                  |                          |
| <b>REPTILIA</b> | Order Squamata      |                                     |                           |                    |                          |
|                 | Family Agamidae     | <i>Agama agama</i>                  | Common Agama lizard       | +++                |                          |
|                 | Family Elapidae     | <i>Naja melanopleura</i>            | Black cobra               | ++                 |                          |

| PHYLUM/CLASS             | ORDER/FAMILY             | SCIENTIFIC NAME                  | COMMON NAME              | Relative abundance | Conservation Status IUCN |
|--------------------------|--------------------------|----------------------------------|--------------------------|--------------------|--------------------------|
|                          |                          | <i>Boiga blandingii</i>          | Blanding's tree snake    | +                  |                          |
| <b>AMPHIBIA</b>          | ANURA                    | <i>Bufo regularis</i>            | Toad                     | +++                |                          |
|                          |                          | <i>Hyperolius fusciventralis</i> | Tree frog                | +                  |                          |
|                          |                          | <i>Rana</i> sp.                  | Common frog              | ++                 |                          |
| <b>PHYLUM ARTHROPODA</b> |                          |                                  |                          |                    |                          |
| <b>CLASS INSECTA</b>     | <b>Order Coleoptera</b>  | Carabid spp                      | Ground beetles           | +++                |                          |
|                          |                          | <i>Auchmeromyia luteola</i>      | Blue beetles             | +++                |                          |
|                          |                          | <i>Anthophorid spp</i>           | Bumble bees              | ++                 |                          |
|                          | <b>Order Dictyoptera</b> | <i>Blatella</i> sp.              | Cockroaches              | +++                |                          |
|                          | <b>Order Diptera</b>     | <i>Musca domestica domestica</i> | Houseflies               | +++                |                          |
|                          | <b>Order Hymenoptera</b> | <i>Formica</i> spp.              | Black ants               | +++                |                          |
|                          |                          | <i>Sima</i> spp.                 | Medium sized ants        | +++                |                          |
|                          | <b>Order Lepidoptera</b> |                                  | Butterflies              | +++                |                          |
|                          | <b>Order Odonata</b>     |                                  | Dragonflies              | ++                 |                          |
|                          | <b>Order Orthoptera</b>  | <i>Zonocerus variegatus</i>      | Variiegated grasshopper  | +++                |                          |
|                          |                          | <i>Gryllus</i> sp.               | Crickets                 | ++                 |                          |
| <b>Gastropoda</b>        |                          | <i>Archachatina marginata</i>    | Giant African land snail | ++                 |                          |

| PHYLUM/CLASS         | ORDER/FAMILY | SCIENTIFIC NAME                | COMMON NAME  | Relative abundance | Conservation Status IUCN |
|----------------------|--------------|--------------------------------|--------------|--------------------|--------------------------|
|                      |              | <i>suturalis</i>               |              |                    |                          |
|                      |              | <i>Limicolaria aurora</i>      | Garden snail | ++                 |                          |
|                      |              | <i>Lymnea</i> sp.              | Water snail  | ++                 |                          |
| Annelida / Flatnorms |              |                                |              |                    |                          |
|                      | Oligochaeta  | <i>Eudriliuseuginiae</i>       |              | +                  |                          |
|                      | .            | <i>Lumbricus</i> spp           | Earth worm   | +++                |                          |
|                      |              | <i>Hyperiodrilus africanus</i> | Oligochaetes | ++                 |                          |

**Note:** +++ Abundant, ++ Common, + Rare

Among the birds, the cattle egrets, sun-birds and the African swifts were the most abundant. The cattle egrets Little egret *Egretta egretta*, sun-birds were fond of the farmland fallow lands while the latter were often sighted on palm trees and near buildings. The weaver birds were abundant particularly in farms where they feed on grains. Among the diurnal birds of prey were the black kite, which occur in very low numbers.

Data obtained from interview indicate that there are many species of snakes including the cobras, and some of these are poisonous. The snakes take refuge in low bushes around farmlands and fallow lands. Of the amphibian fauna within the area, the common toads, and *Bufo* sp was most abundant and its primary habitat was the humid forest and farmland s where they found a lot of insects to feed on.

The invertebrates were dominated by the arthropods represented by the ants, grasshoppers, locust, dragon flies, butterflies, and crickets. Soil fauna were dominated by the segmented worms Annelida represented by the oligochaetes.

Generally, the faunal and floral diversity was poor because of serious limitation by suitable habitats; major part of the catchment area is residential and developed up to few metres from the Ikpoba River.

## **CHAPTER FOUR**

### **SOCIO-ECONOMIC CHARACTERISTICS AND PUBLIC CONSULTATIONS**

#### **4.1 Background**

The socioeconomic feature is the social science that studies how economic activity affects and is shaped by social processes. In general, it analyses how societies progress, stagnate, and/or regress because of their local or regional economy or the global economy. Gully erosion, is one of the severe environmental problems facing Edo State. It threatens urban and rural infrastructure, properties, lives and physical growth towns. Thus, the socio-economic assessment of the proposed Ogiso Osunde gully erosion intervention project in Edo State covers a wide range of diverse but interconnected aspects and variables that relate to a group of social and economic factors of the study area. The socioeconomic aspects and variable of the projects were grouped into various categories such as demographic, socio-, economic and public services. Demographic categories include population growth structures and distribution, the social aspects involve the project affected communities lives as well as their social and cultural attitudes and values as the case may be. The community services are concerned with housing and requirements for public services such as water, sanitation, communication waste disposal as well as health and education service.

##### **4.1.1 Expected Output**

This section is expected to present the following:

1. Analysis of the existing livelihoods opportunities in the study community;
2. The socio-economic characteristics of household members in the community;
3. Analysis of the existing formal and informal grievance redresses mechanisms in and around the intervention area;
4. Consultations with relevant stakeholders and affected persons;
5. The existing individual, household and community structures

#### **4.2 Population Characteristics of the Proposed Project Area**

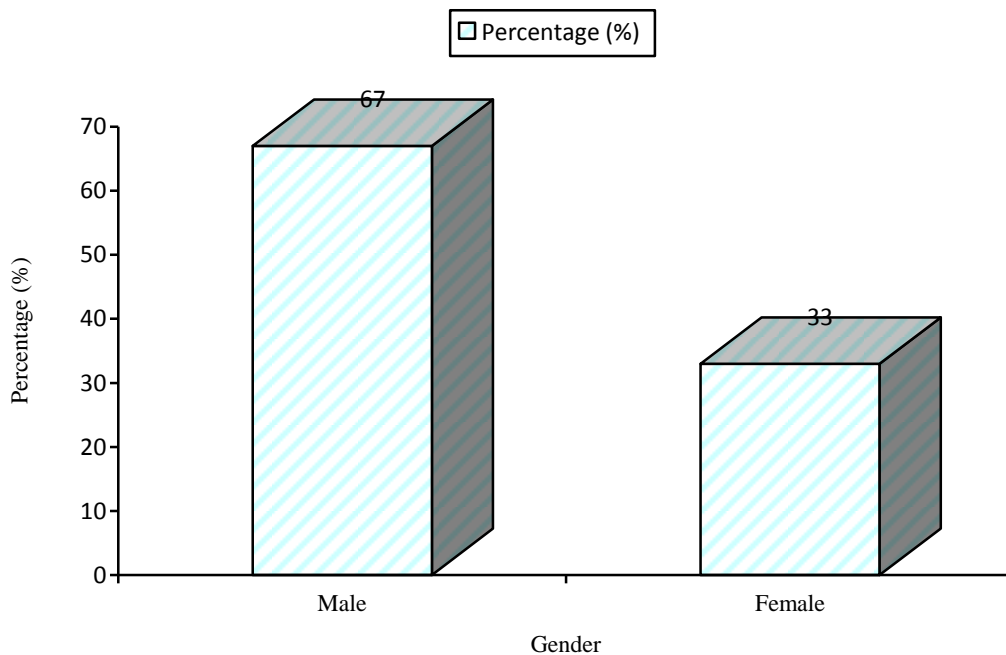
The population of Ikpoba Okha Local Government Area of Edo State has a current estimated projection of 487, 400 people which cuts across 30 communities; this includes men and women (NPC, 2016). The community under study is Ogiso Osunde found in Ward 2 in Ikpoba Okha. The population of Ogiso community is about 1000-1200 (information from Odionwere).



### 4.3 Socio-Demographic Characteristics of Ogiso Community

#### 4.3.1 Gender Profile of Respondents

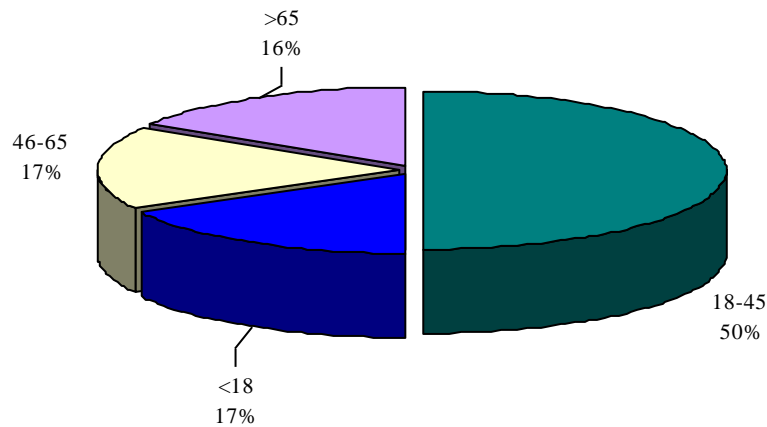
A total of 300 respondents representing households in Ogiso community was surveyed. Majority of the respondents were male recording 198 (67%) while female recorded 99(33%), Nigeria specifically operates a patriarchal society where the male dominates as the head of household, notwithstanding, various circumstances also create opportunity for the female to also head their households such as being a widow, single-parenthood and/or standing in for her spouse.



**Fig. 4.1:** Gender Profile of Respondents  
Source: ESMP Field Survey 2017

#### 4.3.2 Age Profile

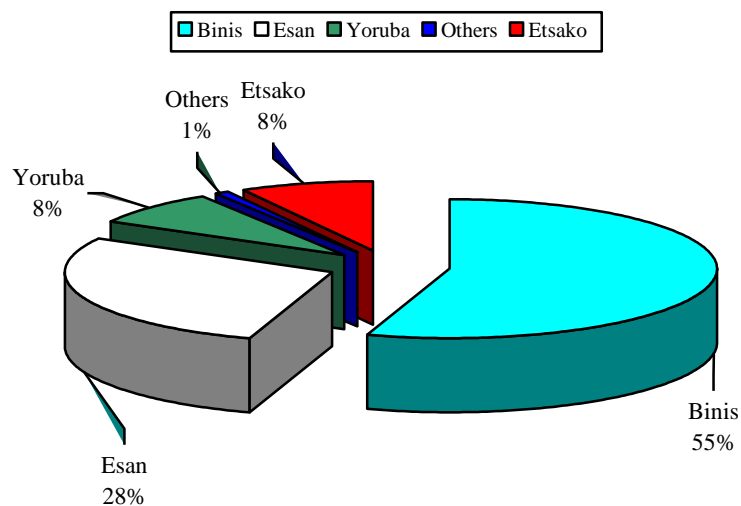
The age distribution of the 300 respondents in Ogiso-Osunde gully site is shown in Figure 4.2, explains that majority of the sampled respondents is within the ages of 18-45 years (50%), respondents below 18 years and those between 46-65 years recorded (17%) respectively. The respondents above 65 years recorded 16% respectively. It could be deduced that since the community is situated in an urban centre, the workforce which is the predominant age group is inevitable.



**Fig. 4.2:** Age Profile of Respondents  
 Source: ESMP Field Survey 2017

### 4.3.3 Ethnic Composition

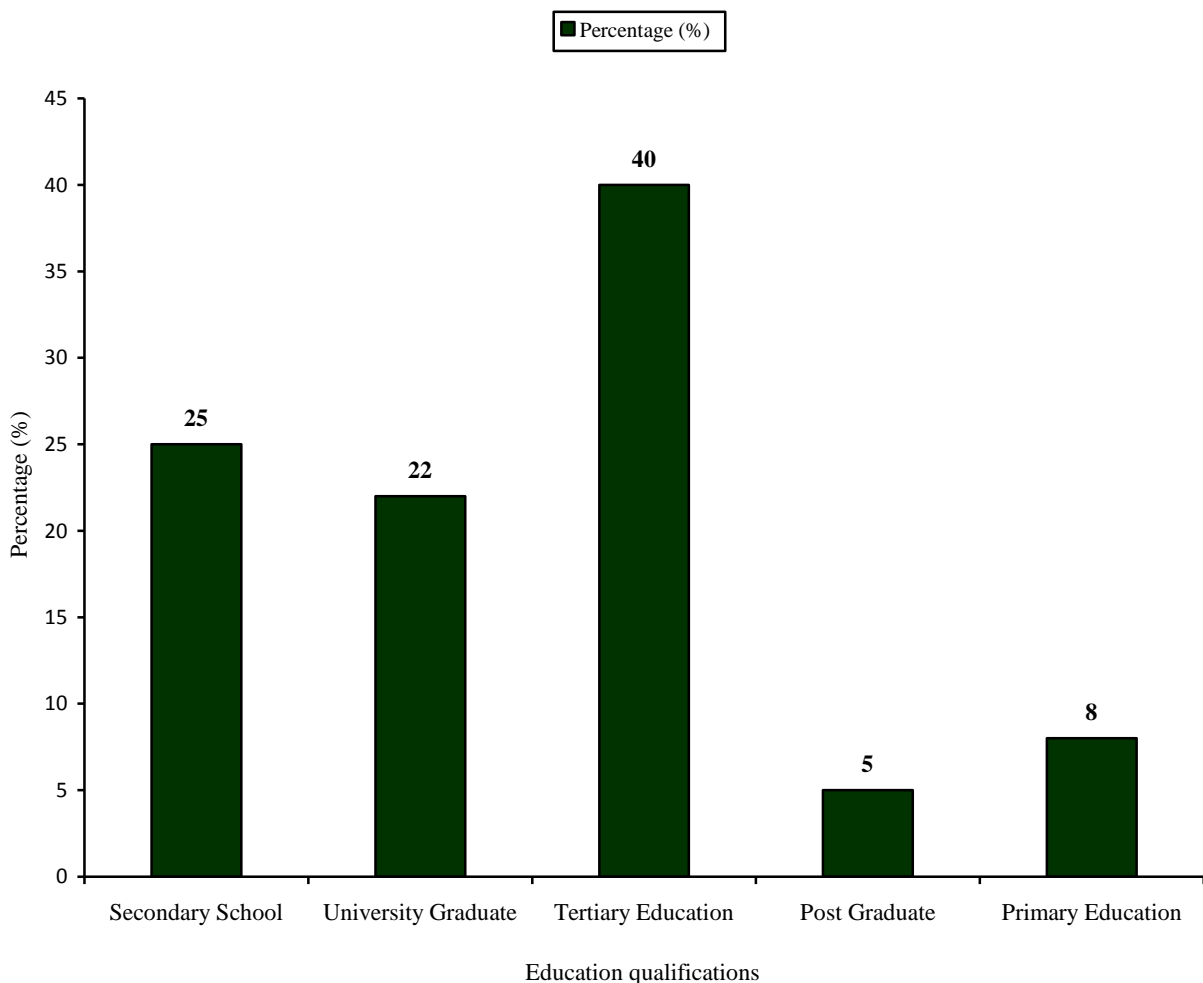
The ethnic composition and classification of respondents in Ogiso community shown in Figure 4.4 reveals that the predominant ethnic group was the Binis recording 165(55%), Etsako recorded 24(8%), Yoruba 24(8%), Esan 84(28%) while other constitute 3(1%). This shows that most of the respondents are traditional landowners, thus, social stratification and resettlement plans should be handled with the comprehension of their cultural socioeconomic ties to land.



**Fig. 4.3:** Ethnic Profile of Respondents  
 Source: ESMP Field Survey 2017

### 4.3.4 Education

The education level of the people living in Ogiso-Osunde gully site is presented in Figure 4.5. It shows that on the average, the respondents have a form of education and are thus enlightened. Most of the respondents 75(25%) have secondary school (High School) education, 66(22%) of the respondents are university graduates, 120(40%) has tertiary education (mostly ONDs, HNDs and NCE holders), 24(8%) has primary education while 15(5%) are postgraduate degree holders.



**Fig. 4.4:** Educational Group Profile of Respondents

Source: ESMP Field Survey 2017

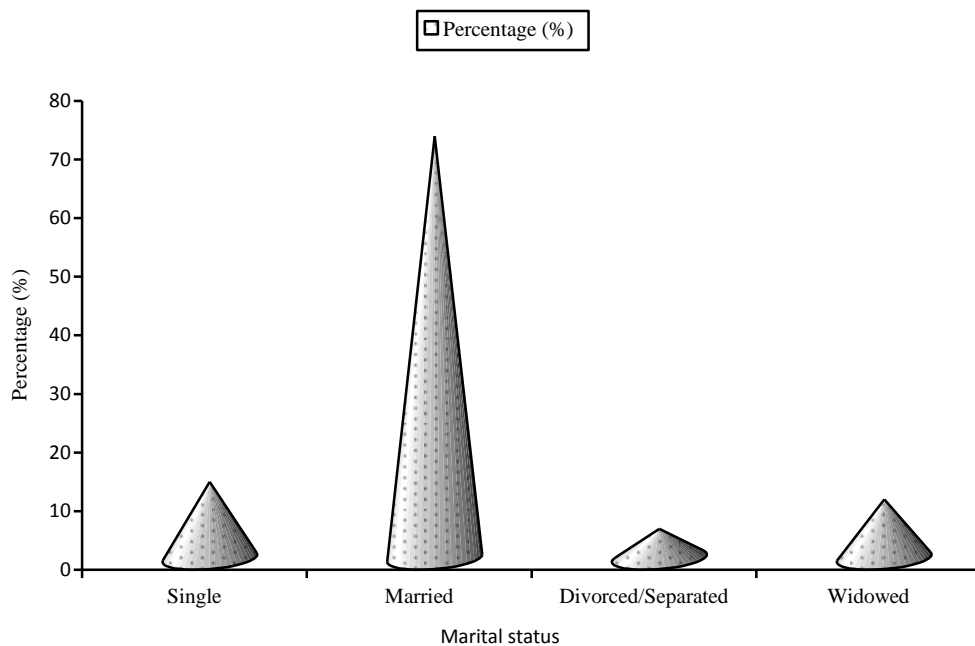
## 4.4 Families and Households

### 4.4.1 Marital Status

The marital status of the respondents in Ogiso community shows that 216 respondents (72%) are married. This aligns with the population projections (an increase in the nearest future) stated for the LGA by NPC. This increase in population will have direct impact on the

consumption power, health services and other infrastructure needs of the residents of the community. 39 respondents (13%) were unmarried (i.e. single), 15 respondents were divorced (5%) while 30 respondents (10%) were widowed.

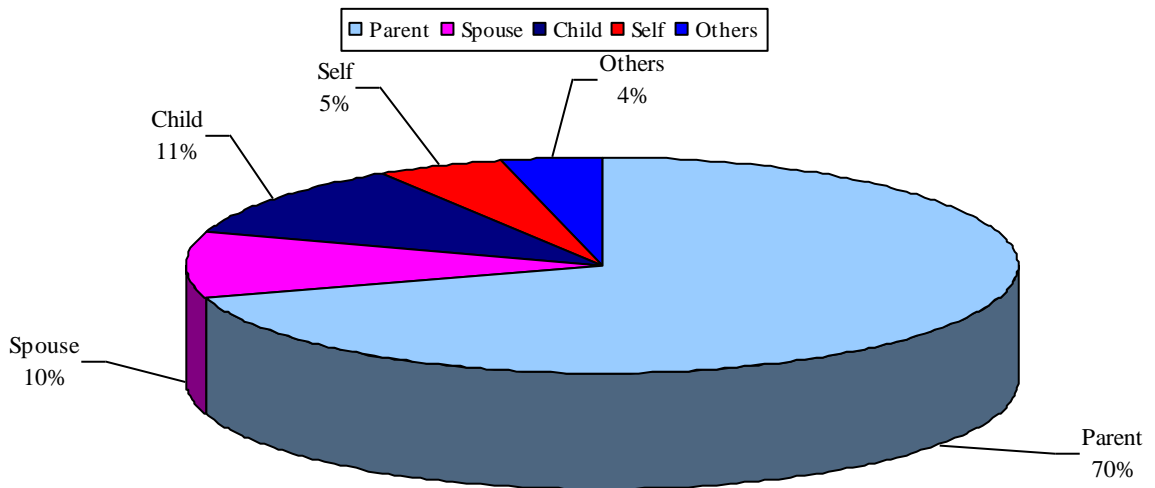
Respondents' marital status actually buttresses the extent of impact it would create in this community. Majority are married which explains a high rate of responsibilities amongst household members.



**Fig. 4.5:** Marital Status of Respondents in Ogiso Community  
Source: Field Survey 2017

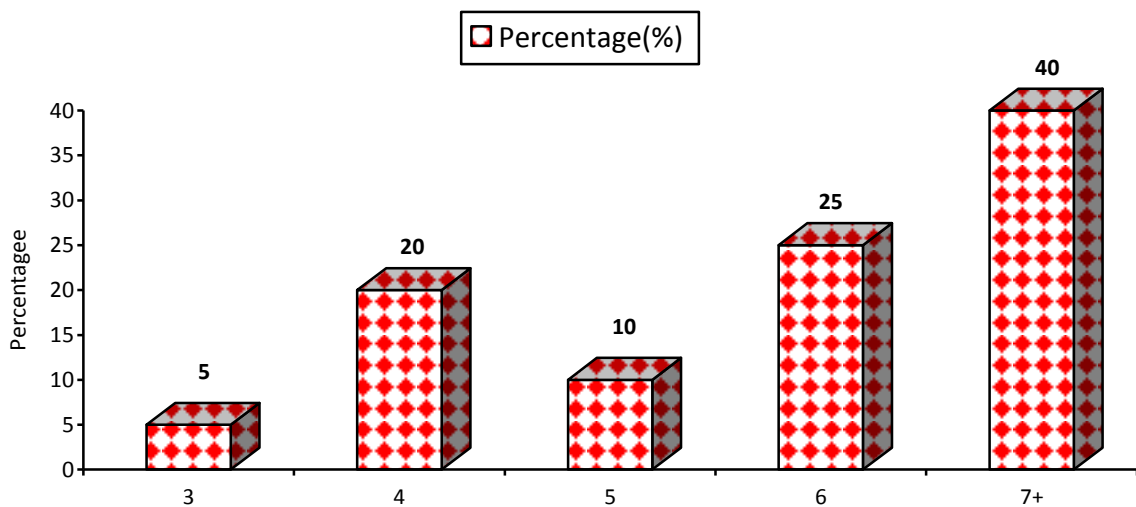
#### 4.4.2 Household Characteristics

There are four categories of respondents who explains their relationships to the household heads in Ogiso community. 210 (70%) respondents surveyed were actually the heads to their households, 30 (10%) claimed they were spouses to the household heads, this could be deduced that as female respondents, their husbands are the household heads who were not around during the period of the survey; 33 (11%) respondents were children to the household heads, 15 (5%) claimed they live alone which makes them household head though without dependents while 12 (4%) respondents refers to the distance and/or non-relatives to the household heads.



**Fig. 4.6:** Household Relationship Profile  
 Source: ESMP Field Survey 2017

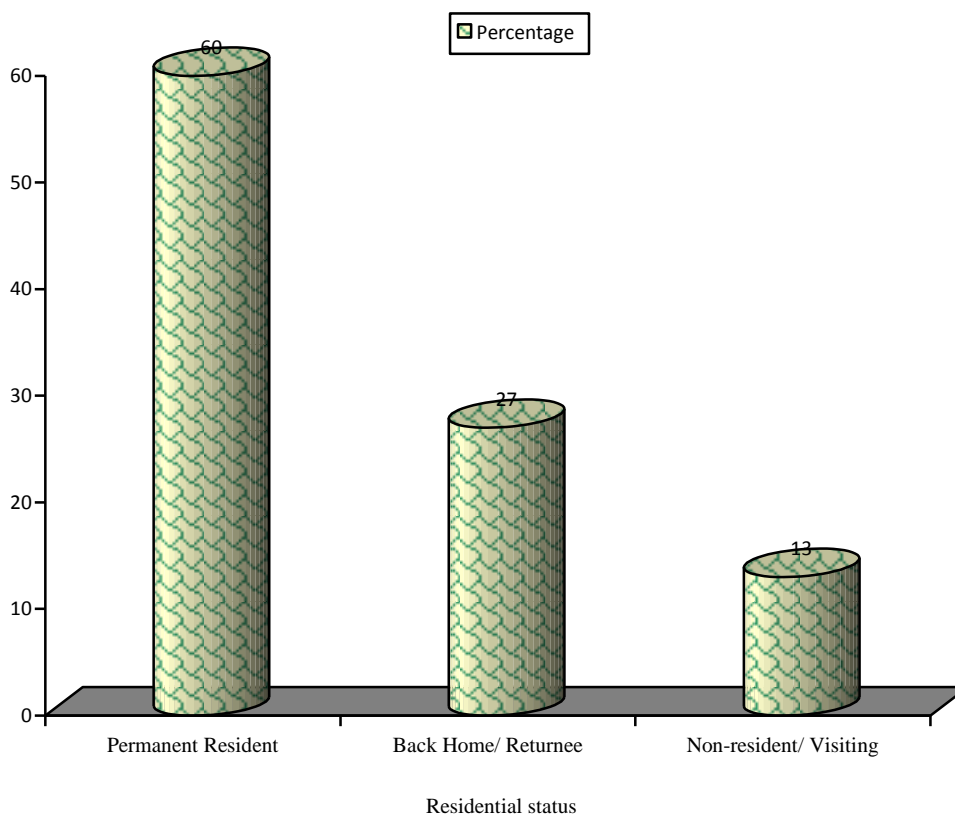
The size of the family is a socioeconomic parameter for understanding and determining the structure of families in a particular population. It can also be used in understanding the average number of people expected in a family. In Fig. 4.7 below, there are five family size categories with three (5%) as the minimum and over seven being the maximum family size (40%). Others include four (20%), five (10%), and six (25%). By implication, the number of people that are susceptible to social and environmental impact of the proposed project is high within a particular family.



**Fig. 4.7:** Size of Households  
 Source: ESMP Field Survey, 2017

#### 4.4.3 Residential Status of Respondents

The assessment of the household’s residential status is illustrated in the Table 4.1. Majority of the respondents 180 (60%) of the sample individuals and households are permanent residents. The visitors who are not permanent residents 39(13%) and the back home returnees constitute 81(27%) each. The residential status of the sampled households has an implication on the desirable socioeconomic information concerning the existing situations in the project area. By implication, much of the socioeconomic data extracted from the study constitute the views of those who are conversant with the nature of the environment and with the genesis of the gully in the project area.



**Fig. 4.8:** Residential Status of respondents in Ogiso Community  
 Source: ESMP Field Survey, 2017

#### 4.4.4 Employment Status of Respondents

As depicted in table 4.1, most of the respondents are employed salary earners 120(40%), traders 30(12%), daily labourers 48(17%) and artisans 30(10%) unemployed 15(5%), self-employed 28(11%), farmers 54(18%) and retirees 13(5%). The labour structure of the area is composed mainly of salary earners who constitute a very informed and educated class of the society. Most of the respondents who are daily labourers work daily in the Benin metropolis

as block moulders, builders and drivers. The shop owners include hairdressers, barbers, restaurants (canteen), bars etc.

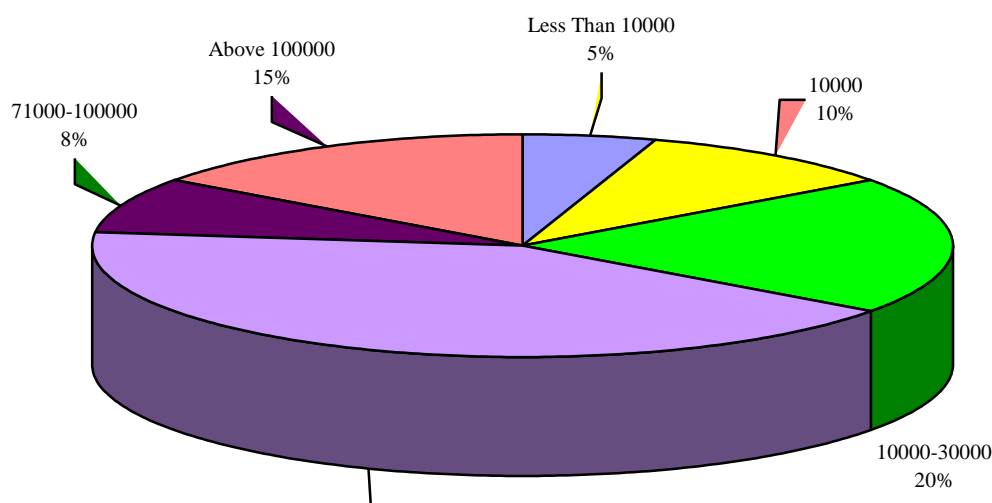
**Table 4.1:** Occupation Profile of Respondents

| <b>Occupation</b>      | <b>Percentage (%)</b> |
|------------------------|-----------------------|
| Farmer                 | 6                     |
| Daily Labourers        | 17                    |
| Trading & Shop keeping | 12                    |
| Artisans               | 8                     |
| Employed (Salary)      | 40                    |
| Self Employed          | 7                     |
| Unemployed             | 5                     |
| Retired                | 5                     |
| <b>Total</b>           | <b>100</b>            |

*Source: ESMP Field Survey, 2017*

#### **4.4.5 Average Monthly Income of Respondents**

The income status of the respondents, estimated on a monthly scale, is presented in Figure 4.9. The highest income earners with a monthly income with the range of N31, 000-70,000 made up 126(42%) of the population and those who earn N10, 000- 30000, 60(20%) and above N100, 000 constitute 45(15%). Conversely, the lower income group that earn N10, 000 30(10%) and those that earn less than N10, 000 15 (5%) constitute. The respondents that earn between N70, 000- 100,000 were 24 (8%).



**Fig. 4.9:** Average income Profile  
Source: ESMP Field Survey, 2017

## 4.5 Assessment of Social Infrastructure and Standard of Living

### 4.5.1 Housing Characteristics in the Project Area

Table 4.2 shows the basic housing systems which comprises of the distribution of materials used for the construction of the different sections of the buildings, the tenure systems of land and building. For wall construction, most of the buildings are made of concrete blocks (98%) the parameter plastered mud was just 2%. This is usual in a township setting because of modernization and sophisticated edifices. For roofing, 60% of the buildings have corrugated roofing sheets while 30% is roofed with aluminum roofing sheets and asbestos was 10%, variable like thatched and wooden roofs were not mention which is consistent with urban settings. Floor materials are made mainly of concrete cement (80%), earthen floor (5%), and tiles (15%). This is not at variance with earlier descriptions given for the wall and roofing material expected within an urban setting. The number of rooms in a house determines the house type and size and is a house defining parameter. It is an essential element in ascertaining the available space used for living by the households within the project area. The variety of rooms is roughly distributed between the following categories: 1-2 rooms (10%), 3-4 rooms (20%), 5 plus more rooms (70%).

On the average, respondents use at least two rooms, excluding lavatories. The available toilet facility was assessed showed that most of the respondents use water closet (60%) and



the two types of pit latrine (40%). Those without toilets (2%) and respondents with toilets constructed outside their dwelling houses have the same proportion (8%). This shows that some of the residents use the gully for defecation purposes. 35% of the sampled respondents are tenants while 55% live in their houses either as owner-occupier or as family dwellers. The owner-occupier ratio in the community is at par. The tenure of the land follows the same statistical analysis. Most of the rented lands are mainly for businesses sited within the community.

**Table 4.2:** Type of Materials in the Building and Tenure Systems in Ogiso Community

| BUILDING SECTION  | MATERIALS                       | PROPORTION (%) |
|-------------------|---------------------------------|----------------|
| Wall Materials    | Plastered Mud                   | 2              |
|                   | Cement block                    | 98             |
|                   | Others                          | 0              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Roofing           | Corrugated roofing              | 60             |
|                   | Aluminum                        | 30             |
|                   | Asbestos                        | 10             |
|                   | Others                          | 0              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Floor Materials   | Earthen                         | 5              |
|                   | Concretes                       | 80             |
|                   | Tiles                           | 15             |
|                   | Others                          | 0              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Number of Rooms   | 1-2 Rooms                       | 10             |
|                   | 3-4 Rooms                       | 20             |
|                   | 5+ Rooms                        | 70             |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Toilet Facility   | Water closet/flush toilet       | 60             |
|                   | Covered pit toilet latrine      | 25             |
|                   | Ventilated improved pit latrine | 15             |
|                   | Pan/bucket                      | 8              |
|                   | Outside/bush/forest             | 2              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Tenure of Housing | Owned                           | 55             |
|                   | Rented                          | 35             |
|                   | Occupied for free               | 7              |
|                   | Others                          | 3              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |
| Tenure of Land    | Owned                           | 50             |
|                   | Rented                          | 40             |
|                   | Occupied for free               | 10             |
|                   | Others                          | 0              |
|                   | <b>TOTAL</b>                    | <b>100</b>     |

Source: ESMP Field Survey, 2017

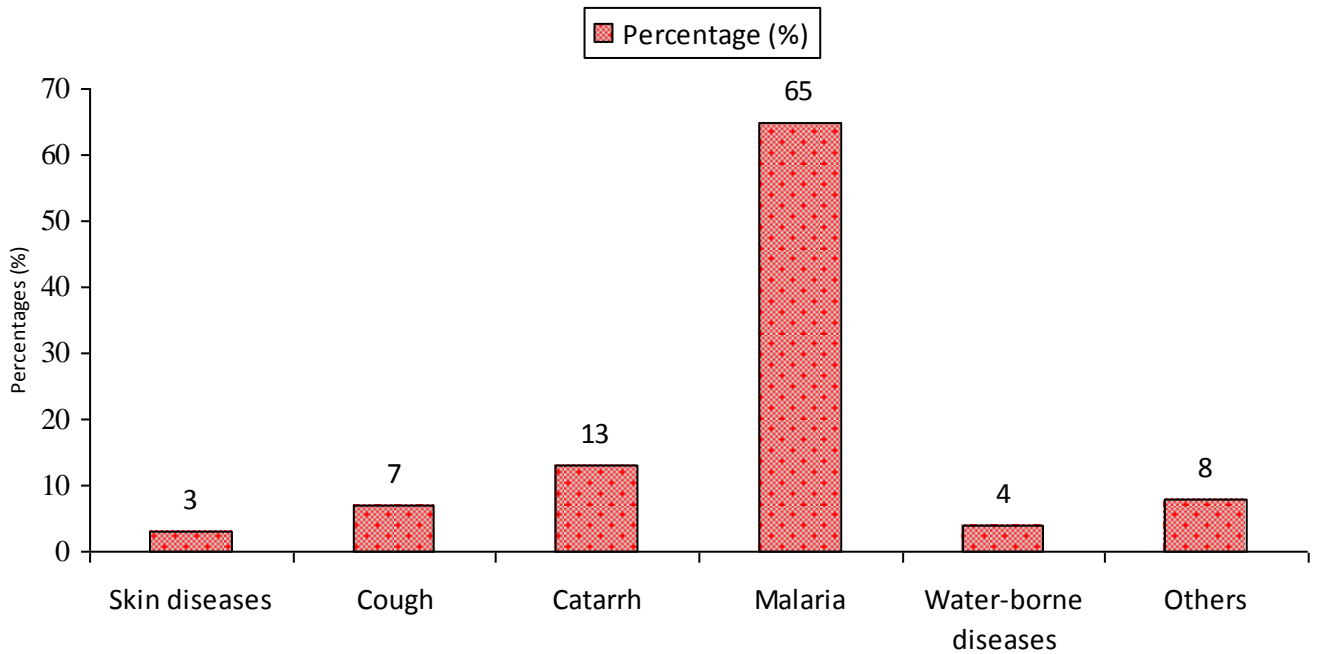
#### **4.5.2 Assessment of Health Status of Surveyed Households**

To understand the health status of the residents, the relationship between the current health status and the gully was assessed using a cause-effect analysis from extrapolated data from their questionnaire responses. In this assessment, over 55% claimed that their health status is not triggered or related to the gully. These records formed the basis for the other health assessment in the community.

##### **4.5.2.1 Ailments Associated with the Gully and Method of Healthcare**

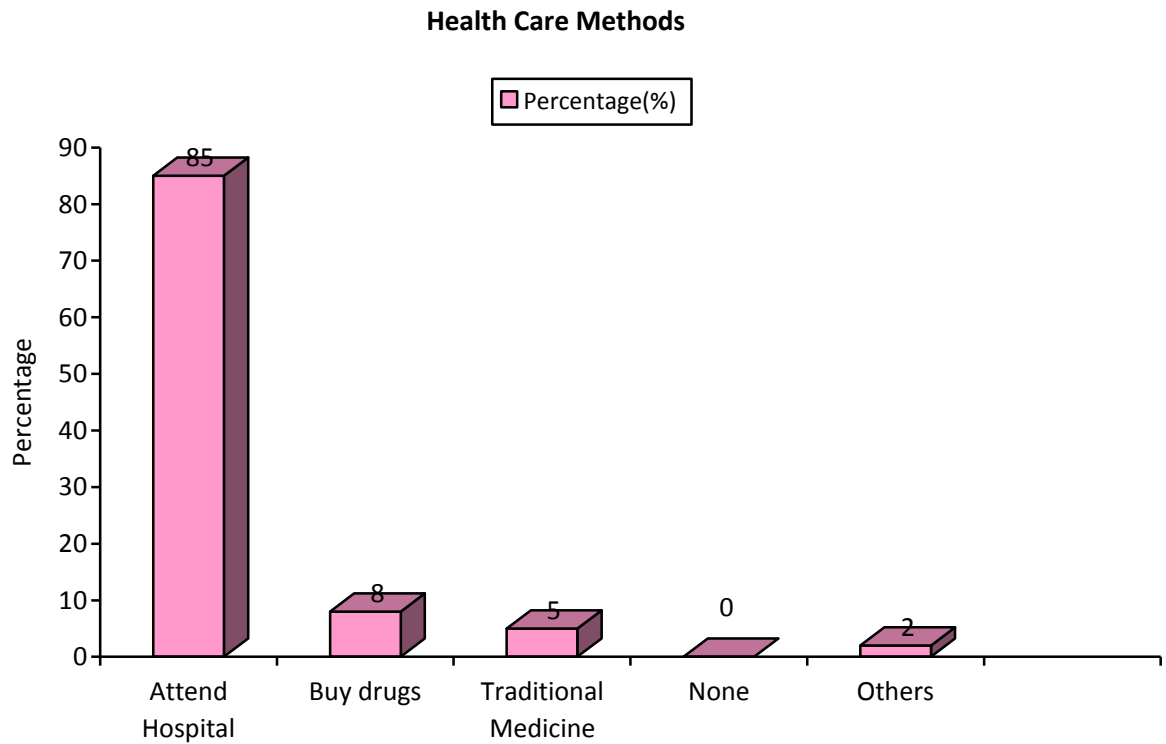
Knowing that the health status of the respondents maybe connected to the gully as claimed by some of them, it was therefore essential to know the reported ailments associated with the gully. Figure 11 below displays the reported ailments. The most reported ailment is malaria as claimed by 65% of the respondents. Other reported diseases include: skin diseases (3%), cough (7%), catarrh (13%), water-borne diseases (4%) and others like typhoid and other opportunistic illnesses constituted just 8%. It can be concluded that such health challenges are connected to the gully erosion. Responses from the community also show that that waste and sewage management is also very poor in the area. Some respondents claim that some community members use the gully as waste dumpsites with human waste littering the gully alignment.

The perceptions of the residents on the dominant health challenges showed that the environment affects their health significantly. This was emphasized further by the claim that the diseases are sometimes seasonal. For instance, it was expressed that some of these diseases become prominent during the wet season affecting the family either simultaneously or consecutively from one family member to another. Other diseases, for example tuberculosis, asthma, dysentery, diarrhea, cholera, pile, hypertension, congestive health problem, rheumatism, rashes, eczema, ringworm, eye pains, cataract, glaucoma, typhoid fever, sickle cell anemia, epilepsy, and migraine were screened among the residents of the community. However, skin diseases like eczema, rashes, and other external signs of unhealthy skin were captured for the group. Thus, malaria is the most dominant health issue which. According to the residents, is seasonal and sometimes related to temperature changes.



**Fig. 4.10:** Perceived illness associated with the gully erosion  
 Source: ESMP Field Survey, 2017

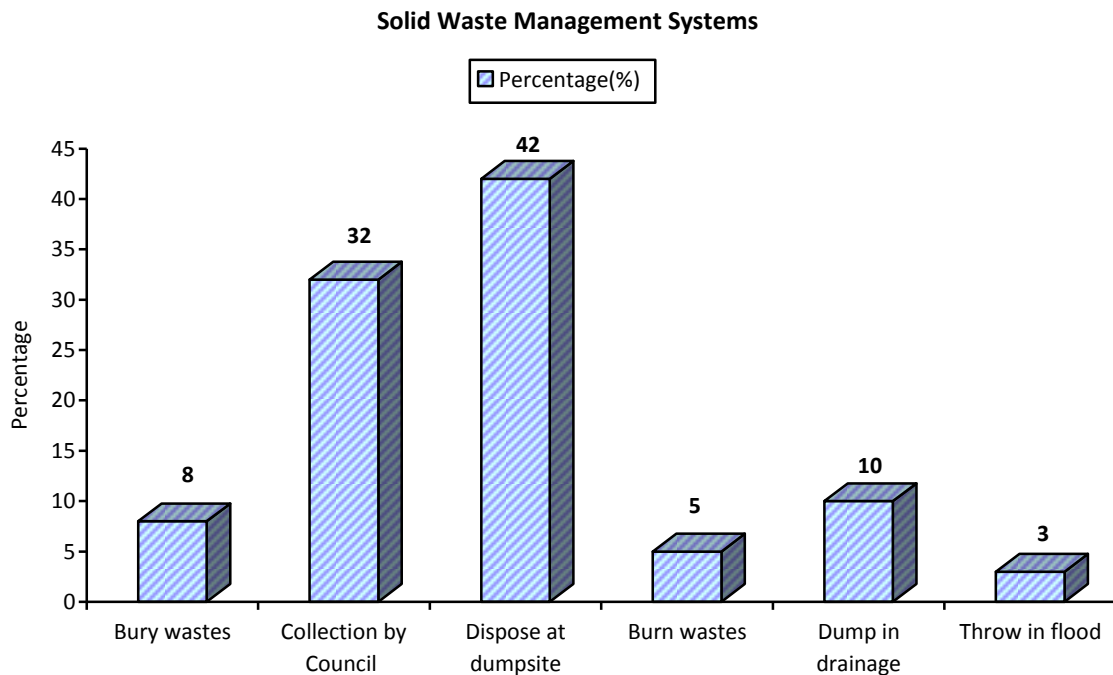
The outcome of the initial assessment of the respondents' current state of health showed that there are invariabilities in their claim that the gully affects their health status. It is therefore imperative to ascertain the method of healthcare treatment from the ailments reported. As captured in Figure 13 below, in case of any ailment, most of the residents (85%) claimed to use the available health facilities by attending a nearby hospital (particularly government tertiary facilities). The proportion that uses the nearby chemist as alternative constitutes 8% of the residents. This group engages in self-medication. Also, 5% of the respondents claimed to use the trado-medical alternative in which natural herbs are used at home to treat ailment. Just 2% of the surveyed population relies on religious/spiritual care as their treatment plan.



**Fig. 4.11: Health Care Methods of Respondents**  
Source: ESMP Field Survey, 2017

#### 4.6 Assessment of Waste Management Methods

Most of the residents of the community engage in an unsafe mode of waste management. Dumping waste in the dumpsites (42%) is erroneously seen around in the community thus, reducing erosion. 5% of the respondents claimed to use the local waste incineration methods like burning after the waste has been generated in large quantity while 8% bury their wastes. 32% claim to use the waste managers who visit the community from time to time, which could also mean dumping in the gully. 10% use the drainage channel as a means to dump waste, just 3% drop their wastes in flood.



**Fig. 4.12:** Waste Management system adopted by Respondents  
 Source: ESMP Field Survey, 2017

#### 4.7 Communities' Environmental Concerns (CECs)

The most visible effects of global environmental challenges are erosion and land degradation. The impacts on human life is tremendous could curtail livelihood leading to human lives if left uncontrolled. The project area is not immune to these impressions. So, the proposed project has become inevitable as human lives and properties are constantly under threat due to the effect of the gully. Though the community embraced the commencement of the proposed project, some environmental and socio-economic concerns were raised during the different stakeholders meetings and respondents.

##### 4.7.1 Perceived Evaluation of the Gully Erosion Intervention Activities

The residents' awareness of the NEWMAP intervention project is high in the community as over 85% of the respondents concur through the local gully erosion site Monitoring Committee that consistent and continuous information have been disseminated to virtually all concerned stakeholders on the gully erosion and the proposed project activities. Although, most claimed that several studies have been conducted by various research and governmental agencies in the area before now, they hope and believe that this time around serious remediation works will be carried out. The medium for the dissemination of the community information is the consistent community gathering. 70% of the respondents claimed that the community gathers as soon as matters of urgency arise. To this end, most

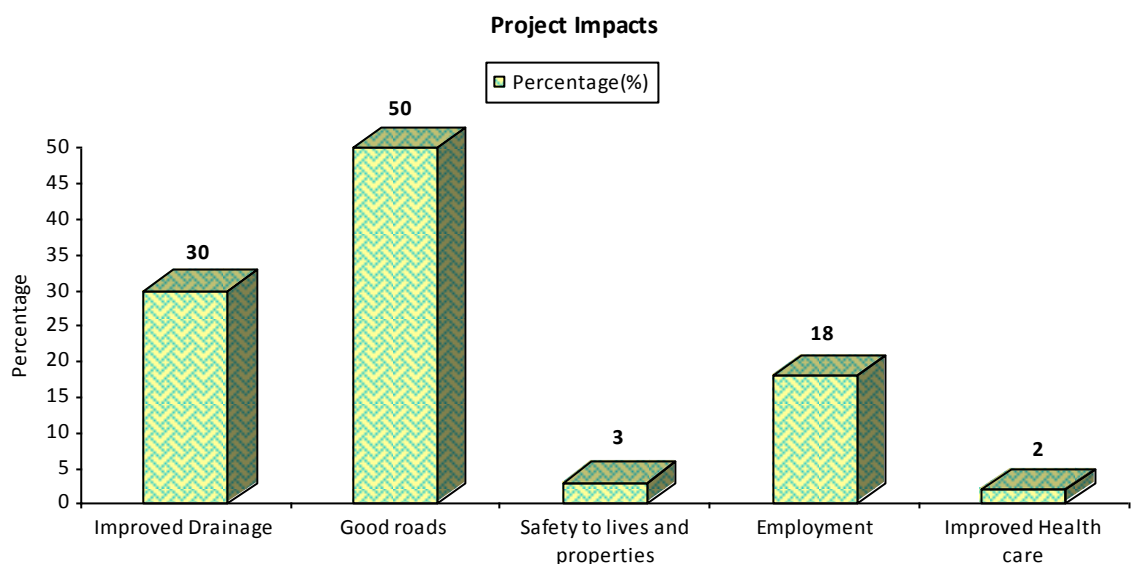
of them claimed to have attended the community meetings where the gully erosion project was discussed in depth.

Members of the community affirmed that the community is peaceful. They promised to give their full support during the rehabilitation activities but asked the community participation can be improved to avoid issues that could stimulate youth restiveness.

The community claimed that there are local professionals who can be employed as ad hoc staff specifically for the project. To this end, the contractor and the engineers will have to take advantage of using local able pool of manpower for the work. Loss of farmland and or property without being handled with sufficient compensation could also disrupt the project in the area.

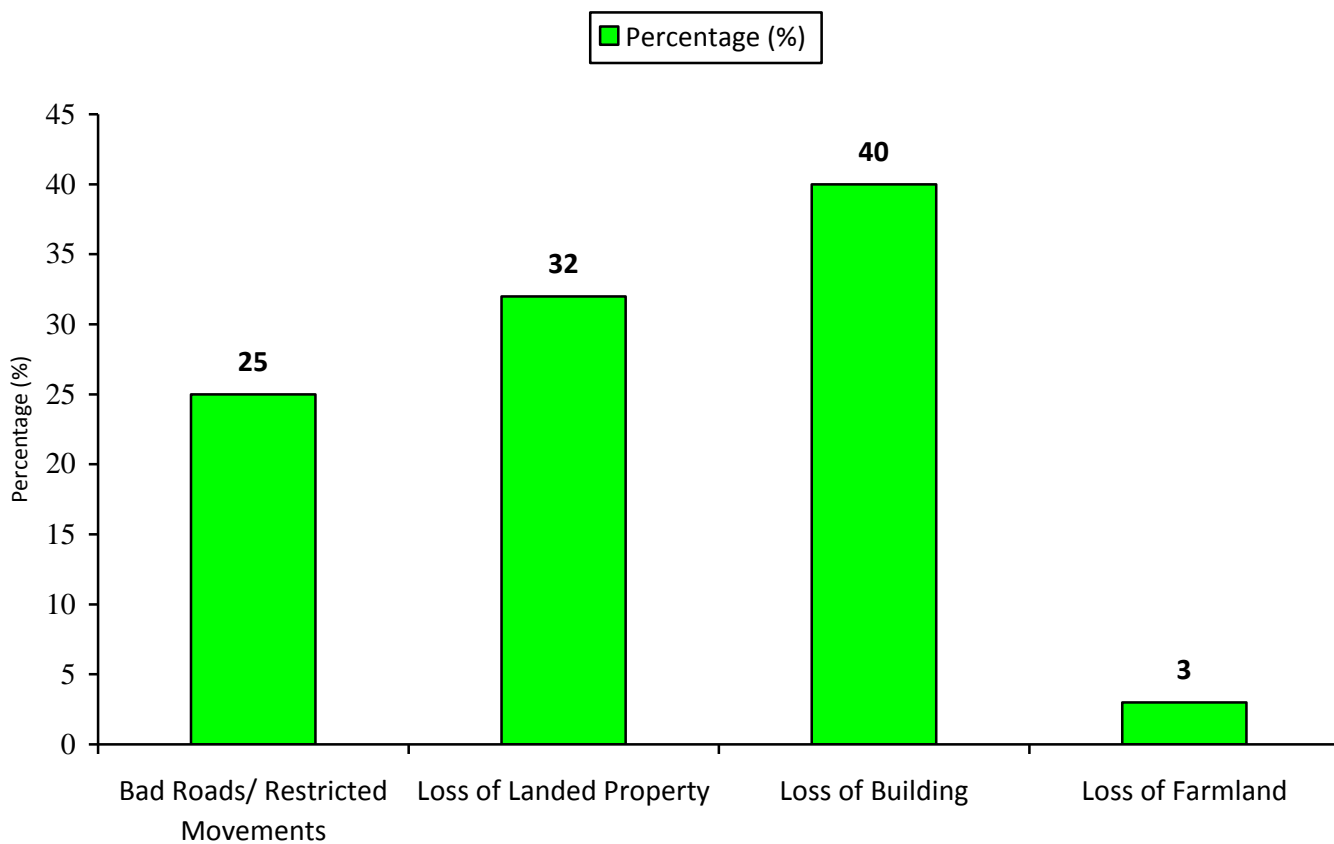
#### 4.7.2 Project Impact on Ogiso Community

The impact of the project on the community is represented below. Some of the respondents perceived beneficial impacts like improved drainage (30%), good roads and infrastructure (50%), safety of lives and properties (3%), provision of employment for locals (youths and able-bodied men) (18%) and improved healthcare (2%). This outcome represents the variety of expectations of the community towards the project. The level of success expected thus goes beyond the rehabilitation project to other key infrastructure provisions such as roads, electricity, and pipe-borne water amongst others.



**Fig. 4.13:** Project Impacts on Respondents  
Source: ESMP Field Survey, 2017

The dangers envisaged by respondents however if the project does not take place is presented below. 25% claimed that the project would lead to development of bad roads, 3% say it would result in the loss of their farmlands and properties. Others claimed that the project might lead to loss of their landed properties (32%), and loss of residential buildings (40%). These fears show that there are urgency and concealed threats that the project portends for the project communities with personal properties and means of livelihood being their principal concern. It is, therefore, paramount that the all reports should be conducted carefully and made all-inclusive in order to cover every form of property and economic activities that might be affected during the construction stage of the project.

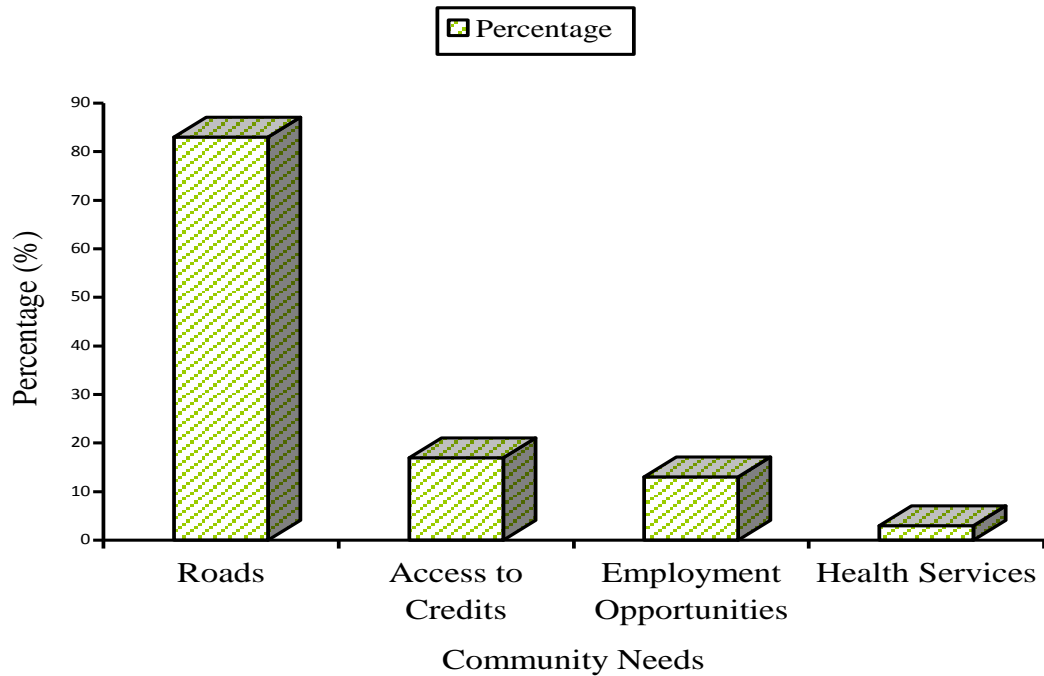


**Fig. 4.14:** Effects of gully development  
Source: ESMP Field Survey, 2017

#### 4.7.3 Major Needs in Ogiso Community

The needs in the community were prioritized, majority of the respondents 248 (83%) claimed that good roads are their main need, this will give them accessibility to going about with earning a living; employment was priority to 39(13%) in the community, 42(17%) desires

access to credit facilities while health services recorded 9(3%). These needs can be used as a parameter for determining developments in the community.

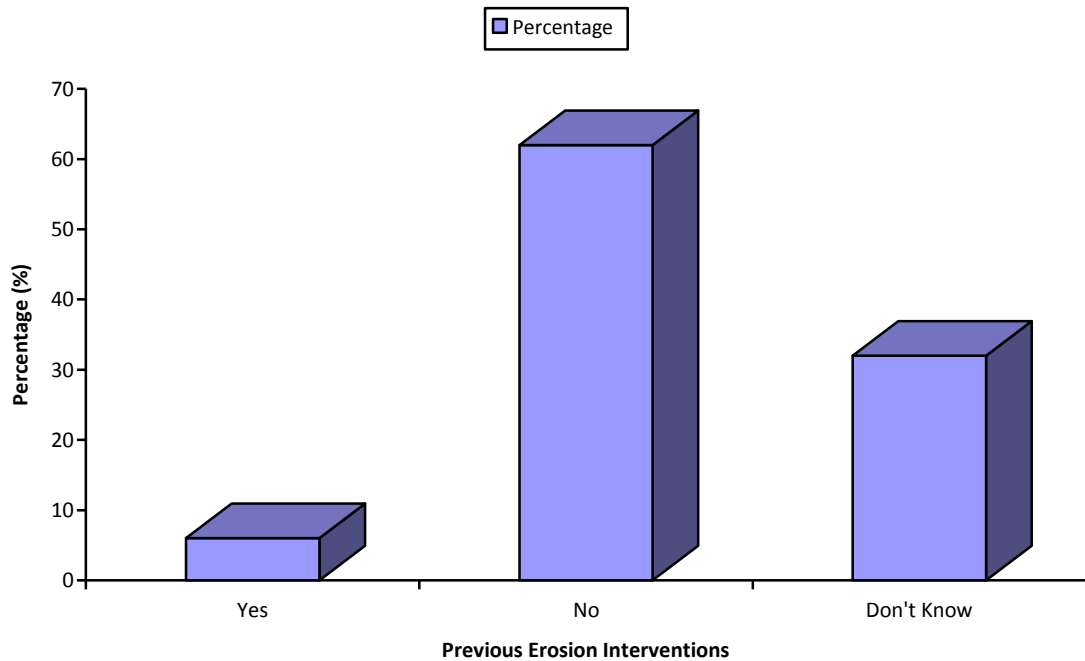


**Fig. 4.15:** Needs in community  
*Source: Field Survey, 2017*

#### **4.7.4 Erosion control In Ogiso Osunde gully site**

The knowledge of the proposed NEWMAP intervention in Ogiso Community is known by most of the residents. However, when asked about previous intervention mechanisms, most of the respondents, 80 (32%) claimed they don't know because of the overwhelming effects of the gully. However, 15(6%) says yes they have benefited from previous interventions with relics of existing structures though no longer functional. 155 (62%) says the community hasn't benefited from previous erosion control.





**Fig. 4.16:** Benefit from previous erosion interventions

Source: ESMP Field Survey, 2017

### Themes from Stakeholders' Engagement: Findings

#### ***Severeness of Erosion/Flooding in the community***

In the Ogiso community, stakeholders' meeting/discussions were conducted for various groups (men, women and youth) to understand the seriousness and effects of erosion/flooding in their community. The men as the head of household experienced loss of their property in form of houses, and landed property, the women also complained of their subsistence farming being closed down by the effect from the erosion/flooding. They have been records of death in the time past arising from the severeness of the erosion/flooding. The youth claim they have been affected because customers to their businesses such as barbing or hair dressing salons, electrical stores, etc. have reduced drastically, hence, an increase in unemployment.

A point that was most emphasized by elders in Ogiso is that some of the houses in the erosion laden part of the community have been abandoned. It was also discovered from the findings that water comes directly from the ground, because part of the river was reclaimed, sandfilled, and then sold as land to build houses.

The impact of erosion has also affected business activities in the community for instance, a prominent shoe company, Bata in the community closed down some years ago of the erosion problem.



**Plate 4.1: Severe erosion case in Ogiso Community**

### ***Housing Structure***

The erosion/flooding in the community has affected the structure of houses either by deforming it through dilapidated fencing/walls, flooded compound, etc. These in a way affect the well-being/health of the members of the community. There has been records of deaths due to the erosion of menace.



**Plate 4.2: Housing structure in Ogiso Community**

***Government and Social amenities***

There are no government facilities in Ogiso Community. They lack basic amenities like hospital/health centres, primary school, water supply, etc.

***Styles of living***

The members of the community has adopted a style though wrong in coping with their conditions, for instance, their waste disposal are being dumped into the gully site (especially the abandoned manhole constructed by previous interventions) with the intention of using it to prevent further damages, however, it worsens the situation of the study area. A point worthy of note by the elders of the community is that houses have been built on top of the abandoned manholes by members of the community.





**Plate 4.3: Wastes in drainages constructed by previous intervention**



**Plate 4.4: Manhole constructed by previous intervention**



**Plate 4.5: Livelihood option in Ogiso Community**

#### *Failure of Previous Interventions*

Though not by recent administrations (governments), there has been intervention by Edo State government to curb the erosion situation in Ogiso community. The Women group interviewed in the community, said that the manholes constructed by past interventions posed threats to the young children and youths in the community, so members of the community started filling them up with dirt.

Also, the Niger Delta Development Commission (NDDC) rehabilitated the major road that leading into community without attending to the sub-lanes and streets within the community, so that didn't serve much as it was totally destroyed with time.

#### **4.8 Grievance Redress Mechanism (GRM)**

A Grievance Redress Mechanism (GRM) has been designed by the Project and will be operational during ESMP implementation. The main objective of the GRM is to investigate charges of irregularities and complaints received by the Contractors and Edo NEWMAP SPMU, and provide an early, transparent and fair resolution.

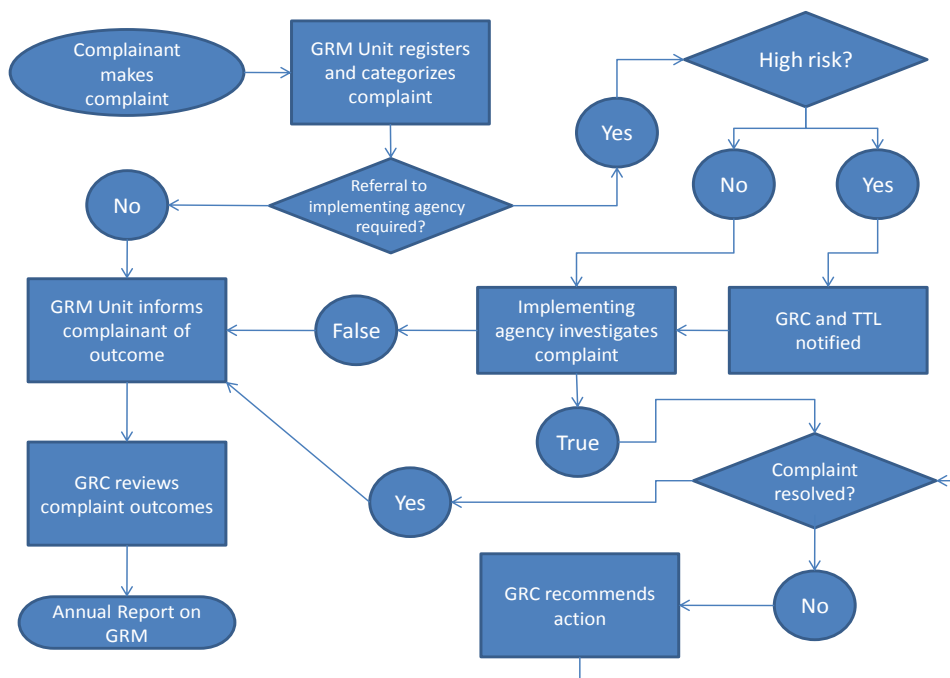
The GRM will be communicated widely, both among the communities living close to the project site through the use of Community Liaison Officer (CLO) for the project, among other stakeholders.

Complaints will be received by the SPMU and can be submitted through phone, email or letter. These will be assessed in 15 days and the result communicated to the complainant. The SPMU will be responsible for investigating the complaints and preparing reports based on these complaints. In case the complainant is not satisfied with the outcome or the process of complaint handling, he/she will have the option of appealing to the Project Coordinator (PC). The Project Coordinator will be the final authority in this case and will communicate a final decision to the complaint within 15 days.

Complaints will be lodged and tracked through a tracking number. A complaint record will be maintained and the progress of GRM will be shared with World Bank on a monthly basis.

Edo State PMU will also maintain an inquiry helpline which will enable stakeholders to obtain information on a range of issues including employment, contracting, procurement, supply and machinery hiring procedures.

Below is the flowchart of stages in the GRM:



**Fig. 4.17: Flowchart of Stages in Grievance Redress Mechanism**

## **OTHER CONCERNS FOR PUBLIC CONSULTATION, IDIs, FGDs AND COMMUNITY MEETING**

The major concern and impact expressed by the stakeholders and the residents of the Ogiso Community concerning the gully rehabilitation works covered aspects of the project, these were summarized as outcome of the public consultation events, the focus group discussions, and community meetings with key members of the community of the project. (The minutes of meeting is shown in Appendix 1).

The summary of the concerns expressed during these gatherings are stated as follows;

- Accelerated increase in the expansion of the gully in recent time;
- Massive damage to lives and property especially during rainy season;
- Destruction of existing road and footpaths to connect nearby communities;
- Threats to the safety of all residents of all ages especially the vulnerable groups children, women and the aged;
- Threats to means of livelihood particularly to farmers especially during rainy season;
- Previous rehabilitation measures have led to intensification of the gully expansion consequently leading to development of new gullies that connects to the main gully.
- Local palliatives only work to reduce the velocity of the waters rushing downslope but did not prevent the destructive potency of the gully.

However, with respect to the proposed intervention, the expectations of the people during construction phase includes;

- Employment of the youths during the construction phase of the project;
- Adequate compensation to people whose property will be damaged due to the intervention.

Also, they assured total cooperation with the Edo State NEWMAP, contractors and consultants. They promised adequate security and protection of lives, properties and equipment and machineries during construction.



## **CHAPTER FIVE**

### **ASSESSMENT OF POTENTIAL ADVERSE IMPACTS AND ANALYSIS OF ALTERNATIVES**

#### **5.1 Methods and techniques used in assessing and analyzing the environmental and social impacts of the proposed project**

This chapter presents the potential adverse impacts of the proposed intervention as well as the methods and techniques used in assessing and analyzing the environmental and social impacts of the proposed project. It discusses potentially significant adverse environmental and social impacts. Furthermore, it presents alternatives to the current project and reasons for their rejection, including short description of likely future scenario without intervention.

##### **5.1.1 Evaluation of Impact Significance and Magnitude**

An impact is defined as “Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation’s environmental aspects (activities, products or services)” (EMS, ISO14001:2004). Where project activity and environmental receptor interactions occur, an impact is defined.

Potential impacts were generated from a matrix (interactions between project activities and environmental sensitivities), which considers each of the issues with regard to the following questions:

- i. What is the potential issue or impact?
- ii. What aspects of the project will cause the impact, and when or where is it likely to occur?
- iii. What are the sensitive or vulnerable resources or receptors?
- iv. Who are these impacts likely to affect?
- v. What information (project data/Environmental data) do you need to predict the magnitude of the impact?
- vi. Is the potential impact significant? And why? (Impact magnitude x impact value)
- vii. What potential mitigation measures would you propose to eliminate or reduce impact?
- viii. How can the beneficial impacts be enhanced?

The ESMP evaluates impacts according to their “significance” determined by considering project activity “event magnitude” and “receptor sensitivity”. Determining event magnitude requires the identification and quantification (as well as practical) of the sources of potential environmental and social effects from routine and non-routine project activities. An



understanding of the biophysical environment is the first step in determining receptor sensitivity.

### **Method for Determining Event Magnitude**

- **Extent / Scale:** Events range from those affecting an area of up to 500m from the source to those affecting an area greater than 500m and up to 1km from the source; and to those affecting an area of greater than 1km from the source.
- **Frequency:** Events range from those occurring once to those occurring up to 50 times; and to those occurring more than 50 times or continuously.
- **Duration:** Events range from those occurring for less than 24 hours to those occurring or more than 24 hours and up to one week; and to those occurring for periods longer than one week.
- **Intensity:** Concentration of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment. This ranges from a low intensity event, to a moderate intensity event, and to a high intensity event.

### **Method for Determining Receptor Sensitivity**

#### **(a) Biological/Ecological Receptors**

**Resilience (to the identified stressor):** This ranges from species or community unaffected or marginally affected, to probability of species undergoing moderate but sustainable change which stabilises under the constant presence of impact source, with ecological functionality maintained; and to probability for substantial loss of ecological functionality (e.g. loss of species in key groups, substantially lowers abundance and general species diversity).

**Presence:** Routine, regular or reliably predictable presence of any species which is, in reverse order, a unique, threatened or protected species, to regionally rare or largely confined to project area or sensitive to disturbances; and to a species which is none of the above and is therefore assessed at the community level only.

#### **(b) Human Receptor**

**Presence:** This ranges from people being uncommon in the study area of anticipated impact; to people being present some of the time (e.g. commercial property); to people being permanently present (e.g. residential property) in the area of anticipated impact.

**Resilience (to the identified stressor):** This ranges from people being least vulnerable to change or disturbance (i.e. ambient conditions (air quality, noise)) are well below applicable legislation and international guidance); to quite vulnerable to change or disturbance (i.e.

ambient conditions (air quality, noise) are below adopted standards)); and to the most vulnerable groups (i.e. ambient conditions (air quality, noise) are at or above adopted standards)).

Impact significance, as a function of event magnitude and receptor sensitivity was subsequently ranked as “Negligible”, “Minor”, “Moderate” or “Major”. Any impact classified as “major” is considered to be significant and where the impact is negative, requires additional mitigation. Impacts of negligible, minor or moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not warrants further mitigation.

### **Trans-boundary and Cumulative Impacts**

**Trans-boundary impacts** are impacts that occur outside the jurisdictional borders of a project’s host vicinity. The potential trans-boundary impacts considered include:

- Social and economic issues surrounding the sourcing of labour, goods and services;
- GHG emissions to air; and
- Discharges to the aquatic environment.

On the other hand, “**Cumulative impacts**” arise from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time of the study. Such impacts arise from:

- Interactions between separate project-related residual impacts; and
- Interactions between project-related residual impacts in combination with impacts from other projects and their associated activities.

## **5.2 Discussion of the potentially significant adverse environmental and social impacts of the proposed intervention**

The proposed activities of the NEWMAP gully erosion intervention project in Ogiso-Osunde are capable of impacting various components of the biophysical, health and social environments. The potential adverse impacts are expressed as threats to human and environmental wellbeing. Project activities/environmental interfaces generally encompass a broad range of issues: air pollution, water pollution, effects on employment and community structure. These issues have been considered in arriving at the impacts of the proposed NEWMAP gully erosion intervention project in this Site.

### 5.2.1 Impact Indicators

The environmental impact indicators are easily observable parameters that will indicate change/deviation, which can be used to monitor the various environmental components. Those considered in this study are summarized in Table 5.1.

**Table 5.1: Environmental components and potential Impact Indicators**

| Environmental component                | Potential Impact Indicator                                                                                                                                                           |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Climate                                | Temperature, Rainfall, Relative humidity, Wind direction/speed.                                                                                                                      |
| Air quality Suspended                  | Particulate Matter (SPM), Nitrogen Oxides (NO <sub>x</sub> ), Sulphur dioxide (SO <sub>x</sub> ), Carbon Monoxide (CO), Volatile Organic Compounds (VOCs), Hydrocarbons etc.         |
| Noise and Vibration                    | Disturbance, Hearing Loss, Speech Interference.                                                                                                                                      |
| Surface and Ground Water quality       | Physico-chemistry (Dissolved and suspended solids, pH, Biochemical Oxygen Demand, Chemical Oxygen Demand, turbidity etc), Microbiology (Total Heterotrophic bacteria and fungi).     |
| Soil/Agriculture                       | Soil type, Soil pH, Total Organic Carbon (TOC), Soil nutrients, Total Heterotrophic bacteria and fungi, Hydrocarbon Utilizing bacteria and fungi and Coliform, Hydrocarbon Utilizer. |
| Biodiversity (Vegetation and wildlife) | Diversity and Abundance                                                                                                                                                              |
| Wastes                                 | Type of wastes, disposal methods,                                                                                                                                                    |
| social                                 |                                                                                                                                                                                      |
| Socio-economic                         | Population, livelihoods, income level, Needs and concerns of host community, culture, perceived employment, and security and infrastructure change, vulnerable groups etc.           |
| Health and safety                      | Incident, Accidents, work hazards,                                                                                                                                                   |
| Labour and workforce                   | working conditions of all workers, gender issue                                                                                                                                      |

The identified potential adverse impacts during the pre-construction, construction and operation phase of the proposed project are discussed below.

### 5.2.2 Potential Impacts

The NEWMAP gully erosion intervention project will be an effective way of controlling flood and erosion, and the consequent environmental damage, loss of life and property ravaging

Ogiso-Osunde. The likely adverse impacts of the Project on the biophysical and cultural components of the study area are described below. Most negative adverse potential impacts, especially during the construction phase will be on air quality, relief, water quality and fisheries. Other impacts will be on relief/hydrology and wildlife. Anticipated beneficial impacts would emanate from increased economic activities in the host community as a result of construction activities, re-vegetation activities, influx of workers, transportation activity, betterment of infrastructure and improvement of education (through skills development). These potential adverse impacts are summarized in Table 5.2 below.

**Table 5.2: Potential Adverse Impacts during Different Project Phases**

| Description of impact                                                      | Project Phases                   |              |                           |
|----------------------------------------------------------------------------|----------------------------------|--------------|---------------------------|
|                                                                            | Mobilization<br>Pre-construction | Construction | Operation/<br>Maintenance |
| Movement of heavy equipment to work sites which may pose danger to public  | x                                | X            |                           |
| Increase in potential for road traffic Volume and risk of accidents/injury | x                                | x            |                           |
| Influx of people, leading to Alteration in age-sex distribution            | x                                | x            |                           |
| Increase in local population due to influx of workers                      | x                                | x            |                           |
| Pressure on existing infrastructure                                        | x                                | x            |                           |
| Increase in communicable diseases ( including STIs)                        | x                                | x            |                           |
| Increase in cost of living/Inflation                                       | x                                | x            |                           |
| Increase in social vices/awareness                                         | x                                | x            |                           |
| Stress on existing security Structures                                     | x                                | x            |                           |
| Injury/fatalities in workforce/Communities                                 | x                                | x            |                           |
| Alteration/destruction of ecosystem                                        | x                                | x            |                           |
| Reduction in air quality                                                   | x                                | x            |                           |
| Increase in noise nuisance                                                 | x                                | x            |                           |
| Emotional disturbances                                                     | x                                | x            |                           |
| Potential for increased community agitation                                | x                                | x            |                           |
| Impairment of Ikpoba River quality by dredging activities                  |                                  | X            |                           |
| Reduction in biodiversity/Loss of Flora Fauna                              |                                  | X            |                           |
| Increased water run-off                                                    |                                  | X            |                           |
| Increase in breeding grounds for disease vectors                           |                                  | X            | x                         |
| Alteration of soil fauna community                                         |                                  | X            |                           |
| Soil degradation                                                           |                                  | X            |                           |
| Loss of employment (after commissioning)                                   |                                  |              | x                         |
| Potential resettlement of residents and properties                         |                                  | x            |                           |

### 5.2.3 Description of Potential Adverse Impacts

#### Significant Adverse Impacts

#### Road Traffic Accidents

Road traffic Accidents involving motorists, cyclists and pedestrians especially pupils are likely to increase if the volume of vehicular traffic on routes to schools increases. During the construction stage, dismantling of structures, cutting of trees, clearing of bush and foliage, haulage of laterite and other construction materials can form dust bowls obscuring vision. Associated spillage of lubricants on roads can generally cause accidents and increasing speed by truck drivers, not minding road signs, can increase the severity of accidents.

### **Air Quality – Reduced Visibility**

Project activities like vegetation clearing, excavation, provision of laterite for filling etc. will impact on the air quality due to generation of dust, particulates and gaseous emissions from movement of heavy trucks/machineries. The vehicle pollutant emissions may have negative health impacts. The particulate matter that would be released into the air could reduce visibility and settle on photosynthetic surfaces (leaves). Exhaust fumes from heavy machinery may contain gaseous hydrocarbons and noxious oxides like CO<sub>x</sub>, NO<sub>x</sub> and SO<sub>x</sub>. Gaseous discharges and dust particles from vegetation clearing, excavation and heavy machinery/vehicles during construction.

However, impacts though considered significant, are localized to the immediate vicinity of the emission source, and short-term in nature.

### **Noise and Vibration**

Prolonged exposure to noise of frequencies greater than regulatory limit can result in temporary or permanent hearing loss. Noise and vibration from heavy construction equipment such as heavy duty trucks, pay loaders, excavators and caterpillars can adversely affect houses close to the construction site with resultant cracks and falling plaster. If the foundation is defective with poor quality blocks used in construction, this could result in building collapse and fatality. The loud noise and vibration can also cause hearing impairment and communication interference among work force.

### **Impacts on Soils (Degradation)**

Removal of vegetation exposes the soil to direct rays of sunlight. This may elicit erosion, increase in soil temperature and changes in soil moisture regimes. These will in turn lead to changes in soil physical characteristics and subsequent mortality of edaphic organisms. The impact of machines that will be used will lead to soil compaction, loss of organic matter, deterioration of soil structure and reduction in infiltration rate and water holding capacity. These impacts will be direct and long term. Other impacts include:

- Loss of soil structure and increased soil erosion tendencies due to exposure;

- Reduction of soil productivity via soil pollution and pedoturbation (fauna, flora etc);
- Decreased fungal and microbial load of soil environment could deprive the inhabitants of major microbial benefits of the ecosystem. Nutrient cycling of organic matter will be obstructed. This can affect primary producers and affect crop production and yield.

### **Migration of Wildlife/Loss of Biodiversity**

Clearing of remnant forests along the project route will result in habitat destruction. Habitat destruction will result in loss of biodiversity, destruction of potential nesting/breeding sites and emigration of wildlife from the project area. Where there is no adjoining vegetation for refuge, these animals may gradually be exterminated or turn to be pests or disease vectors in human homes. The impact may be local in extent but could be serious, direct and irreversible. Other impacts include loss of natural runoff/storage capacity in vegetation, wasteland and soil. The proposed project will channel storm waters to the project endpoint. This could cause changes in hydrological regime in the area, with new tolerant communities emerging in balance to the new hydrological regime.

### **Health of workers and project community**

Increase in communicable diseases (including STIs): The influx of a largely youthful, sexually active people, many of who are likely to be single is anticipated to increase the potential for casual sex and the transmission of STIs. Experience from past projects indicates that commercial sex workers often constitute a significant proportion of camp followers and if the same occurs for this project, it is likely to increase the risk of contracting STIs. Also, the presence of youthful people could lead to various social pathological conditions such as increase in crime rate, fraud, prostitution, drug and alcohol abuse, etc.

Increase in breeding ground for disease vectors. Standing bodies of water (if storm waters are not properly channelled) could enhance the breeding of the mosquitoes *Anopheles gambiaense* and *Aedes aegypti*, that serve as vectors in the transmission of malaria.

Personnel injury/death resulting from welding burns and malfunction/ mal-operation of excavator/cranes etc.

During excavation, workers and members of the project community are likely to be exposed to a lot of dust and consequent respiratory problems. Besides, bacterial and parasitic infections are likely to occur since casual workers often pass excreta on bare ground at the roadside. This could pollute local stream and expose community members to health problems. Pollution of water bodies could also result from continued dumping of refuse in project re-vegetated areas.

### **Socio-economic Impacts**

The influx of workers and service providers will result in more social diversity with the attendant social problems of conflict and deviant behaviour, putting pressure on existing security, facilities/personnel in the locality. Edo NEWMAP and her contractors shall work with traditional leaders and existing social groups in the area to ensure good relations, with youths and women as important stakeholders.

During mobilization of personnel and equipment to site, there shall be increased traffic along some sections of the Murtala Mohamed Way/Third East Circular road, which could cause occasional, though localised, disturbance to local commuters and residents. Some of the socio-economic adverse impacts are summarized as follows:

- **Increased potential for road traffic volume and risk of accidents/injuries:** It is anticipated that road traffic might be disrupted during mobilization of personnel and equipment to site. Throughout the construction phase traffic is also expected to be disrupted because people and vehicles may be diverted away from the project area or confined to use only a section (lane) of the road. Given the present narrow condition of existing access road to the gully head, these disruptions and increases in volume of traffic have the potential to cause traffic jams, worsen the already bad condition of the road and increase the risk of accidents.
- **Pressure on existing infrastructure:** Influx of people mostly during the mobilization and construction phases will put more pressure on the already deficient physical, social and economic institutional infrastructure. Increased pressure on existing infrastructure may also result from the disruption/destruction of power and telecommunications cables crossing roads in and to the project area.
- **Increase in Community agitation:** During all project phases, there would be an influx of people (job seekers, business persons, CSWs, etc). When locals perceive that immigrants would deprive them of job/business opportunities, it could lead to community unrest. Intra-communal conflicts with respect to job opportunity allocation might also occur.

- **Blocking of the only access road to the community:** The community has only one access road which poses great risk in time of emergency and evacuation. Construction work may interfere with movements in and out of the community, as there is no other access road.

### **5.3 Discussion of Project Alternatives**

Analysis of project alternatives in the context of this ESMP, refers to the performance of the resources with or without the completion of the project or with or without the implementation of the measures designed with this ESMP and/or safeguard instruments considered appropriate. It is therefore a comparison of possible alternatives to be considered with respect to the proposed intervention project.

A ‘No Action’ scenario in Ogiso-Osunde will spell doom, leaving the communities at the mercy of the devastating and life threatening erosion, annual flooding and inundation. The flood and gully erosion intervention project under Nigeria Erosion and Watershed Management Project (NEWMAP) is, therefore, a much welcome development.

For this project, analysis of the alternatives is presented as follows:

#### **Alternative 1: No-Action Scenario**

The assumption on this alternative is based on the impression that there will be no alteration to the existing condition at the Ogiso-Osunde Gully Erosion Site. Specifically, the prevailing erosion status of the area will be left untouched, unaddressed and without any civil works or any engineering construction works.

The gully eroded areas and the expansion of the gully will be left to persist without any attempt at addressing the environmental challenge. Consequently, the conditions at the gully erosion site and its alignment will worsen resulting in destruction of houses, farmlands, roads and road infrastructures and life of the inhabitants. Essentially, the prevailing conditions will be left without any amelioration efforts. As a result of these effects, the no-action alternative is not recommended for this project.

#### **Alternative 2: The Use of Civil Works (Biological and the Construction of Hard Structures)**

This rehabilitation works and associated enhancements will involve intensive civil works across the broad spectrum of the affected and high-risk areas. Thus, physical construction works and bioengineering cum technological approaches will be adopted in rehabilitating and enhancing affected areas as envisioned according to the goals of NEWMAP. Adverse



impacts of these activities will be highly minimised in such a way that the benefits outweighs the demerits, thus, manageable.

Furthermore, quality of lives and livelihood of the community residents will be enhanced with the implementation of the stated measures in the ESMP. The cost of transportation will either normalise or be reduced to the anticipate cost. Adverse impacts such as air, water and noise pollution, destruction of vegetation, disruption of economic activities might be experienced during various stages of the implementation of the provision of ESMP. These impacts will be slight and of short duration thus are manageable.

The merits of the Civil Works Alternative outweigh the No-Action Alternative and it is thus recommended.

## CHAPTER SIX

### ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

#### 6.1 Proposed Mitigation Measures

This section presents the actions and measures that NEWMAP intends to take to reduce (or eliminate) significant adverse impacts of the proposed project. These actions and measures are aimed at reducing the impacts to As Low As Reasonably Possible (ALARP). The residual impacts that could arise despite these mitigation measures were also noted. Significant adverse impacts are expected to be mitigated through effective implementation of Health, Safety and Environment (HSE) plans put in place during the different phases of the project. The mitigation measures proposed are in keeping with the following:

- World Bank's performance standards;
- Environmental laws at national, regional and internal levels;
- FMEEnv (formerly FEPA, 1991) regulations on infrastructure and waste management;
- Edo State Ministry of Environment policies;
- Best Available Technology for Sustainable Development;
- Social wellbeing and
- Concerns of stakeholders.

The following criteria were used to define mitigation measures for the identified associated and potential impacts:

**Prevention** - Exclude significant potential impacts and risks by design and management measures.

**Reduction** - Minimize the effects or consequences of those significant associated and potential impacts that cannot be prevented to a level as low as reasonably possible by implementing operational and management measures.

**Control** - Implement operational and management measures to ensure that residual associated impacts are reduced to a level as low as reasonably practical.

To successfully mitigate all the social impacts that may be associated with this project, it is recommended that Edo NEWMAP PMU establishes a Stakeholder Forum to include directly affected parties, representatives from the local municipality and other identified persons. The forum will serve to communicate project progress, material changes to the project, grievances received and corrective actions taken. Further details on stakeholder participation are provided under public consultations and disclosure requirements.

Table 6.1 presents a summary of the mitigation measures recommended to ameliorate all the significant associated and potential adverse impacts identified for the proposed intervention Project.

**Table 6.1: Mitigation measures for identified associated and potential impacts of the NEWMAP gully intervention project in Ogis-Osunde**

| Associated and Potential Adverse Impacts                                                                                                                                                                                                                                                                                                               | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <p>Land-take for project works, displacement of farmlands, properties, Legal issues.</p> <p>Increase in potential for road traffic volume, traffic jams and risk of accidents/injuries</p> <p>Waste generation from construction works</p> <p>Site Hazards–<br/>Community interaction with site works;<br/>Accidents resulting in injury or death.</p> | <p>Required resettlement of residents and businesses; Providing alternative activities, capacity building, Equity, conflict prevention and resolution mechanisms; Promotion of vegetative, and adaptive natural resource based livelihood measures/ Community based forest management planning of restored sites. Ensure that measures outlined in the Resettlement Action Plan for the project are implemented.</p> <ul style="list-style-type: none"> <li>•Edo NEWMAP PMU shall ensure pre-mobilization inspection of all vehicles.</li> <li>•Vehicles shall be maintained at optimal operating condition to avoid breakdown and obstruction of roads.</li> <li>•NEWMAP PMU shall ensure that contractor provides a mobile workshop in case of unforeseen breakdown.</li> <li>•Visible warning signs shall be placed on roads and large construction vehicles.</li> <li>•If vehicles are parked on an incline set parking brakes and chock wheels.</li> <li>•Effective journey management (Large and slow moving vehicles shall be scheduled during off-peak periods).</li> <li>•Contractor shall ensure that only certified and medically fit drivers are used for all vehicles.</li> <li>•Arrangements should be concluded to map out alternative routes that will be traversed by vehicular traffic in the case of temporary denial of access ways.</li> <li>•Contractor shall organize Defensive Driving Course for all vehicle drivers.</li> <li>•Contractor shall maintain adequate first aid in all project vehicles;</li> <li>•Awareness creation amongst communities on potential of increased traffic.</li> <li>•Daily pep talk is conducted with job hazard analysis carried out.</li> </ul> <p>Waste minimization, Recycle, Reuse, Give away or sell.</p> <p>Where there is a potential for the community (including workers) to be exposed to hazards. The Contractor shall:</p> <ul style="list-style-type: none"> <li>• Identify the hazard;</li> <li>• Inform all individuals/communities as to the presence and nature of the hazard/increased traffic.</li> <li>• Restrict public access to work areas including construction areas, staging and storage sites via appropriate security.</li> </ul> <p>This will include:</p> |

| Associated and Potential Adverse Impacts                                                                                                                                                                                                                                                                                                                                                  | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| <p>Personnel Injury (fatalities in workforce resulting from ergonomic Risks, malfunction/wrong operation of equipment, risks from confined spaces and excavations).</p> <p>Disruption of power cables crossing roads, underground power and communications cables, water pipes etc.</p> <p>Loss of top soil; soil degradation, potential for erosion and flooding on the project site</p> | <ul style="list-style-type: none"> <li>• Security fencing and appropriate signage;</li> <li>• The presence of security personnel;</li> <li>• Permitting of site access with a requirement for site induction and the use of appropriate personal protective equipment (PPE).</li> <li>• Identification and enforcement of haul routes (including avoiding dangerous routes during specific times);</li> <li>• Establishment and enforcement of speed limits for all construction related vehicles.</li> <br/> <li>• Provision of training to all drivers on the requirements for safe driving measures, e.g., speed limits;</li> <li>• Consult with local emergency services to agree on procedures for accidents/ emergencies relating to construction activities;</li> <li>• Compensation for proven project-induced injuries, accidents and fatalities</li> <li>• Equipment used shall be properly maintained.</li> <li>• Equipment operation shall be by competent personnel with years of experience in excavation.</li> <li>• Use PPE as appropriate for the task (e.g. hard hats, gloves, and work vests).</li> <li>• Provide conveniently located equipment for lifting heavy objects;</li> <li>• Train workers on ergonomic risks and prevention.</li> <li>• Prevention of risks from confined spaces using appropriate EHS measures.</li> <br/> <li>•Conduct pre-construction survey to identify any existing underground Cables and pipelines. These should be properly relocated before trenching/ Excavation.</li> <li>•Drivers and vehicles shall avoid physical contact with power cables at road crossings during movement of equipment/bulky materials.</li> <br/> <li>•Soil shall be stabilized especially in hilly areas using Compactors/stone pitching/grassing to reduce erosion potential.</li> <br/> <li>•Use of Gabions and Reno Mattress to stabilize side slopes in areas affected or not affected by filling/cut.</li> <li>•Storm waters shall be properly channeled, with provision for impact basin, with rip rap at the outfall, before emptying into stream channels at project end point.</li> <li>•Preserve forested areas. Any non-paved area is re-vegetated immediately.</li> <li>•NEWMAP PMU shall encourage community members to minimize impervious area (minimize paved yards) by grassing/tree planting.</li> </ul> |

| Associated and Potential Adverse Impacts                                                                                             | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Pollution of the Ikpoba River from storm water Contaminants (especially at project end point); change in hydrological pattern</p> | <ul style="list-style-type: none"> <li>•Preserve forested areas. Vegetated areas are essential to filter the water before it enters the watershed.</li> <li>•Sediment traps/screens should be used to control sedimentation, particularly at the project end point.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>Contamination of soils, surface water and underground Water from spilled oil/fuel from storage facilities and sedimentation</p>   | <ul style="list-style-type: none"> <li>•Operators shall be trained on safe fuel handling practice.</li> <li>•Storage containers shall be periodically checked for leaks. Containers shall be provided with secondary containment capable of holding 110% of its contents.</li> <li>•Monitor waste water and sewage discharges in line with FMEEnv requirements.</li> <li>•All effluents shall be treated to regulatory limits before discharging into the environment.</li> <li>•Contractor shall ensure that untreated effluents are not released into the public drain or bush.</li> <li>•Storage areas should also be made of impermeable materials.</li> <li>•Fuel handling and storage should take place on impermeable surfaces.</li> </ul>                                       |
| <p>Increase in breeding ground for disease Vectors</p>                                                                               | <ul style="list-style-type: none"> <li>•Burrow areas should be well selected in order to cause minimum negative impact.</li> <li>•Edo NEWMAP to ensure maintenance of Catch pits and Impact Basins during operation.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>Reduction in biodiversity/Loss of Flora and Fauna; Alteration/destruction of ecosystem.</p>                                       | <ul style="list-style-type: none"> <li>•Preserve forested areas. Site for base camp shall be at a location with the most minimal impact on the vegetation and forestry resources.</li> <li>•Site clearing shall be limited to the area needed.</li> <li>•Use of bulldozers for site clearing shall be minimized.</li> <li>•Re-vegetation of trucking space shall be carried out as far as practicably possible</li> </ul>                                                                                                                                                                                                                                                                                                                                                               |
| <p>Reduction in air quality/<br/>Increase in respiratory diseases/<br/>Increase in noise nuisance</p>                                | <ul style="list-style-type: none"> <li>•Contractor shall ensure that only pre-mobbed equipment/vehicles are used</li> <li>•Water shall be sprayed on construction site to reduce fugitive dust levels especially during dry season.</li> <li>•Inspections and regular maintenance of equipment shall be conducted.</li> <li>•Construction workers shall be compelled to use PPEs (including nose masks) as appropriate.</li> <li>•Engines shall be switched off or reduced to idle when not in use.</li> <li>•Contractors should enforce no night driving policy.</li> <li>•Communities shall be consulted by the Contractor prior to periods of expected peak noise levels.</li> <li>•Contractors shall ensure that combustion engines are fitted with effective silencers;</li> </ul> |
|                                                                                                                                      | <p>Woody plant debris, Cement slurries and mix, Scrap metal, metal clippings, nails etc. resulting from the project shall be periodically moved to designated scrap yard for further management. The scrap yard</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Associated and Potential Adverse Impacts                                                                                                                                                                                                                                                                                                                     | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <p>Pollution from solid wastes</p> <p>Change in public health due to workers influx (Increase in communicable diseases including STIs)</p> <p>Pressure on existing infrastructures</p> <p>Blockage of drainage canals. Potential for increased injuries /fatalities (if poorly maintained).</p> <p>Increase in social vices</p> <p>Armed robbery attacks</p> | <p>shall be located around the project/camp site.</p> <ul style="list-style-type: none"> <li>•Edo NEWMAP shall undertake community based training on the prevention of common communicable diseases, water protection/purification techniques and basic sanitation.</li> <li>•EDO NEWMAP shall support activities of National Action Committee on Aids in the area.</li> <li>•EDO NEWMAP shall encourage workers to as much as possible avoid sexual interaction with the locals.</li> <li>•Contractor shall include requirements for entrance and exit medical exams for recruitment of workers.</li> </ul> <ul style="list-style-type: none"> <li>•Workforce shall as far as practicable, be isolated from host communities.</li> <li>•Base camp should be self sufficient with medical facilities.</li> <li>•Prior to commencement of the construction phase, EDO NEWMAP/contractor shall advertise construction jobs that will be available. This will, hopefully, discourage unqualified personnel from moving into the project area.</li> </ul> <p>EDO NEWMAP shall ensure regular de-silting and repairs to concrete canals, Catch pits and Impact Basins</p> <ul style="list-style-type: none"> <li>•Intensive enlightenment campaign and health education for the abatement of abuse of drugs and alcohol shall be carried out in the communities and among workers throughout the life of the project.</li> <li>•EDO NEWMAP shall ensure that Contractor enforces the no alcohol &amp; drug policy for staff.</li> <li>•EDO NEWMAP shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS.</li> <li>•EDO NEWMAP shall ensure that Contractor Implement social and health awareness programs for all workers at Induction and on a continuous basis throughout the life of the project.</li> </ul> <p>Engagement of private security agents</p> <ul style="list-style-type: none"> <li>•Contractor should perform appropriate due diligence on any security personnel with regard to past performance (e.g. violence, etc.).</li> <li>•Engagement of Police whenever money/materials are to be moved to site;</li> </ul> |

| Associated and Potential Adverse Impacts                                                      | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Damage to designated sacred sites/shrines</p> <p>Agitations by stakeholder communities</p> | <ul style="list-style-type: none"> <li>•Materials shall not be handled in a way to attract third party</li> <li>•Cash shall not be paid on site or transported to site without security arrangement.</li> </ul> <p>Not applicable as no sacred sites and shrines were found in and around the vicinity of the Ogiso-Osunde project boundary.</p> <ul style="list-style-type: none"> <li>•EDO NEWMAP shall brief all employees and contractors to ensure awareness of and sensitivity to local cultures/traditions of the host community. EDO NEWMAP shall advise all employees and contractors against entering sacred forests or tampering with totems where applicable.</li> <li>•EDO NEWMAP shall maintain established channels of communication with host community throughout the duration of the project.</li> <li>•EDO NEWMAP shall require contractors to hire local labour for unskilled job positions and possibly skilled jobs.</li> <li>•Utilisation of imported labour should be reduced to the very barest minimum and should be concentrated on skilled activities for which local personnel may not be readily available.</li> <li>•No night-driving policy shall be enforced by all the contractors; Construction activities shall be limited to daytime hours; Contractor shall utilize low noise generating equipment as much as practicable.</li> </ul> |



### **6.1.1 Description of Mitigation Measures**

#### **Pre-construction Phase**

##### ***Site Clearance***

All site clearance works shall be carried out within defined perimeters and only when necessary. The permissible time lapse between site clearing and initiation of construction operations shall be reduced to the barest minimum. Clearing of vegetation shall be kept to the barest minimum necessary to permit safe operations. Trees felled from site shall be re-utilized in construction or for the benefit of the host community. Organic waste can also be converted to organic manure through composting for subsequent use in reforestation programmes. Areas cleared in excess of operational requirements shall be re-vegetated with indigenous species.

#### **Construction Phase**

##### ***Construction Guidelines***

- The principal contractor will be required assign a senior member of his/her staff the day to day responsibility of overseeing compliance with the ESMP.
- Compliance reviews will be submitted by the principal contractor to Edo NEWMAP SPMU on a weekly basis.
- Non-conformances, incidents and deviations from the action plan will be communicated to Edo NEWMAP SPMU as soon as possible within 24hours from the time of occurrence. All tendering contractors will be required to provide a formal commitment to comply with the requirements of this ESMP.
- The contractor will undertake to provide formal written reports to Edo NEWMAP SPMU. General environmental management conditions for construction contracts and civil works are summarized in Annexure 3 of this ESMP document.

##### ***Human Resource Policies and Procedures***

- All workers for the contractor must have a contract which describes the employment relationship.
- The contract shall describe all policies and procedures related to working conditions and terms of employment.
- There shall be no discrimination against vulnerable groups, including women workers, young workers (but not child labour), migrant workers and workers with disabilities (i.e. Non-Discrimination & Equal Opportunity).
- Policies and procedures must cover all workers, including direct, contracted and supply chain workers.

### **Occupational Health and Safety**

- Develop a H&S Management Plan (HSMP) as part of ensuring that adverse impacts on the safety, health and welfare of Project personnel or local communities are avoided, and in order to deliver compliance with relevant good practice and the following Project standards:
  - Equator Principles;
  - World Bank Group Environmental, Health and Safety Guidelines;
- A site induction shall be given to all personnel working on site.
- The appointed contractor will identify potential hazards and develop responses (including organization, use and maintenance of workplaces, working environment and work processes) to eliminate sources of risk or minimize workers' exposure to hazards. Where hazards are inherent to the project activity, or it is otherwise not feasible to completely eliminate the hazard, residual risks shall be managed through appropriate protective measures, such as controlling the hazard at source through protective solutions and by providing adequate personal protective equipment at no cost to the worker.
- Training must be provided to all workers on all relevant aspects of occupational health and safety associated with their daily work, including emergency arrangements.
- Third parties (visitors and external service providers) must be briefed on the relevant aspects of health and safety and emergency response when accessing the premises. The appointed contractor must document and report occupational injuries, illnesses and fatalities.
- Adequate access to first aid and medical assistance in cases of work related accidents or injuries must be provided.

### **Safety and Security**

Measures to reduce safety and security risk must include (but not limited to) the following:

- Access to construction sites must be restricted;
- Trespassing on neighbouring properties (by workers) must be prohibited and the appropriate disciplinary action must be taken in the event of transgression;
- The appropriate signage must be placed on the boundary or at the entrance to all construction sites, warning against entering the site and highlighting the health and safety risks; and
- Public awareness programmes must be developed to identify areas of particular risk and approaches to reduce risk. This should be expanded to include programmes in any

school in the project area in order to advise children on the dangers of traffic and construction activities.

### ***Prevention of Accidents/Incidents/Emergency Response***

Compliance to regulatory requirements, operations/maintenance codes as well as safety guidelines shall form the basis for the execution of the ESMP, in order to prevent or minimize workplace accidents and incidents. However, a contingency plan shall be developed as back up to handle emergency situations resulting from equipment failure, weather, negligence and/or sabotage. As a minimum, the contingency plan shall address the following emergency situations:

- Fires and Explosions;
- Serious injury or illness affecting many students and staff;
- Weather related disasters; and
- Land vehicle mishaps.

Project contractors shall be required to submit project security plans to Edo NEWMAP SPMU for review and approval. Where required, the SPMU shall organize security workshops to identify, evaluate and recommend contingency plans for all security risks associated with the gully erosion intervention project. The SPMU shall ensure that they are in touch with the State Security agencies and call them at times of distress.

### ***Transport Operations***

#### ***Increase in Road Traffic Volume and Risk of Accidents/Injury***

In order to mitigate the anticipated increase in road traffic during the construction phase of the project, EDO NEWMAP shall request the contractor(s) to ensure that roads in the project site are pedestrian friendly. Furthermore, in order to reduce traffic congestion and discomfort to road users, especially during the mobilization and construction phases, movement of large and slow-moving vehicles will be scheduled during off-peak traffic periods. Arrangements should be concluded to map out alternative routes that will be traversed by vehicular traffic in the case of temporary denial of access ways.

The project shall manage all transportation operations in line with the following guidelines in order to forestall accidents/incidents.

#### ***Pre-Mobilization of vehicles***

All vehicles to be used to convey equipment, personnel and materials shall be pre-mobilized by the responsible HSE officer. The pre-mobilization shall be conducted to ensure that the

vehicles are fit for whatever purpose to which they shall be deployed. The pre-mobilization shall also confirm that all the personnel handling the vehicles have the necessary competences needed for the journey. It shall also be confirmed during the pre-mobilization exercise that a Job-Hazard Analysis (JHA) has been conducted for the trip and that all recommended precautions have been adopted.

### ***Journey Management Plan***

All trips to be undertaken in the course of the project shall be managed in such a manner as not to result in injury to life or property. A journey management plan specific to each trip shall be produced and submitted to the environmental focal point for approval. The details of the journey management plan shall include proposed mobilization date, mode of transport, route(s), and nature of cargo as well as the details of the JHA conducted for the trip. The environmental officer for the project shall approve such trips only when all the necessary precautions to forestall accidents/incidents have been demonstrated and confirmed.

### ***Traffic and Vehicle Management Plan***

To achieve the desired outcomes, the Contractor (Edo State NEWMAP) is required to undertake the following measures:

- Place speed limits and appropriate road signage along all Project roads;
- Enforce speed limits for safety, air quality, and noise purposes both on the Project site and beyond;
- All Edo State NEWMAP drivers should be trained by a road safety specialist; and,
- All vehicles should be properly maintained and undergo periodic safety inspections.

### ***Health and Safety of Workers***

Operations at all work sites shall be subject to World Bank, State and federal government regulatory policies and guidelines. All Edo NEWMAP and contractor staff shall be well informed and trained on the CASHES policies and guidelines. All facilities shall also be designed to enhance safety planning and activities shall be executed within the confines of relevant legislation and stakeholders' interests. Contractors shall provide adequate health services as well as site first aid services for its workforce. The first aid services shall be extended to visiting personnel and casual workers. All construction activities shall be properly managed through careful planning and the application of relevant CASHES policies including the following:

- Use of Permit to Work (PTW);
- Job Hazard Analysis and toolbox meetings;

- Use of PPE in designated hazard areas;
- Prohibition of alcohol during work hours and at work sites and facilities;
- Prohibition of night work;
- Regular emergency drills;
- Prohibition of smoking in fire hazard areas; and

***Personnel Injury (Prevention of risks from confined spaces and excavations)***

Confined spaces that may be present in construction or demolition sites include silos, vats, hoppers, utility vaults, tanks, sewers, pipes and access shafts. Ditches and trenches may also be considered confined spaces when access or egress is limited. The appropriate measures are addressed in the WB/IFC General EHS Guidelines. In addition to this guidance, the occupational hazards associated with confined spaces and excavations in construction and decommissioning sites should be prevented according to the following recommendations:

- Controlling site-specific factors which may contribute in excavation slope instability including, for example, the use of excavation dewatering, side-walls support and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment or drowning.
- Providing safe means of access and egress from excavation, such as graded slopes, graded access route, or stairs and ladders.
- Avoiding the operation of combustion equipment for prolonged periods inside excavation areas where other workers are required to enter unless the area is actively ventilated.

***Loss of biodiversity***

Light in construction areas should be directed downwards so as to reduce illumination of surrounding areas and minimize disturbance to nocturnal fauna, where security and health and safety factors allow. Vegetation from cleared areas should be left to rot and burning should be prohibited if a fire hazard exists (as in the dry season). All construction personnel should be provided with appropriate training in ecological awareness, as appropriate to their work activities. Effective short term measures for slope stabilisation, sediment control and subsidence control should be provided.

### ***Loss of livelihoods***

Providing alternative activities, capacity building training or employment opportunities can lessen the effects of this impact. The influx of more money into the local economy will likely have a positive impact upon the traders by having a higher demand for their products and more customers with the attendant higher prices for their goods. However, it may negatively impact upon the standard of living for other inhabitants in the area, particularly among socially marginalized groups.

### ***Increase in community unrest***

The presence of a large number of vehicles and unusual movements is likely to create agitation within the communities given the present state of the roads. As a mitigation measure, the contractor and EDO NEWMAP shall maintain established channels of communication and inform communities in advance of all the phases of the project.

Community unrest could stem, amongst others, from perceptions of failure by EDO NEWMAP to deal even-handedly with all strata of community stakeholders. This situation may continue during the project. In order to deal with this, EDO NEWMAP shall establish channels of communication with the communities during all phases of the project.

During construction, there could be agitation for employment. EDO NEWMAP shall require contractors to hire local labour where feasible. Unskilled labour shall be drawn from the community; preference shall be given to qualified skilled labour from the project area. It is important that EDO NEWMAP ensures that the contractors adopt transparent approaches in matters of employment even for the unskilled labour. EDO NEWMAP shall honour all MOU items with the local communities.

### ***Reduction in quality of health***

Site clearing is expected to cause the proliferation of disease vectors, e.g. mosquitoes, rodents, snakes etc. and also injuries from construction activities. The community has no standard health facility. EDO NEWMAP should ensure contractor maintains a well equipped Accident/emergency unit or maintains a medical retainership with a nearby clinic during the construction phase of the project. Also, there is need for periodic health education/enlightenment programmes to raise people's awareness and change their attitude and practice of sanitation and waste management. Contractor should arrange for provision

of clean, hygienic and potable water in the event of disruption of water supplies from boreholes within the project boundary.

### ***Soil degradation, Surface and Groundwater Contamination***

Construction equipment generates some volumes of waste oil. Its proper handling is critical because improper discharge and/or storage, and leakage can result in the contamination of soils, surface and underground water if there is a lack of a controlled fuelling, maintenance and servicing protocol for construction machinery at the project site. Storage areas should, therefore, be made of impermeable materials and fuel handling and storage should take place on impermeable surfaces.

To achieve the desired ESMP outcome, the Contractor is required to undertake the following measures:

- Effective site drainage including cut-off drains to divert surface runoff from exposed soils or construction areas;
- Construct temporary drainage channels to channel and divert surface water away from any down slope land and agricultural plots;
- Ensure that all construction activities are performed by methods that will prevent pollution of the soil media from accidental spills of contaminants, debris, and other objectionable pollutants;
- In the event of a significant spill, relevant spill control measures shall be applied and contaminated soil shall be cleaned as appropriate;
- Regular checks shall be conducted on equipment to minimize minor lube oil and combustible leaks from engines;
- The contractor will undertake regular checks of earth storage mounds and compounds to confirm that there is no encroachment of soil from storage mounds onto vegetated areas adjacent to work areas;
- Rehabilitate and revegetate cleared areas before the next wet season;
- Bunding of areas where hazardous substances are stored (eg fuel, waste areas);
- Areas of open ground are to be paved or rehabilitated and revegetated;
- To the extent possible use gravel (or similar material) for large area of hardstanding to allow for greater permeability;
- Ensure that regulatory requirements are met before discharge of contaminated or potentially contaminated construction area run-offs;
- Forested areas should be preserved to ensure reliable quantity and quality of water;

- The general public shall be educated on the need for prudent watershed management, including forest conservation;
- During construction, Edo NEWMAP SPMU shall ensure that clearing is during dry season so as to put in place appropriate erosion-control facilities before heavy rains begin. Before construction activities begin, the Contractor shall prepare and put in place a storm water pollution prevention plan for erosion during construction;
- Excessive site clearing shall be avoided and exposed surfaces shall be re-vegetated as soon as practicable to minimize erosion and silt runoff;
- All temporary and permanent drains are to be designed and constructed to prevent surface runoff from further eroding natural and built slopes; and
- Catch chambers or settlement ponds should be constructed wherever necessary to prevent eroded materials from reaching water bodies. This will minimize siltation of rivers and streams.

### ***Air Quality***

To achieve the desired outcomes, the Contractor is required to undertake the following measures:

- Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt and mud;
- Water suppression or dust extraction fitted to construction equipment where possible;
- Implement dust suppression measures (such as spraying) if required;
- Spray surfaces prior to excavation and clearing;
- Speed limit on-site of 15 km/h on unhardened roads and surfaces;
- All vehicles used should be regularly maintained;
- Indiscriminate burning of materials resulting from construction waste, bushes and combustible materials shall not be permitted.

### ***Noise Quality***

To achieve the desired outcomes, the Contractor is required to undertake the following measures:

- Avoid dropping materials from height, where practicable;
- Avoid metal-to-metal contact on equipment;
- Avoid mobile plant clustering near residences and other sensitive land uses;
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events;



- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the Community Liaison Officer (CLO);
- Train construction staff on noise control plan during health & safety briefings;
- Select 'low noise' equipment, or methods of work;
- Use most effective mufflers, enclosures and low-noise tool bits and blades;
- Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant;
- Use temporary noise barriers for small equipment, where required;
- Reduce throttle settings and turn off equipment and plant when not used;
- Regular inspection and maintenance of all plant and equipment;
- Exhaust stacks will be designed to meet a power level of 92 dB(A);
- Fit a silencer to the exhaust gas system
- Earmuffs shall be provided for all workers in the vicinity of high noise generating equipment or operations.
- Use short haulage distances to construction site and as far as possible from sensitive receptors;
- If noise levels at any time give rise to public complaint, the issue shall be treated as public nuisance and Edo NEWMAP SPMU will take appropriate measures to resolve the problem with the appropriate authorities. In any case, the community shall be consulted prior to periods of expected peak noise levels.

### ***Flora and Fauna Management Plan***

The primary purpose of the Flora and Fauna Management Plan is to protect the biodiversity of the area from any unintended damage due to the rehabilitation constructions and operation, and to protect the Project personnel from dangers associated with the native flora and fauna. This plan will include the following provisions as well as others that may be identified as it is further developed:

- Animals shall not be handled, removed, killed or unnecessarily disturbed by the proposed activities;
- Edo State NEWMAP will not tolerate poaching of fauna or flora by its personnel or by any of its contractors' or subcontractors' personnel;
- Edo State NEWMAP will ensure through a High Conservation Value study that all High Conservation Value Forest sites are properly marked and left untouched;
- Edo State NEWMAP will help to maintain the integrity and quality of biodiversity in the project area;

- Edo State NEWMAP will assist in protecting the swampy section from liquid effluent generated in the rice processing centre;
- The gully rehabilitation is to occur over a period of eight years. Edo State NEWMAP should plan its development projects in advance to minimize the impact on the fauna, help identify and control impacts such as flood zones and to result in a lower amount of biomass to manage;
- Edo State NEWMAP shall monitor the general condition of the aquatic habitat downstream to ensure that its water withdrawals are not creating significant stresses to that habitat and if so, Edo State NEWMAP shall develop plans to install wells to replace enough of the surface water usage to mitigate the significant impacts;
- Edo State NEWMAP shall ensure that the site is kept clean, tidy and free of garbage that would attract animals;
- In order to reduce the risk from invasive species, the monitoring programme for the interventions should track what types of invasive species occur, where they occur, how they were most likely introduced to the area, how they were eradicated, and the success of the various eradication measures. If any of the Edo State NEWMAP officials or contractor identifies a continuing problem with invasive species, it should determine the root cause of that problem and investigate additional measures to address that root cause;
- In order to decrease the demand for local bush meat, Edo State NEWMAP should take the following measures:
  - decrease hunting pressure by ensuring that adequate supplies of meat other than local bush meat as well as other protein sources are available in stores and markets within the study area;
  - educate its employees on the adverse impacts of hunting and consuming bush meat;
  - to the degree possible, prohibit and enforce prohibitions on hunting inside the project area;
  - sponsor education programmes in local villages about the adverse impacts of hunting and consuming bush meat; and
  - sponsor programmes to transition hunters to other, sustainable livelihood activities.
- Edo State NEWMAP will work with conservation groups and other stakeholders around the Project Area to help prevent poaching. Initiatives may include hiring guards, posting signs among others.

### ***Waste Management***

To achieve the desired outcomes, the Contractor is required to undertake the following measures:

- Develop a Waste Management Plan;
- An estimate of the types and quantities of waste to be generated during construction and operation;
- Project requirements with respect to waste segregation at source, waste storage areas (on hardstanding and bunded where appropriate), handling and disposal of all wastes, including sludge;
- Project procedures to ensure waste is managed in accordance with the waste hierarchy;
- Procedures in place to ensure that spent oils (including transformer oils) are recycled;
- Recycling opportunities (for metal etc.) are identified and taken advantage of;
- Identify appropriate waste facility/haulage operators for each type of waste;
- Demonstrate the capacity of each facility to accept Project waste;
- Provide evidence that each of the proposed facilities have an appropriate license, which has been checked and verified;
- Provide information where necessary to support a Project application for a waste licence;
- Implement the WMP and operate at all times in accordance with the conditions of the Project waste licence (when it is granted) and any associated regulatory requirements;
- Ensure that compliance with the WMP is a contractual requirement for all Project personnel (including contractors);
- Liquid wastes must meet the recommended BOD and COD values before being discharged into the water environment;
- Solid wastes which are biodegradable can be disposed of in landfills;
- Non-biodegradable forms such as plastics, metal cans and scraps require special treatment;
- Contractors shall define and document all wastes generated and transferred in the course of this project;
- provide marked bins/strategic locations to ensure proper segregation. Components such as wood, plastic and paper should be sent for recycling or reuse; and
- All wastes should be disposed at approved dumps.

The waste management guidelines for the gully erosion intervention project are presented in Table 6.2.

**Table 6.2: Waste management guidelines for NEWMAP gully erosion intervention project in Ogiso-Osunde**

| Source of waste<br>Impact                                                                                                                                                                                                                                                        | Composition/<br>Classification                                                                                                                                     | Potential Impact                                                                                                                                                                         | Disposal Options                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Pre-construction Preparation works.</b><br/>To include waste associated with: Demolition of structures, Clearing trees and ground etc.</p>                                                                                                                                 | <p>Concrete, gravel, stone, soil, inert materials, wood, metals, plastics, general waste. Some are combustible; recyclable.</p>                                    | <p>Increased generation of Waste; Generation of dust/noise; Pollution of nearby receptors (e.g. streams); flooding, reduced Agricultural productivity and impact on receiving stream</p> | <p>It is envisaged that the majority of the waste generated during demolition is reusable. Incorporate into the design the use of recyclable materials. Disposal of unused materials to landfill. Develop procedures and controls to ensure appropriate storage of waste to minimize risk of pollution. Establish specific erosion and sediment controls, particularly in relation to site preparation earthworks (e.g. soil storage mounds, sediment ponds). The controls should limit the mobilization and dispersion of sediment into freshwater and estuarine environments. Ensure that appropriately licensed transportation contractors and disposal sites</p> |
| <p><b>Construction Phase;</b><br/>To include waste associated with: Reconstruction of laterite road washed away at the gully head; sub-grading, excavating and embanking the road base; construction of concrete drains with slabs; Construction Equipment, Concrete mixing.</p> | <p>Concrete, gravel, Soil, stone, inert materials, wood, metals, plastics, insulation, packaging (material bags), gypsum, general waste. Some are combustible;</p> | <p>Generation of stone and waste earth, toxic gas, waste oils, domestic waste. Flooding, reduced Agricultural productivity and impact on reservoir capacity.</p>                         | <p>Develop a waste inventory; this should detail the different waste streams, classification, quantities, storage requirements, potential use, and treatment and disposal arrangements; Provide</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Source of waste<br>Impact                                                                                                   | Composition/<br>Classification | Potential Impact                                                                                                             | Disposal Options                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                             | recyclable.                    |                                                                                                                              | storage for domestic waste on the construction sites and at the site huts. Excavated material shall be used for backfilling, landscaping or other remedial works on site.                                                                                                                                                                                          |
| Work camp                                                                                                                   |                                | Domestic waste.                                                                                                              | Segregate recyclable materials (glass bottles, paper, plastics, metals etc.) and send to reprocessors; disposal to landfill; Composting of food waste offsite                                                                                                                                                                                                      |
| Material extraction for road construction.                                                                                  | Waste earth, stone, Gravel.    | Physical (i.e. dust, sediments) and chemical (i.e. oil, petrol, etc) contaminants resulting in a reduction in water quality. | <ul style="list-style-type: none"> <li>- If possible, work should be scheduled to avoid heavy rainfall periods (i.e. work during the dry season);</li> <li>- Contouring and minimizing length and steepness of slopes;</li> <li>- Provide temporary surface water drainage system including settlement ponds/ sediment traps prior to discharge points.</li> </ul> |
| Generation of hazardous waste<br>Activities include: Replacing machine oils; Performing Maintenance tasks on equipment etc. | Hazardous /combustible         | Groundwater and surface Water contamination.                                                                                 | Establish and implement operational controls for on-site storage of hazardous waste. Hazardous waste as well as hazardous materials should be stored in a secure area with impermeable surface on concrete hardstanding (or in                                                                                                                                     |

| Source of waste<br>Impact                                                                                               | Composition/<br>Classification          | Potential Impact                                                                                                                | Disposal Options                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                         |                                         |                                                                                                                                 | bunded containers with adequate secondary containment); Ensure containers are labelled so contents can be identified.                                                                                                                                       |
| Empty drums and aerosol Cans (plastic and steel)<br>Miscellaneous scrap metal from construction                         | Potentially hazardous (non-combustible) | Dependent on original contents of drums (lubricating oil, fuel and corrosion inhibition chemicals); Build-up of stagnant water. | Residues from drums shall be purged and cleaned before reuse (subject to quality assurance) otherwise, they shall be returned to the supplier. Recycled/reused, given away or sold. Unusable volumes shall be disposed at an appropriate landfill facility. |
| Oil, Oily rags and diesel/fuel leaks, used protective clothing (hand gloves, shoes, rainwear, etc)                      |                                         | Maintenance operations, fuel storage, regular work wear                                                                         | Where possible, oily rags and protective clothing shall be washed and reused at site. Otherwise, these wastes shall be incinerated or disposed at an appropriate landfill facility. Where possible waste oil should be recycled.                            |
| Contaminated surface water /storm water discharge during operation of restored road.                                    |                                         | Reduced water quality and Associated impacts on fish and benthic fauna.                                                         | Ensure that road drains and silt traps are maintained on a regular basis.                                                                                                                                                                                   |
| Medical wastes; soiled dressings, used needles and syringes, empty drug containers etc from First aid treatment, clinic | Hazardous (combustible)                 | Potential to contaminate soil and surface waters                                                                                | Medical wastes shall be packaged and incinerated or sterilized before disposal.                                                                                                                                                                             |
| Woody plant debris                                                                                                      | Hazardous (combustible)                 | Wooden plant debris from site preparation,                                                                                      | Recycled/reused, given away or sold.                                                                                                                                                                                                                        |

| Source of waste<br>Impact | Composition/<br>Classification  | Potential Impact                                                 | Disposal Options                                                  |
|---------------------------|---------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------|
|                           |                                 | Trenching,<br>excavation, etc                                    | Unusable materials shall be disposed at an appropriate dump site. |
| Cement slurries and mix   | Non-hazardous (non-Combustible) | Concrete works for culverts and drains.<br>Potential health risk | Give out, sell or dispose at approved waste dump site             |

## 6.2 Capacity Building Plan (Training and Awareness)

All staff of Edo NEWMAP and all members of the workforce for the gully intervention project will be made aware of their environmental responsibilities through induction and training courses. All site personnel must have a basic level of environmental awareness training. Topics covered should include:

- What is meant by the term “Environment”?
- Why should the environment be protected and conserved?
- In what ways do construction activities impact on the environment?
- What can be done to mitigate such impacts?

The training shall also include the following:

- Safety induction course,
- Social responsibility during construction (Community interaction and relations)
- Basic First aid for first aiders and more in depth training for selected personnel,
- Defensive driving,
- Permit to Work System

This training programme will help create environmental awareness and sensitivity amongst the personnel and shall be reviewed periodically. SAFETY awareness campaigns shall also be conducted for the host community and general public with the aim of sensitizing them to the potential impacts and hazards associated with the Edo NEWMAP gully intervention project and the appropriate response to accidents/incidents. The public awareness campaigns shall be conducted periodically and the proceedings documented for subsequent audit.

### **6.3 Public Consultation Plan**

The Edo State NEWMAP has been implementing its Stakeholder Engagement Plan since the inception of the Project invention. It includes the following major considerations:

- Identification of Project stakeholders;
- Summary of past consultation efforts;
- Planned consultation efforts to prepare for construction activities;
- Stakeholder engagement during construction;
- Stakeholder engagement during operations;
- Resources for stakeholder engagement;
- Monitoring and reporting on stakeholder engagement; and
- Formation of the site monitoring committees particularly the Ogiso-Osunde Gully Erosion Site Monitoring Committee.

### **6.4 Labor influx and Gender Based-Violence (GBV)**

#### **6.4.1 Labor Influx**

The project may face an influx of non-local labor and working conditions issues as skilled laborers might not be available in the project sites. The project shall take concrete measures to mitigate potential labor influx-related risks such as workers' sexual relations with minors and resulting in pregnancies, presence of sex workers in the community, the spread of HIV/AIDS, sexual harassment of female employees, child labor and abuse, increased dropout rates from school, inadequate resettlement practices, and fear of retaliation, failure to ensure community participation, poor labor practice, and lack of road safety.

To this end, the project shall include mitigation measures such as: (a) assessing living conditions of workers' camps and ensuring appropriate living conditions; (b) establishing and enforcing a mandatory Code of Conduct for the company, managers and workers and an Action Plan for implementation; (c) ensuring appropriate location for these camps; (d) taking countermeasures - indicated in the Social Management Plan - to reduce the impact of the labor influx on the public services; and, (e) devising and implementing a strategy for maximizing employment opportunities for local population, including women.

The following guidelines lays out the principles that will guide the management of adverse impacts that may result from temporary NEWMAP induced labor influx into the project communities.

- The SPMU shall have to hire, to the maximum extent, skilled and unskilled workers from affected communities in the project area. The SPMU shall adopt or implement all possible measures to avoid if not minimize labor influx into the project area.



- The SPMU shall assess and manage labor influx risk based on appropriate instruments such as those based on risks identified. Depending on the risk factors and their level, appropriate mitigation instruments need to be developed including the ESMP, Site-specific Labor Influx Management Plan and/or a Workers' Camp Management Plan<sup>1</sup>,
- Risk factors to the SPMU that shall be considered, include,
  - predominant presence of contractors without strong worker management and health and safety policies;
  - anticipated high volumes of labor influx;
  - pre-existing social conflicts or tensions;
  - weak local law enforcement;
  - prevalence of gender-based violence and social norms towards it in the community (acceptance of gender based violence);
  - prevalence of transactional sex;
  - local prevalence of child and forced labor;
  - existing conflict situation between communities;

absorption capacity of workers to the community (See <http://pubdocs.worldbank.org/en/497851495202591233/Managing-Risk-of-Adverse-impact-from-project-labor-influx.pdf>)

The SPMU will incorporate social and environmental mitigation measures into the civil works contract and responsibilities for managing these adverse impacts. This will be a binding contractual obligation on the SPMU, with appropriate mechanisms for addressing non-compliance

The Supervision Consultant shall be responsible for monitoring the contractor performance and adherence to the labor influx guideline and that of its Sexual Exploitation and Abuse (SEA) obligations, with a protocol in place for immediate, timely, mandatory and confidential reporting in case of incidents to project community.

This allows the SPMU to enforce the implementation of such mitigation measures, which are required to ensure that the consultant's own compliance with Bank policy requirements.

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<sup>1</sup>A Labor Influx Management Plan addresses specific activities that will be undertaken to minimize the impact on the local community, including elements such as worker codes of conduct, training programs on HIV/AIDS, etc. A Workers' Camp Management Plan addresses specific aspects of the establishment and operation of workers' camps.

#### **6.4.2 Gender Based Violence**

Nigeria is among the 10 percent of countries worldwide that exhibit the highest levels of gender discrimination according to the Social Institutions and Gender Index. Gender-Based Violence (GBV) remains pervasive and underreported in the country, largely constraining women's autonomy and life chances. Besides interpersonal and sexual violence, child marriage and Female Genital Mutilation are the other culturally harmful practices prevalent across Nigeria. However, GBV risks in the project area do not appear to be high. There might be verbal insults, physical abuse due to disagreement of workers on site and with community members and all of these shall be mitigated by the recent Bill on violence against persons that was signed into Law in February 2019 by the Edo State Government.

### **6.4.3 Description of Grievance Mechanism**

In coordination with its Stakeholder Engagement Plan, Edo State NEWMAP will develop and implement a Grievance Procedure that will include the following components:

- Anyone may contact the Project, in person, by email, or by telephone to submit a grievance;
- Contacts about grievances may be by the affected person or through an agreed local liaison committee;
- All complaints will be documented by Edo State NEWMAP and tracked to resolution, and information on the status will be available to the person making the complaint;
- The Edo State NEWMAP will investigate the complaint, using technical assistance if necessary, and determine the response including, if applicable, proposed actions;
- The Edo State NEWMAP will inform the person making the complaint, either verbally or in writing, of the SPMU's response and proposed actions (if any);
- Prior to construction, Edo State NEWMAP will work with stakeholders to develop a binding arbitration system for resolving complaints;
- The grievance mechanism will inform complainants of their options if the complaint cannot be resolved;
- The Edo State NEWMAP will strive to investigate and resolve complaints promptly;
- There will be no cost to the person presenting the complaint;
- All complaints will be treated with appropriate confidentiality;
- Complaints will be investigated and resolved without retribution to the complainant or other persons; and,
- Project personnel, especially those who have contact with the public, will be briefed/trained about the grievance procedure, including who to contact within the Edo State NEWMAP or the Edo State Government about a complaint.

### **6.5 Environmental and Social Management, Monitoring and Evaluation Plan**

In order to ensure that mitigation measures and environmental and social management objectives are integrated into the project planning and design based on identified impacts, this Section has been developed. It provides specific description of the impacts identified, mitigation measures as well as the institutional arrangements, i.e. who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting and staff training). The ESMP is implemented throughout the project life-cycle.

Edo NEWMAP has therefore developed this Environmental and Social Management Plan (ESMP) to identify the environmental and social management and mitigation actions required to implement the NEWMAP gully erosion intervention project in Ogiso-Osunde in accordance with the World Bank's Performance Standards and the requirements of applicable Nigerian legislation and environmental policies. It provides an overview of the environmental and social baseline conditions of the project area, summarizes the potential impacts associated with the proposed gully intervention project and sets out the management measures required at all phases of project development. The ESMP is to be utilized by the contractors commissioned by Edo NEWMAP for the project and will form the basis of the site-specific management plan that will be prepared by the contractors as part of their construction methodology. The potential impacts and associated mitigation measures and management procedures presented in this ESMP are based on the baseline information and assessments made during a single-season field data gathering exercise in November 2017. The baseline information (referred to above) has been incorporated into this ESMP document (See Chapters 3, 4).

The objectives of this ESMP include but not limited to the following:

- Achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;
- Avoid, where practicable, and reduce impacts on terrestrial and aquatic habitats and specific habitat features of ecological importance;
- Minimize, contain, transport, handle and dispose of solid and liquid wastes arising from project construction activities in such a manner as to minimize impacts to human health and the environment;
- Minimize potential air emission impacts on receptors;
- Minimize potential effects on water resources and associated receptors (i.e. rivers, streams, drainage channels, ponds, groundwater resources and associated users and specific flora and fauna);
- Prevent risk and resulting adverse impacts of the contractors activities on the health, safety and wellbeing of individuals and the community;
- In the event that damage or harm is caused, take action to repair and return to condition comparable to pre-impact condition;
- Implement a system to maintain communication with the community and raise awareness of proposed construction activities and the potential impacts that they may represent.
- Identify the roles and responsibilities of the environmental and social management organization of the project; and
- Ensure compliance with existing legislation.

### **6.5.1 Environmental Management System**

#### ***Organization and Responsibility***

For clarity in the management structure, the Project Management Unit (PMU) of Edo NEWMAP will be the focal point for environmental management issues related to the operation and construction phases of the project implementation programme. That is, Edo NEWMAP SPMU will be responsible for the management of all phases of the project and also have overall responsibility for planning, implementation, monitoring and enforcement of activities associated with this ESMP and environmental and health and safety performance. Edo NEWMAP SPMU shall assign an environmental officer with the responsibility to liaise with the contractors/sub-contractors towards review and implementation of the mitigation measures necessary. Environmental protection should be seen as a line responsibility for which everyone has accountability. Individual responsibility, from senior administrators who allocate resources and monitor environmental performance to individual staff and contractors who have responsibility for environmentally sound practices in their workplace, will be defined in job descriptions and company contracts. These guidelines shall ensure that the detailed design complies with the conceptual design. The project implementation team (i.e. PMU) shall include:

- The Environmental Officer, who shall be an environmental specialist;
- The project quality assurance engineer/scientist of Edo NEWMAP;
- The community liaison officer (CLO) of Edo NEWMAP;
- Representatives from the immediate host community; and
- Relevant government departments (Edo Min. of Env., Forestry Dept. etc.).

It is the responsibility of the Environmental Officer to ensure that the implementation design conforms to those in the concept plan. The implementation design may be reviewed and approved, referred or rejected if considered environmentally unjustifiable.

Consequently, the ESMP shall be updated periodically, throughout the project's life span to incorporate improved technologies, better environmental management systems and in the event of new guidelines from governmental agencies. It shall remain a dynamic working tool and will be owned by Edo NEWMAP or at project expiration such other establishment that will take over her responsibilities. Constructive suggestions by users (contractors, management, line and operating personnel) shall be assessed by the SPMU and integrated into the ESMP. It shall be reviewed with changes in regulatory regime and in the event of new policies or guidelines from regulatory/governmental agencies. All contractors and

subcontractors shall comply with the ESMP requirements as applicable to their assigned tasks. The measures and procedures outlined in this ESMP are commitments made by Edo NEWMAP SPMU and therefore remain responsible for their implementation. It is recognized that practical implementation of many of the measures may rest with contractors and subcontractors and consequently, Edo NEWMAP SPMU will require the implementation of a robust review/audit programme, as described in this ESMP, to measure and ensure that it is executed on her behalf.

The contractor shall ensure that all personnel responsible for the execution of the tasks and requirements contained in this ESMP are competent on the basis of education, training and experience. The Contractor's training activity associated with this ESMP shall be appropriately documented by means of a training needs assessment, training matrix/plan and records of training undertaken.

#### ***External Monitor for ESMP Implementation***

It would be necessary to employ the service of an External Monitor/Auditor to ensure the total implementation of the Mitigation/Management Measures contained in the ESMP for all phases of the intervention project. The External Monitor audits the activities of the contractor during all phases of the project and ensures that all the mitigation measures and environmental management requirements spelt out in the ESMP are completely adhered to. The External Monitor visits the site on quarterly basis and submits reports to the funding agency stating the level of compliance and /or non-compliance to all requirements.

#### **6.5.2 Monitoring and Auditing Plans**

The Federal Ministry of Environment (FMEnv) guidelines require an environmental monitoring plan as part of an ESIA and ESMP. The aim of the monitoring programme is to ensure that the negative environmental impacts already identified are effectively mitigated in the design, construction, operational and decommissioning stages of the Ogiso-Osunde Gully Erosion Intervention Project. It also instills confidence in the host communities, the proponent of the project and regulatory bodies that the identified impacts are adequately mitigated. Environmental monitoring of the project is therefore advocated in order to ensure that the mitigation processes put in place have adequately taken care of the predicted impacts. This will necessitate establishing programmes to address the following:

- Alteration to the biological, chemical and physical characteristics of the recipient environment;
- Social and health issues;

- Alterations in the interactions between project activities and environmental sensitivities, and interactions between the sensitivities;
- Determination of long term and residual effect;
- Identification of project specific cumulative environmental effects.

Environmental Monitoring plan specifies the mitigation measures, monitoring requirements, duration and frequency of the monitoring, and the action parties to manage the biophysical, social and health environment at the various phases of the project.

ESMP guidelines have been developed to cover all activities of the Ogiso-Osunde gully erosion intervention project. These include pre-construction activities (mobilizations, establishment of base camp-site, etc), construction activities and operations. These guidelines, with performance indicators for each of the environmental components, are presented in Table 6.3.

**Table 6.3 Environmental and social Management Plan for the Proposed Ogiso-Osunde gully intervention project**

| Project Phase And Activity       | Potential Impact                                  | Mitigation/Management                                                                          | Parameter for Monitoring      | Frequency of monitoring | Frequency of formal reporting | Responsible Party       | Implementation Costs (₦)** |
|----------------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------|-------------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|
| <b>Pre-constructi on</b>         | Loss of farmland, Loss of income and livelihoods. | Ensure that measures outlined in the Resettlement Action Plan for the project are implemented. |                               |                         |                               | Edo NEWMAP              |                            |
| <b>Land acquisition (if any)</b> | Potential increase in road traffic volume         | Large and slow moving vehicles should be scheduled during off peak periods                     | No driving at night           | Continuous              | Monthly                       | Contractor & Edo NEWMAP |                            |
|                                  |                                                   | Raise community awareness of unusual activity                                                  | Record of awareness sessions  | Monthly                 | Six monthly                   | Contractor/ Edo NEWMAP  |                            |
|                                  | Potential increase in road traffic incidents      | Pre-mob all vehicles---                                                                        | Pre-mob certification         | Monthly                 | Monthly                       | Contractor/ Edo NEWMAP  |                            |
|                                  |                                                   | Install visible warning signs on roads and vehicles                                            | Adequate signs/speed breakers | Continuous              | Monthly                       | Contractor/ Edo NEWMAP  |                            |
|                                  | Increase in noise level                           | No night driving                                                                               | Night driving permit          | Continuous              | Monthly                       | Contractor/ Edo NEWMAP  |                            |
|                                  |                                                   | Contractor to ensure that all vehicles conform to limits for noise                             | Vehicles maintenance records  | Monthly                 | Monthly                       | Contractor/ Edo NEWMAP  |                            |



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| Project Phase And Activity                                         | Potential Impact                                | Mitigation/Management                                                                          | Parameter for Monitoring                                                 | Frequency of monitoring | Frequency of formal reporting | Responsible Party      | Implementation Costs (₦)** |
|--------------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------|-------------------------------|------------------------|----------------------------|
| <b>Mobilization:</b><br>Movement of goods, equipment and personnel | Reduction in Air quality (dusts, exhaust fumes) | Contractor to ensure that only pre-mobbed vehicles are used to reduce emissions from exhaust   | Pre-mob certificate                                                      | Continuous              | Monthly                       | Contractor/ Edo NEWMAP |                            |
|                                                                    |                                                 | Defensive driving course for Edo NEWMAP and contractor drivers                                 | Driving permit                                                           | Monthly                 | Monthly                       | Contractor/ Edo NEWMAP |                            |
|                                                                    |                                                 | First aid training of workforce and provision of first aid boxes in operational vehicles audit | Number of first aid certificates; records of vehicles, first aid boxes   | Weekly                  | Monthly                       | Contractor/ Edo NEWMAP |                            |
| <b>Construction</b>                                                | Community unrest                                | Contractor to ensure recruitment of locals for clearing and excavation                         | Employment records for locals;                                           | Weekly                  | Monthly                       | Contractor/ Edo NEWMAP |                            |
| <b>Land clearing, Excavation</b>                                   |                                                 | Edo NEWMAP to abide by all MOUs signed with host communities.                                  | Record of compliance with MOU items; Use of grievance redress mechanism. | Continuous              | Yearly                        | Edo NEWMAP             |                            |
|                                                                    | Loss of flora/fauna                             | Land to be limited to approved drainage route.                                                 | Site clearing inspection record;                                         | Continuous              | Weekly                        | Edo NEWMAP             |                            |

| Project Phase And Activity | Potential Impact                                                  | Mitigation/Management                                                                    | Parameter for Monitoring                                                 | Frequency of monitoring | Frequency of formal reporting | Responsible Party      | Implementation Costs (₦)**                                                                                      |
|----------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------|-------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------|
|                            |                                                                   |                                                                                          | revegetation efforts.                                                    |                         |                               |                        |                                                                                                                 |
|                            |                                                                   | Edo NEWMAP to educate workers and community on sensitive nature of biodiversity of area. | Records of HSE meetings                                                  | Weekly                  | Monthly                       | Edo NEWMAP             |                                                                                                                 |
|                            |                                                                   | Re-vegetation of unwanted/un-used area                                                   | Implementation records                                                   | 1 month after clearance |                               | Contractor/ Edo NEWMAP | <b>200,000.00</b> Revegetation                                                                                  |
|                            | Increase in dust and noise level/ Reduction of air quality        | Contractor to ensure that nose masks and earmuffs are worn by workers during excavation  | SPM, NOx, CO, SOx, VOC, records of respiratory diseases and noise levels | Continuous              | Monthly                       | Contractor/ Edo NEWMAP | <b>550,000</b> Air quality and noise in three locations (Ogiso-Osunde Upper and Lower Watershed, and community) |
|                            | Water to be sprayed at work site especially in dry season         | Records of compliance                                                                    | Continuous                                                               | Monthly                 | Contractor/ Edo NEWMAP        |                        |                                                                                                                 |
|                            | Threat to health of Workers/insect, snake bites, stings, injuries | Contractor to enforce use of PPEs by workers                                             | Compliance records                                                       | Continuous              | Monthly                       | Contractor/ Edo NEWMAP |                                                                                                                 |
|                            |                                                                   | Contractor to provide trained first aiders at work site                                  | First aid records                                                        | Monthly                 | Quarterly                     | Contractor/ Edo NEWMAP |                                                                                                                 |

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| Project Phase And Activity | Potential Impact                               | Mitigation/Management                                                                                          | Parameter for Monitoring                            | Frequency of monitoring | Frequency of formal reporting | Responsible Party      | Implementation Costs (₦)**         |
|----------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------|-------------------------------|------------------------|------------------------------------|
|                            |                                                | Contractor to ensure availability of anti-venom, anti-histamines at work site                                  | Record of anti-venom/histamines at work site/clinic | Weekly                  | Monthly                       | Contractor/ Edo NEWMAP |                                    |
|                            |                                                | Contractor to ensure that all workers are made aware of dangers from poisonous animals and plants at work site | Awareness records                                   | Monthly                 | Monthly                       | Contractor/ Edo NEWMAP |                                    |
| Influx of migrant labour   | Increase in STIs, HIV/AIDS and other illnesses | Edo NEWMAP to encourage sex education and awareness of transmission of HIV/AIDS, other communicable diseases   | Record of health awareness lectures                 | Monthly                 | Quarterly                     | Edo NEWMAP             | <b>400,000</b><br>Community health |
|                            |                                                | Vector control through regular fumigation of work site                                                         | Records of fumigation                               | Monthly                 | Quarterly                     | Contractor/ Edo NEWMAP |                                    |
|                            |                                                | Edo NEWMAP to support activities of State Action Committee on HIV/AIDS/STIs (SACA)                             | Record of support to SACA                           | Monthly                 | Quarterly                     | Edo NEWMAP             |                                    |
|                            |                                                | Contractor to provide clinic at work site for treatment of minor illnesses of workers                          | Records of attendance at clinics                    | Weekly                  | Monthly                       | Contractor/ Edo NEWMAP |                                    |
|                            |                                                | Contractor to carry out first aid training of workers                                                          | Compliance                                          | Continuous              | Half-yearly                   | Contractor/ Edo NEWMAP | Component of community health      |

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| Project Phase And Activity | Potential Impact                                                     | Mitigation/Management                                                                                                                           | Parameter for Monitoring                     | Frequency of monitoring | Frequency of formal reporting | Responsible Party                 | Implementation Costs (₦)**                                               |
|----------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------|-------------------------------|-----------------------------------|--------------------------------------------------------------------------|
|                            |                                                                      | Contractor to enforce use of PPE (e.g. boots, hard hats, goggles, etc)                                                                          | Compliance                                   | Continuous              | Monthly                       | Contractor/ Edo NEWMAP            |                                                                          |
| Waste generation           | Increase in breeding ground for disease vectors/other disease agents | Contractor to enforce waste management policy                                                                                                   | Compliance                                   | Continuous              | Monthly                       | Contractor/ Edo NEWMAP            |                                                                          |
|                            | Contamination of soils, surface and ground water bodies              | No discharge of untreated effluents, use of storage containers with secondary containment capacity, Compliance with waste management guidelines | Compliance; Physico chemistry, Microbiology  | Monthly                 | Monthly                       | Contractor/ Edo NEWMAP            | Soil, Ground and surface water at three locations.<br><br><b>850,000</b> |
|                            | Blockage of natural drainage                                         | Contractor to ensure that wastes generated are quickly disposed of at appropriate locations                                                     | Compliance                                   | Continuous              | Quarterly                     | Contractor/ Edo NEWMAP            |                                                                          |
| Influx of migrant labour   | Changes in local population                                          | Contractor to recruit most unskilled labour from host communities                                                                               | Records of applications at employment office | Continuous              | Monthly                       | Contractor/ Edo NEWMAP/ Community |                                                                          |
|                            |                                                                      | Contractor to look into development of off-site job recruitment to                                                                              | Documentary evidence of                      | 3-months                | 6 monthly                     | Contractor/ Edo NEWMAP/           |                                                                          |

| Project Phase And Activity | Potential Impact          | Mitigation/Management                                                                                                                                            | Parameter for Monitoring                           | Frequency of monitoring                  | Frequency of formal reporting | Responsible Party                 | Implementation Costs (₦)** |
|----------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------|-------------------------------|-----------------------------------|----------------------------|
|                            | Increases in social vices | discourage influx of people                                                                                                                                      | implementation                                     |                                          |                               | Community                         |                            |
|                            |                           | Movement of unauthorized persons to worksite to be restricted                                                                                                    | Records of access control                          | Monthly                                  | Quarterly                     | Contractor/ Edo NEWMAP/ Community |                            |
|                            |                           | Edo NEWMAP to intensify enlightenment campaigns and health education against alcoholism, drug abuse in communities and among workers throughout project life     | Enlightenment campaign/health education statistics | 1- 2 months before start of construction | Annually                      | Edo NEWMAP                        |                            |
|                            |                           | Edo NEWMAP to ensure contractors' enforcement of alcohol and drug policy among workers                                                                           | Records of violation                               | 6-monthly                                | Annually                      | Edo NEWMAP                        |                            |
|                            |                           | Edo NEWMAP to ensure that contractors implement social and health programmes for all their workers at recruitment and on a continuous basis through project life | Records of social/health awareness programmes      | At recruitment and quarterly thereafter  | Annually                      | Edo NEWMAP                        |                            |

| Project Phase And Activity                      | Potential Impact                                                                                   | Mitigation/Management                                                                                             | Parameter for Monitoring                     | Frequency of monitoring        | Frequency of formal reporting | Responsible Party      | Implementation Costs (₦)**                                                |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------|-------------------------------|------------------------|---------------------------------------------------------------------------|
|                                                 | Pressure on existing infrastructures and utilities                                                 | Contractor to develop an accommodation plan for workers prior to mobilization to reduce pressure on local housing | Accommodation plan                           | 3-months prior to mobilization | 1 month to mobilization       | Contractor/ Edo NEWMAP |                                                                           |
|                                                 | Potential increase in erosion, Contamination of surface water bodies and loss of agricultural land | Contractor to ensure that trenches are back filled as quickly as possible                                         | Compliance; Physico-chemistry, Microbiology  | Continuous                     | Monthly                       | Contractor/ Edo NEWMAP | <b>450,000</b><br>Microbial studies of water and sediments (2 locations). |
|                                                 | Potential for falls into trenches by animals/passers-by                                            | Contractor to erect barriers and signs close to trenches                                                          | Number and adequate signs/barriers           | Continuous                     | Monthly                       | Contractor/ Edo NEWMAP |                                                                           |
| Operation and maintenance of Drainage channels, |                                                                                                    | Investment in soil erosion management                                                                             | Area returned to use, increase in vegetation | Annually                       | Bi-ennially                   | Community / Edo NEWMAP | <b>400,000</b>                                                            |

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| Project Phase And Activity                                                         | Potential Impact | Mitigation/Management                                                                                                    | Parameter for Monitoring                                               | Frequency of monitoring | Frequency of formal reporting | Responsible Party      | Implementation Costs (₦)** |
|------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------|-------------------------------|------------------------|----------------------------|
| catch pits and impact basins;For est Management                                    |                  | Sustaining livelihoods and protecting biodiversity                                                                       | No. of people employed, No. of people using produce from project area. | Annually                | Bi-ennially                   | Community / Edo NEWMAP | 400,000                    |
|                                                                                    |                  | Contractor shall ensure the use by site workers of appropriate personal protective equipment (PPE)                       | Compliance                                                             | Weekly                  | Monthly                       | Contractor/ Edo NEWMAP |                            |
|                                                                                    |                  | Edo NEWMAP to ensure the training of first aiders                                                                        | Record of first aid training                                           | Monthly                 | Quarterly                     | Edo NEWMAP             |                            |
|                                                                                    |                  | Contractor to ensure that anti-venom/antihistamine is available in her clinic to mitigate snake bites/insect stings etc. | Records of anti-venom/antihistamine Provision                          | Monthly                 | Quarterly                     | Contractor/ Edo NEWMAP |                            |
| <b>Total Budget for ESMP implementation</b>                                        |                  |                                                                                                                          |                                                                        |                         |                               |                        | <b>3,250,000</b>           |
| <b>Additional cost of engaging an External Monitor for the ESMP implementation</b> |                  |                                                                                                                          |                                                                        |                         |                               |                        | <b>5,000,000</b>           |
| <b>TOTAL BUDGET</b>                                                                |                  |                                                                                                                          |                                                                        |                         |                               |                        | <b>11,500,000</b>          |

The total budget for implementation of the Environmental Monitoring Plan is Eleven million, five hundred naira only (i.e. \$22,917, at N360.00 to \$). Exclusive of training

## 6.6 Maintenance Procedures

Once operational, Edo NEWMAP SPMU shall carry out regular inspection of the project route. The main objective of such inspection shall be to ascertain environmental performance and level of compliance with mitigation measures and recommendations of the ESMP. The inspection team shall, during their visit, examine and inspect all operations along the project route which are likely to cause pollution or environmental degradation. Samples of any effluent discharges and solid waste deposits shall be taken for analyses and interpretation. After each visit the team shall compile a report detailing the specific areas inspected and highlights of any observed non-compliance/persistent negligence. In case of non-compliance the contractor shall be requested to take appropriate measures. The Edo NEWMAP SPMU shall report twice a year to the World Bank on ESMP compliance and to the authorities as per the relevant authorisation requirements. Copies of the audit report shall also be forwarded to the Edo Min. of Environment and the operating contractor.

The maintenance system shall include plans and procedures for:

- Normal maintenance {routine maintenance performed by the maintenance technicians (to be trained for the proposed project)};
- Preventive maintenance (activities carried out at pre-determined intervals);
- Predictive maintenance (replacement of section(s) of drain channel that could fail even though it is still working).

Routine maintenance shall include regular de-silting of drains and impact basins to remove accumulated sediments and thrash. Sediment and trash detention can cause blockage of drains.

## ESMP and Community Development

The SPMU shall ensure that implementation of this ESMP does not conflict with the community development programmes of government authorities, NGOs and aid agencies for the project area. The SPMU shall integrate any such Community Development/Assistance project with the NEWMAP gully erosion intervention project.

## 6.7 Decommissioning and Abandonment

The concept of abandonment of project site fits in with projects which are set up to exploit non-renewable resources like petroleum, gas deposits and other minerals. Since the utilitarian value of the project will not cease, then the project will not be abandoned. Such abandonment will spell doom and a return to the devastating and life threatening effects of 'runaway' gullies. The only circumstance under which this project could be abandoned is if a natural disaster or war destroys the structures or if new knowledge/technology dictates



further refinement. Even under such scenarios, the structures can be rebuilt/redesigned to continue to serve an important unique purpose.

## **6.8 Frame work for Implementation of the ESMP**

A monitoring program requires a number of components to ensure effective results. These include:

- Relevant baseline data (- presented in Chapters 3 and 4 of this ESMP document)
- Verifiably objective indicators for each project component for which monitoring will be conducted (- presented in Chapters 5 and 6 of this ESMP document);
- A body responsible for monitoring.
- For the ESMP to be effectively implemented the following areas have to be addressed:
  - Organization, roles and responsibilities
  - Assessment and improvement
  - Reporting and managing changes
  - Training, education and competency

### **6.8.1 Institutional Arrangements, Responsibilities and Accountabilities**

Well-defined roles and responsibilities and adequate institutional arrangements are central to the effective implementation of the environmental and social safeguard measures outlined in the current ESMP. Accordingly, details of institutional arrangements and the roles and responsibilities of the various institutions in the implementation of the current ESMP are discussed below.

#### **6.8.1.1 Pre-construction Phase**

##### **Key Agencies**

The Key Agencies with major roles in the implementation of the ESMP during the pre-construction phase are:

- The Contractor;
- The Federal NEWMAP-SPMU;
- The Edo State NEWMAP-SPMU;
- Edo State Ministries, Departments and Agencies (Information, Human Capital Development, Land, Finance, Physical Planning and Urban Development, and Agriculture);
- Community Based Organisations;
- The Ogiso-Osunde Gully Erosion Site Monitoring Committee;
- The RAP (Resettlement Action Plan) Consultant; and

- The World Bank.

### ***Role of the Involved Agencies***

The main responsibility for monitoring and reporting on the implementation of the ESMP lies with the Contractor. At the preparation stage, ground works and preparatory meetings and consultations were being conducted with the Ogiso-Osunde Gully Erosion Site Monitoring Committee, Community Based Organisations (CBOs) as well as with members of the concerned communities in the project area. The contractor will liaise with the Edo State NEWMAP-SPMU on the issues raised in order to find a balance in responding to the issues to meet international safeguard policies of the World Bank. These issues will be communicated to Edo State Ministries with their respective departments and agencies (MDAs) for prompt action on issues raised. In cases of displacement of people due to the land properties along the gully alignment the provisions of the RAP will be implemented.

It is assumed that RAP consultant would have consulted widely prior to the submission of the final report to Edo State NEWMAP-SPMU. The implementation of the issues raised will be managed based on the Federal NEWMAP-SPMU in conjunction with the Edo State NEWMAP-SPMU as well as World Bank.

### ***Reporting and Follow-Up***

The follow-up process is duty-based. First, the Environmental and Social Specialists (ESS) must prepare and document monthly and incident reports that would be submitted to the Edo State NEWMAP project coordinator for comments, observations, and recommendations. Then, the Edo State NEWMAP-SPMU would send feedback to the Engineer through the Supervising Consultant or directly when urgent action is required. In essence, checking and reporting on the implementation of follow-up action will also be part of the duties of the ESS.

The Contractor in conjunction with the Site Engineer should prepare and submit monthly reports on the implementation of the ESMP to the Edo State NEWMAPSPMU. The ESS officers who will advise the project management unit accordingly will vet this report. In case of any discrepancy on environmental issues, the project coordinator should convene Project Environmental Management (PEM) meeting to discuss and instruct on the way forward. The Site Engineer and the Contractor must participate in the meetings. Wherever possible, representatives of World Bank and Federal NEWMAP-PMU should also be invited to such meetings. Also, serious accidents (involving lost time, evacuation to a hospital, or a fatality) should be reported immediately to the SPMU and the World Bank.

### **6.8.1.2 Construction Phase**

#### **Key Agencies**

The Key Agencies with major roles in the implementation of the ESMP during construction works are:

- The Engineer;
- The Contractor;
- Edo State NEWMAP-SPMU;
- Federal NEWMAP-SPMU;
- Edo State Ministries, Departments and Agencies (Works and Infrastructure, Environment, Agriculture, and Forestry);
- Environmental Officers of the Federal NEWMAP-SPMU;
- Environmental Officers of Edo State NEWMAP-SPMU;
- Federal Ministry of Environment (FMEnv), NESREA; and
- World Bank.

In addition to the key agencies, the Edo State Government through the MDAs will also have a role in general oversight of ESMP implementation.

#### **Role of Involved Agencies**

**The Engineer** shoulders the main responsibility for monitoring and reporting on the implementation of the ESMP. Therefore, the Engineer through its Environmental and Social Specialist (ESS) will be responsible for regular supervision and reporting on ESMP implementation. The Engineer's ESS will have access to a team of experts in different fields (water, soil, social consultant etc.) in order to ensure sufficient capacity to oversee implementation of ESMP.

**Edo State NEWMAP SPMU** manages the implementation of the ESMP through the Environment Officers (EO) that will be primarily responsible for daily inspection and monitoring of ESMP implementation.

**The Edo State Ministries of Works and Infrastructure, Environment, Agriculture, and Forestry** will monitor ESMP implementation on the fundamentals of the internal mechanisms and policies as established by laws guiding their operations. These institutions may conduct announced and unannounced site visits with representatives of Federal NEWMAP-SPMU. The reports of the findings should be forwarded to the World Bank.

**The Federal Ministry of Environment (FMEnv) and NESREA** should also send Environment Officers and officials monitoring ESMP projects under the Federal NEWMAP approved projects to observe the level of implementation of the provisions of the ESMP.

**The Edo State Ministries of Environment** and Public Utilities at the local level, can also pay visits to the project site to observe and monitor the level of compliance to the provisions of the ESMP.

### ***Reporting and Follow-Up***

The follow-up process is duty-based. First, the Environmental Officer (EO) in conjunction with the Social/Livelihood Officer (SO) will prepare and document monthly and incident reports that will be submitted to the Edo State NEWMAP Project Coordinator (PC) for comments, observations, and recommendations. Then, the Edo State NEWMAP-SPMU will send feedback to the Engineer through the consultant(s) or directly when urgent action is required. In essence, checking and reporting on the implementation of follow-up action will also be part of the duties of the EO and SO.

The contractor in conjunction with the Site Engineer will prepare and submit monthly reports of the implementation of the ESMP to the Edo State NEWMAP-SPMU. The EO and SO officers who will advise the project management unit accordingly will vet this report. In case of any discrepancy on environmental issues, the project coordinator will convene Project Environmental Management (PEM) meeting to discuss and instruct on the way forward. The Engineer and the Contractor will participate in the meetings. Wherever possible, representatives of World Bank and Federal NEWMAP-SPMU will also be invited to such meetings.

#### ***6.8.1.3 Operational and Maintenance Phase***

It must be stated that the mitigation and monitoring activities will not be the sole responsibility of Edo State NEWMAP or Federal NEWMAP during the operational phase. The Edo State NEWMAP in conjunction with the Federal NEMWAP as the managing entity of the rehabilitated Ogiso-Osunde gully erosion site has the responsibility to consider these measures, and to bring them/the latter to the attention of other government agencies for their action as appropriate.

### ***Key Agencies***

During the operational phase, the key institutions to which Edo State NEWMAP will enter into collaborative relations are Edo State Ministries which include:

- Environment;
- Forestry;
- Transport;
- Works and Infrastructure; and
- Police.

Likewise, at the construction phase the Local government administrative council during the operational phase will have a role in general oversight of ESMP implementation and in ESMP updating.

### ***Role of Involved Agencies***

The responsibilities of the institutions having a role in the process of the operation of the rehabilitated Ogiso-Osunde Gully erosion monitoring are stated as follows.

- **The Monitoring and Supervision Unit of the Edo State Ministry of Environment** will conduct regular visits to the site to examine and verify how the gully erosion site is operated and maintained. Several components such as water, soil, flora and fauna of the environment, waste management, noise and vibration, air and water quality and others will be monitored. This will be conducted within the legal and administrative capacity of the Ministry of Environment through their respective departments, and agencies.
- **The Edo State Ministry of Forestry** will be conducting regular inspections to check the compliance of the site operators with afforestation plans which should be in concordance with international standards.
- **The Ministry of Transport** will check the nature of vehicular traffic and road transportation pattern in the area with respect to transportation safety and vehicular controls. This will be conducted with respect to safety of road users and the residents of the community.
- **The Ministry of Works and Infrastructure** will conduct regular checks on the nature of infrastructure provided within the duration of the project and the period of assessment. The approach will be conducted in such a way to provide a mechanism for prompt response and rehabilitation of any of the provided infrastructures within the gully erosion alignment.

- **The Police** should ensure that crimes and criminal activities are reduced to the barest minimum in order to avoid wrong attachment of such events to the rehabilitation of the gully.

#### ***Local Level ESMP Institutional and Implementation arrangements***

At the local level, NEWMAP ESMF vested the overall implementation of the ESMP on the Site Monitoring Committee. The committee, has mentioned earlier, represent the interest of the community in the entire process of the proposed project.

**The Ogiso-Osunde Gully Erosion Site Monitoring Committee** shall be constituted by Edo State NEWMAP and the committee shall form a critical mass of source of information and community liaison during the implementation of this ESMP. The committee has several sub-committees including women wing and environmental sub-committee. However, considering the diverse background of the committee members and the need for adequate knowledge on the environmental procedure of the proposed project, the committee and sub-committee members need further capacity building on environmental and social issues on implementation of the ESMP at all stages of project implementation. Consequently, capacity strengthening and sensitization of the Ogiso-Osunde Gully Erosion Site Monitoring Committee and the Environmental subcommittee members is critical to successful implementation of this ESMP.

The content of the training should include but not limited to:

- (i) Role of community during construction and post contraction
- (ii) Sustainable practice to ensure gully stabilization
- (iii) Implementation of the ESMP at the local level.

#### ***Contractor Social and Environmental Management System***

The contractor should have a documented Social and Environmental Management System (SEMS) that identifies individuals in the contractor's organization who have responsibility for EHS issues, their scope of work, and reporting lines and requirements.

Edo NEWMAP will be accountable for the management and supervision of all project activities, including management of all contractors/sub-contractors. The Project Management Unit (SPMU) of Edo NEWMAP will be the focal point for all management and supervision issues. In Nigeria environmental oversight responsibilities are vested in the Ministries of Environment (Federal and State). Consequently, Edo NEWMAP SPMU will implement the ESMP in close collaboration with the Monitoring and Evaluation arm of the Edo State

Ministry of Environment (- i.e. the Planning, Research and Statistics unit) and the Project and Programme Monitoring Department of the Edo State Governor's Office. Edo NEWMAP and these regulators will:

- Carry out regulatory monitoring to ensure that all agreed mitigations are implemented in line with regulatory requirements.
- Assess the efficacy of the mitigation measures and manage continuous improvement around these measures.
- Maintain records of non-performance and work with the relevant parties for corrective and preventive action within reasonable time frames.
- Monitor and report on any project activities that could negatively impact on the community.
- Facilitate reciprocal information sharing and communication between Edo NEWMAP and the communities, including helping to resolve project-related complaints.

### **6.8.2 Assessment and Improvement**

Inspection, monitoring, audit, corrective action and improvement are important components of the ESMP implementation.

#### **Inspection**

Contractors will be required to implement field-based inspection programmes that demonstrate their implementation and effectiveness of mitigation measures. Edo NEWMAP SPMU will inspect contractors' documents for compliance.

#### **Monitoring and Auditing**

Monitoring and testing activities are to be carried out as part of the ESMP implementation. Two types of monitoring and auditing will be carried out to achieve the objectives of the ESMP, namely:

##### **1. Contractors' Monitoring Activities:**

Contractors will be required to implement field-based environmental monitoring (sampling and analysis) and social monitoring to monitor the effectiveness of the mitigation measures, assess impacts and demonstrate compliance with legal and other requirements. Edo NEWMAP SPMU will verify contractors' monitoring activities.

## **2. Internal Monitoring by Edo NEWMAP Project Staff**

Edo NEWMAP shall also conduct similar monitoring activities. Monitoring will be carried out by the Project's Environmental Officer. Non compliance of ESMP recommendations will be reported to the SPMU. The capacity of relevant staff (Field Officers/Environmental Officer) will be strengthened through trainings.

## **3. External Monitoring/Third Party Validation**

The Project Coordinator needs to engage an internal or external independent Environmental Auditor prior to the commencement of the project with practical experience in the type of project. The auditor will evaluate the quality of overall ESMP implementation and ensure that agreed mitigation measures are implemented and in case of any deviation or changing conditions, corrective actions are taken where necessary.

Edo NEWMAP SPMU will carry out internal audits to ensure compliance with ESMP requirements, regulatory requirements and compliance with standards, policies and procedures. Periodic third party audits should also be undertaken. Edo NEWMAP SPMU will assign actions to responsible parties for corrective actions for identified environmental and social non-conformances.

### **6.8.3 Reporting Requirements**

The Edo NEWMAP Project Coordinator (PC) will be the focal person for reporting to the World Bank regarding the ESMP implementation. The Edo NEWMAP Environmental Officer will be responsible for monitoring and reporting to the PC.

Since practical implementation of many of the ESMP requirements may rest with contractors/subcontractors, Edo NEWMAP environmental officer will liaise with the contractors' project environment officer/consultant. Reporting and notification associated with implementation of the ESMP will cover the following:

- Contractor Monthly Reporting that covers implementation of the environmental and social requirements and mitigation measures. Monthly Progress Reporting by contractors' project environment officer (through the Environmental officer) to the PC. The Edo NEWMAP SPMU shall also produce monthly environmental and social monitoring reports which will be shared with all stakeholders. It is expected that the monthly compliance audit reports will only be during the pre-construction and construction phases.



- Quarterly reporting to be prepared and submitted by Edo NEWMAP SPMU to relevant regulatory authorities. The quarterly report will document information on the project's performance against the ESMP requirements (Environmental Performance Audit).
- Edo NEWMAP shall report twice a year to the World Bank and relevant regulatory authorities. The frequency of reporting is expected to reduce to annual reports during the operation phase, if substantial compliance is achieved in the first year of operation.
- Third Party Validation (if appointed) shall report annually to the PC and the World Bank.

The contractor will maintain records of implementing the mitigation plan with the help of checklists developed for this purpose. The contractor shall produce monthly reports during the pre-construction and construction phases for submission to Edo NEWMAP SPMU. Records of audit reports and site inspection checklists will be maintained by the contractors and Edo NEWMAP SPMU.

#### 6.8.4 Training/Capacity Building

Capacity building is essential for the effective implementation of the ESMP. All contractors and Edo NEWMAP personnel responsible for the implementation of the tasks and requirements contained in this ESMP document should be competent on the basis of education, training and experience. Edo NEWMAP will undertake internal training and education activities to ensure that project expectations regarding environmental and social performance are achieved. Edo NEWMAP will undertake an initial evaluation of training needs associated with this ESMP and on this basis, develop and maintain an ESMP training matrix. There might be serious gaps in the capacity of the Edo State Ministry of Environment and Public Utilities to monitor environmental issues arising from this project, as the capacity of officers and finances of the State Ministry of Environment may be inadequate. Specific training on the ESMP components and mitigation measures is required to enhance the capacity of field officers to deliver their responsibilities. Consequently, Edo NEWMAP SPMU will arrange environmental and social trainings for all environmental and social focal point officers (inclusive of NEWMAP personnel, State and contractor staff). Refresher trainings will be arranged during subsequent years of project duration.

Table 6.4 Training Plan

|   | Course                                                                                                                                                            | Target                                                                                  | Cost (N)     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------|
| 1 | Personnel require appreciation of WB's, Federal/State environmental policies, as well as, an application of these policies in implementing the World Bank support | <b>SPMU Training</b><br>PC, Environment and safeguards specialist, Project engineer and | 1,500,000.00 |

|   |                                                                                                                                                             |                                                                                                                                             |              |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------|
|   | for Ogiso-Osunde Gully control.                                                                                                                             | Social safeguards specialist. The estimated number of participant is Ten (10) persons                                                       |              |
| 2 | NEWMAP institutional arrangement target audience responsible for site monitoring and liaise with the community and the Edo State NEWMAP and the Contractors | <b>Community</b><br>Ogiso -Osunde Gully site monitoring committee members. The estimated number of participant is Twenty-Five (25) persons. | 2,500,000.00 |
|   | <b>TOTAL</b>                                                                                                                                                |                                                                                                                                             | 4,000,000.00 |

**Management System Review**

The Edo NEWMAP PC shall convene an initial review meeting of the ESMP within 15 days of commencing pre-construction/construction activities. Thereafter review meetings can be scheduled at intervals not exceeding 30 days. These intervals are flexible and can be adjusted depending on the tempo of construction activities. There may be need for unscheduled reviews where critical non-conformance is identified during implementation of the project.

**6.8.5 BUDGET**

The Budget covers the mitigation measures and each of the activities identified for each of the phases of the Ogiso- Osunde Gully Rehabilitation project. It covers the preconstruction, the construction and the operation phases mitigation measures as essential. In addition, the cost is designed for a global spread across the stated measures. The table 6.5 below illustrate the Ogiso -Osunde Gully Rehabilitation project with estimation in NGN Naira. However, if there is no need for a contractor different from the one who has won the bid, the mitigation measures should be included directly in the construction contract.

**Table 6,5: Budget /Cost Analysis of the Proposed Project ESMP Implementation**

| S/N | MITIGATION IMEASURES                                                                    | COST ESTIMATES (N) |
|-----|-----------------------------------------------------------------------------------------|--------------------|
| 1   | Re-vegetation of unwanted/un-used area                                                  | <b>200,000.00</b>  |
| 2   | Contractor to ensure that nose masks and earmuffs are worn by workers during excavation | <b>550,000</b>     |
| 3   | Water to be sprayed at work site especially in dry season                               |                    |

|   |                                                                                                                                                             |                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|   | Air quality and noise in three locations (Ogiso-osunde Upper and Lower Watershed, and community                                                             |                   |
| 4 | Edo NEWMAP to encourage sex education and awareness of transmission of HIV.AIDS, other communicable diseases<br>Community health                            | <b>400,000</b>    |
| 5 | Contamination of soils, surface and ground water bodies<br><br>Soil, Ground and surface water at three locations.                                           | <b>850,000</b>    |
| 6 | Potential increase in erosion, Contamination of surface water bodies and loss of agricultural land<br>Microbial studies of water and sediments (2 locations | <b>450,000</b>    |
| 7 | Investment in soil erosion management                                                                                                                       | <b>400,000</b>    |
| 8 | Sustaining livelihoods and protecting biodiversities                                                                                                        | <b>400,000</b>    |
| 9 | <b>Training plan</b>                                                                                                                                        | <b>4,000,000</b>  |
|   | <b>Total Budget for ESMP implementation</b>                                                                                                                 | <b>3,250,000</b>  |
|   | <b>Additional cost of engaging an External Monitor for the ESMP implementation</b>                                                                          | <b>5,000,000</b>  |
|   | <b>TOTAL BUDGET</b>                                                                                                                                         | <b>15,500,000</b> |

The total budget for implementation of the Environmental Monitoring Plan is Fifteen million, five hundred thousand naira only (i.e. \$43,055.55, at N360.00 to \$).

#### **6.8,6 ESMP Disclosures**

After a review and clearance by the World Bank, the ESMP will be disclosed at the FMEnv, SME and the host LGA offices as well as at the World Bank website. The purpose will be to inform stakeholders about the project activities, impacts, anticipated and proposed environmental management actions as well as to obtain the certificate of conformity from the Federal Ministry of Environment. Also, the ESMP will be subjected to mandatory Technical Review as scheduled by Federal Ministry of Environment followed by the Impact Mitigation Monitoring (IMM) exercise for the purpose of EIA Certification

## CHAPTER SEVEN

### SUMMARY, RECOMMENDATIONS AND CONCLUSION

The ESMP study has provided a systematic procedure including specific action plans to incorporate environmental and social considerations into the proposed intervention project involving reclamation, channelling and remediation works at Ogiso-Osunde flood and gully erosion Site in Benin City, Edo State, Nigeria by Edo State NEWMAP. It documents the baseline biophysical and social conditions of the proposed project site, identifies environmental indicator parameters that may be adversely impacted at the various phases of the project execution and provides the mitigation and management measures for such identified impacts.

The ESMP was prepared in accordance with the World Bank's Performance Standards and the requirements of applicable Nigerian legislation and international environmental policies. The impact assessment was based on the interactions between the different phases of the project activities and the biophysical, social and health components of the environment.

The study has established that the problem at Ogiso-Osunde site arose from inadequate and poorly maintained urban drainage systems. The lower end of Osunde Street has been severely undermined by erosion and has totally collapsed. There is an existing underground drainage system that was designed to take surface water from Third East Circular Road, down Aigbedion Street, through an old moat and towards an outlet to the Ikpoba River which has now become dysfunctional. This has resulted in excessive quantities of water reaching Ogiso/Osunde Street, a situation that has caused residents in the area nightmares over the years.

The adverse impacts of the intervention project include air quality impairment from trucks and machinery emissions and increase in suspended particulate matter, noise nuisance, traffic disturbance and accidents/injuries, waste generation, possible land acquisition for camps and construction facilities, soil impact, land use issues arising from displaced community members, pressure on public facilities and infrastructure due to population influx, soil and water contamination from river dredging activities.

The identified adverse impacts were generally short-term and can be prevented, reduced, ameliorated, or controlled if the recommended mitigation measures are implemented. Mitigation measures were proffered to reduce the magnitude of identified adverse impacts, to a level as low as reasonably practicable (ALARP). These mitigation measures are

incorporated in the Environmental and Social Management/ Environmental Monitoring Plan developed specifically for the Ogiso-Osunde gully erosion Site.

The project community has also significantly spelt out their desires for the project, calling for better drainage system and more access roads to enhance their socio-economic life. They are however weary over possibility of delay in project execution due to past experience. In all, the proposed intervention project is a welcomed development by the affected community and is therefore recommended for timely execution. This intervention project could be implemented sustainably without serious adverse environmental impact if the recommended mitigation measures are strictly adhered to.

Annexure 1: List of Persons met

Attendance during Stakeholders consultation

**ATTENDANCE**

STAKE HOLDERS CONSULTATION / MEETING HELD FOR THE PREPARATION OF NEWMAP  
ESMP FOR GULLY EROSION INTERVENTION PROJECT ON SATURDAY, 11<sup>TH</sup> NOVEMBER,  
2017 AT OGISO SITE, BENIN CITY.

| S/N | NAME                   | POSITION                   | TELEPHONE NO/EMAIL | SIGNATURE        |
|-----|------------------------|----------------------------|--------------------|------------------|
| 1   | Mr Moses Akpan         | Therapist Okaro            |                    |                  |
| 2   | ✓ OMOIGUI RT           | Ochiowea                   | 08058766548        | ND...            |
| 3   | ✓ Moses Usuanble       | Okaladumun                 | ✓                  |                  |
| 4   | John D. Okunribido     | Central Ogoja Street       | 08056672817        |                  |
| 5   | Chris Odeh             | 7 Ogoja                    | 08074001326        |                  |
| 6   | Elder Patrick Echarasa | 1 <sup>st</sup> Ogoja Lane | 09135513819        | #12              |
| 7   | Elder Alexander Ovicwe | Elder                      | 09034820399        |                  |
| 8   | Benson Ediaoghanya     | Elder                      | 08055400508        | A. Ediaoghanya   |
| 9   | LUCKY AICBE            |                            | 09026245411        | L. Aicbe         |
| 10  | Mr H.O. Okunribido     | Elder                      | 08055281386        | H. O. Okunribido |
| 11  | Mr. Olan. Obasohan     | 10 Ogiso 442               | 0815164543         | O. Obasohan      |
| 12  | How Amadi              | Democracy #21, Swampy area | 07037140298        | H. Amadi         |
| 13  | Mr Charity Dokie       | 56 Ogiso lane              | 08025609376        | C. Dokie         |
| 14  | Mrs R. Ogiemwense      | 7 Bata Road                | 08055651920        | R. Ogiemwense    |
| 15  | Mr. S. Ojinsota        | 51 Ogiso                   | 08068940391        | S. Ojinsota      |
| 16  | Mr. D. Eboigbo         | 10 Ogoja Lane              | 08037255557        | D. Eboigbo       |
| 17  | MR OMOROGBE BA         | 5 ENABULELE RIVE BATA RD   | 08034645003        | O. Omorogbe      |
| 18  | MR SUNDAY OTIDE        | 19 Bata Road               | 0802369479         | S. Otide         |
| 19  | AMOS EUBOTA            | - OGISO                    | 0813228997         | A. Eubota        |
| 20  | Joshua Ehasua          | Ogiso                      |                    | J. Ehasua        |



| NAME                     | POSITION             | TELEPHONE NO/EMAIL | SIGNATURE |
|--------------------------|----------------------|--------------------|-----------|
| 21 IGBINOMWENHIA         | 43 09 30<br>of 81 C. | 080509227          |           |
| 22 M.F. EMOKPALE         | A.B.C.               | 0805857627         |           |
| 23 Philip Edia           | Elder                | 08134126264        |           |
| 24 MR GODFREY ASENOTA    | ELDER                | 08056750700        | As. D     |
| 25 HON E GINOSA OMBIWADE | ELDER                | 0702612185         |           |
| 26 Prince Ebulole        | Chief                | 08069510887        |           |
| 27 Igbinomwenhia         | youth                | 07036525726        |           |
| 28 Annada Sun Paul       | Comm. Sec.           | 08114032966        |           |
| 29 Obasuyi Kingsley      | Landlord             | 0815820789         | 50.50     |
| 30 S. Kambel             | landlord             | 08209656124        |           |
| 31 L.F. Osewa            | Landlord             | 0805596759         |           |
| 32 Monday Osewa          | Landlord             | 08050277670        |           |
| 33 Paul Osewa            | Landlord             | 08058768107        |           |
| 34 S. Ape                | landlord             | 08056750498        |           |
| 35 Ikpetuan Samson       | Church owner         | 0806755778         |           |
| 36. Otolu Rukay          | church owner         | 0806128520         |           |
| 37 Felicia Agwobise      | landlady             |                    |           |
| 38 MR ANDO OLAVE         | landlord             | 0703268332         |           |
| 39 Moderate E. Obah      | landlord             | 0807919204         |           |
| 40 Amos Nosa             | Comm. Son            | 07092597502        |           |
| 41 Mr Oshagha Benjamin   | landlord             | 08056332363        |           |
| 42 Mr Amoyi              | landlord             | 08027932294        |           |

| NAME                  | POSITION             | TELEPHONE NO/EMAIL         | SIGNATURE |
|-----------------------|----------------------|----------------------------|-----------|
| 43 Ogbode A.          | youth                | 08069703127<br>08069703127 |           |
| 44 Chief J.N. OBASEJI | CHIEF                | 08049926251                | J.N.      |
| 45 PA VICTOR ABUBOK   | Comm. Sec.           | 08128000921                | V.C.      |
| 46 MR CLIFAS OBASEJI  | SECRETARY            | 08032885370                |           |
| 47 MR JOHNSON OSSAI   | COMM. WITH<br>MEMBER | 0802310862                 |           |
| 48 OGIGBAH H. (MRS)   | PAC. SECRETARY       | 08065181502                |           |
| 49 PASTOR MARK        | PASTOR               | 0803779471                 |           |
| 50 Mr Franke Inoh     | Landlord             | 08039798129                |           |
| 51 Mr. Osoli Samuel   | Youth                | 08069809142                |           |
| 52 Mrs Sathia Okun    | Member               | 08037476773                |           |
| 53 Daniel Oboh        | Youth                | 0706053105                 |           |
| 54 Hada Rose          | Youth                | 07035182744                |           |
| 55 KADIRI A. KINGSLEY | Youth                | 08056067074                |           |
| 56 Oliver Odeunsejia  | Youth                | 08039171444                |           |
| 57 Ifije Paul. E      | AEO, NEWMAP          | 08037533853                |           |
| 58 Gladys Fayami      | E.O. NEWMAP          | 08033962723                |           |
| 59 S.A. SALAMI        | Committee            | 08022118222                |           |
| 60 Dr E.O. McInbye    | "                    | 08035456775                |           |
| 61 Prof A.E. Ogburn   | Consultant           | 08032443322                |           |
| 62 Mr Mike Anghora    | landlord             | 0806626781                 |           |
| 63 Mr Philip Ono      | landlord             | 08035088512                |           |
| 64 Omoduro Kingsley   | Consultant           |                            |           |

## Annexure 2: Summary of World Bank Safeguard Policies (10+2)

- **Use of Country Systems (OP 4.00).** The Bank's environmental and social ("safeguard") policies are designed to avoid, mitigate, or minimize adverse environmental and social impacts of projects supported by the Bank.
- **Environmental Assessment (OP 4.01).** Outlines Bank policy and procedure for the environmental assessment of Bank lending operations. The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA process.
- **Natural Habitats (OP 4.04).** The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank does not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs.
- **Pest Management (OP 4.09).** The policy supports safe, affective, and environmentally sound pest management. It promotes the use of biological and environmental control methods. An assessment is made of the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management.
- **Involuntary Resettlement (OP 4.12).** This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons. The ESMF and RPF reports discuss the applicability of this policy in detail.
- **Indigenous Peoples (OD 4.20).** This directive provides guidance to ensure that indigenous peoples benefit from development projects, and to avoid or mitigate adverse effects of Bank-financed development projects on indigenous peoples. Measures to address issues pertaining to indigenous peoples must be based on the informed participation of the indigenous people themselves.
- **Forests (OP 4.36).** This policy applies to the following types of Bank-financed investment projects: (a) projects that have or may have impacts on the health and quality of forests; (b) projects that affect the rights and welfare of people and their level of dependence upon or interaction with forests; and (c) projects that aim to bring about changes in the management, protection, or utilization of natural forests or plantations, whether they are publicly, privately or communally owned.
- **Physical Cultural Properties (OP 4.11).** Assist in preserving physical cultural resources and avoiding their destruction or damage. PCR includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance.
- **Safety of Dams (OP 4.37).** For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety to the dam, irrespective of its funding sources or construction status.
- **Projects on International Waterways (O 7.50).** The Bank recognizes that the cooperation and good will of riparians is essential for the efficient utilization and protection of international waterways and attaches great importance to riparians making appropriate agreements or arrangement for the entire waterway or any part thereof.
- **Disputed Areas (OP/BP/GP 7.60).** Project in disputed areas may occur the Bank and its member countries as well as between the borrower and one or more neighbouring countries.
- **Disclosure Policy (OP 17.50).** Supports decision making by the Borrower and Bank by allowing the public access to information on environmental and social aspects of projects. Mandated by six safeguard policies that have specific requirements for disclosure in country (Before project appraisal in local language and in English) and World Bank INFO-Shop (Before project appraisal in English). Documents can be in draft but must meet WB standards).



### **Annexure 3: General Environmental Management Conditions for Construction Contracts/Civil Work**

This section deals with the purpose and structure of the Contract. It allocates responsibilities and sets up the procedures for making the Contract work. Underlying it are the basic principles of clear definition of roles, responsibility for outcomes, and promoting best practice. The management conditions for construction contracts detailed here have been extracted and modified, as appropriate for the gully erosion intervention project, from the Environmental and Social Management Framework for State and Local Governance Reform (SLOGOR) Project of the Federal Government of Nigeria (2013) and the New South Wales (Australia) Government General Conditions of Contract (GC21; 2013).

#### **General responsibilities**

The Contractor must:

- Construct the Works in accordance with the Contract; and
- Perform and observe all its other obligations under the Contract.
- The Principal (herein also referred to as Edo State NEWMAP SPMU) must:
- Pay the Contractor the Contract Price for its performance, in accordance with and subject to the Contract; and
- Perform and observe all its other obligations under the Contract.

The Edo State NEWMAP SPMU may give instructions to the Contractor concerning the Works and anything connected with the Works, and the Contractor must comply at its own cost unless the Contract expressly provides otherwise.

#### **Contractor's Authorised Person**

The Contractor must ensure that, at all times, there is a person appointed to act as the Contractor's Authorised Person. The Contractor's Authorised Person acts with the Contractor's full authority in all matters relating to the Contract. The Contractor must promptly notify the Principal of the name and contact details of the Contractor's Authorised Person and of any change in those details. If the Principal reasonably objects to the Contractor's Authorised Person at any time, the Contractor must replace that person.

#### **Principal's Authorised Person**

The Principal must ensure that, at all times, there is a person appointed to act as the Principal's Authorised Person. The Principal must promptly notify the Contractor of the name and contact details of the Principal's Authorised Person and of any change in those details.

The Principal's Authorised Person does not act as an independent certifier, assessor or Valuer. The Principal's Authorised Person acts only as an agent of the Principal.

The Principal's Authorised Person may delegate any of its contractual functions and powers to others by written notice to the Contractor.

#### **Co-operation**

The parties must do all they reasonably can to co-operate in all matters relating to the Contract, but their rights and responsibilities under the Contract (or otherwise) remain unchanged unless the parties agree in writing to change them.

#### **Duty not to hinder performance**

Each party must do all it reasonably can to avoid hindering the performance of the other under the Contract.

#### **Early warning**

Each party must promptly inform the other if it becomes aware of anything that is likely to affect the time for Completion, or the cost or quality of the Works. The parties must then investigate how to avoid or minimise any adverse effect on the Works and Scheduled Progress.

### **Evaluation and monitoring**

As the Contract proceeds, regular meetings (usually monthly) allow the parties and selected stakeholders to evaluate performance and identify priorities for improvement.

The parties must meet regularly to evaluate and monitor performance of the Contract.

The parties must decide jointly who will participate in the meetings. Participants may include Subcontractors, Suppliers, Consultants and, if appropriate, representatives of government authorities, end users and local communities. Participation in meetings does not give the participants any additional rights or responsibilities.

Participants in the evaluation and monitoring meetings must meet their own costs for attendance, and the parties must share equally the other costs.

### **The Contract**

The Contract is formed by the Principal sending a Letter of Award to the Contractor, unless the Principal requires the Contract to be formed by execution of a formal agreement or deed. The Contract is made up solely of the Contract Documents, which supersede all understandings, representations and communications made between the parties before the Date of Contract in relation to the subject matter of the Contract.

The Contract Documents must be read as a whole, and anything included in, or reasonably to be inferred from, one or more documents must be read as included in all other documents, unless the context requires otherwise.

The terms of the Contract cannot be amended or waived unless both parties agree in writing. Even where a Letter of Award has been used to form the Contract, the Principal may require the Contractor to execute a formal agreement or deed on terms no different from those contained in the existing Contract Documents. If required, the Contractor must execute and return to the Principal two copies of the agreement or deed within 14 days after the Principal's written request for their execution. The Principal will return an executed copy to the Contractor.

### **Scope of the Works, Temporary Work and work methods**

The Contractor acknowledges that:

- it is both experienced and expert in work of the type, complexity and scale of the Works;
- it has made full allowance in the Contract Price for the matters referred to in the contract document;

unless the Contract expressly provides an entitlement to payment, everything required to be done by the Contractor under the Contract is to be done at the Contractor's own cost.

The Contractor acknowledges that Variations instructed by the Principal may change the scope of the Works.

Unless the Contract specifies, or the Principal instructs, that the Contractor use a particular work method or perform particular Temporary Work, the Contractor is solely responsible for determining the work methods and the requirements for all Temporary Work.

If requested in writing by the Principal, the Contractor must, within the time specified in the request, advise the Principal of:

its price (excluding all costs of delay or disruption) for any proposal by the Principal to use a particular work method or perform particular Temporary Work proposed by the Principal or to change a work method or Temporary Work specified in the Contract;

the anticipated effect of the Principal's proposal on achieving Completion; and

the effect of the Principal's proposal on any other matter specified by the Principal.

If the parties agree in writing on the effects of the Principal's proposal and the Principal instructs the Contractor to carry out the proposal, any affected Contractual Completion Dates and the Contract Price must be adjusted as agreed.

### **Assignment**

The Contractor must not assign a right or benefit under the Contract without first obtaining the Principal's written consent.

### **Governing law of the Contract**

The Contract is governed by World Bank Operational Directives, the laws of Nigeria and the Edo State (See Annexure 2 of this document), and the parties submit to the non-exclusive jurisdiction of the courts of Edo State.

### **Subcontractor relationships**

The Contractor is solely responsible for all Subcontractors and is liable for their acts and omissions as if such acts or omissions were those of the Contractor. Subcontracting of any obligation under the Contract does not affect the Contractor's obligations or liability under the Contract.

The Contractor indemnifies the Principal against all claims (including Claims), actions, loss or damage and all other liability arising out of any acts or omissions of Subcontractors.

The Contractor must include in every Subcontract:

- details of the Contractor's obligations in connection with the Contract which are to be carried out by the Subcontractor;
- consent for the Subcontract to be novated to the Principal or its nominee, if required by the Principal; and when possible, a right of termination for convenience.

## **Contract Provisions for Civil Works: Environmental and Social Impacts**

### **1. General Provisions and Precautions**

The contractor shall take all necessary measure and precautions and otherwise ensures that the execution of the works and all associated operations on the work sites or off site are carried out in accordance with the World Bank's Performance Standards and the requirements of applicable legislation and environmental requirement of Nigeria. The contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the work. This shall, wherever possible, be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated. In the event of any soil or debris or silt from the work sites being deposited on any adjacent land, the contractor shall immediately remove all such spoil debris or silt and restore the affected area to its original state to the satisfaction of the responsible authorities.

### **2. Water Quality**

The following conditions shall apply to avoid adverse impacts to water quality:

- The contractor shall prevent any interference with supply to, or abstraction from, water resources and the pollution of water resources (including underground percolating water) as a result of the execution of the works.
- The contractor shall not discharge or deposit any matter arising from the execution of the work into any waters except with the permission of the regulatory authorities concerned.

- The contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the site are kept safe and free from any debris and any material arising from the works.
- The contractor shall protect all water courses, waterways, ditches, canals, drains, and the like from pollution, silting, flooding or erosion as a result of the execution of the works.

### **3. Air Quality**

The following conditions shall apply to avoid adverse impacts to air quality:

- Open burning will be prohibited.
- In periods of high wind, dust- generating operations shall not be permitted within 200 meters of residential areas having regard to the prevailing direction of the wind.
- Asphalts and hot- mix plants sites shall be located at least 500 meters away from the nearest sensitive receptor (e.g. schools).
- Water sprays shall be used during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Stockpiles of materials shall be sited in sheltered areas or within hoarding, away from sensitive areas. Stockpiles of friable material shall be covered with tarpaulins.
- Vehicle with an open load – carrying area used for transporting potentially dust-producing material shall have proper fitting side and tailboards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extend over the edges of the side and tailboards.
- In periods of adverse weather adverse, impacts to adjacent residents or site employees during construction will be mitigated by either discontinuing until favourable conditions are restored, or, if warranted, sites may be watered to prevent dust generation.
- Machinery and equipment will be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in working order. Best available pollution control technologies will be used.

### **4. Protection of soils**

Borrow pits. The following conditions shall apply to borrow pits:

- Borrow areas will be located outside the ROWs.
- Pit restoration will follow the completion of works in full compliance of all applicable standards and specification.

- The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of regulatory authorities is required before final acceptance and payment under the terms of contracts.
- Borrow pit areas will be graded to ensure drainage and visual uniformity, or to create permanent tanks\dams.
- Topsoil from borrow pit areas will be saved and reused in re-vegetating the pits to the satisfaction of regulatory authorities.
- Additional borrow pits will not be opened without the restoration of those areas no longer in use.

To avoid potential adverse impacts due to erosion, the contractor shall:

- Line spillage ways with riprap to prevent undercutting.
- Provide mitigation plantings and fencing where necessary to stabilize the soil and reduce erosion.
- Upgrade and adequately size, line and contour storm drainage to minimize erosion potential.
- To avoid erosion and gullyng, the contractor should reduce his earthworks during the peak of rainy seasons, use gabions and miter drains.

### **5. Avoidance of Social Impacts**

To avoid adverse social impacts, the Contractor shall:

- Coordinate all construction activities with neighboring land uses and respect the rights of local landowner. Written agreements with local landowners for temporary use of the property will be required and sites must be restored to a level acceptable to the owner within a predetermined time period.
- Maintain and cleanup campsites.
- Attend to health and safety of their workers by providing basic emergency health facilities for workers and incorporate programs aimed at the prevention of sexually transmitted diseases as a part of all construction employee orientation Programs.
- Obtain approval of all diversions and accommodation of traffic. The Contractor shall provide a written traffic control plan which is to include when and where flagmen shall be employed and when and where traffic cones or other devices such as barricades and \or lights will be used.

### **6. Noise**

To avoid adverse impacts due to noise, the contractor shall:

- Consider noise as an environmental constraint in planning and execution of the works.

- Use equipment conforming to international standards and directives on noise and vibration emissions.
- Take all necessary measures to ensure that the operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking into account applicable environmental requirements.
- Maintain exhaust systems in good working order; properly design engine enclosures, use intake silencers where appropriate and regularly maintain noise-generating equipment. Schedule operations to coincide with periods when people would least likely be affected and by the contractor having due regard for possible noise disturbance to the local residents or other activities. The contractor must observe statutory requirements which regulate working hours and working days (-Construction activities will be strictly prohibited at night).
- Incorporate noise considerations in public notification of construction operations and specify methods to handle complaints. Disposal sites and routes will be coordinated with local officials to avoid adverse traffic noise.

#### **7. Protection of Utilities**

To avoid potential adverse impacts to utilities, the Contractor shall:

- Ascertain and take into account in his method of working the presence of utility services on and in the vicinity of the site.
- Take into account the periods required to locate, access, protect, support and divert such services, including any periods of notice required to effect such work in consultation with authorities operating such services.
- Assume all responsibility to locate or to confirm the details and location of all utility services on or in the vicinity of the site.
- Exercise the greatest care at all times to avoid damage to or interference with services.
- Assume responsibility for any damage and \or interference caused by him or his agents, directly or indirectly, arising from actions taken or a failure to take action, and for full restoration of the damage.

#### **8. Waste Disposal and Hazardous materials**

- Water and waste products shall be collected, removed via suitable and properly designed temporary drainage systems and disposed of at a location and in a manner that will cause neither pollution nor nuisance.
- Insofar as possible, all temporary construction facilities will be located at least 50 metres away from a water course, stream or canal. The contractor shall not dispose of used cement slurry or

- material in the bush or road side, nor in water courses or wetlands. Such material shall be utilized or disposed of in places approved by the Edo State Min. of Environment.

### **9. Environmental Monitoring**

Monitoring or direct impact will be carried out by Edo State NEWMAP and Min. of Environment and will include, but not restricted to, the following concerns:

- Erosion along highway segments and borrow sites during and after construction;
- Silting and increased sediment loads to streams.
- Verification that proper waste disposal at construction sites and base camps is done;
- Assurance that construction sites and base camps are cleaned after construction and
- Inspection of vegetation covers (removal and re- growth) on the basis of field examinations.

### **10. Scheduled Progress**

- The Contractor must carry out all work in connection with the Contract so as to achieve Scheduled Progress.
- Whenever requested, the Contractor must demonstrate to the Principal that it is achieving Scheduled Progress.

### **11. Care of people, property and the environment, indemnities and limitations**

#### **Obligations of care**

- The Contractor is responsible for all of the following:
  - preventing personal injury or death;
  - preventing loss or damage to the Site and the Works;
  - preventing loss or damage to adjoining and other properties and the environment arising in connection with carrying out the Works;
  - locating and caring for existing services;
  - repairing or making good loss or damage to the Works and the Site; and
  - bearing the cost of repairing, or making good, loss or damage to adjoining and other properties and the environment arising in connection with carrying out the Works.
- If, in the opinion of the Principal, urgent action is required to avoid death, injury, loss or damage, and the Contractor does not take the necessary action immediately when the Principal requests it, the Principal may take the action (without relieving the Contractor of its obligations), at the Contractor's cost, and the Principal's costs of doing so will be recoverable as a deduction from the Contract Price.

**Indemnities for property, personal injury or death**

The Contractor indemnifies the Principal against loss or damage to:

- the Works, from the date the Contractor begins carrying out the Works; and the Site and anything brought onto the Site for the purposes of the Contract from the date the Contractor is given access to the Site, or the relevant part of the Site, until and including the Actual Completion Date of the whole of the Works except that, in respect of any part of the Works which is occupied or taken into use by the Principal, this indemnity ceases when that part is occupied or taken into use and the indemnity then applies as if the Actual Completion Date had been achieved with respect to that part.
- After the Actual Completion Date of the whole of the Works, the Contractor indemnifies the Principal against loss or damage to the Works, the Site, and anything brought onto the Site for the purposes of the Contract:

Arising out of carrying out its obligations under the Contract, including carrying out Variations, making good Defects and removing Materials from the Site.



## Annexure 4

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**Annexure 5: Summary of the database of information collected for ESMP****5.1a: Summary of physico-chemical properties of Soil, Ogiso-Osunde Site, Nov., 2017**

| Parameters                     | Soil level | SS 3 Control | SS1   | SS 2 | SS 4 | SS 5 | SS 6 |
|--------------------------------|------------|--------------|-------|------|------|------|------|
| pH                             | 0-15cm     | 6.3          | 6.4   | 5.8  | 6.5  | 6    | 6.9  |
|                                | 15-30cm    | 6.1          | 6     | 5.5  | 6.4  | 5.9  | 6.9  |
| EC ( $\mu\text{S}/\text{cm}$ ) | 0-15cm     | 251          | 688   | 331  | 272  | 357  | 330  |
|                                | 15-30cm    | 240          | 640   | 294  | 260  | 339  | 312  |
| Org.M (%)                      | 0-15cm     | 0.62         | 2.56  | 1.89 | 0.82 | 2.12 | 1.73 |
|                                | 15-30cm    | 0.42         | 1.98  | 1.32 | 0.66 | 1.92 | 0.87 |
| Org.C                          | 0-15cm     | 0.36         | 1.43  | 1.1  | 0.56 | 3.2  | 1.01 |
|                                | 15-30cm    | 0.22         | 1.15  | 0.77 | 0.42 | 3.1  | 0.57 |
| T. N                           | 0-15cm     | 0.24         | 0.55  | 0.11 | 0.25 | 0.21 | 0.09 |
|                                | 15-30cm    | 0.21         | 0.13  | 0.07 | 0.22 | 0.19 | 0.04 |
| EA (meq/100g of soil)          | 0-15cm     | 0.2          | 1     | 0.9  | 0.3  | 1.6  | 0.3  |
|                                | 15-30cm    | 0.3          | 0.6   | 1.1  | 0.3  | 1.3  | 0.1  |
| Na ,,                          | 0-15cm     | 0.34         | 1.15  | 0.67 | 0.44 | 0.53 | 0.56 |
|                                | 15-30cm    | 0.21         | 0.91  | 0.24 | 0.39 | 0.2  | 0.43 |
| K ,,                           | 0-15cm     | 0.03         | 0.38  | 0.12 | 0.05 | 0.09 | 0.1  |
|                                | 15-30cm    | 0.01         | 0.15  | 0.08 | 0.03 | 0.05 | 0.1  |
| Ca ,,                          | 0-15cm     | 1.41         | 5.29  | 2.74 | 1.51 | 2.66 | 2.85 |
|                                | 15-30cm    | 0.9          | 3.52  | 1.63 | 1.1  | 2.43 | 2.68 |
| Mg ,,                          | 0-15cm     | 0.73         | 2.3   | 0.93 | 0.85 | 1.88 | 0.71 |
|                                | 15-30cm    | 0.43         | 1.2   | 0.52 | 0.56 | 1.62 | 0.59 |
| CEC ,,                         | 0-15cm     | 2.51         | 9.12  | 4.46 | 2.85 | 5.16 | 4.22 |
|                                | 15-30cm    | 1.55         | 5.78  | 2.47 | 2.08 | 4.3  | 3.8  |
| ECEC ,,                        | 0-15cm     | 2.71         | 10.12 | 5.36 | 3.15 | 4.86 | 4.52 |
|                                | 15-30cm    | 1.85         | 6.38  | 3.57 | 2.38 | 4.71 | 3.9  |
| Clay (%)                       | 0-15cm     | 4.4          | 5     | 6.5  | 5.6  | 4.3  | 5.7  |
|                                | 15-30cm    | 4.3          | 6.8   | 4.9  | 5.9  | 5.6  | 5.1  |

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| Parameters                     | Soil level | SS 3 Control | SS1   | SS 2  | SS 4  | SS 5  | SS 6  |
|--------------------------------|------------|--------------|-------|-------|-------|-------|-------|
| <b>Silt ,,</b>                 | 0-15cm     | 1.3          | 3.8   | 3.7   | 2.1   | 2.6   | 2.9   |
|                                | 15-30cm    | 2.5          | 2.5   | 2.6   | 2     | 2.1   | 2.3   |
| <b>Sand ,,</b>                 | 0-15cm     | 94.3         | 91.2  | 89.8  | 92.3  | 93.1  | 91.4  |
|                                | 15-30cm    | 93.2         | 90.7  | 92.5  | 92.1  | 92.3  | 92.6  |
| <b>Av. P. (mg/kg)</b>          | 0-15cm     | 1.98         | 14.2  | 9.77  | 2.91  | 9.62  | 6.63  |
|                                | 15-30cm    | 1.76         | 11.6  | 5.82  | 1.87  | 5.64  | 6.32  |
| <b>NH<sub>4</sub>N (mg/kg)</b> | 0-15cm     | 0.85         | 7.6   | 2.54  | 1.05  | 3.14  | 1.21  |
|                                | 15-30cm    | 0.64         | 3.11  | 1.47  | 0.87  | 2.97  | 0.92  |
| <b>NO<sub>2</sub> (mg/kg)</b>  | 0-15cm     | 0.27         | 2.43  | 1.19  | 0.36  | 1.82  | 0.62  |
|                                | 15-30cm    | 0.19         | 1.56  | 0.84  | 0.27  | 1.64  | 0.55  |
| <b>NO<sub>3</sub> ,,</b>       | 0-15cm     | 3.14         | 19.3  | 12.7  | 3.18  | 15.1  | 10.4  |
|                                | 15-30cm    | 2.89         | 15.8  | 8.63  | 2.9   | 13.3  | 9.1   |
| <b>SO<sub>4</sub> ,,</b>       | 0-15cm     | 0.45         | 3.13  | 0.92  | 1.15  | 0.88  | 0.63  |
|                                | 15-30cm    | 0.38         | 1.14  | 0.56  | 0.88  | 0.53  | 0.61  |
| <b>Cl ,,</b>                   | 0-15cm     | 41.8         | 109.4 | 55.2  | 42.8  | 57.6  | 55.6  |
|                                | 15-30cm    | 39.7         | 106.7 | 49.3  | 39.9  | 53.1  | 52.1  |
| <b>Fe ,,</b>                   | 0-15cm     | 100.8        | 273.1 | 198.2 | 103.1 | 186.1 | 168.4 |
|                                | 15-30cm    | 91.2         | 265.7 | 157   | 97    | 149   | 163.1 |
| <b>Mn ,,</b>                   | 0-15cm     | 11.5         | 20.1  | 28.9  | 13.2  | 32.4  | 12.1  |
|                                | 15-30cm    | 10.3         | 17.4  | 20.1  | 11.3  | 29.6  | 10.9  |
| <b>Zn ,,</b>                   | 0-15cm     | 24.6         | 36    | 47.8  | 24.9  | 46.1  | 29.8  |
|                                | 15-30cm    | 22.9         | 33    | 32.6  | 23.1  | 39.5  | 27.6  |
| <b>Cu ,,</b>                   | 0-15cm     | 1.58         | 8.61  | 9.13  | 1.83  | 10.1  | 6.51  |
|                                | 15-30cm    | 1.39         | 7.59  | 5.98  | 1.69  | 8.08  | 6.29  |
| <b>Cr ,,</b>                   | 0-15cm     | 0.36         | 2.45  | 2.64  | 0.42  | 2.04  | 1.94  |
|                                | 15-30cm    | 0.28         | 1.29  | 1.22  | 0.37  | 1.82  | 1.79  |
| <b>Cd ,,</b>                   | 0-15cm     | 0.54         | 5.21  | 1.52  | 1.14  | 0.82  | 0.76  |
|                                | 15-30cm    | 0.48         | 3.11  | 1.3   | 0.58  | 0.63  | 0.68  |
| <b>Pb ,,</b>                   | 0-         | 0.49         | 2.13  | 1.43  | 1.19  | 1.83  | 1.15  |

| Parameters | Soil level | SS 3 Control | SS1  | SS 2 | SS 4 | SS 5 | SS 6 |
|------------|------------|--------------|------|------|------|------|------|
|            | 15cm       |              |      |      |      |      |      |
|            | 15-30cm    | 0.37         | 1.38 | 1.12 | 0.77 | 1.78 | 1.05 |
| Ni ,,      | 0-15cm     | 0.11         | 1.42 | 0.27 | 0.21 | 0.99 | 0.19 |
|            | 15-30cm    | 0.07         | 0.34 | 0.16 | 0.17 | 0.76 | 0.13 |
| V ,,       | 0-15cm     | 0.06         | 0.59 | 0.15 | 0.09 | 0.55 | 0.13 |
|            | 15-30cm    | 0.02         | 0.18 | 0.1  | 0.04 | 0.31 | 0.5  |
| THC ,,     | 0-15cm     | 0.09         | 2.1  | 0.48 | 0.11 | 0.48 | 0.28 |
|            | 15-30cm    | 0.05         | 0.55 | 0.32 | 0.09 | 0.39 | 0.25 |

**5.1b: Summary of microbiological properties (cfu/g) of Soil, Ogiso-Osunde Site, Nov., 2017**

| Parameters              | SS1                               | SS2 | SS3 | SS4 | SS5 | SS6                               |
|-------------------------|-----------------------------------|-----|-----|-----|-----|-----------------------------------|
| THB (x10 <sup>4</sup> ) | 4.1                               | 3.9 | 3.4 | 4   | 4.7 | 4.5                               |
| HUB (x10)               | 0                                 | 0   | 0   | 0   | 0   | 0                                 |
| Bacterial isolates      | Bacillus sp., Enterobacter sp.    |     |     |     |     | Bacillus sp., Enterobacter sp.    |
| THF (x10 <sup>4</sup> ) | 3.2                               | 2.9 | 3.1 | 3.7 | 2.4 | 3.4                               |
| HUF (x10)               | 0                                 | 0   | 0   | 0   | 0   | 0                                 |
| Fungal isolates         | Aspergillus spp., Penicillium sp. |     |     |     |     | Aspergillus spp., Penicillium sp. |

**Annexure 5.2a: Summary of physico-chemical properties soil, Ogiso-Osunde Site, Nov., 2017**

| Sample Code         | BH1   | BH2   | BH3   | BH4   | Hand dug Well |
|---------------------|-------|-------|-------|-------|---------------|
| pH                  | 4.8   | 4.2   | 4.6   | 4.1   | 6.1           |
| EC (µS/cm)          | 235   | 242   | 254   | 267   | 650           |
| Sal. (g/l)          | 0.106 | 0.109 | 0.112 | 0.123 | 0.293         |
| Col. (Pt.Co)        | ND    | ND    | ND    | ND    | ND            |
| Turb. (NTU)         | ND    | ND    | ND    | ND    | ND            |
| TSS (mg/l)          | ND    | ND    | ND    | ND    | 3.8           |
| TDS ,,              | 116   | 123   | 115   | 112   | 321           |
| DO ,,               | -     | -     |       |       | 6.8           |
| BOD5 ,,             | -     | -     |       |       | 4.4           |
| COD ,,              | 6.3   | 4.2   | 7.1   | 8.3   | 44            |
| HCO <sub>3</sub> ,, | 45.2  | 49.4  | 51.2  | 43.1  | 84.2          |
| Na ,,               | 0.68  | 0.37  | 0.26  | 0.72  | 1.26          |
| K ,,                | 0.1   | 0.12  | 0.19  | 0.21  | 0.31          |
| Ca ,,               | 2.18  | 2.33  | 2.56  | 2.89  | 6.05          |

| Sample Code             | BH1   | BH2   | BH3   | BH4   | Hand dug Well |
|-------------------------|-------|-------|-------|-------|---------------|
| Mg ,,                   | 0.93  | 0.59  | 0.79  | 0.49  | 2.34          |
| Cl ,,                   | 77.9  | 72.2  | 80.2  | 90.1  | 141.8         |
| P ,,                    | 0.5   | 0.01  | 0.07  | 0.03  | 0.19          |
| NO <sub>2</sub> ,,      | 0.004 | 0.013 | 0.021 | 0.031 | 0.027         |
| NO <sub>3</sub> ,,      | 0.73  | 0.51  | 0.89  | 0.93  | 1.3           |
| NH <sub>4</sub> N(mg/l) | ND    | ND    | ND    | ND    | 0.074         |
| SO <sub>4</sub> ,,      | 0.37  | 0.33  | 0.46  | 0.51  | 0.55          |
| Fe ,,                   | 0.21  | 0.48  | 0.35  | 0.41  | 0.63          |
| Mn ,,                   | ND    | ND    | ND    | ND    | 0.027         |
| Zn ,,                   | 0.07  | 0.12  | 0.21  | 0.18  | 0.52          |
| Cu ,,                   | 0.003 | 0.009 | 0.010 | 0.012 | 0.017         |
| Cr ,,                   | ND    | ND    | ND    | ND    | 0.002         |
| Cd ,,                   | ND    | ND    | ND    | ND    | 0.004         |
| Ni ,,                   | ND    | ND    | ND    | ND    | ND            |
| Pb ,,                   | ND    | ND    | ND    | ND    | 0.006         |
| V ,,                    | ND    | ND    | ND    | ND    | ND            |
| THC ,,                  | ND    | ND    | ND    | ND    | 0.03          |

**Annexure 5.2b: Summary of microbiological qualities of Borehole water, Ogiso-Osunde Site, Nov., 2017**

| Parameters                  | BH1                                             | BH2 | BH3 | BH4 | HDW                                             |
|-----------------------------|-------------------------------------------------|-----|-----|-----|-------------------------------------------------|
| THB (x10) cfu/ml            | 2                                               | 2.7 | 2.4 | 2.2 | 2.8                                             |
| Total Coliform (MPN/100ml)  | 4                                               | 6   | 3   | 5   | 4                                               |
| HUB (x10) cfu/ml            | 0                                               | 0   | 0   | 0   | 0                                               |
| <i>E. coli</i> counts/100ml | 0                                               | 0   | 0   | 0   | 0                                               |
| Bacterial isolates          | <i>Bacillus</i> sp.,<br><i>Enterobacter</i> sp. |     |     |     | <i>Bacillus</i> sp.,<br><i>Enterobacter</i> sp. |
| THF (x10) cfu/ml            | 0                                               | 0   | 0   | 0   | 0                                               |
| HUF (x10) cfu/ml            | 0                                               | 0   | 0   | 0   | 0                                               |
| Fungal isolates             | Nil                                             | Nil | Nil | Nil | Nil                                             |

**Annexure 5.2c: Summary of physico-chemical properties of Surface water, Ogiso-Osunde Site, Nov., 2017**

| Sample Code  | SW 1  | SW 2  | SW 3  |
|--------------|-------|-------|-------|
| pH           | 5.9   | 4.9   | 5.3   |
| EC (µS/cm)   | 67    | 89    | 75    |
| Sal. (g/l)   | 0.047 | 0.054 | 0.034 |
| Col. (Pt.Co) | 7.3   | 9.3   | 8.8   |
| Turb. (NTU)  | 9.1   | 6.6   | 7.3   |
| TSS (mg/l)   | 19.1  | 22.1  | 11.3  |
| TDS ,,       | 49    | 65    | 38    |

| <b>Sample Code</b>      | <b>SW 1</b> | <b>SW 2</b> | <b>SW 3</b> |
|-------------------------|-------------|-------------|-------------|
| DO ,,                   | 7.7         | 9.2         | 5.5         |
| BOD <sub>5</sub> ,,     | 4.1         | 4.5         | 3.7         |
| COD ,,                  | 32.2        | 22.2        | 29.6        |
| HCO <sub>3</sub> ,,     | 22.1        | 19.1        | 12.2        |
| Na ,,                   | 0.59        | 0.82        | 0.55        |
| K ,,                    | 0.15        | 0.22        | 0.08        |
| Ca ,,                   | 0.59        | 1.51        | 1.36        |
| Mg ,,                   | 0.45        | 0.82        | 0.79        |
| Cl ,,                   | 55.1        | 75.6        | 35.5        |
| P ,,                    | 0.57        | 0.32        | 0.24        |
| NO <sub>2</sub> ,,      | 0.071       | 0.089       | 0.058       |
| NO <sub>3</sub> ,,      | 1.56        | 1.06        | 1.19        |
| NH <sub>4</sub> N(mg/l) | 0.111       | 0.154       | 0.132       |
| SO <sub>4</sub> ,,      | 0.39        | 0.12        | 0.16        |
| Fe ,,                   | 1.45        | 1.77        | 1.92        |
| Mn ,,                   | 0.063       | 0.038       | 0.043       |
| Zn ,,                   | 0.53        | 1.13        | 0.78        |
| Cu ,,                   | 0.027       | 0.034       | 0.014       |
| Cr ,,                   | 0.017       | 0.029       | 0.013       |
| Cd ,,                   | 0.033       | 0.055       | 0.021       |
| Ni ,,                   | 0.005       | 0.015       | 0.007       |
| Pb ,,                   | 0.022       | 0.049       | 0.018       |
| V ,,                    | 0.015       | 0.018       | 0.005       |
| THC ,,                  | 0.01        | 0.22        | 0.09        |

### **Annexure 5.3**

#### **MINUTES OF MEETING WITH THE MEMBERS OF OGISO- OSUNDE COMMUNITY OF THE GULLY EROSION IN EDO STATE ON APRIL 11<sup>TH</sup> OF NOVEMBER, 2017 AT 12:00 PM**

The meeting with the stakeholders of Ogiso-Osunde Community was organized to have discuss with them the purpose of the NEWMAP project intervention to be carried out in their community.

The meeting lasted for 1hr 20min. in which the socioeconomic consultant addressed the issue affecting the community.

The following points were discussed;

- (a) A brief explanation about the gully
- (b) Awareness of the NEWMAP
- (c) The extent of damages in form of properties, loss of farmlands, fatalities and deaths
- (e) The vulnerable groups - women, widows, children and physically challenged
- (f) What are the key issues that concerns the youth concerning the projects
- (g) Additional input to ensure that the project is executed without any glitch

#### **Opening remarks**

The meeting commenced with an opening prayer and then the brief introduction of the project details in the community to the people. The need to get the members of the community informed before the commencement of questionnaire administration and survey for ESMP in the area was also emphasized.

#### **A brief explanation about the gully**

The details about the gully erosion and need for the researchers presence was done by a member of the NEWMAP (Mrs Gladys Fayomi).

The people claimed that the gully developed in such a way that it started from the blocked from drainage and abandoned manhole. Gradually, the gully developed further into settlements leading to destruction of properties, fatalities, and some instances of deaths. The rate at which properties are being destroyed currently is alarming. There was a case where the community members tried to use local means to curb the erosion problems but it didn't amount to nothing. It was also told that NDDC came few years ago but fixed only the major roads, due to the high intensity of erosion in the community the was road was also



destroyed. They believe that the current NEWMAP intervention would yield better results at curbing erosion menace plaguing the community.

### **Knowledge of NEWMAP**

The community members stated that they are familiar with NEWMAP Intervention and the objectives of the government towards the programme.

### **Efforts of the youths**

The people claimed that there have been several efforts by the community members especially youths. They added that the youths have resulted to the use of cement sacks packed with water-resistant sand in order to control the opening of the soil in the gully affected areas. The approach is seasonal and a response to the commencement of rain to curtail the expansion of the gully.

Apart from local palliatives, the youths also engage in several meetings in order to get the information about rescue of those that have been affected by a fresh case of gully expansion.

Also, the community has helped several agencies of government to do house numbering for those properties within the gully strip.

### **Level of Gully stimulated physical damages**

The level of damage is very vast and cannot be estimated easily. For years, properties have been lost. In fact, the losses recorded in the past few year is high. There are buildings that have been completely destroyed while others are about to be consumed by the gully.

Also, the damages recorded (death and fatality) are unquantifiable. At least in the past three years, about 8 people have been rescued. But there was a case of a young boy that got killed by the gully last year. So damages have been enormous that cannot be measured. Probably, it will run into hundreds of millions in naira.

### **Vulnerable groups**

Going by the nature of the area being affected by the gully, there are old people, widows, children and pregnant women in numbers. There is an increase in the affected area during the raining season, affecting families that have these categories of people. Thus, there are vulnerable people in the area.

### **Key issues that concerns the Ogiso-Osunde Community**

The maximum support needed is guaranteed. The youths of the area particularly the gully-affected groups are ready to support the project.

However, some things are critical that must be addressed. The area listed below;

1. The youths must be employed as members of manual labour staff for the project. Some of the youths are unemployed graduates who are looking for jobs to make ends meet. And, there are unlettered unskilled youths that can form the basis of labourers to be used for menial jobs during the civil works. Some of the skilled youths can be used as administrative staff members particularly within the duration of the project.
2. Some of the youths can be employed as local security personnel. Although, there would have been special security provided by the government, the local security who understands the terrain better would provide better security for either expatriate workers or top executives of the company.
3. The contractor should avoid being misled into believing that quota system should be used. The either should be to engage people – particularly those that have been affected by the gully.
4. There is an assurance of peace and tranquility for the period of the project and other civil works that the youths can help to fast-tracked the completeness of the project.

The youths have the energy and are also self-motivated.

### **Further words to ensure success of the project**

Prior to the commencement of the main civil works, the contractor with NEWMAP official must engage the community about the next phase of the project. In order words, people must be carried along. This will enhance information dissemination for the project. This should be based on sensitization across social and demographic lines. All social groups must be aware of the project.

Some of the female youths can also be considered key as well. They can be employed as cooks or be permitted to supply food to the workers on the field during break periods. This will also provide a means of livelihood for some of the female youths which can be continued after the project.

The full cooperation of everyone must be sort and the project must not be taken a political statement by one. In order to ensure this, information about the project must be aired on different media houses.

**Closing**

The interview ended afterwards

## **Annexure 6: Maps (See Chapters 1, 3 and 4 of Report)**

**Annexure 7: Photos**



**A** – Flood prone area, **B** – conduit emptying into Ikpoba River, **C** – Receiving point of Ikpoba River, silting up, **D** – ESMP Consultant, Prof. A.E. Ogbeibu addressing stakeholders, **E** – Participant making a point, **F** – Participants attending to questionnaires





Indepth interview with the Secretary of Ogiso Community



Focus Group Discussion with Elders of Ogiso Community



Previous Erosion Interventions in Ogiso Community



Manhole constructed by previous Interventions in Ogiso Community



House Type in Ogiso Community



Livelihood options in Ogiso Community

**Annexure 8: Location of Key Facilities and Stakeholders' Residences in Ogiso-Osunde Area of Benin**

| Location I.D                     | Nothings     | Eastings     | Remark(s)                                                         |
|----------------------------------|--------------|--------------|-------------------------------------------------------------------|
| <b>OGISO FACILITIES/SOCIAL</b>   |              |              |                                                                   |
| Community Elder's Residence CER1 | 6°20'27.57"N | 5°39'4.18"E  | Mr. Ike Bassil House                                              |
| Community Elder's Residence CER2 | 6°20'14.13"N | 5°38'57.78"E | Back of 'Bush-Lodge'                                              |
| Community Elders' Residence CER3 | 6°20'27.14"N | 5°38'49.20"E | Pa Ogbebor House                                                  |
| Community Elder's Residence CER4 | 6°20'30.63"N | 5°38'45.00"E | Mr. Henry Osa House                                               |
| Community Elder's Residence CER5 | 6°20'28.07"N | 5°38'50.55"E | Mr. Etinosa Omoigiade house                                       |
| Educational Institution EDC1     | 6°20'22.34"N | 5°39'8.82"E  | Shaka Momodu Polytechnic ( Community Consultation Venue)          |
| Educational Institution EDC2     | 06 20.190    | 005 39.11.7  | Institute of Training Lads Group of Schools Close to Shaka Momodu |
| Religious's House RLH1           | 06 20.17.8   | 005 39.06.0  | Wave of Glory Miracles Assembly                                   |
| Religious's House RLH2           | 06 20.18.0   | 005 38.58.9  | Holy Christ the Saviour Church of God (along Ogiso street)        |
| Educational Institution EDC3     | 06 20.21.5   | 005 38.53.9  | Lambano Excellent of Knowledge Academy (84 Ogiso street)          |
| Communication Facility           | 06 20.23.9   | 005 38.52.7  | Telecom Mast before Ogiso Poly                                    |
| Educational Institution EDC4     | 06 20.29.6   | 005 38.46.8  | Eternal Spiritual Church of Christ (7 Ogiso Street)               |
| Landmark Point LDM1              | 6 02.028.9   | 005 38.41.8  | Ogiso Community Entrance by 3 <sup>rd</sup> East Circular Road    |



**Annexure 9: Socio-economic Questionnaire**

**QUESTIONNAIRE ON ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)  
FOR OGISO-OSUNDE GULLY EROSION SITE**

**Dear Respondent,**

**Read the following to respondent before proceeding**

The goal of this survey is to collect baseline data for the Nigeria Erosion and Watershed Management Project. The data will ensure the proper monitoring and evaluation of the implementation of the erosion control interventions of the Government in partnership with the World Bank in your community.

Please read each question carefully. Your answers are completely confidential and will be included only in summaries where individual answers cannot be identified. Unless otherwise stated, please tick appropriate answer category that best describes your opinion. It is your chance to express your personal opinion.

**A. IDENTIFICATION SECTION**

Settlement/Community: .....

State/L.G.A:.....

Name of Interviewer: .....

Date:.....

Coordinates: Northing ..... Easting.....

**Survey Location:** (a) Major Urban (b) Other Urban (c) Rural

**SECTION A: Household data and Socio-economic Characteristics**

1. Gender of Respondent: (a) Male (b) Female
2. Age: (a) Below 18 yrs (b) 18-45 yrs (c) 46-65 yrs (d) Above 66 yrs
3. Marital Status: (a) Single (b) Married (d) Divorced/Separated (e) Widowed
4. Residential Status: (a) Permanent Resident (b) Back Home (Returnee) (c) Non Resident, Visiting
5. Ethnic Group: (a) Etsako (b) Edo (c) Yoruba (d) Esan (e) Other, specify.....
6. Religion: (a) Islam (b) Christianity (c) Traditional (d) None
7. Education: (a) None (b) Primary School (c) Secondary School (d) Tertiary (Excluding University) (e) University Graduate (f) University Post Graduate
8. Relationship to HH: (a) Self (b) Spouse (c) Child (d) Parent (e) Other, specify

9. Type of HH (a) Normal (Father) (b) Woman (c) Child
10. Size of the HH .....
11. Are you affected by the gully development? (a) Yes (b) No
12. If question 11 is yes, how (a) loss of farmland (b) loss of building (c) loss of landed Property (d) others specify.....
13. Occupation: (a) Farmer (b) Daily Labourer (c) Trading & Shop Keeping (d) Artisans (e) Employed (salary) (f) Self Employed (g) Social Support (h) unemployed (i) Retired (j) Dependent
14. How long have you been living in this area? (a) 0-2 yrs (b) 3-5 yrs (c) 6-9 yrs (d) 10 yrs and Above
15. If non-resident, please state your actual location:  
.....(Location/LGA/State)
16. Give an estimate of average monthly income ₦.....
17. What is the average household Expenditure per month? ₦.....

**SECTION B: RESOURCES/ CULTURAL PROPERTY**

1. Please indicate the environmental problems which your settlement/community experiences and whose cause can be linked to the gully erosion? (a) Soil infertility (b) Poor drainage system (c) Bad road (d) Low visibility (e) Bad lands (f) Flooding (g) environmental degradation (h) Degraded land (i) Destruction of infrastructures (j) Others (specify) .....
2. Please indicate the environmental problems which your settlement/community would likely experience and whose cause can be linked to the proposed gully erosion intervention project during construction? (a) Soil infertility (b) Poor drainage system (c) Bad road (d) Low visibility (e) Erosion Problems (f) Flooding (g) environmental degradation (g) Destruction of infrastructures (h) encroachment of land properties (i) Pollution (air, surface water, ground water, noise) (j) Others (specify) .....
3. Please indicate the environmental problems which your settlement/community would likely experience and whose cause can be linked to the proposed gully erosion intervention project during operation? (a) Soil infertility (b) Poor drainage system (c) Bad road (d) Low visibility (e) Erosion Problems (f) Flooding (g) environmental degradation (h) Destruction of infrastructures (i) encroachment of land properties (j) Pollution (air, surface water, ground water, noise) (k) Others (specify) .....
4. Do you think the gully erosion intervention activities will affect any valued resource/cultural/archaeological property in your area? (a) Yes (b) No
5. If yes mention the name(s) of the valued resource/cultural/archaeological Property.....
6. How will valued resource/cultural/archaeological property be affected? (a) Displacement of such

valued cultural properties (b) Vandalisation of sacred items/locations(c) Possible theft of sacred/archaeological items(d) Others, specify: .....

7. Which of these best describes the house you live in? (a) mud wall (b) mud floor (c) thatch/bamboo roof (d) zinc/aluminium roof (e) brick/block wall (f) asbestos roof

8. What is the size of agricultural land owned or cultivated by you in this community (m<sup>2</sup> or ha)?

9.Farm Products Produced by your Household (a) vegetables (b) tuber crops (yam, cocoyam, cassava) (c) cereal (rice , maize) (d) legumes (groundnut, etc) (e) tree crops (oil palm) (f) Plantain, banana (g) fish pond

10.Types of farming practised (a) shifting cultivation (b) continuous cropping (c) mixed farming (d) mono cropping or plantation (e) livestock farming

11. What are the major farming problems in your community? (a) Infertile soil (b) Insufficient Land (c) Labour shortages (d)Lack of access to credit facilities (e) Unpredictable weather conditions (f) Pests/ diseases (g) Land disputes

12. What are the uses of your non-agricultural land(s)? (a) Residential building (b) Warehouse Trading (c) Recreation

13. Which of the following water sources does your household depend on? (a) Pipe borne-water (b) Village wells (open & covered (c) Individual wells (open & covered) (d) Rivers, streams or ponds (e) boreholes (f) rainwater

14. Which of these Rain harvesting methods is practiced by your household? (a) Roof catch to underground tanks (b) Roof catch to Storage tanks (c) Roof catch to pits (d)Pond water from surface run-offs

15. What is your household source of energy for domestic (lighting and cooking) purposes? (a) Firewood/fuel wood (b) Crop Residue/Saw Dust (c) Kerosene (d) gas (e) Electricity (f) Generating plant (g) Charcoal

### **SECTION C: Gully Erosion/ Intervention Activities Impact Evaluation**

1. Status of sub-watershed in the community (a) Upper watershed/gullies (b) Lower watershed/gullies

2. Are you aware of climate change? (a) Yes (b) No

3. What are your suggestions on how to control erosion in your community? (a) Opening up water ways (b) Breaking up channels (c) Erecting barriers like rock piles to slow runoffs (d) Digging contour trenches (e) Contour farming (f) Encourage natural regeneration (g) Planting ground cover

and trees (h) Adopting recommended crop planting techniques (i) Mulching and use of organic manure (j) Building a check dam to stabilize gully bottom

4. Which of these factors do you consider to be responsible for soil/gully erosion and watersheds degradation (a) Wind (b) Rain water (c) Deforestation (d) Over cultivation of farmland (e) Overgrazing (f) Extreme temperature (g) Paved surface

5. Have you observed any threat of soil or gully erosion in your community? (a) Yes (b) No

6. Do you see any need for erosion control in your community? (a) Yes (b) No

7. Are you willing to practice soil conservation on or off farm? (a) Yes (b) No

8. Do you have any experience with soil conservation practices? (a) Yes (b) No

| Positive impacts | Negative impacts |
|------------------|------------------|
| a.               |                  |
| b.               |                  |
| c.               |                  |
| d.               |                  |
| e.               |                  |
| f.               |                  |

9. Can you name some of the animals and other habitat around the gully site that may be affected by the intervention

.....

.....

.....

**SECTION D: WASTE MANAGEMENT**

1. What kind of toilet facility does your household use? (a) Flush Toilet (b) Ventilated Improved Pit Toilet (c) Pan/ Bucket (d) Covered Pit Latrine (e) Uncovered Pit Latrine (f) Open Air (Bush/forest) (g) River/stream/ Pond

2. How does your household dispose its solid waste? (a) Collection by independent private company collectors (b) Collection by council from household door step (c) Take rubbish by self to dump sites rubbish collection points (d) Bury waste around premises or residence d. Burn wastes (e) Dump in drainages/open spaces/bushes/abandoned properties e.t .c (f) Throw into flood

3. Are there piles of exposed garbage visible along the roads/streets/paths? (a) Yes (b) No

4. Are there obstructed sewers, gutters or canals in your community? (a) Yes (b) No
5. Is there waste/refuse/garbage in the gully erosion sites close to you? (a) Yes (b) No
6. If yes, are they clogged with solid waste?
7. Which of these describes the wastes in the gullies around your area? (a) The entire community uses the gully as a dumping ground (b) The waste is generated by only a few of the households around the gully

### **SECTION E: COMMUNITY DEVELOPMENT AND PARTICIPATION**

1. What do you consider to be the major needs and priorities in your community? (a) Domestic water supply (b) Roads (c) Health Services (d) Schools (e) Better Homes (f) Markets (g) Agricultural Storage facility (h) Employment opportunities (i) More land for farming (j) Access to credits
2. Does anyone in your household participate in community meetings? (a) Yes (b) No
3. Are women actively involved in community development decision-making? (a) Yes (b) No
4. Are the youths actively involved in community development decision making? (a) Yes (b) No
5. Are you willing to participate in future community initiative to combat erosion? (a) Yes (b) No
6. Are you willing to contribute in cash or kind towards erosion control initiative in your community? (a) Yes (b) No
7. Has your community benefitted from any major erosion control intervention project in the past? (a) Yes (b) No C. Dont know
8. What are the sources of these interventions? (a) Federal government (b) Local government (c) Community (d) Development partners (e) individuals

### **SECTION F: HEALTH STATUS**

1. Is your present state of health affected in any way by the gully erosion? (a) Yes (b) No
2. If yes, in what way? (a) Skin diseases (b) Cough (c) Catarrh (d) Malaria (e) Water-borne diseases (f) Other, Specify.....
3. How do you manage your health conditions when sick? (a) Attend hospital/clinic (b) Buys drugs from nearby chemist (c) Traditional medicine (d) None (e) Others Specify.....
4. If you do attend hospital/clinic, when last did you visit one? (a) Last six months (b) last one year (c) last five years (d) more than five years ago (e) Never visited one.
5. Please tick one or more of the under-mentioned ailment/sickness, you suffer from most

accordingly?

| Degree Ailment                | Always | Sparingly | Seldom | Never |
|-------------------------------|--------|-----------|--------|-------|
| Whooping cough                |        |           |        |       |
| Rheumatism                    |        |           |        |       |
| Tuberculosis                  |        |           |        |       |
| Rashes                        |        |           |        |       |
| Asthma                        |        |           |        |       |
| Eczema                        |        |           |        |       |
| Dysentery                     |        |           |        |       |
| Ringworm                      |        |           |        |       |
| Diarrhoea                     |        |           |        |       |
| Eye pains                     |        |           |        |       |
| Cholera                       |        |           |        |       |
| Cataract                      |        |           |        |       |
| Pile                          |        |           |        |       |
| Glaucoma                      |        |           |        |       |
| Hypertension                  |        |           |        |       |
| Rheumatism                    |        |           |        |       |
| Tuberculosis                  |        |           |        |       |
| Typhoid fever                 |        |           |        |       |
| Malaria                       |        |           |        |       |
| Pneumonia                     |        |           |        |       |
| Sickle cell anaemia           |        |           |        |       |
| Epilepsy                      |        |           |        |       |
| Sexually transmitted diseases |        |           |        |       |

6. Do you think your ailment/sickness will be directly or indirectly affected by the proposed intervention? (a) Yes (b) No

7. If yes, how? (a) Contamination of ground water (b) Contamination of surface water  
 (c) Provide breeding site for disease vectors (d) Noise/air pollution  
 (e) Others, specify:.....

(Interview Completed)

**Annexure 10.1: Nigerian Ambient Air Quality Standard.**

| <b>Pollutants</b>                  | <b>Time of Average</b>                            | <b>Limit</b>                                                               |
|------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------|
| Particulates                       | Daily average of hourly values<br>1 hourly value. | 250 µg/m <sup>3</sup><br>600* µg/m <sup>3</sup>                            |
| SO <sub>x</sub> as SO <sub>2</sub> | Daily average of hourly values<br>1 hourly value  | 0.01 ppm (26<br>µg/m <sup>3</sup> )<br>0.1 ppm (260<br>µg/m <sup>3</sup> ) |
| NO <sub>x</sub> as NO <sub>2</sub> | Daily average of hourly values<br>(range)         | 0.04 - 0.06 ppm<br>(75 - 113 µg/m <sup>3</sup> )                           |
| Carbon Monoxide                    | Daily average hourly values<br>8 hourly average   | 10 ppm (11.4<br>mg/m <sup>3</sup> )<br>20 ppm (22.8<br>mg/m <sup>3</sup> ) |
| Petrochemical Oxidants             |                                                   | 0.06 ppm                                                                   |
| Non - Methane<br>Hydrocarbon       | Daily average of 3 - hourly<br>values             | 160 µg/m <sup>3</sup>                                                      |

\*Note: Concentrations not to be exceeded for more than once a year.

**Annexure 10.2: World Health Organization (WHO) Guidelines for Maximum Exposure to the major pollutants and some possible effects if these recommendations are exceeded.**

| <b>Pollutant</b>                      | <b>Possible Effects</b>                                                                                                                        | <b>WHO Guidelines</b>                                                                                                                                                                                   |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sulphur dioxide<br>(SO <sub>2</sub> ) | Worsening respiratory illness from short term exposure, increased respiratory symptoms, including chronic bronchitis, from long-term exposures | 40-50 µg/m <sup>3</sup> (annual mean);<br>100-150 µg/m <sup>3</sup> (Daily average)                                                                                                                     |
| Suspended Particulate Matter (SPM)    | Pulmonary effects are associated with the combined exposure to SPM and SO <sub>2</sub>                                                         | Black:<br>40-60 µg/m <sup>3</sup> (Annual mean).<br>100-150 µg/m <sup>3</sup> (Daily average)<br><br>Total SPM:<br>60-150 µg/m <sup>3</sup> (Annual mean);<br>150-230 µg/m <sup>3</sup> (Daily average) |
| Nitrogen dioxide (NO <sub>2</sub> )   | Effects on lung function in persons suffering from asthma from short-term exposures                                                            | 150 µg/m <sup>3</sup> for 24 hr mean;<br>400 µg/m <sup>3</sup> : Not to be exceeded                                                                                                                     |
| Carbon Monoxide (CO)                  | Reduced oxygen - carrying capacity of blood                                                                                                    | 10 ppm (for 24 hr); not to be exceeded.                                                                                                                                                                 |

Source: WHO Air Quality Guidelines for Europe

**Annexure 10.3: Natural Atmospheric Concentration of Some Greenhouse gases.**

| <b>Gases</b>     | <b>Concentrations</b> |
|------------------|-----------------------|
| CO <sub>2</sub>  | 340 ppmv              |
| CH <sub>4</sub>  | 2 ppm v               |
| N <sub>2</sub> O | 0.3 ppm v             |
| CO               | 0.05 - 0.2 ppmv       |
| O <sub>3</sub>   | 0.2 –10 ppmv          |
| NH <sub>3</sub>  | 4 ppbv                |
| NO <sub>2</sub>  | 1 ppbv                |
| SO <sub>2</sub>  | 1 ppbv                |
| H <sub>2</sub> S | 0.05 ppbv             |

**Source: Andersen-Sellers & Robinson (1986)**

**Notes:** ppmv = parts per million by volume, ppbv = parts per billion by volume

**Annexure 10.4: Evolution of Atmospheric Concentrations of Key Greenhouse gases influenced by human activities.**

| <b>Parameter</b>                                       | <b>CO<sub>2</sub></b> | <b>CH<sub>4</sub></b> | <b>N<sub>2</sub>O</b> |
|--------------------------------------------------------|-----------------------|-----------------------|-----------------------|
| Pre-industrial atmospheric concentration (1750 - 1800) | 280 ppmv              | 722 ppmv              | 270 ppmv              |
| Atmospheric concentration as @ 2016                    | 399.5 ppmv            | 1834 ppmv             | 328 ppmv              |
| Current rate of annual atmospheric accumulation        | 2.5 ppmv (0.5%)       | 15 ppbv (0.9%)        | 0.8 ppbv (0.25%)      |
| Atmospheric life time (years)                          | (100 - 300)           | 12.4                  | 121                   |

**Source: IPCC 2016; US Department of Energy, Oak Ridge National Laboratory, 2016**



