Rivers State Ministry of Works

EIA

ENVIRONMENTAL IMPACT ASSESSMENT

Of the Proposed

DUALIZATION AND REHABILITATION OF RUMUOLA JUNCTION FLYOVER, CONSTRUCTION OF FLYOVER AT GRA JUNCTION, AND DUALIZATION OF TOMBIA EXTENSION AND EZIMGBU ROAD IN OBIO/AKPOR LGA, PORT HARCOURT, RIVERS STATE

Submitted

by: GOVERNMENT OF RIVERS STATE

to: FEDERAL MINISTRY OF ENVIRONMENT

Draft Report September 2020

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List of Abbreviations /Acronyms

Abbreviation/ Acronyms	**Meaning**
%	Percentage
<	Less than
A.C. I	American Concrete Institute
A.S.T.M	American society for testing and material
AISC	American Institute of Steel Construction
ALARP	As low As Reasonably Possible
APHA	American Public Health Association
AQ	Air and Noise
ARV	Anti-retroviral drugs
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
C	Carbon
Ca	Calcium
CDC	Community Development Committee
CEC	Cation Exchange Capacity
cfu/g	Colony forming unit per gram
cfu/ml	Colony forming unit per millilitre
Cl^-	Chloride
Cm	Centimetre
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cu	Copper
Db	Decibel
E	East, Easting
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency in USA
FEPA	Federal Environmental Protection Agency
FGD	Focus Group Discussion
FMEnv	Federal Ministry of Environment
FRSC	Federal Road Safety Corps
GC	Gas Chromatograph
GPS	Global Positioning System
H_2SO_4	Tetraoxosulpate (VI) acid
Ha	Hectare
HAZOP	Hazard and Operability
HEMP	Hazards and effects Management Process
HNO_3	Nitric acid
HP	High Pressure
HSE	Health, Safety and Environment
HUB	Hydrocarbon Utilizing Bacteria
HUF	Hydrocarbon Utilizing Fungi

Abbreviation/ Acronyms	**Meaning**
IFC	International Finance Corporation
JBN	Julius Berger Nigeria PLC
Km	Kilometres
LGA	Local Government Area
M	Metres
Max	Maximum
mg/kg	milligram per kilogram
mg/l	milligram per litre
Min.	Minimum
Ml	Millilitre
Mm	Millimetre
ms^{-1}	metres per second
N	North
N	Northings
NE	North East
NGOs	Non-Governmental Organizations
NMT	Non-Motorised Transport
NOx	Nitrogen Oxides
^{O}C	Degree Celsius
PAC	Project Affected Community
PAH	Poly Aromatic Hydrocarbon
PC	Personal Computer
Ph	Hydrogen ion Concentration
Ppm	Parts Per Million
Ppt	Parts Per Thousand
PU	Per Unit
QC/QA	Quality Control /Quality Assurance
QHSE	Quality, Health Safety and Environment
RE	Resident Engineer
RMEnv	Rivers State Ministry of Environment
RMW	Rivers State Ministry of Works
ROW	Right of Way
RS	Rivers State
S	South
SE	South East
SPM	Suspended Particulate Matter
Spp.	Species
SSW	South South West
STDs	Sexually Transmitted Diseases
STIs	Sexually Transmitted Infections
SW	South West
TDS	Total Dissolved Solid
TFC	Total Fungal Count
THB	Total Heterotrophic Bacterial Count

Abbreviation/ Acronyms	**Meaning**
THC	Total Hydrocarbon Content
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
VIO	Vehicle Inspection Office
VOC	Volatile Organic Carbon
W	West
WHO	World Health Organization

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EXECUTIVE SUMMARY

E1.1 Introduction

Many manhours are spent on the roads, commuting in Port Harcourt City due to the perennial chaotic traffic situations, putting commuters through enormous stress and strain. To mitigate this situation, the government of Rivers State has recently embarked on the construction of three of flyover at Okoro-Nu-Odo (Rumuokoro), Rebisi (Garrison) and Rumuogba (Artillery 1& 2) junctions. However, further assessment of the traffic situation in the city has necessitated the construction of more flyovers and dualization of some roads, urgently.

The Rivers State Government, therefore has proposed to dualize and rehabilitate the flyover at Rumuola Junction, construct a new flyover at GRA Junction, and dualize Tombia Extension and Ezimgbu Road, in Port Harcourt City. The proposed project is expected to have both negative and positive impacts on the environment and people of the area.

E1.2 Government of Rivers State's Intent

The proponent, the Rivers State Government (RVSG), recognizes the importance of comprehensive Environmental Planning and Management to the success of any project and is committed to the necessary studies to understand the environmental system of the proposed project area in order to address areas where significant negative environmental impacts (natural, physical and social) may occur, with a view to addressing them, adequately.

In pursuance of this, RVSG is conducting an Environmental Impact Assessment (EIA) of the project, prior to the commencement of the project. This intention is in line with the Federal Ministry of Environment's (FMEnv's) Environmental Impact Assessment Procedural/Sectoral Guidelines for infrastructural projects as well as other international environmental standards.

E1.3 Proposed Project Location

The proposed Tombia Extension is defined by latitude 4°49'10.97"N, longitude 6°58'55.78"E on Ikwerre Road, to meet the GRA Junction flyover on and latitude 4°49'27.86"N, longitude 7° 0'21.52"E which stretches for about 500m to meet the Ezimgbu Road, ending at Stadium Road on latitude 4°49'37.27"N and longitude 7° 0'54.91"E located within Obio/Akpor Local Government Areas, River State. The entire area is built-up, with no bushes for flora and fauna studies.

E1.4 Legal and Administrative Framework for EIA In Nigeria

The legal, regulatory and policy framework for carrying out the EIA of the proposed flyovers project is contained in the applicable acts and regulations of the Federal and State Government, statutes and international conventions to which the Nigerian Government is a signatory.

Federal Ministry of the Environment

Federal Ministry of the Environment developed National EIA procedures following the enablement of the EIA Act CAP E12 LFN 2004. The procedure indicates the steps to be followed from project conception to commissioning to ensure that the project is implemented with maximum consideration for the environment.

Other applicable national laws and regulations include

- Harmful Waste (Special Criminal Provisions) Act, CAP H1, LFN 2004
- Criminal Code Act
- Land Use Act CAP 202, LFN 2004
- The Labour Act of 1990
- The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004
- Federal Road Safety Corps (Establishment) Act
- Highway Codes
- Engineering Standards and odes

Rivers State Ministry of Environment

The Rivers State Ministry of Environment (RMEnv) has the overall responsibility (directly or indirectly through various agencies) of environmental protection within the state.

International Regulations and Conventions

The following conventions and treaties support the use of EIA as key tool to achieving pollution control and sustainable environmental development and Nigeria is a signatory to them.

S/NO	Regulations	Year Adopted
1.	World Bank Environmental Assessment Source Books	1998
2.	UN Convention on Biological Diversity	1994
3.	UN Framework Convention on Climate Change	1992
4.	Convention on the Control of trans-boundary Movements of Hazardous Waste and their Disposal of 1989 (Basal Convention)	1989
5.	Protocol on Substances that Deplete the Ozone Layer. Note: The Protocol was amended for the first time on 29 June 1990 in London. A second set of amendments was adopted in Copenhagen in November 1992; these entered into force on 1994.	1987
6.	Convention for the Protection of the Ozone Layer	1985
7.	Convention Concerning the protection of the World Cultural and National Heritage (World Heritage Convention)	1972
8.	African Convention on the Conservation of nature and Natural Resources	1968

E1.5 Environmental Impact Assessment

RVSG has undertaken this environmental impact Assessment (EIA), to predict the impacts of this proposed flyover bridges development on the environment and propose mitigation measures that will be incorporated into the project environmental management plan and detailed engineering design. The EIA covers:

- Baseline studies – including biophysical studies, social and health impact assessment
- Consultation programmes
- Environmental quality assessment and impact quantification, using predictive modelling tools.

The EIA is being carried out in parallel with the conceptual design of the project, to ensure that any identified adverse impacts are addressed in the detailed design and mitigated during the development activity stages which Involve site preparation, construction, commissioning, operation, decommissioning and abandonment.

E1.6 Terms of Reference for the EIA

In line with the EIA Procedural guidelines (FMEnv, 1995) the terms of reference (ToR) for EIA of the flyovers project was submitted to the FMEnv and approval obtained, defining the scope of work, objectives, baseline data requirements and assessment tools and methods for the EIA.

❖ Objectives of the EIA

This EIA is executed to establish the environmental baseline, sensitivities, impacts and mitigation measures with respect to the development (including operation) of the proposed flyovers project. The EIA will ensure the effective systematic study process. These include:

- Assessment of the present environment status, establishment of environmental issues and factors which are associated with the flyovers project development;
- Assessment and prediction of all possible and potential impacts of the project on components of the environment in terms of magnitude and significance;
- Evaluation of alternatives and identification of the best options that is both cost effective and with least potential environmental impact; and
- Incorporation of EIA recommendations into the flyovers project's detailed design as well as other stages of the project development.

❖ Structure of the EIA Report

The EIA Report is presented in eight chapters, containing background information and the legal and administrative framework for EIA in Nigeria among other information; project justification, the

need/value and its envisaged sustainability as well as the project development and site/route options considered; detailed description of the proposed project including its location, overall layout, basis for design, type and specifications of equipment / facilities to be installed and operation/maintenance of the proposed flyover bridges; description of the existing environment, consultation with stakeholders; identified potential and associated environmental impacts of the proposed project; the various mitigation measures proffered against the identified significant impacts; a cost-effective environmental management plan that would be adopted throughout the project's lifecycle; and conclusions the report and requests approval for project implementation.

Other sections of the report include (not in any chronological order) the table of content, the list of references, list of EIA preparers, list of abbreviations and acronyms, acknowledgement page, the executive summary and various appendices.

E2.1 Project Justification

Roads and bridges play a key role in the socio-economic development of any city. Developments in the industry, agriculture, service, trade and other major sectors of a country's economy depend to a large extent on the efficiency of the existing road network.

E2.2 Project Objectives

The objectives of the proposed project are to ease the flow of traffic at the designated areas, save travelling time, save fuel and reduce emissions, and improve infrastructure.

E2.3 Need for the Project

The Rivers State Government's intention to undertake the construction of flyovers and dualize roads in Port Harcourt is based on the need to decongest traffic and therefore ease vehicular movements in the city. The proposed dualization and rehabilitation of flyover at Rumuola Junction, construction of a new flyover at GRA Junction, and the dualization of Tombia Extension and Ezimgbu Road, in Port Harcourt City of Rivers state is to ease and decongest the traffic flow.

E2.4 Envisaged Sustainability

The sustainability of this project stems from the fact that it will satisfy economic contributions, meet the demand for safe transportation and also maintain environmental friendliness. The sustainable development philosophy of minimizing land-take, cost and the impact on the environment shall be adopted for this development project. The set goal is, "meeting the needs of the present without compromising the ability of future generations to meet their own needs".

E2.5 Project Options and Alternatives

The project following project options were considered based on the health, safety and environmental impacts; best available technology; and economic/social considerations:

Option 1: Do Nothing Option

This implies maintaining the status quo by not constructing the proposed flyovers and not dualizing the roads thereby retaining the existing ones.

This would imply that the opportunity for potential benefits of safer roads, employment creation will be missed; and there will be no environmental impacts due to construction but increased impacts due to worsened traffic situations. This option was therefore rejected

Option 2: Delayed Option

This implies the implementation of the proposed project at a later time for such reasons as lack of funds, communal crises, war, etc. This option was rejected since none of these situations is obtainable and the proposed flyovers construction is urgently needed.

Option 3: Construction of the proposed Flyovers and Dualize Roads

This implies the construction of proposed flyover at GRA junction, dualization and rehabilitation of Rumuola flyover, dualizations of Tombia extension and Ezimgbu Road in Obio/Akpor LGA, Port Harcourt, Rivers state. This option was accepted for implementation because it aligns with the urgent need to improve the traffic situation in the city.

E3.1 Project Description

The proposed project is to dualize and rehabilitate the flyover at Rumuola Junction, construct a new flyover at GRA Junction, and dualize Tombia Extension (1.63km x (7.3m + 7.3m)) and Ezimgbu Road (1km x (7.3m + 7.3m)), in Port Harcourt City.

The Rumuola flyover junction is a 293m of reinforced flyover, with two lanes (3.65 m each), total width of 9.1m, with a new service road width of 7.3 m and 1.0 m lay by lane, having a total construction of around 780m along the Port Harcourt – Aba Expressway with a maximum ramp of 4%.

The GRA junction flyover is a 13 spans with corresponding length of the main bridge part from 293m of reinforced flyover with two lanes (3.65 m each), with a total width of flyover shall be 9.1m, with an approach way ramp made with maximum flight of 4%, new service road with a road width of 7.3 m and 1.0 m lay by lane with a total construction length of around 784m along the Port Harcourt – Aba Expressway.

E3.10 Major Project Equipment

The major equipment to be deployed for the construction of the proposed flyover bridges are Incremental launching machine, 2 x tower cranes 180EC-H/185, 2 x electrical towage winches, hydraulic jacks, and earth work equipment.

E3.11 Project Yard Facility

The project yard, already captured in the recently approved EIA of the construction of flyovers at Rumuogba, Rebisi and Okoro Nu Odo junctions, is located in Port Harcourt, about 900m from the Rebisi (Garrison) junction. It lies within latitude 4°48'23.53"N and longitude 7° 0'55.14"E, on about 3 hectares, with elevation points of 1-2m above sea level. There are about sixteen (16) separate buildings/sections within the premises, which is about 70% built up.

The key production activities of the yard occur in the following sections: scaffolding section, iron bending workshop, main store, precast workshop, painting section, carpentry workshop, asphalt plant, concrete batching plant and water treatment plant.

E3.16 Waste Management

The waste management plan for the proposed project has been informed by the understanding of the possible waste characteristics.

The construction waste to be considered includes: -

- Demolition waste – concrete, soil, sand, metals
- Soil: excavated soil which will be reused as backfilling materials for the flyover bridges foundations.
- Oil: oil & grease from malfunctioning vehicles and equipment at site
- Office waste and domestic solid waste (refuse): this is generated at the construction site.

E3.13 Proposed Maintenance Plan

RMW is committed to making sure that the proposed flyover bridges, on commissioning, is safe and efficient for all travellers.

A general maintenance inspection is conducted at least twice a year. The bridge inspectors are trained engineers and technicians with several years of flyover bridges-related experience.

A general maintenance inspection is conducted at least twice a year. The bridge inspectors are trained engineers and technicians with several years of flyover bridges-related experience.

During inspection, inspectors will carefully assess each part of the flyover bridges and identify any maintenance work that needs to be completed. Each flyover bridge component, as shown in the following pictures, is rigorously examined to ensure that flyover bridges remains safe for travel.

There are four kinds of inspections the proposed flyover bridges will undergo throughout its lifetime. They include:

Detailed visual inspection which will occur every two years.

General maintenance inspection, which takes place twice a year.

Road patrol inspection, which takes place on a regular basis.

An emergency inspection takes place after a major vehicle collision involving one or more flyover bridges components, a flood, an earthquake, etc. This type of inspection is carried out by a trained, professional engineer.

E3.16 Project Execution Schedule

The proposed flyover bridges project execution is scheduled to take 12 months.

E4. Existing Environmental Data Acquisition

E4.1 Scope of Study

Field studies and data collection for characterization of the baseline conditions of the project environment using a radius of 500m as Area of Influence, in line with the TOR approved by the FMEnv.: climate and meteorology; air quality and noise levels; geology/hydrogeology; soil & ground water qualities; socio economics/health impact, demography and community characteristics. The entire area is built-up, therefore there were no flora, fauna, and surface water studies.

E4.2 Baseline Data Acquisition Methods

This exercise involved a multi-disciplinary approach and was executed within the framework of a QHSE Management System approach. This approach assured that the required data and samples were collected in accordance with agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel.

The data gathering exercise was undertaken on the between 17th August through 4th September, 2020. Sampling locations were established and the coordinates of each location was recorded.

E4.3 Baseline Data

E4.4 Meteorology

Rainfall Pattern

The mean monthly rainfall distribution for 30 years (1985-2015) in the study area. Average highest rainfall peaks were attained in September (370mm), July (364mm) and August (325mm). Lowest rainfall values were attained in January (15.3mm) and December (19.2mm). It should be noted that rainfall is very important in managing construction projects since it may cause erosion and erode soil particles from ground level surfaces.

Air Temperature

July-September recorded lower temperatures (28-29 ^{o}C) due to rainy periods while the months December to March recorded higher temperatures (32-34^{o}C) due to intense solar radiation prevalent in

the dry season (Uko and Tamunobereton-Ari, (2013) noted that the average maximum and minimum temperatures during the dry and wet seasons are within 31-33 ^{o}C and 21-23 ^{o}C as well as 25-33 ^{o}C and 18 23^{o}C respectively.

Relative Humidity

Relative humidity (RH) was moderate across the entire Tombia road and its surroundings falling between 61.40 % and 65.11 %. GRA and some part of Rumuola flyover recorded the highest RH ranging from 65.12-76.29 %. Lowest RH was captured in part of Ezimgbu road close to Stadium road and north of Rumuola flyover ranging from 50.21-61.39 %.

Wind Speed/Direction

Wind speed was observed to be very low along Tombia road by Ikwerre junction, east of Ezimgbu road as well as GRA flyover ranging from 0.37-1.38 m/s. Wind speed increases a little towards Rumuola flyover and extreme east of Tombia road ranging between 1.39-2.73 m/s.

Noise level

Noise level at Tombia road and GRA flyover axis was the lowest ranging from 72.11-78.49 [d(B)A]. On the other hand, Rumuola flyover and Ezimgbu road recorded highest noise level ranging from 80.63-87.00[d(B)A].

However, the noise values recorded were lower than threshold limits of FMENV standard of 90 dB A for 8 hourly exposure.

E4.5 Air quality

Carbon Monoxide

Proposed GRA flyover area and Tombia road (by Ikwerre junction) are the two points observed to have recorded highest concentration of CO (though not exceeding the required standard) ranging from 7.44-10.00 ppm. The lowest concentration was observed towards north of Rumuola, east of Tombia road and east of Ezimgbu road ranging from 4.00-5.71 ppm. The concentration was moderate towards south of the area covering Rumuokalagbo, Woji settlements ranging from 5.72-7.43 ppm. Other settlements with moderate concentration include Rurorolukwo, Elekahia, among others.

Sulphur dioxide

Moderate concentration of SO_2 was observed across proposed Rumuola flyover and part of Tombia road by Ikwerre junction ranging from 0.20-0.21ppm. The highest concentration was captured within the proposed GRA flyover (0.22-0.30 ppm) while its lowest point was captured mostly along Ezimgbu road towards stadium road and Tombia road by Polo park ranging from 0.10-0.16 ppm.

The recorded levels of SO_2 were above the FMENV regulatory limits of 0.01ppm – 0.1ppm for daily average of 8-hourly values in Nigeria. Almost every activity at the project area had the potential to generate considerable amounts of sulfur dioxide.

Hydrogen sulphide (H2S)

The concentration of H_2S was the same across the entire study area (<0.1 ppm).

No permissible value for H_2S has been given by Federal Ministry of Environment.

Nitrogen dioxide

NO_2 as indicated in the model recorded highest concentration toward the proposed Tombia road construction project by Ikwerre junction, proposed GRA flyover by Rumuola and Rumuola flyover toward Aba road recorded not less than 0.20 ppm. The concentration reduced with increase in distance from the afore-mentioned axis. Its least concentration was observed toward Tombia road as well as Ezimgbu road off stadium road ranging from 0.10-0.13 ppm.

Hydrogen cyanide (HCN)

A great dynamic model was observed in the concentration of HCN across the study area. Peak concentration was observed around GRA flyover axis, east of Tombia and Ezimgbu road (1.58-2.00 ppm). Tombia extension by Ikwerre road, middle of Ezimgbu road and the entire Rumuola flyover and its environs recorded the lowest concentration ranging from 1.00-1.29 from ppm.

Ammonia (NH3)

The dispersion model indicated that NH_3 concentration was moderate in not less than 47 % of the study area ranging from 1.87-2.14 ppm which covered the entire GRA flyover, part of Tombia road and Ezimgbu road. A slight increase was recorded at the extreme of Tombia road by Polo Park. However, the peak concentration of NH_3 was recorded toward Rumuola flyover axis recording between 2.15 ppm and 3.00 ppm.

Chlorine (Cl2)

Cl_2 recorded moderate concentration across Tombia and Ezimgbu road ranging from 0.20-0.21 ppm. The highest concentration was recorded toward GRA flyover ranging from 0.22-0.30 ppm. The least concentration was recorded around Rumuola flyover and northern part of the study area ranging from 0.13-0.19 ppm.

Particulate Matter PM2.5

$PM_{2.5}$ recorded least concentration towards east of Tombia road with concentration less than 45.29 µg/m^3. However, peak concentration was recorded north of Rumuola and north of GRA flyover ranging from 65.86-70.99 µg/m^3. The remaining part of the study area recorded moderate concentration

ranging from 45.30-60.71 µg/m^3 as observed along Ezimgbu road, Tombia road by Ikwerre junction, among others.

Particulate Matter PM10

PM_{10} as shown in the dispersion model recorded least concentration at the extreme east of Tombia road ranging from 62.01-79.43 µg/m^3. The highest concentration was recorded around Rumuola and GRA flyovers as well as extreme west of Tombia road and the adjoining Ikwerre road ranging from 105.58-122.99 µg/m^3. The concentration around Ezimgbu road towards stadium road was in moderation ranging between 88.16-96.86 µg/m^3.

Total Volatile Organic Compounds (TVOC)

TVOC measured in mg/m^3 was observed to have highest concentration along Port-Harcourt-Aba Expressway (in between Rumuola and GRA flyover) recording between 0.95 and 1.55 mg/m^3. Moderate concentration was capture along Rumuola flyover and part of Tombia road by Ikwerre road read between 0.74 and 0.94 mg/m^3. The southern and north-western part of the study area recorded lowest concentration ranging from 0.12-0.53mg/m^3.

Formaldehyde (CH_2O)

The highest point of CH_2O concentration was found in-between the two flyovers ranging from 0.118-0.192 ppm. The concentration was in moderation (0.093-0.117ppm) towards east of Ezimgbu road and toward Tombia Road by Ikwerre axis. The lowest concentration (0.017-0.092 ppm) was recorded across the GRA flyover and eastern part of Tombia Road.

Methane (CH4)

The entire area of GRA and Rumuola flyover, Ezimgbu Road and extreme west of Tombia Road recorded the lowest CH_4 concentration which ranged from 0.100-0.214 ppm. The peak concentration was found towards Tombia Road by Polo Park and the immediate surroundings ranging from 0.272-0.498 ppm.

Carbon Dioxide (CO_2)

CO_2 was observed to record highest along Tombia Road by Ikwerre axis same with zone in between Rumuola and GRA flyovers with its concentration ranging from 667.70-901.83 ppm. Lowest was recorded south of the study area including Ezimgbu Road and part of Tombia Road ranging from 527.09-634.16 ppm. A slight increase in CO_2 concentration was recorded north of the study area ranging from 634.17-687.69 ppm.

E 4.5.2 Bio-aerosols (Bacteria and Fungi)

Bacteria recorded lowest at the south of the study area including GRA flyover, Tombia and Ezimgbu Road which ranged from 4.11×10^5- 4.30×10^5 cfu/m^3 while the highest bacteria count was captured along Rumuola flyover point ranging from 4.41×10^5– 4.70×10^5 cfu/m^3.

Fungal counts in the model showed that lower concentration was observed toward GRA flyover, Tombia and Ezimgbu Road 4.40 × 10^5 - 4.63 × 10^5 cfu/m^3, while the peak fungal load was captured around Rumuola axis ranging from 4.87 × 10^5- 5.20 × 10^5 cfu/m^3.

E4.5.3 Heavy Metal Content in Air

The recorded concentration of lead ranged from 0.622 – 1.121 mg/m^3 with the mean of 0.901±0.24 mg/m^3. The measured concentrations of arsenic ranged from 0.011 – 0.025 mg/m^3 with the mean of 0.018±0.005 mg/m^3. The amount of chromium found in air ranged from 0.222 – 0.252 mg/m^3 with the mean of 0.235±0.01 mg/m^3. The recorded concentration of cadmium ranged from 2.323 – 2.351 mg/m^3 with the mean of 2.338±0.1 mg/m^3. Nickel found in ambient air ranged from 0.310 – 0.321 mg/m^3 with the mean of 0.314±0.04 mg/m^3, while vanadium was found in the range of 0.001 – 0.008 mg/m^3 with the mean of 0.004±0.003 mg/m^3.

E4.6 Soil Quality

- ✓ **Soil Sampling**

Soil for analysis were collected at geo-referenced points in the study area. All sample collection was carried out using standard procedures recommended by the American Public Health Association (APHA, 1992). Nine soil samples were taken around the project are, this include 8 sampling point and 1 control point using soil auger into sterile zip locked bags. Samples were transported to the laboratory within 24 hours of collection and air-dried for extraction/digestion for actual assay.

- ✓ **Soil Moisture Content**

The moisture content of the soil ranged from 40.3 – 46.7 % with the mean of 42.69 %.

- ✓ **Permeability**

The permeability of the soil ranged from 46.8 – 54.6 % with the mean of 49.43.

- ✓ **Porosity**

The porosity of the soil ranged from 67.3 – 74.8 % with the mean of 70.34%.

- ✓ **Bulk Density**

The bulk density of the soil ranged from 0.2 - 1.3mg/kg with the mean of 0.71mg/kg .

- ✓ **pH**

The pH values of the soil of the project area ranged from 4.82-5.67 with the mean of 5.33. This indicates a predominantly acidic soil which is consistent in all locations and with previous studies conducted in the study area.

Generally, the soils of the area vary from the order Oxisols to Ultisols which are strongly acidic, extensively weathered soils of tropical and subtropical climates.

- ✓ **Soil Nutrients**

The ranges for nitrate, phosphate and sulphate were 7.38 – 8.24 mg/kg with the mean of 7.83mg/kg; 1.08– 1.42 mg/kg averaging 1.28 mg/kg; and 2.28 – 2.56 mg/kg with the mean of 2.44 mg/kg respectively.

Nitrate accounted for 68 % of the soil nutrient followed by sulphate 21 % and the least phosphate 11 %.

- ✓ **Particulate Size Distribution**

The soils of the sample area were predominantly sandy loam with silt on the surface and sandy-silt to clay on the sub-surface. The colour varied between dull reddish brown and reddish grey. The recorded percentages for clay, silt and sand represent a conservative ratio of 1:1:3.5. These results are however consistent with the values recorded in previous soil study of the area.

- ✓ **Cation Exchangeable Capacity (CEC)**
- ✓ Magnesium

The concentration of magnesium recorded in the soil ranged from 1.50 mg/kg to 2.15 mg/kg with the mean of 1.87 mg/kg. Soils values obtained were fairly consistent across the study area.

- ✓ **Sodium**

The sodium concentrations in soils of the study area ranged from 0.18 mg/kg to 0.43mg/kg with the average of 0.28 mg/kg.

- ✓ **Calcium**

The concentrations for the soil of the area ranged from 23.7 mg/kg to 28.8 mg/kg averaging 26.19mg/kg.

Generally, the exchangeable cations concentrations were consistent with recorded values in similar environment within the region. However, the implementation of the proposed project will not affect the exchangeable cations in the project site. Hence, no foreseeable effect on the baseline concentrations of the exchangeable cations in the area is envisaged.

- ✓ **Soil Microbiology**

Total heterotrophic bacteria (cfu/g) ranged between 1.8×10^5 and 3.1×10^5; Total heterotrophic fungi (cfu/g) ranged between 2.4×10^5 and 3.5×10^5; Hydrocarbon utilizing bacteria (cfu/g) ranged between 1.0×10^5 and 1.6×10^5, and Hydrocarbon utilizing fungi (cfu/g) ranged between 1.3×10^5 and 1.7×10^5. 36 genera of microorganisms were isolated, out of which 19 were bacteria and 17 fungi.

E4.7 Land use

The notable land use within the study area included fuel stations, shopping mall, shopping plaza and road infrastructure network.

ES 4.8 Geology

Regional Geology

The Tertiary Niger Delta Basin located in southern Nigeria at the inland margin of the Gulf of Guinea and is situated at the southernmost part of the intra-continental Benue Trough. The basin which was formed at a recognized triple junction of the south Atlantic rifting (Delhaya et al, 2009), is bounded by the Calabar Flank to the east, Benin Flank to the west, Gulf of Guinea to the south and to the north by the Anambra Basin and Afikpo Syncline (Tuttle et al. 1999). The Niger delta basin is one of the largest subaerial basins in Africa. It has a total area of 300,000 km^2, and a sediment fill of 500,000 km^3 (Fatoke, 2010).

Local Geology

The study area has a flat topography and its elevation varies between 30m to 60m above sea level. thus, no outcrop was observed within the study area. The study area consists of alluvial and fluvial sediment deposits of sandstone and clay in which sand percentage increases as observed from the lithologs during the geotechnical investigations in Rumuola junction. According to Etu-Efeotor et al, 1990 the Niger Delta is composed of three subsurface lithostratigraphic units (Akata, Agbada and Benin formations overlain by various deposits of Quaternary Age. The Benin formation (2100m thick) is the most prolific aquifer in the region and constitutes over ninety percent (90%) massive, porous sands with localized clay/shale interbeds. The quaternary deposits (40 – 150m thick) generally consist of rapidly alternating sequences of sand and silt/clay, with the latter becoming increasing more prominent seawards. The Agbada formation underlies the Benin formation and was deposited under transitional environment, makeup of sands and shales. However, increasing clay may occur with depth. Underlying the Agbada formation is the Akata formation, which was deposited, in marine environment. It consists of marine clays, silts and shales with occasional turbidite sand lenses. The formation is rich in organic matter and is the source rock of oil in the Niger Delta. It has a relative thickness of 20,000ft (5882m).

E4.9 Hydrogeology and Hydrology

Geologically, the site is underlain by the coastal plain sands, overlain by firm – stiff clay/sandy clay sediments belonging to the pleistocenic formation. The area essentially reflects the influence of

movements of water runoff in their search for lines of flow to the sea with consequent deposition of transported sediments.

- ✓ **Ground Water Quality and Contamination**

Ground water samples were obtained from 5 boreholes from the study area and these were analysed for physico-chemical and microbiological properties.

- ✓ **Appearance**

The presence of dissolved and suspended organic materials and compounds of calcium and iron (Shelton, 1991) can cause colour in drinking water. However, the water samples collected from project area were all clear in appearance. All samples conformed to WHO recommended standard for any water suitable for drinking.

- ✓ **Odour**

All samples collected had no odour and therefore were in accordance to the recommended FMEnv/WHO standard.

- ✓ **pH**

Water pH is widely used to express the intensity of acidity or alkalinity of water. The pH plays an important role in all chemical reactions associated with formation, alteration and de-solution of minerals in water. Recorded pH values for groundwater ranged from 6.62-6.75with the mean of 6.68 ±0.03. This observed pH values are within the WHO/FMEnv permissible limits of 6.5-8.5 and 6.5-9.0 respectively.

- ✓ **Turbidity (NTU) and Total Dissolved Solids (TDS) (mgl-1)**

The recorded turbidity values from the collected groundwater samples ranged between 0.46-0.52NTU. This is within FMEnv permissible limits of 5NTU.

TDS values of 7.4-7.55mg/l with the mean of 7.46±0.11 mg/l.is recorded for the ground water samples. These values were generally low and were less than 1000mg/l WHO allowable limits for TDS for drinking water standards. TDS values may be an indication that the ground waters within the study area is drinkable.

- ✓ **Electrical Conductivity (µS/cm)**

The values for electrical conductivity of the groundwater samples was analysed to be 14.7-15.2µS/cm with the mean of 14.92±0.23 µS/cm and falls below the World Health Organization's limit of 1000 - 1500 µS/cm.

- ✓ **Total Hardness, mg/l**

These range of values are low when compared with 250 mg/l allowable limit for drinking water quality by WHO. While soft water with a hardness of less than 100mg/l can enhance corrosion in water pipes due to a low buffering capacity, a hardness of water above 200 mg/l may cause scale deposition in the distribution system.

- ✓ **Mineral Oil and Grease**

The amounts of THC in the ground water samples were below the equipment detection limit of 1.00mg/l; hence assumed to be zero and therefore within the WHO regulatory limit of < 0.01.

- ✓ **Biochemical Oxygen Demand (BOD) (mg/l)**

The measured value of BOD level (<0.01) was less than equipment detection level. There is however, no recommended WHO/FMEnv permissible limit for BOD in drinking water.

- ✓ **Dissolved Oxygen (DO), mg/l**

The DO concentration values ranged from 0.13-0.17mg/l with the mean of 0.62±0.11 mg/l. These values are within WHO/FMEnv permissible limits of <5mg/l and 5mg/l respectively.

- ✓ **Nitrate (NO3-) mg/l**

Nitrates recorded was 0.214mgl^{-1} limit allowed by WHO/FMEnv.

- ✓ **Phosphate (PO4-) mg/l**

The concentration across the ground water samples suggest low phosphate presence of mean concentration value of 0.058mgl^{-1}. WHO/FMEnv permissible limit.

- ✓ **Sulphate (SO42-) mg/l**

The recorded mean concentration value of 0.021mgl^{-1} revealed the concentration is below 250mgl^{-1} WHO/FMEnv permissible limits.

- ✓ **Heavy Metals**

The heavy metals investigated in the ground water samples include copper, iron, lead, zinc, cadmium, chromium, and barium. Both lead and chromium were less than equipment detection level. The mean concentration value of copper (0.037mgl^{-1}), iron (0.294mgl^{-1}), zinc (0.674mgl^{-1}), cadmium (0.03mgl^{-1}) and barium (0.046mgl^{-1}) were all within WHO/FMEnv permissible limits of 0.01-1mgl^{-1}, 0.36mgl^{-1}, <1.0-3mgl^{-1} and <1.0-0.003mgl^{-1} respectively.

- ✓ **Microbial Analysis of Groundwater**

Ground water samples were obtained from 5 boreholes. These include 3 stations as sampling point in close proximity to the study area and 2 stations as control point and these were analysed for physico-chemical and microbiological properties.

ES 4.10 Socio-economics

The study was conducted in the four host communities of Rumuola, Ezimgbu (Rebisi), Rumuadaolu, Rumuomoi, and Rumuepirikom in Obio/Akpor Local Government Council, Rivers State. It covered the socio-cultural resources of these communities, demographic issues including population and growth, age and sex distribution, and adult literacy.

- ✓ **Household Composition, Structure and Size**

The typical household unit in the study area has a head and several members. In many cases, the head is the father and members include his wife, children, and wards. The wards are often children of relations and, in some cases, friends. These are usually fed and generally catered for from the resources of the household. Members of the household are not necessarily related biologically. The household could also be composed of members who are not related but have agreed to live together under a common household head. This latter type of household group is not common in the study area.

- ✓ **Migration Trend Pattern**

Those who were born in or had lived in the communities for more than ten years were considered non-migrant while those who had lived for less than ten years were considered migrants. The result shows that between 65% and 80% of respondents were non-migrant. This trend was not entirely unexpected given that the communities are rural areas. However, there were also indications that some household members had relocated over the years for various reasons.

- ✓ **Language, Marriage, and Family**

The people of the study area are dominant of Ikwerre (natively known as Iwhuruọha ethnic extraction. They are considered a part of the larger Igbo ethnic group, although many Ikwerre does not consider themselves Igbo, a distinct ethnic nationality. They speak Ikwerre, an Igbo dialect, now considered a separate language in the Igboid family, as a result of the quest for Ikwerre's recognition as a separate ethnic nationality.

The Ikwerre exists in well-delineated clans, with each clan having its paramount king. The Ikwerre does not have an overall paramount ruler or king, but designated kings, rulers, or leaders are mostly approved by their constituents. However, all paramount rulers in Ikwerre are united in what is known as Ogbakor Ikwerre, which was formed in 1963 as an umbrella socio-cultural organization of the Ikwerre people

The family is recognized as a very important social unit and both nuclear and extended families exist in the communities. The typical nuclear family is headed by the father, with the mother and children. The extended family includes members who are not biological offspring of the same parents but relations. A nuclear family where the father was dead could be headed by the mother if the children are juveniles or by the eldest son if he is a grown man and able to bear the financial responsibility of taking care of the family. The extended family is always headed by a male member.

- ✓ **Conflict Management and Security**

These communities have various organs of society traditionally involved in resolving conflicts. These organs include the social organizations to which household members belong to, like the women organizations, the compound chiefs, and the CDC. However, at the apex of the traditional conflict resolution process in each community are the traditional leadership. Their decisions on intra communal conflict issues are usually binding on all parties.

- ✓ **Livelihood Activities**

Livelihood activities across the surveyed communities are similar. The identified activities are mainly commerce and provision of services like petty trading, artisanship practices, and employment in the civil/public services. The largest proportion of household members in all the communities are engaged in trading. Artisanship practices inclusive of electrical repairs, boat building, tailoring, etc are significant in the study area. Civil/public service employees in the communities are limited mostly to Local Government workers, teachers, and health workers. Others are inclusive of a few residents who are employed in oil companies and those involved in contracting.

- ✓ **Health Facilities and Services**

The study area has both orthodox and non-orthodox health care providers and facilities. The General Hospital in the area provides first aid, serves as an HIV/AIDS counselling center and treatment for minor ailments, as well as immunization services for children and women of childbearing age. The antigens they give include BCG, OPV, DPT, Measles, TT, YF, and HBV.

Apart from the orthodox facility, there are drug stores (chemists) located in all the communities. There are also hawkers (individuals who carry drugs, especially malaria drugs, analgesics, antibiotics, and various creams and balms) hawking drugs from one settlement to another. The number and the quality of drugs being distributed could not determine during the study.

- ✓ **Water, Waste Management and Sanitation**

The sources of water used in households in the study area include water from rain water, well and water from public and private bore holes. In the surveyed area many households avoid the use of rain water as a result of their belief that rain water is being polluted by gaseous emissions from flares from oil and

gas activities in and around their communities. For this reason, also, the use of rain water is mostly limited to washing of cloths and other things and not for cooking.

Waste disposal practices in the project affected communities are quite similar. Refuse is unfortunately mostly deposited by the roadside medians by households, for eventual collection and disposal by Rivers State Waste Management Agency. Similarly, two methods of sewage disposal practiced are use of pier system toilets and water closet toilets. About 91% of households in the study communities dump their refuse in open space awaiting government to evacuate, while 32% use the pit toilets.

- ✓ **Nutrition**

The average household in the study area is able to provide two meals daily for its members. The meals consist predominantly of carbohydrate and protein. Commonly available sources of protein are fish and sea foods, especially periwinkles, oysters, prawns and crayfish. These proteins are always available in the soups with which garri (the staple and most common food) is eaten. Other foods eaten include yam, rice, cocoa yam, sweet potato and beans.

- ✓ **Prevalent Diseases and Disease Vectors**

Interviews in household and with health workers in the proposed project communities revealed that the most frequently reported diseases are malaria, diarrhoeal diseases and respiratory tract infections (RTI).

The commonest disease vector is mosquito which transmits Plasmodium which causes malaria in humans. Others are house flies and rodents. The environment around the project communities provides the necessary breeding grounds for these disease vectors.

- ✓ **Land Ownership and Tenure**

Land in all the project communities is primarily owned by families. Ownership rights over lands are handed down from one generation to another within the extended family. Such inherited land is put to any use as desired by the owner(s). These are the lands on which family members build their houses and are allocated for businesses. Land could be bought from owners who were willing to sell. Apart from the family, individuals and organisations also owned some land.

Any intentions to obtain land for corporate or industrial use are initiated through the CDCs and various councils of chiefs which are in the best position to offer proper guidance concerning ownership. This condition is important whether the required land is owned by a family individuals and organisations. This approach to obtaining land helps avoid intra/ inter communal conflicts over ownership of any land that may be required for any project.

- ✓ **Infrastructural Base**

Public access to the project affected communities is by roads with most of the communities having paved internal link streets and lanes. Additionally, telecommunication services from GSM service providers are received in all the parts of the communities.

Education facilities in the LGA consist mainly of public primary, junior and senior secondary schools and array of private schools. The infrastructures in many of the schools are inadequate.

There is generally a dearth of functional orthodox health facilities in the entire study area. The basic problems of government hospitals and PHC are inadequate staffing, broken down and unmaintained equipment and lack of drugs. Public water and electrification are very much dysfunctional in the communities. Several water boreholes have been constructed in the communities but most of them are not working largely because the water produced is deemed unfit for consumption by community residents, usually because of colouration. Similarly, electricity in the area is generally characterized by frequent blackout and poor voltage.

In terms of trading opportunities, all the surveyed communities can boast of small, functional but poorly infrastructures a makeshift marketing facility which deals with foodstuff basically from which the people may procure their essential needs.

ES 4.11 Traffic Survey

This traffic study was carried out to analyse the traffic characteristics in the selected routes. This study helps in deciding the geometric design features for traffic control for safe and efficient traffic movement. The study was to determine the number of vehicles crossing sections of roads proposed for flyover per unit time at any selected period and also to quantify measure of flow. The units used are vehicles/day or vehicles/hour.

- ✓ **Traffic analysis of the location**

Traffic situations in these areas both during weekends and weekdays are similar. One domination in the area is that there are more cars and buses on the routes than trucks, and tricycles popularly known as Keke and motorcycles are not allowed access to these routes.

Data obtained from the field shows that Waterline to PH town route of the project site has more traffic flow than others with 20,636 vehicles plying the route from 7 am to 6 pm on a weekend and it is followed by PH town to Waterline route with 15,460 vehicles plying the route between 7 am to 6 pm on a weekend. 5610 cars were recorded on Waterlines to the PH town route on a Thursday between 3-4 pm representing 25% of the total vehicle recorded on that day. The proposed project sites serve as both intra and interstate transportation routes and account for a large proportion of traffic flow in the state. The multipurpose nature of these routes makes determining peak days and time difficult as it changes

regularly depending on other variables like school sessions, events, and functions in and around Port Harcourt,

This study reveals predominant use of cars as a means of transportation for short shuttles within the state capital and neighbouring LGAs. The recent burgeoning growth in the commercial cars in Port Harcourt could generally be attributed to its inherent advantages of door-to-door service, manoeuvrability during traffic congestion, and ease of responsiveness to demand.

ES 6.1 Summary of Impacts and Mitigation measures

POSSIBLE IMPACTS	MITIGATION MEASURES
Acquisition of property for flyover ROW (where necessary); and land for earth borrow pits, water, spoil pits and workmen's camp	The acquisition would be done in conjunction with the local community. Determination of agreeable rates for compensation to affected persons by key players being Ministry of Works, and all other relevant statutory institutions. Cultivable lands will not be used as borrow pit sites for excavation of construction materials, unless other sites have been exhausted. Develop and implement an approved EPRP (MMSD), and without perjury to same, adopt the following key rehabilitation principles during decommissioning; Rehabilitate the affected areas to a state equal to or better than the original, that supports plant growth. Rehabilitate within terms agreed between the affected party (land owner) and the contractor.
Contamination of soil by fuels, oil spills and lubricants	Vehicle, machinery, and equipment maintenance and refuelling will be carried out on paved surfaces so that spilled materials do not seep into the soil. Fuel storage and refilling areas will be located at least 300 m from drainage structures and important water bodies (rivers, water pans etc). All spoils and wastes will be disposed of as per approved disposal plans in

POSSIBLE IMPACTS	MITIGATION MEASURES
Air Pollution due to dust generation and exhaust emissions	JBN will sprinkle water on dry and dusty surfaces regularly including the access roads and diversions. All precautions will be taken for reduction in dust emissions from batching and/or hot mix plants and crushers, etc. Adherence to personal protective clothing such as the use dust masks and respiratory masks by workers. Enforcement of onsite speed limit regulations.
Noise Pollution and Excessive Construction	Ensure that all vehicles and construction machinery are kept in good condition all the time to avoid excessive noise generation. Ensure that all workers wear ear muffs and other personal protective gear/equipment when working in noisy sections.
Possible Displacement and disruption of Businesses located at the proposed flyover and road locations	The affected community members should be informed early enough. The affected businesses will be compensated appropriately according to existing best practices on current market rates or mutually agreed rates. Explore the alternative of by-passing the road outside the towns to avoid displacement, The proponent will need to ensure that the final designs of the road will be realigned to ensure that displacements are minimized as much as possible. Ensure that the Resettlement Action Plan is done appropriately and professionally as per the laid Land Use Act CAP 202 LFN 2004. Provide support to squatters to establish small-scale businesses in other suitable locations of the towns.
Water Abstraction and Consumption	Install water conserving taps and toilets where possible e.g. in the base camps. Construct water pans and for storage of harvested storm water in conjunction with the local community members. Drilling of boreholes to supplement water obtained from other sources. It would be a noble arrangement to enhance community water supply by

POSSIBLE IMPACTS	MITIGATION MEASURES
Solid Waste generation	Maximizing the rate of recycling of road resurfacing waste either in the aggregate (e.g. reclaimed asphalt pavement or reclaimed concrete material) or as a base. Collecting road litter or illegally dumped waste and managing it according to the Waste Management; Regulations 2006 and as provided in the Environmental Management and Monitoring Plan. Provision of temporary waste handling facilities (litter bins) both during construction and operation
Energy Consumption	• Promote the use of solar energy and energy efficient bulbs in workers base camps and for street lights on and under the flyover when completed road. • Switch off lights when not in use. • Install electricity meters to monitor the consumption of electricity in workers camps. • Ensure construction machineries and trucks are well maintained. • Use energy-efficient construction machineries and trucks during
Discharge of Wastewater, Sewage and Degradation of Water Quality Storm water	Construction of a communal septic tank linked to an approved wetland system. Explore the use of bio-digester in treatment of sewage in the workers camps. Promote recycling of wastewater especially storm water for dust suppression • Use of storm water management practices that slow peak runoff flow, reduce sediment load and increase infiltration. • Use of vegetated swales, filter strips, terracing, check dams, detention ponds or basins, infiltration trenches and infiltration basins. • Regular inspection and maintenance of permanent erosion and runoff control features.

Environmental Monitoring Plan

Monitoring Scope	Parameter	Location	Frequency		Responsibility	Oversight
			Construction	Operation		
Air	TSP, NO_2, SO_2, CO, CH_4	Settlement areas, close	Weekly	-	JBN	FMEnv with RMEnv,

Monitoring Scope	Parameter	Location	Frequency		Responsibility	Oversight
			Construction	Operation		
		to flyover sites				Obio/Akpor LGC
Noise	Sound level (dBA)	Sensitive spots, e.g., school, residential buildings close to flyovers	Weekly	-	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Solid waste	Ignitability, Corrosivity, Reactivity etc	Designated dump site	Monthly	-	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Public safety	Signs, culvert, incidence/ accident records	Flyover/road Locations	Monthly	Quarterly for the first year, then annually thereafter	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Land acquisition and population and structures resettlement	Compensation, income, employment, social adaptation	Relocated families and receiving communities	Middle and end of land acquisition and resettlement		JBN	FMEnv with RMEnv, Obio/Akpor LGC

Conclusion and Recommendation

It is hoped that all data/evidence contained in this report is sufficient in the development of an environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of project; and also, that there is no major environmental issue to impede the development of the proposed project. We strongly recommend the proposed Flyovers and dualize project for EIA Approval

INTRODUCTION 1

1.1 Introduction

Many manhours are spent on the roads, commuting in Port Harcourt City due to the perennial chaotic traffic situations, putting commuters through enormous stress and strain. To mitigate this situation, the government of Rivers State has recently embarked on the construction of three of flyover at Okoro-Nu-Odo (Rumuokoro), Rebisi (Garrison) and Rumuogba (Artillery 1& 2) junctions. However, further assessment of the traffic situation in the city has necessitated the construction of more flyovers and dualization of some roads, urgently.

The Rivers State Government, therefore has proposed to dualize and rehabilitate the flyover at Rumuola Junction, construct a new flyover at GRA Junction, and dualize Tombia Extension and Ezimgbu Road, in Port Harcourt City. The proposed project is expected to have both negative and positive impacts on the environment and people of the area.

1.2 PROJECT SCOPE

These will involve the following scope:

Rumuola Junction Flyover Dualization

- **Building of one new bridge with service lane on one side (Figure 1.3):**

i. 293m of reinforced flyover at Rumuola Junction with two lanes (3.65 m each) in accordance to the Federal Highway Standards and Specifications.
ii. The total width of flyover shall be 9.1m
iii. Approach way ramps shall be made with a maximum flight of 4%
iv. New service road with a road width of 7.3 m and 1.0 m lay by lane
v. Total construction length of around 780m along the Port Harcourt – Aba Expressway
vi. Provision of drainages and culverts at the new service lane
vii. Elliptical roundabout under the bridge at Rumuola Junction including traffic islands
viii. The new road pavement shall be 200mm thick cement-sand subbase with 5% average cement content by weight; 200mm granular stone base and 100mm thick total asphalt concrete surface
ix. Road marking
x. Traffic lights at the junction Rumuola Road/Aba Express Way
xi. Fencing and grassing of the area under the bridge.
xii. Street light

- **Rehabilitation of the EXISTING bridge and service lane:**

i. New asphalt concrete surface (40 mm wearing course) on the existing bridge deck and service lanes. Partial replacement of damaged subbase sections where required
ii. Rehabilitation/Refurbishment of damaged parapets and walkways
iii. Cleaning and/or partial repair of existing concrete U-Channel and bridge dewatering
iv. Road marking

1.2.1 GRA Junction Flyover

Building of ONE new bridge with service lane on one side (Figure 1.4):

xiii. 293m of reinforced flyover at GRA Junction with two lanes (3.65 m each) in accordance to the Federal Highway Standards and Specifications.
xiv. The total width of flyover shall be 9.1m
xv. Approach way ramps shall be made with a maximum flight of 4%
xvi. New service road with a road width of 7.3 m and 1.0 m lay by lane
xvii. Total construction length of around 784m along the Port Harcourt – Aba Expressway
xviii. Provision of drainages and culverts at the new service lane
xix. Elliptical roundabout under the bridge at GRA Junction including traffic islands
xx. The new road pavement shall be 200mm thick cement-sand subbase with 5% average cement content by weight; 200mm granular stone base and 100mm thick total asphalt concrete surface
xxi. Road marking
xxii. Traffic lights at the junction Tombia/Ezimgbu Roads/Aba Express Way
xxiii. Fencing and grassing of the area under the bridge.
xxiv. Street light

Ezimgbu Road - Dualization

Tombia Street Extension – Dualization

1.3 Work Process

The proposed project construction involves:

- Surveying
- Site Clearing of all demolition debris
- Piling works
- Earth Work
- Precast of bridge members
- Construction
- Decommissioning of construction sites
- Commissioning, operation and maintenance

1.4 PROJECT LOCATION

The proposed Tombia Extension is defined by latitude 4°49'10.97"N, longitude 6°58'55.78"E on Ikwerre Road, to meet the GRA Junction flyover on and latitude 4°49'27.86"N, longitude 7° 0'21.52"E which stretches for about 500m to meet the Ezimgbu Road, ending at Stadium Road on latitude 4°49'37.27"N and longitude 7° 0'54.91"E (Figure 1.1). Rumuadaolu, Rumuepirikom, Rumuomoi, Ezimgbu (Rebisi) and Rumuola communities in Obio/ Akpor LGA are the host communities (Figure 1.1).

1.5 Proponent's Intent

The Government of Rivers State, the proponent, intends to undertake this environmental impact Assessment (EIA), to predict the impacts of this proposed flyovers and roads dualization on the environment and propose mitigation measures that will be incorporated into the project environmental management plan and detailed engineering design. The EIA covers:

- Baseline studies – including biophysical studies, social and Health Impact Assessment
- Consultation programmes
- Environmental quality assessment and impact quantification, using predictive modelling tools.

The EIA is being carried out in parallel with the conceptual design of the project, to ensure that any identified adverse impacts are addressed in the detailed design and mitigated during the development activity stages which involves site preparation, construction, commissioning, operation, decommissioning and abandonment.

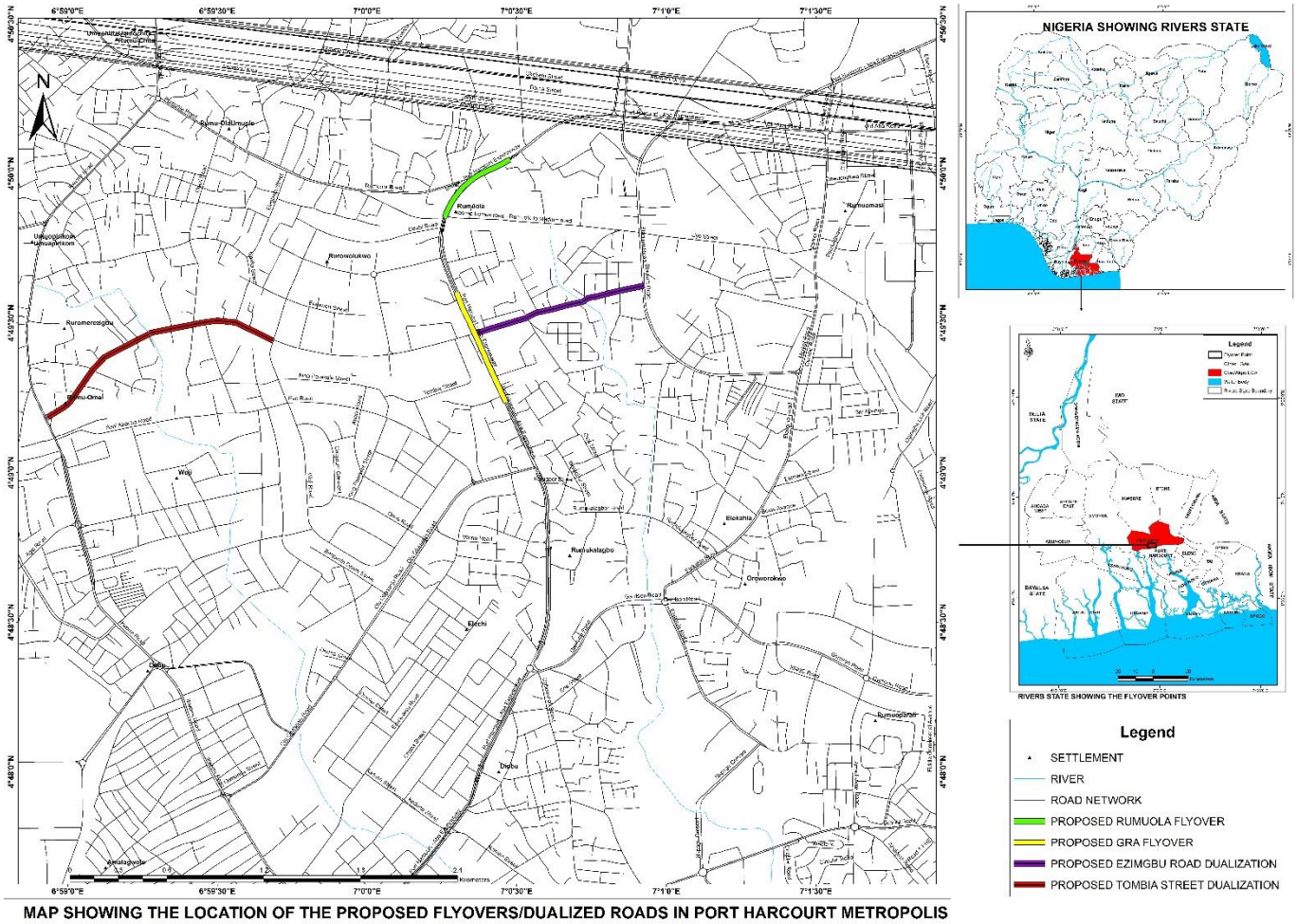


Figure 1:1 Map of Rivers State showing Obio/Akpor LGA (Project LGA)

Objectives of the EIA

The objectives of the EIA are as follows:

- Establish the existing biological, physical, social and economic conditions of the project area.
- Characterize the environment thereby identifying the resultant hazards (including social) associated with the flyover and roads and infrastructures.
- Make recommendations to eliminate / mitigate / control the magnitude and significance of identified potential and associated adverse impacts of the project.
- Develop a cost effective EMP that recommends plans and procedures to manage the consequences and recover from exceptional events throughout the lifecycles of the project.
- Ensure proper consultations with the communities bordering the Flyover and roads and infrastructures in the line with the Federal Ministry of Environment guidelines and other international standards.
- Obtain EIA project certification and other associated environmental permits.

Statutory (Legal and Administrative) Framework

The legal, regulatory and policy framework for carrying out the EIA of the proposed Flyover and roads project is contained in the applicable acts and regulations of the Federal and State Government, statutes and international conventions to which the Nigerian Government is a signatory.

Various environmental studies and related strategic initiatives would meet or surpass the relevant Nigerian and international environmental legislative requirements and guidelines. These include but not limited to:

Federal Ministry Environment

Act 58 of 1988 established the Federal Environmental Protection Agency (FEPA) as the chief regulatory body for environmental protection in Nigeria. The Act establishing FEPA placed on it the responsibility of ensuring that all industries meet the limits prescribed in the national guidelines and standards and the associated various regulations of environmental pollution management in Nigeria (e.g. effluent limitation, management of solid hazardous waste, etc.). FMEnv may update the National Guidelines and Standards from time to time.

Relevant specific standards, discharge limits, and other environmental requirements of the FEPA guidelines (1991) and subsequent relevant directives were reviewed. The Federal Government released the Environmental Impact assessment (EIA) Act CAP E12 LFN 2004. The Act makes the EIA process mandatory for any major development project and prescribes the procedures for conducting and reporting EIAs.

1.5.1.1 FMEnv's Guidelines on EIA

Federal Ministry of the Environment developed National EIA procedures following the enablement of the EIA Act CAP E12 LFN 2004. The procedure indicates the steps to be followed from project conception to commissioning to ensure that the project is implemented with maximum consideration for the environment.

1.5.1.2 EIA Sectoral Guidelines of the Federal Ministry of Environment

Federal Environmental Protection Agency (FEPA) was established by Act 58 of 1988 to monitor and prevent the pollution of the environment following the Koko toxic waste dump incident. This status empowered the then FEPA to prepare Environmental Guidelines and Standards as instruments for prevention of environmental pollution. This Act also gives specific powers to FMEnv to facilitate environmental assessment of projects.

In addition, FMEnv regulations S.I.8, S.I.9 and S.I.15 of 1991 provides guidelines and standards for the following:

- Solid and Hazardous waste management
- Effluent limitations
- Pollution abatement in industries generating waste.

In September 1995, EIA Sectoral Guidelines for proposed projects in Nigeria were published. The guidelines are intended to assist the proponent to conduct proper and detailed EIA Studies in compliance with the EIA Act of 1992.
The procedure for EIA involves the project proposal stage where the project proponent officially notifies FMEnv of the proposed project. This proposal is to contain concise information of the project including a land use map.

The legal and regulatory framework for carrying out EIA of the proposed flyover and roads project are contained in relevant national statutes and international environmental conventions to which Nigeria is a signatory.

This stage is followed by the screening phase, whereby an Initial Environmental Examination (IEE) is executed by the FMEnv then the projects are assigned into categories based on the following criteria:

Magnitude

- Extent or Scope
- Duration and Frequency
- Risks
- Potential Environmental Impacts

Another stage of FMEnv's EIA procedure is the scoping stage, the main feature of which the proponent is required to submit the Terms of Reference (ToR) for the proposed EIA. In some cases, the FMEnv may demand a Preliminary Assessment Report from the proponent to assist in vetting the scope and the ToR of the proposed EIA.

This stage is followed by:

- Actual Implementation of the EIA
- Preparation of Draft Report
- Final EIA Reports
- Review Process and Approval/Certification.

Apart from the general EIA Guidelines, the Ministry has issued sectoral guidelines for EIA in different infrastructural sectors.

Other applicable national laws and regulations include

Harmful Wastes (Special Criminal Provisions etc) Act No 42

Activities relating to the purchase, sale, importation, transit, transportation, deposit and storage of harmful wastes are prohibited and declared unlawful under the Act. From the commencement of this Act, any person who, without lawful authority: (a) carries, deposits, dumps or causes to be carried, deposited or dumped, or is in possession for the purpose of carrying, depositing or dumping, any harmful waste on any land or in any territorial waters or contiguous zone or Exclusive Economic Zone of Nigeria or its inland waterways; or (b) transports or causes to be transported or is in possession for purpose of transporting any harmful waste; or (c) imports or causes to be imported or negotiates for the purpose of importing any harmful waste; or (d)sells, offers for sale, buys or otherwise deals in any harmful waste, shall be guilty of a crime under this Act. Remaining provisions deal with prosecution, crimes by body corporate and penalties.

Criminal Code

The Nigerian Criminal Code makes it an offence punishable with up to 6months 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 carrying 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.

Land Use Act CAP 202 LFN 2004)

The Land Use Act of 2004, the Constitution of 1999 and the Public Lands Acquisition Laws of the relevant states constitute the governing policy for land acquisition in Nigeria. As is the case with most national and state laws on compulsory acquisition of land in the public interest or for a public purpose, the legislation

enables the State to acquire land (more precisely, to abrogate leases and other authorizations to occupy land). The Act also specifies the procedures the State must follow to clear the land, and defines the compensatory measures the State must implement in order to compensate the people affected.

The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004

This law established a Development Control Department (DCD) charged with the responsibility for matters relating to development control and implementation of physical development plans at Federal, State and Local Government levels within their respective jurisdiction.

FRSC Act CAP 141 (LFN) 2007

In February 1988, the Federal Government created the Federal Road Safety Commission through Decree No. 45 of the 1988 as amended by Decree 35 of 1992 referred to in the statute books as the FRSC Act CAP 141 Laws of the Federation of Nigeria (LFN). Passed by the National Assembly as Federal Road Safety Commission (establishment) Act 2007.

The Labour Act, (1990)

The Labour Act (1990) is the primary law protecting the employment rights of individual workers. The act covers protection of: wages; contracts; employment terms and conditions; and recruitment. It also classifies workers and special worker types. Union membership is governed by the Trade Union Amendment Act (1995). 1999 constitution includes stipulation of "equal pay for equal work without discrimination on account of sex, or any other ground whatsoever".

While Nigeria has ratified all eight core International Labour Organization Conventions and enacted laws to enforce the provisions, there are indications of restrictions on the trade union rights of workers in Nigeria, discrimination, child labour and forced labour.

International Guidelines and Conventions

In addition to the national laws and regulations, Nigeria is signatory to several international conventions and treaties supporting the use of EIA as the key tool for achieving pollution control and sustainable environmental development.

Basel Convention on the Control of trans-boundary Movement of Hazardous Waste and their Disposal

The Basel Convention addresses the worldwide concern over the risks posed by the generation and disposal of hazardous and other harmful substances. This Convention classifies the waste and controls the Trans-boundary movement of hazardous waste and other harmful substances against the adverse effects it can impose on human health and the environment. In the proposed road project, no waste generated shall be transported outside the country.

The objectives of this convention, in addition to the Montréal protocol and the London amendment (1994) are:

- To protect human health and the environment against adverse effects resulting or likely to result from human activities, which modify or are likely to modify the ozone layer; and
- To adopt agreed measures to control human activities found to have adverse effects on the ozone layer.

A comprehensive list of international regulations and conventions has been provided in Table 1.2. These treaties support the use of EIA as key tool to achieving pollution control and sustainable environmental development.

Table 1.1 International Legislation Summaries

S/NO	Regulations	Year Adopted
1.	World Bank Environmental Assessment Source Books	1998
2.	UN Convention on Biological Diversity	1994
3.	UN Framework Convention on Climate Change	1992
4.	Convention on the Control of trans-boundary Movements of Hazardous Waste and their Disposal of 1989 (Basal Convention)	1989
5.	Protocol on Substances that Deplete the Ozone Layer. Note: The Protocol was amended for the first time on 29 June 1990 in London. A second set of amendments was adopted in Copenhagen in November 1992; these entered into force on 1994.	1987
6.	Convention for the Protection of the Ozone Layer	1985
7.	Convention Concerning the protection of the World Cultural and National Heritage (World Heritage Convention)	1972
8.	African Convention on the Conservation of nature and Natural Resources	1968

Terms of Reference for the EIA

RVSG has undertaken the environmental impact Assessment (EIA), to predict the impacts of this proposed flyover bridges development on the environment and propose mitigation measures that will be incorporated into the project environmental management plan and detailed engineering design. The EIA covers:

- Baseline studies – including biophysical studies, social and health impact assessment
- Consultation programmes
- Environmental quality assessment and impact quantification, using predictive modelling tools.

The EIA is being carried out in parallel with the conceptual design of the project, to ensure that any identified adverse impacts are addressed in the detailed design and mitigated during the development activity stages

which Involves site preparation, construction, commissioning, operation, decommissioning and abandonment.

In line with the EIA Procedural guidelines (FMEnv, 1995) the terms of reference (ToR) for EIA of the flyovers project was submitted to the FMEnv and approval obtained defining the scope of work, objectives, baseline data requirements and assessment tools and methods for the EIA. The document also outlined the regulatory and administrative framework within which the EIA is conducted, highlighting key issues and activities of environmental concerns in the proposed project planning and implementation.

EIA Methodology

The procedure adopted for completing this EIA involved site identification and characterization, consultation with stakeholders and experts, literature review, field sampling, laboratory analysis and interpretation, collection of data, impact identification and evaluation, environmental impact analysis, impact mitigation and environmental management planning. The preparation of the report was performed by a multi-disciplinary team. The team selection was based on characteristics of the project environment, experience and subject discipline of each specialist. A team leader coordinated the tasks of team members towards achieving set targets as well as liaison with client.

This EIA study was conducted in compliance with Federal Ministry of Environment requirements. The methods adopted in performing specific tasks of the EIA for the proposed project are as follows.

Desktop Research

The geography and the relevant environmental and socio-economic information on the proposed project location were gathered from maps, charts, articles, previous study reports on the area and similar environment, photographs, etc. The information generated enabled definition of limits of the area to be studied. Data gap analysis was carried out to identify areas where additional information was required and the result used in planning the execution of field sampling and measurement aspects of the EIA project.

Field data Collection

The information gathered from desktop research and site identification were used in categorizing the major habitats in the area, and their respective sampling requirements defined to effectively collect qualitative and quantitative data of the project area. The fieldwork covered all relevant elements of the ecological and socio-economic environments.

Consultation with Stakeholders and Experts

In order to efficiently deliver improved project sustainability and protect the interest of the affected communities, especially the poor and vulnerable, an elaborate public consultation process was undertaken as part of this EIA. It involved engaging each identified community in a dialogue characterized by two-way information flow. Consultation allowed obtaining from the affected population, information that might

influence the decision-making process in scoping, project design, mitigation, monitoring and management plans, as well as the analysis of alternatives to be implemented.

Impact Identification and Evaluation

The environmental aspects of the proposed project that may interact positively or negatively with the environment at the construction, operation and decommissioning phases were identified at this stage of the assessment. In the identification and evaluation process, the information collated, were processed using procedures in the FMEnv EIA Sectoral guidelines for Infrastructure projects and the World Bank Environmental Source Book.

Impact Mitigation

Mitigation measures designed to prevent, reduce or control the adverse impacts of the proposed project activities were proffered using professional judgment based on scientific deductions and project experience. Other resource documentation referred to include the FMEnv Sectoral Guidelines for infrastructures projects, and the World Bank Environmental Assessment Source Book. Similarly, enhancement measures were proffered to ensure that beneficial impacts of the project were optimized. Furthermore, post-auditing or monitoring has been designed into the project and its environmental management plan.

Objectives of the EIA

This EIA is executed to establish the environmental baseline, sensitivities, impacts and mitigation measures with respect to the development (including operation) of the proposed flyovers project. EIA will ensure the effective systematic study process; these include:

- Assessment of the present environment status, establishment of environmental issues and factors which are associated with the flyovers project development;
- Assessment and prediction of all possible and potential impacts of the project on components of the environment in terms of magnitude and importance;
- evaluation of alternatives and identification of the best options that is both cost effective and with least potential environmental impact; and
- incorporation of EIA recommendations into the flyovers project's detailed design as well as other stages of the project development.

1.6 Benefits of the EIA

The benefits of the EIA will include, but not limited to:

- Obtaining permits usually required by regulatory authorities before the commencement of any major development
- Providing a forward-planning tool for environmental implications to be taken into account with other design considerations at the conceptual design stage which allow important decisions to be built into the project while avoiding undue damage to the environment;

- Providing a design tool that will allow a systematic evaluation of potential environmental problems from the proposed flyover bridges and identification of key issues which require special consideration for effective environmental management and controls;
- Involving all stake holders through consultation so as to address common problems, impacts and mitigating measures that might be proposed; and
- Informing and assisting management with a view to establishing and achieving long term management objectives and plans associated with specific activities, in order to minimize associated financial and environmental risks.

1.7 Structure of the EIA Report

The EIA Report is presented in eight chapters as shown in Table 1.2.

Table 1.2: Structure of the Report

Chapter Number	Contents Reading	Explanatory Note
Front Piece		Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables and maps)
	Non-technical summary	Summary of the entire EIA report.
1	Introduction	This Chapter outlines the development and structure of the EIA report including the background, terms of reference and declaration. The policy, legal and institutional framework within which the EIA has been conducted has been discussed. National regulations has been summarized along with relevant international agreements and conventions to which Nigeria is party as well as applicable international best practice guidelines and project standards.
2	Project Justification	This chapter presents the project background, objectives, need for the project, value of the project, envisioned sustainability, alternatives considered (including no project alternative), developed options considered and site selection.
3	Project Description	This Chapter provides a concise description of the project and its geographical and temporal context. It includes site description and overview of the facility, project design and details of project inputs and outputs.
4	Description of the environment	This chapter summarizes the available baseline data on the environmental and social resources and receptors within the project AoI. It has been based on both primary and secondary data resources

Chapter Number	Contents Reading	Explanatory Note
		and considers changes in the baseline condition without the development in place. .
5	Stakeholders Engagement	This Chapter present the results of consultation undertaken as part of the EIA, plus plans for future consultation. It identifies key project stakeholders and presents their feedback on the project
6	Impacts and Mitigation Measures	This Chapter presents the predicted positive and negative impacts of the project. Cumulative impacts of the project. Cumulative impacts will be assessed as appropriate. Also, this Chapter outlines general and specific mitigation measures to reduce, remove or avoid negative impacts to environmental and social receptors. Any residual impacts (post mitigation) will be outlined.
7	Environmental and Social Management Plan (EMP)	The ESMP draws together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation and estimate the costs of the measures.
8	Conclusion	This Chapter summarizes conclusions that are made based on the assessment as well as outline any further recommendations.
References		All references made in the report and documents drawn upon during the course of the assessment.
Annexes		These include technical annexes with details of specific technical surveys.

PROJECT JUSTIFICATION 2

2.1 Project Justification

Roads and bridges play a key role in the socio-economic development of any city. Developments in the industry, agriculture, service, trade and other major sectors of a country's economy depend to a large extent on the efficiency of the existing road network.

This chapter presents the needs, benefits; economic, technical and environmental sustainability of the proposed flyover project in Obio/Akpor LGAs of Rivers State. Also presented are project options of the proposed flyover project.

2.2 Project Objectives

The objective of the proposed project is derived from the following:

- Flyover bridges to ease the flow of traffic at the designated areas
- traffic decongestion, time saving, fuel saving and emission reduction
- Improvement of infrastructure.
- Improvement of the socio-economic status of the nation.

2.3 Need for the Project

The Rivers State Government's intention to undertake the construction of flyovers and dualize roads in Port Harcourt is based on the need to decongest traffic and therefore ease vehicular movements in the city. The proposed dualization and rehabilitation of flyover at Rumuola Junction, construction of a new flyover at GRA Junction, and the dualization of Tombia Extension and Ezimgbu Road, in Port Harcourt City of Rivers state is to ease the decongest traffic flow.

2.4 Benefits of the Project

The proposed flyovers and road construction will result in the improvement of infrastructure as well as uplift the social structure in the city. The major benefit due to the proposed project will be in the sphere of making Port Harcourt more safely accessible and generating temporary employment for substantial number of personnel. The construction phase of the projects is expected to span over 12 months.

The proposed flyover bridges project will have the benefits of temporary employment for indigenes of host communities and the neighbouring communities during construction phase.

2.5 Value of the Proposed Project

The proposed project is estimated to cost about 15 billion Naira.

2.6 Envisaged Sustainability

The sustainability of this project stems from the fact that it will satisfy economic contributions, meet the demand for safe transportation and also maintain environmental friendliness. The sustainable development philosophy of minimizing land-take, cost and the impact on the environment shall be adopted for this development project. The set goal is, "meeting the needs of the present without compromising the ability of future generations to meet their own needs".

2.6.1 Social Desirability

In view of the proponent's continuous consultations with host communities and other stakeholders, a cordial relationship shall be maintained with the people. This no doubt will create a sustainable social relationship between the proponents and the host communities.

2.7.1 Technical Feasibility

The technical feasibility of the proposed project stems from the application of best available technology (BAT) to the development of the proposed project. In addition, strict adherence to international and national engineering designs e.g., construction standards and codes of practices which shall be adopted at all stages of the proposed project development shall ensure the technical viability of the project. Rivers State Government shall depend on Julius Berger Nigeria PLC for the procurement of all materials and construction of the proposed flyover bridges.

2.7.2 Environmental Friendliness

The proposed project shall be environmentally friendly because of the adoption of the best available technology (BAT), Julius Berger Nigeria PLC's HSE policy and the improved EIA process for the project. Incorporating the findings and recommendations of this EIA and subsequent implementation of the Environmental Management Plan for every phase of the proposed flyover bridges project will ensure the required environmental friendliness.

2.7.3 Economic Viability

The locals shall gain temporary employment and requisite skills through direct and indirect involvement of unskilled labour, contractors, consultants, suppliers and other professionals during the construction and operation of the proposed flyover. Apart from the direct employment of persons at the facility,

indirect employment and associated economic effects will be derived from potentially induced development and ease of doing business. These will increase the IGR of the State and host LGAs.

2.8 Project Options and Alternatives

The project following project options were considered based on the health, safety and environmental impacts; best available technology; and economic/social considerations:

Option 1: Do Nothing Option

This implies maintaining the status quo by not constructing the proposed flyovers and dualizing the existing road thereby retaining the existing ones.

This would imply that the opportunity for potential benefits of safer roads, employment creation will be missed; and there will be no environmental impact due to construction but increased impacts due to worsened traffic situations.

This option was rejected because it negates the dire need to improve the traffic situation in the city.

Option 2: Delayed Option

This implies the implementation of the proposed project at a later time for such reasons as lack of funds, communal crises, war, etc. This option was rejected since none of these situations is obtainable and the proposed flyovers and road construction is urgently needed.

Option 3: Construction of the proposed Flyovers

This implies the construction of proposed flyover at GRA junction, dualization and rehabilitation of Rumuola flyover, dualizations of Tombia extension and Ezimgbu road in Obio/Akpor LGA, Port Harcourt, Rivers state. This option was accepted for implementation because it aligns with the urgent need to improve the traffic situation in the city.

Project Description 3

3.1 Introduction

The proposed project is to dualize and rehabilitate the flyover at Rumuola Junction, construct a new flyover at GRA Junction, and dualize Tombia Extension (1.63km x (7.3m + 7.3m)) and Ezimgbu Road (1km x (7.3m + 7.3m)), in Port Harcourt City.

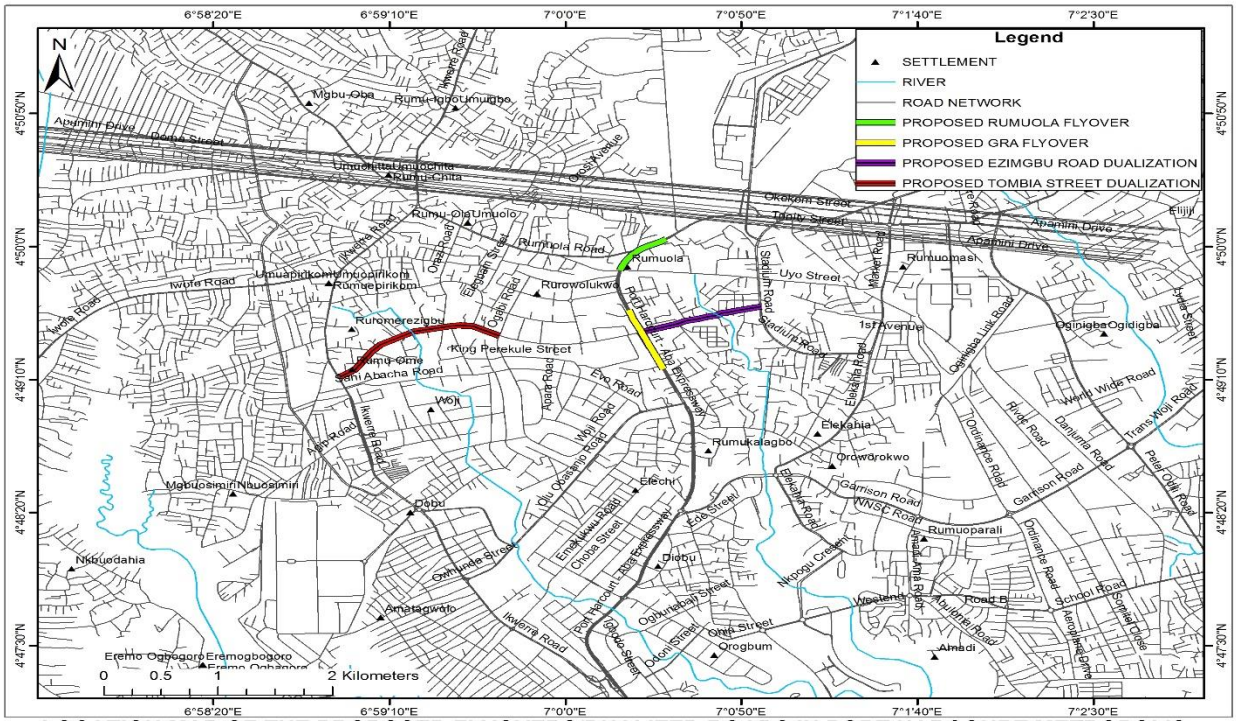


Figure 3.1: Road Network Map of Port Harcourt showing the Locations of the Proposed Flyovers and Roads

3.2 Rumuola Junction Flyover

3.2.1 Building of one new bridge with service lane on one side (Figures 3.4, 3.5), with following features:

i. 293m of reinforced flyover at Rumuola Junction with two lanes (3.65 m each) in accordance to the Federal Highway Standards and Specifications.
ii. The total width of flyover shall be 9.1m

iii. Approach way ramps shall be made with a maximum flight of 4%
iv. New service road with a road width of 7.3 m and 1.0 m lay by lane
v. Total construction length of around 780m along the Port Harcourt – Aba Expressway
vi. Provision of drainages and culverts at the new service lane
vii. Elliptical roundabout under the bridge at Rumuola Junction including traffic islands
viii. The new road pavement shall be 200mm thick cement-sand subbase with 5% average cement content by weight; 200mm granular stone base and 100mm thick total asphalt concrete surface
ix. Road marking
x. Traffic lights at the junction Rumuola Road/Aba Express Way
xi. Fencing and grassing of the area under the bridge.
xii. Street light

3.2.2 Rehabilitation of the existing bridge and service lane:

v. New asphalt concrete surface (40 mm wearing course) on the existing bridge deck and service lanes. Partial replacement of damaged subbase sections where required
vi. Rehabilitation/Refurbishment of damaged parapets and walkways
vii. Cleaning and/or partial repair of existing concrete U-Channel and bridge dewatering
viii. Road marking

3.3 GRA Junction Flyover

The project consists of a flyover with ramps, which is a part of the traffic system in the area of Port Harcourt in Rivers State.

Building of one new bridge with service lane on one side (Figures 3.6, 3.7, 3.8), with the following features:

i. 13 spans with corresponding length of the main bridge part from 293m of reinforced flyover at GRA Junction with two lanes (3.65 m each) in accordance to the Federal Highway Standards and Specifications.
ii. The total width of flyover shall be 9.1m
iii. Approach way ramps shall be made with a maximum flight of 4%
iv. New service road with a road width of 7.3 m and 1.0 m lay by lane
v. Total construction length of around 784m along the Port Harcourt – Aba Expressway
vi. Provision of drainages and culverts at the new service lane
vii. Elliptical roundabout under the bridge at GRA Junction including traffic islands

viii. The new road pavement shall be 200mm thick cement-sand subbase with 5% average cement content by weight; 200mm granular stone base and 100mm thick total asphalt concrete surface

ix. Road marking

x. Traffic lights at the junction Tombia/Ezimgbu Roads/Aba Express Way

xi. Fencing and grassing of the area under the bridge.

xii. Street light

3.3.A Piers

The piers are executed in general as follows:

i. All piers are founded on pile caps and continuous flight augering (CFA) piles with a diameter of 780 mm
ii. Pier shaft: 3 per axis reinforced concrete round columns, diameter 1400 mm
iii. Pier head with elastomeric bearings

3.3.B Abutments

Abutments consist of monolithic concrete walls founded on pile caps and CFA piles which are also used for pier foundation.

3.3.C Retaining walls

In-situ concrete retaining walls with thickness minimum of 400 mm are constructed on strip footing (shallow foundation) with variable geometry according to construction drawings.

3.4 Construction Stages and Time Schedule

The whole project could be divided into three (3) parts: main bridge and retaining walls on both sides of the bridge.

These parts of the project are typically constructed in the following sequence:

- Construction of CFA piles
- Construction of in-situ pile caps or strip foundation
- Construction of in-situ pier with heads / abutments / retaining walls
- Placing of pre-cast beams onto bridge bearings
- In-situ deck concrete
- Installation of concrete walkway and parapets

These parts of the project are typically constructed in the sequence shown in Figure 3.2:

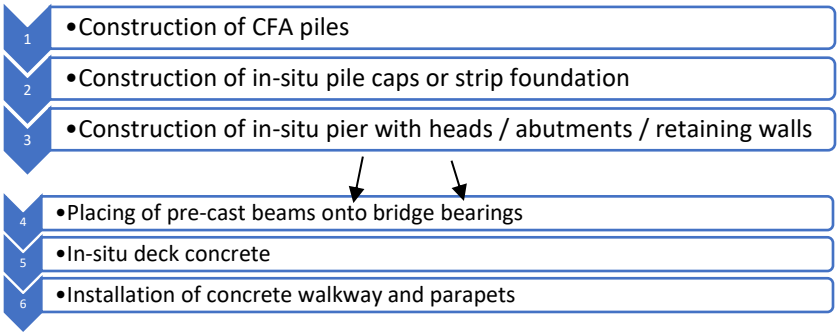
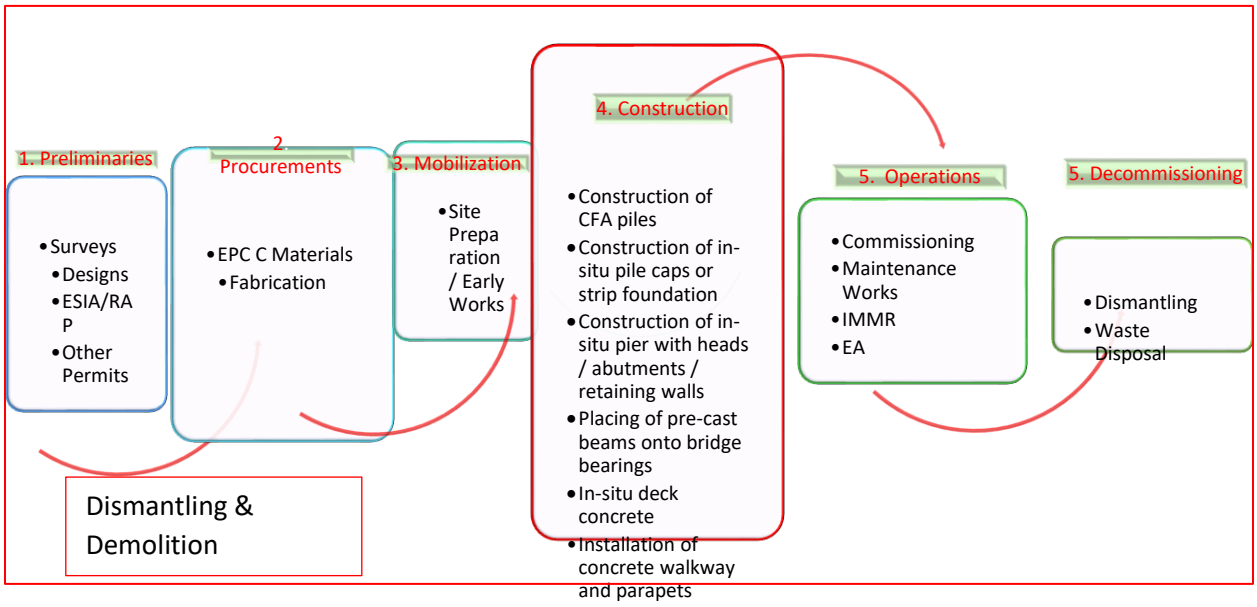


Figure 3.2: sequence of work in the construction of the proposed flyover bridges.

3.5 General Construction Workscope

Figure 3.3 presents flow chart of the work scope and the principal sequence of construction works process for the proposed flyover bridges and roads:



Figures 3.3: Flow Chart of the Work scope

3.6 Geotechnical investigations

The detailed geotechnical investigation report is annexed hereto as Appendix 1.

3.7 Design Prerequisites

Details of design prerequisites are given in the design manual, annexed hereto as Appendices 2a & 2b.

3.8 Foundation Designs are annexed hereto as Appendices 3a and 3b

3.9 Transportation

Load to be transported to site include rebar, batched concrete, wood, parapets, 30tons cross beams, formworks, filigram, sand, U-channels, stone base etc. The transport routes are the existing urban road network, utilising more, the roads that are closed to public use by the traffic diversion. These are transported in trucks and articulated vehicles at least peak periods to the site, from the yard.

3.10 Personnel Requirement and Transport

About 180 personnel will work on the project. There are specialised sub-contractors that will be engaged by the main contractors when the needs arise. These will be sourced from JBN staff and flyover host communities. Personnel carriers pick up workers at designated points within the town and in the outskirts, to work before 7am and return them at close of work.

3.11 Construction Materials

Table 3.1 presents the basic materials to be used in the construction.

Table 3.1: Construction Materials

S/N	Material Input		Product Output	
	Material	Quantity (Tons)	Product	Quantity
1	Cement	540	In situ concrete	1426m^2
2	River sand	2135	Precast concrete	7400 tons
3	Stone dust	2680	Asphalt wearing course	
4	Grave 5/15	3300	Asphalt binder course	
5	Gravel 15/22	1900	Base course	
6	Bitumen	550	Pre-stressing reinforcement	

Figure 3.4: General Layout of the proposed Rumuola flyover

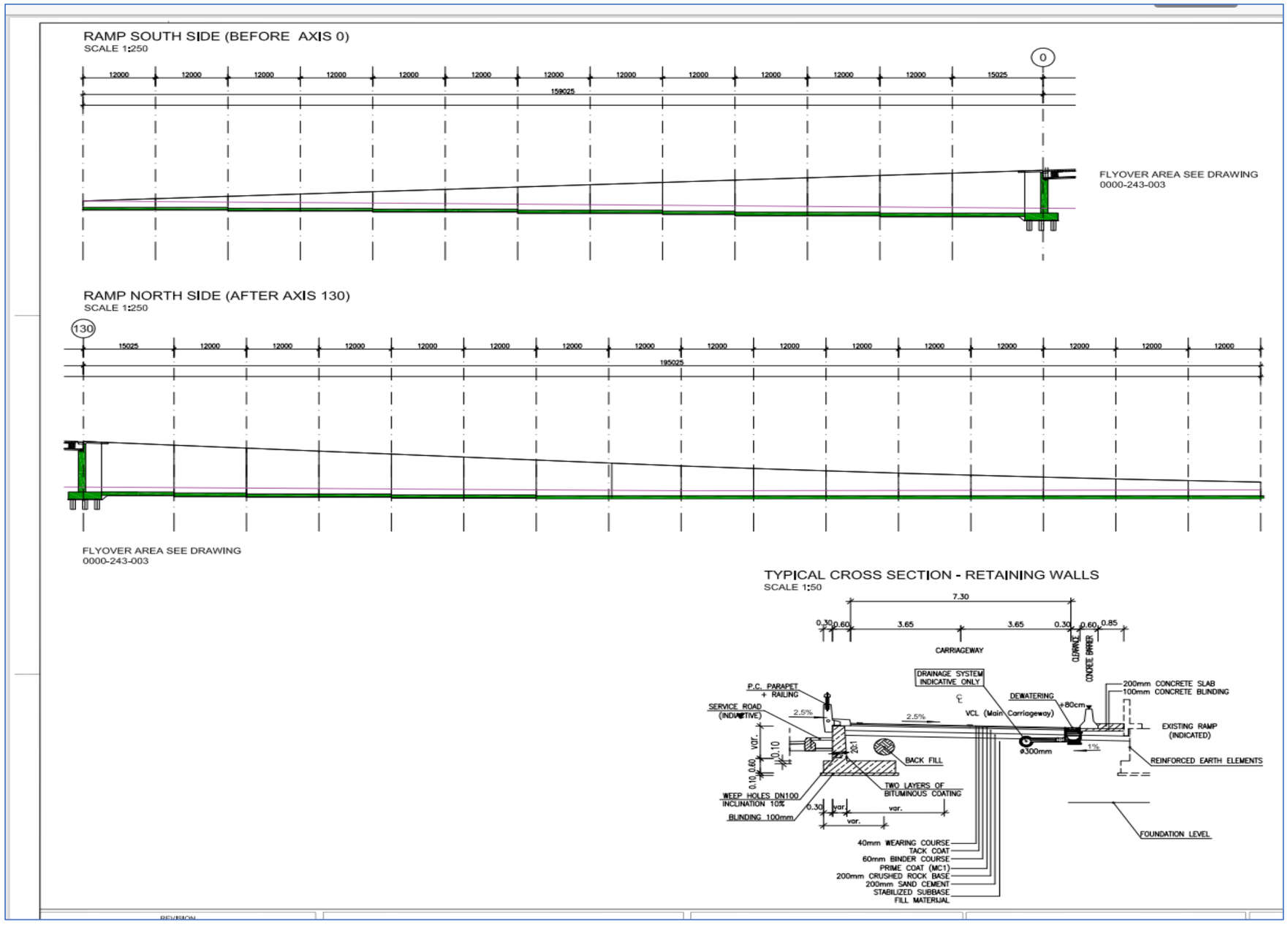


Figure 3.5: Rumuola Junction Flyover Retaining wall Longitudinal Cross section

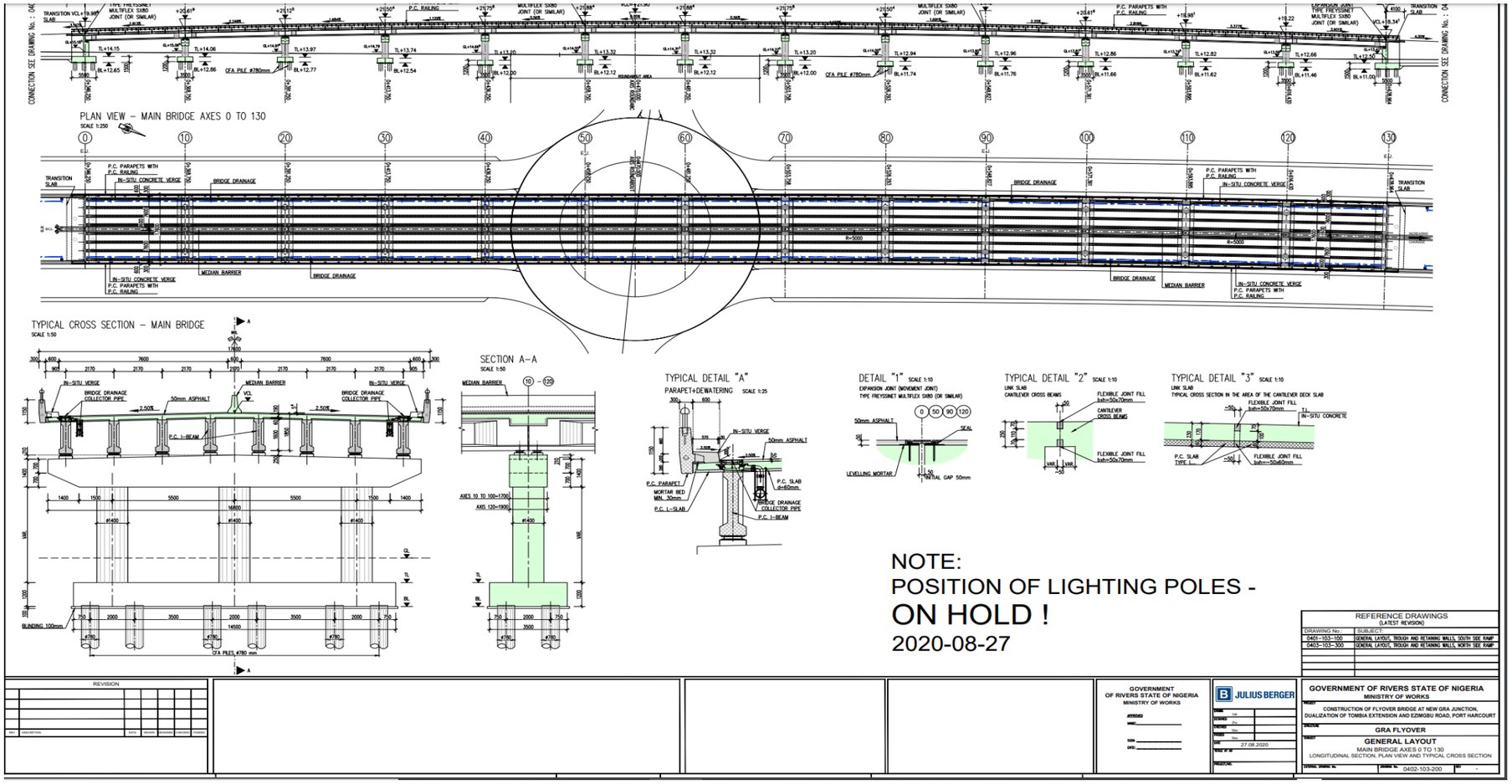


Figure 3.6: General Layout of the proposed GRA Junction flyover

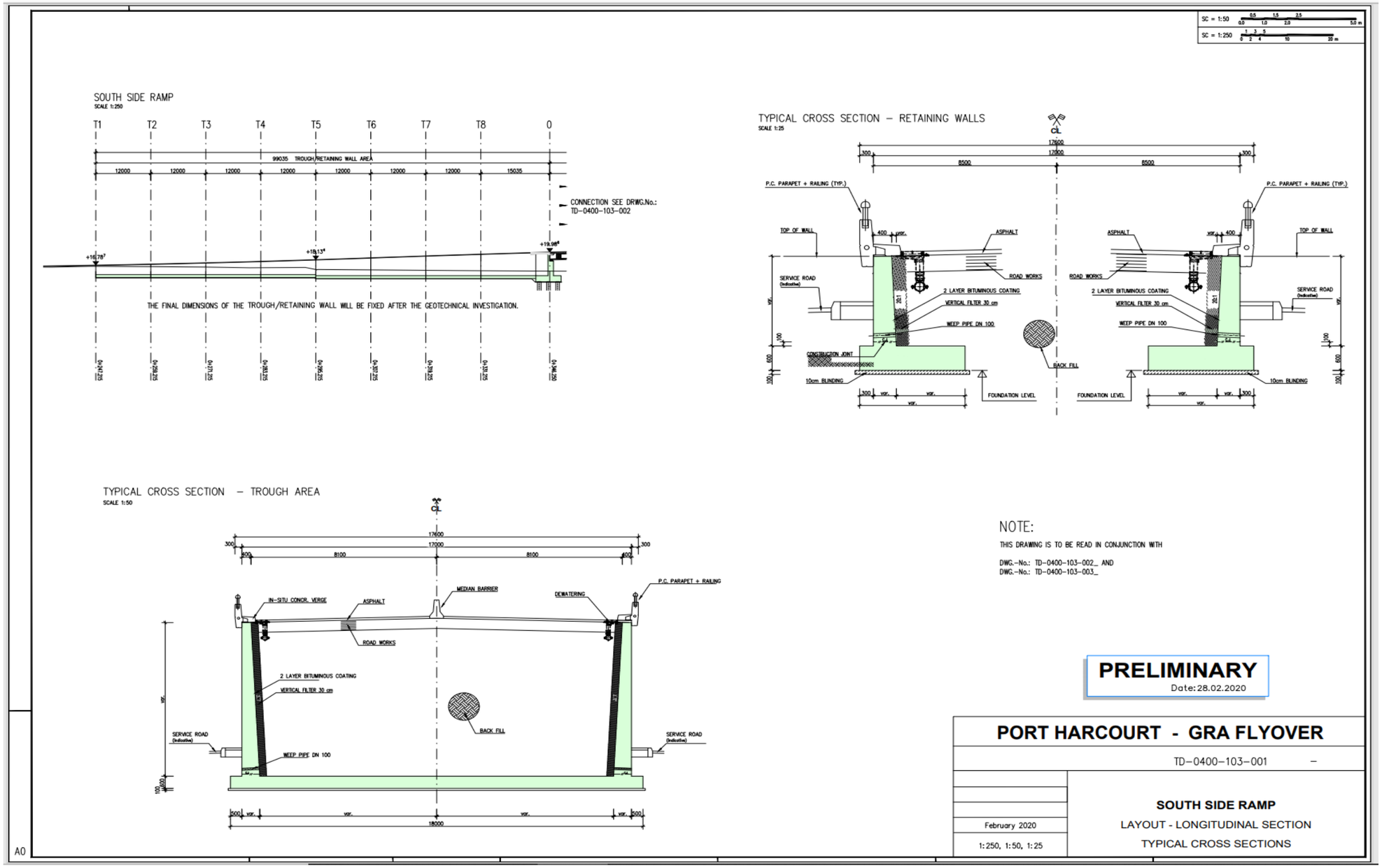


Figure 3.7: GRA Junction Flyover Retaining wall Longitudinal Cross Section

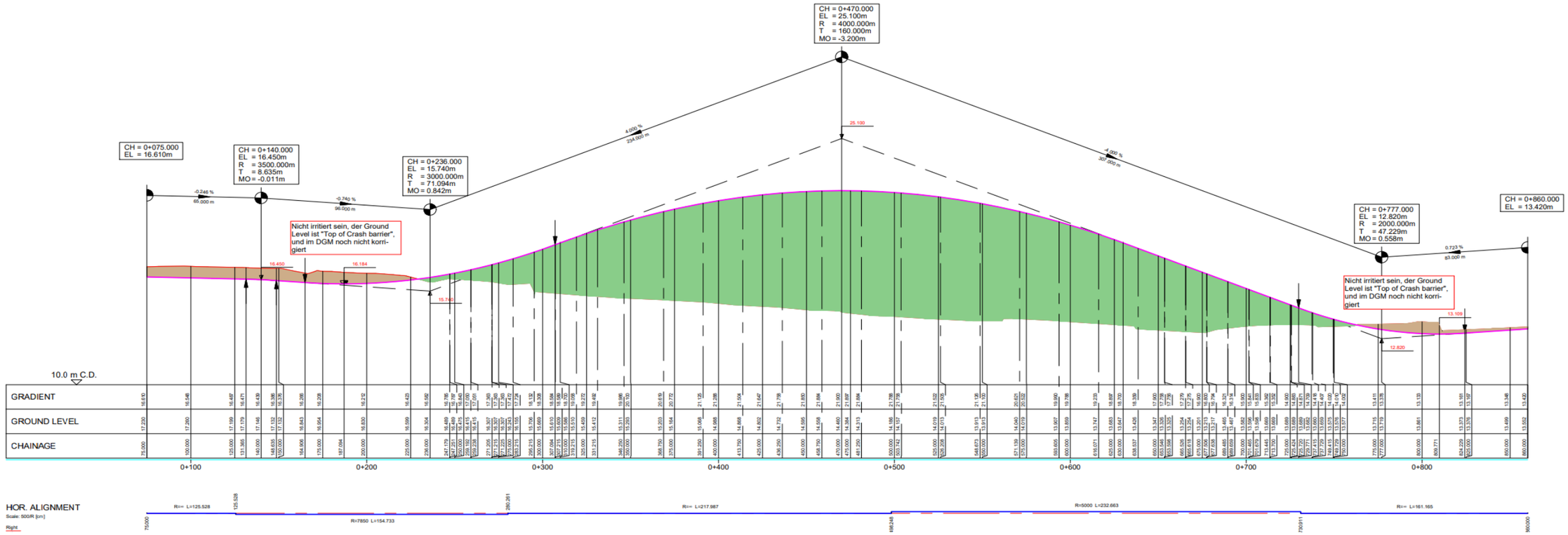


Figure 3.8: GRA Junction Flyover Retaining Wall Vertical Cross Section

3.12 Major Project Equipment

The major equipment to be deployed for the construction are listed in Table 3.2.

Table 3.2: Major Project Equipment

SN	Equipment	Number
1.	Air Compressor	3
2.	Ambulance	2
3.	Back-hoe Loader	3
4.	Borehole machine	2
5.	Bulldozer	6
6.	Concrete Batching Plant	1
7.	Concrete Mixing Machine	1
8.	Concrete Pump (Mobile)	3
9.	Crawler Crane	1
10.	Crusher Plant	1
11.	Dump Truck	24
12.	Excavator	4
13.	Excavator + hammer	3
14.	Forklift	7
15.	Fuel Tanker	7
16.	Generator	6
17.	Grader	6
18.	Iron Cut and Bend	10
19.	Light Equipment	1
20.	Loader	6
21.	Lubrication, Maintenance and Rescue Truck	2
22.	Maintenance Workshop	2
23.	Mini Excavator	6
24.	Mini Loader	6
25.	Mixing Plant	3
26.	Mobile Crane	3
27.	Mobile welding machine	13
28.	Paver (Ballast Laying)	3
29.	Pick - up (double deck)	12
30.	Portal Crane	4
31.	Precast Plant	1
32.	Refrigerated vehicle	2
33.	Road Car	15
34.	Rotary Driller	1
35.	Sand Washing Plant	1
36.	Scale	6
37.	Screen Plant	1
38.	Shotcrete Pump - Dry	8
39.	Shotcrete Pump - Wet	3
40.	Survey Equipment Set	1
41.	Survey Equipment Set for Machinery	1
42.	Tower Crane	2
43.	Tower Light	30
44.	Tractor	4
45.	Trencher	1
46.	Vibro roller	19
47.	Wagon	6
48.	Wastewater tanker	6
49.	Water tanker	6

3.13 Project Yard Facility

The project yard, already captured in the recently approved EIA of the construction of flyovers at Rumuogba, Rebisi and Okoro Nu Odo junctions, is located in Port Harcourt, about 900m from the Rebisi junction. It lies within latitude 4°48'23.53"N and longitude 7° 0'55.14"E, on about 3 hectares, with elevation points of 1-2m above sea level. There are about sixteen (16) separate buildings/sections within the premises, which is about 70% built up.

The key production activities of the yard occur in the following sections: scaffolding section, iron bending workshop, main store, precast workshop, painting section, carpentry workshop, asphalt plant, concrete batching plant and water treatment plant.

3.14 Waste Management

The waste management plan for the proposed project has been informed by the understanding of the possible waste characteristics.

The construction waste to be considered includes: -

- Demolition waste – concrete, soil, sand, metals
- Soil: excavated soil which will be reused as backfilling materials for the flyover bridges foundations.
- Oil: oil & grease from malfunctioning vehicles and equipment at site
- Office waste and domestic solid waste (refuse): this is generated at the construction site.

From the above, the Engineering, Procurement and Construction (EPC) Contractor will design its waste management plan under two categories: solid waste and emissions.

The over-burden will be separated into top soil and sub-soil which shall be dumped in separate locations for reuse during phased construction-pit reclamation.

Generated scrap metals, paper, glasses and plastics will be sorted and sold out for recycling or reuse.

There will be at-source segregation of solid wastes (Figure 3.9). The Rivers State Waste Management Agency will be contracted to collect and dispose of the waste that will be generated after the EPC Contractor has recovered those it can reuse. The waste shall be tracked and dumped in any of the existing approved dumpsites in the City (Figure 4.41(a) and Table 4.31(a)).

On completion of construction works, the EPC Contractor shall demobilize from site and shall clear the site of all debris, including the remains of abandoned temporary structures erected in the vicinity of the flyover bridges site by food and other vendors, to serve the workers at the site. These will be collected and disposed of also by the EPC Contractor's waste disposal subcontractor.

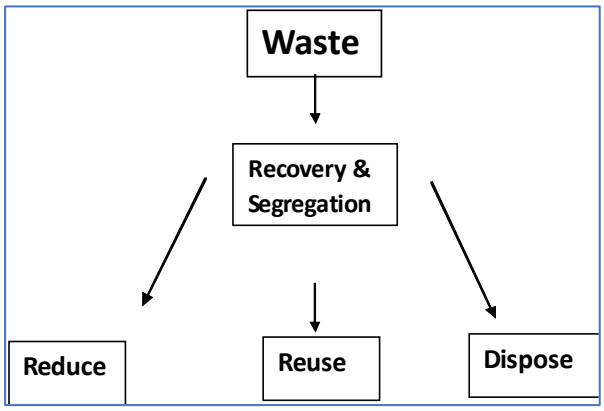


Figure 3.9: Waste Management flowchart for the proposed project.

Figure 3.9 presents a simplified flowchart for proposed waste management strategy for the proposed flyover/road project. Appendix VI also presents the EPCC's Waste Management Plan for construction projects in Rivers State.

3.15 Maintenance Plan

RMW is committed to making sure that the proposed flyover bridges, on commissioning, is safe and efficient for all travellers.

A general maintenance inspection is conducted at least twice a year. The bridge inspectors are trained engineers and technicians with several years of flyover bridges-related experience.

3.15.1 Flyover bridges Components to be inspected

During inspection, inspectors will carefully assess each part of the flyover bridges and identify any maintenance work that needs to be completed. Each flyover bridges component, as shown in the following pictures, is rigorously examined to ensure that flyover bridges remains safe for travel.

3.15.2 Flyover bridges Inspection Plan

There are four kinds of inspections the proposed flyover bridges will undergo throughout its lifetime. They include:

Detailed visual inspection which will occur every two years. This type of inspection includes the following steps:

- Checking the general condition of the flyover bridges.
- Assessing each flyover bridges component close-up. The inspector looks for any problems with the flyover bridges' concrete or steel materials.
- Identifying what repairs are needed for each flyover bridges component and if additional testing is needed.
- Reporting any potential safety issues to supervising engineers and maintenance crews. In these instances, the inspector immediately calls in a repair crew to fix the problem.

General maintenance inspection, which takes place twice a year. During this inspection, the following steps are taken:

- Checking the general condition of the flyover bridges.
- In instances when there is a safety issue, the inspector immediately calls in a repair crew to fix the problem.
- Road patrol inspection, which takes place on a regular basis. This inspection is conducted by a Maintenance Patroller. The Maintenance Patroller ensures that the flyover bridges' roadway is safe. If there are any potential safety issues, the patroller will request a more detailed inspection of the flyover bridges.
- An emergency inspection takes place after a major vehicle collision involving one or more flyover bridges components, a flood, an earthquake, etc. This type of inspection is carried out by a trained, professional engineer.

3.15.3 Flyover Bridge Test Methods

Inspectors also use technology when testing certain flyover bridges components. Some of the testing techniques that can be used include:

3.15.4 External technology testing

This includes ultrasonic and magnetic particle tests. This type of testing helps the inspector to determine if there is a crack that may be undetectable to the human eye.

3.15.5 Steel Fatigue inspections

For older steel bridges, external technology testing, such as ultrasonic testing is used to check for cracks in places where steel parts are connected.

3.15.6 Internal technology testing

Small samples of concrete or steel are removed from the flyover bridges and then tested in a lab to check the strength.

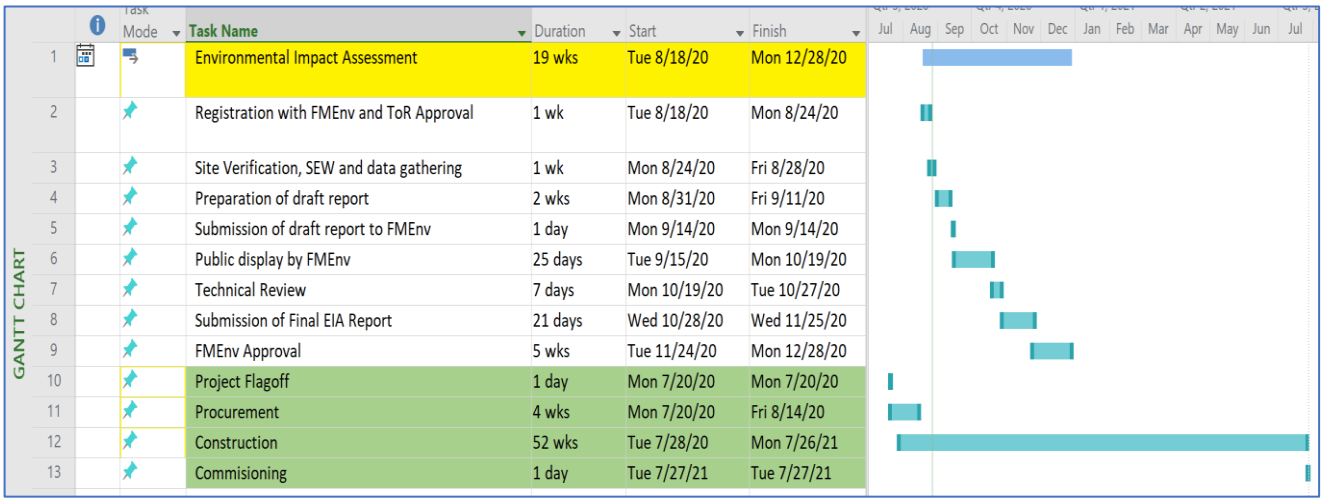
Flyover bridges load capacity tests

A special truck loaded with concrete blocks drives across the flyover bridges while instruments attached to the flyover bridges measure and record its movements. This measures how much weight the flyover bridges can safely carry at one time.

3.16 Project Execution Schedule

Table 3.3 summarizes the proposed flyover bridges project execution schedule.

Table 3.3: proposed project execution schedule



	Task Mode	Task Name	Duration	Start	Finish
1		Environmental Impact Assessment	19 wks	Tue 8/18/20	Mon 12/28/20
2		Registration with FMEnv and ToR Approval	1 wk	Tue 8/18/20	Mon 8/24/20
3		Site Verification, SEW and data gathering	1 wk	Mon 8/24/20	Fri 8/28/20
4		Preparation of draft report	2 wks	Mon 8/31/20	Fri 9/11/20
5		Submission of draft report to FMEnv	1 day	Mon 9/14/20	Mon 9/14/20
6		Public display by FMEnv	25 days	Tue 9/15/20	Mon 10/19/20
7		Technical Review	7 days	Mon 10/19/20	Tue 10/27/20
8		Submission of Final EIA Report	21 days	Wed 10/28/20	Wed 11/25/20
9		FMEnv Approval	5 wks	Tue 11/24/20	Mon 12/28/20
10		Project Flagoff	1 day	Mon 7/20/20	Mon 7/20/20
11		Procurement	4 wks	Mon 7/20/20	Fri 8/14/20
12		Construction	52 wks	Tue 7/28/20	Mon 7/26/21
13		Commisioning	1 day	Tue 7/27/21	Tue 7/27/21

4 DESCRIPTION OF THE ENVIRONMENT

4.1 Existing Environmental Data Acquisition

The establishment of a comprehensive existing environmental condition of the project area is an integral part of this Environmental Impact Assessment (EIA) process. Such environmental data provide information on the current status, characteristics and features of the environment of the project area.

The knowledge of the environmental data is essential in the assessment of the associated/potential impacts of the project activities and future assessment and monitoring of the environment. The existing environmental data of the project area for flyover/road at Rumuola, GRA junction, Tombia and Ezigbmu, Port Harcourt were established through extensive desktop studies, field sampling, laboratory analysis of samples and interpretation of results, social and health environment data collection and analysis.

The summary of baseline conditions is based on information sourced from literatures (see relevant sections) as well as findings from a one season (wet) field sampling program supplemented by approved secondary data (dry season) from approved EIAs. laboratory analyses of samples obtained and socio-economic and health surveys specific to this EIA. The data acquired will be used in further environmental management decisions and future monitoring of changes, if any, in the environmental components.

4.2 Scope of Study

Field studies and data collection for characterization of the baseline conditions of the project environment using a radius of 500m as Area of Influence, in line with the TOR approved by the FMEnv.:

- Climate and meteorology;
- Air quality and noise levels;
- Geology/hydrogeology;
- Geotechnical survey;
- Soil;
- Ground water quality;
- Socio economics/health impact, demography and community characteristics.

Due to the built-up nature of the project locations, there were no flora, fauna, and surface water studies.

4.3 Baseline Data Acquisition Methods

The acquisition of data basically involved field data gathering, measurements and the collection of representative samples used to establish the environmental conditions of the study area. This exercise involved a multi-disciplinary approach and was executed within the framework of a QHSE Management System approach. This approach assured that the required data and samples were collected in accordance with agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

- review of existing reports that contain environmental information on the study area;
- designing and development of field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);
- mobilization to field;
- fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures;
- Demobilization from field; and
- transfer of sample custody to the laboratory for analyses.

The following sections present the field data gathering methodology/procedures and the descriptions of the environmental baseline conditions of the study area. The detailed documentation of the fieldwork execution including descriptions of the laboratory analytical methods and procedures, the detection limits for the various parameters analyzed as well as an overview of the general QHSE plan adopted for field data gathering and laboratory analysis is presented.

4.3.1 Desktop Studies

Desktop studies involved the acquisition of relevant background information on the environment of the study area. Materials that were consulted included approved reports on previous environmental surveys in the area, publications, textbooks, articles, maps, etc. on the area and similar environments. The list of materials consulted is specified in relevant sections. Specific documents consulted are given in their respective sections.

4.3.2 Field Sampling/Measurement

In order to effectively establish the environmental characteristics of study area, a one season field data gathering exercise (as approved by FMEnv, Appendix IV) was performed between 17th August through 4th September. The specific objectives of the ecological field sampling were to:

- determine the ambient air quality and noise level of the study area;
- determine the physico-chemical and biological characterization of groundwater within the study area;
- establish the socio-economic and health status of the host and impacted communities.
- Geological study

Groundwater samples were collected as appropriate. The exercise involved in situ measurement of salinity, temperature and pH. Samples were taken at defined sample points using bottle sampler for water quality determinants. These were stored and preserved as appropriate for each analysis. Water samples were collected for laboratory analyses using

- 2-litre plastic bottle for groundwater samples for physicochemical analysis;
- 1-litre plastic bottle for water samples for microbiological analysis;
- 1-litre glass bottle with Teflon seal cap for water samples to be analysed for hydrocarbon content (oil and grease, etc.).

All water samples were preserved in cool boxes for onward transmission to Akwa Ibom State Ministry of Environment/Science and Technology laboratory in Uyo.

4.3.3 Field Study & Sampling Design

Sampling was designed to comprehensively capture all the ecological and socio-economic components peculiar to the study area. The coverage of various environmental attributes considered recipients and sensitivity of impacted areas. Design of field activities was made prior to mobilization. This was aided by information obtained during reconnaissance survey of the project area.

Sampling locations were decided as waypoints in Geographic Position System (GPS) and later plotted in a sampling map used during the field studies. Locations for biophysical sampling considered ecological types around the project areas, vulnerable environmental attributes with regards to the potential and associated impacts of the environment and control or buffer zones. Socio economic and health impact studies on the other hand, considered human habitations, infrastructure, cultural heritage sites and prevailing health conditions of people within the sphere of influence to the project area. Table 4.1 presents an inventory of the biophysical and socioeconomics/health details collected during field studies. The spatial location maps of the sampled points are presented in the respective component sections.

Table 4.1 Inventory of Biophysical and Social Samples

SN.	Environmental Component	Parameter/Details	No. of Samples approved by FMEnv	No. of Samples Collected
1	Ambient Air	Carbon oxides; Sulphur oxides; Nitrogen oxides; Volatile organic compounds (VOC); Oxygen (O_2); Hydrogen sulphide (H_2S); Particulate matter (PM); Methane and Combustible gas.	Upto 5 samples and control	6 air samples + 1 control
2	Soil samples	Soil type, grain size, Total organic matter, soil microbiology, soil colour, texture, porosity, bulk density and permeability and Nutrients microbiology	Upto 5 samples and control	5 soil sample + 1 controls

SN.	Environmental Component	Parameter/Details	No. of Samples approved by FMEnv	No. of Samples Collected
3	Noise	Acoustical measurements using a Type I or Type II integrating sound level meter will be taken. All measurements will be taken in decibels (dB). The continuous attended noise measurements will record continuous equivalent sound measurements (LAmax, LAmin, LA1, LA5, LA10, LA50, LA90, LA95, LA99) at each of the sampling points.	Upto 5 samples and control	5 noise samples + 1 controls
4	Groundwater	depth to and thickness, hydraulics, recharge, colour, pH and temperature, Salinity and conductivity, Hardness, Heavy metals (Cu, Pb, Fe, K, Ba), Phosphate, SO_4, NO_3, Biological and chemical oxygen demands (BOD and COD), Turbidity, Dissolved and suspended solids, Total hydrocarbons (THC), Oil and grease (mineral and FOG), VOC and SVOC including BTEX, Nutrients microbiology	Upto 3 samples and control	3 groundwater samples + 1 controls

4.3.4 Analytical Methods

Samples collected from the field were analysed in Akwa Ibom State Ministry of Science and Technology laboratory using the various methods shown in Table 4.2. Also shown on the table are the equipment detection limits for the different parameters analysed.

Table 4.2 Laboratory Analytical Methods

Parameters	Methods	Detection Limits
Ground Water Samples		
Temperature (°C)	APHA 2110B	-
Ph	APHA 4500H^+B	-
TSS (mg/l)	APHA 2540D	1
TDS (mg/l)	APHA 2510A	-
Conductivity (µS/cm)	APHA 2510A	-
THC (mg/l)	ASTM D3921	1.0
DO (mg/l)	APHA 4500-O G	-
BOD (mg/l)	APHA 5210A	0.5
COD (mg/l)	APHA 5220D	0.8
Reactive Silica (mg/l)	APHA 4500-SiO_2	0.1
Nitrate (mg/l)	EPA 352.1	0.02
Phosphate (mg/l)	APHA4500-P D	0.002

Parameters	Methods	Detection Limits
Ammonium (mg/l)	APHA 4500-NH_3	0.02
Calcium (mg/l)	APHA 3111B/ASTM D3561	0. 1
Magnesium (mg/l)	APHA 3111B/ASTM D3561	0.1
Potassium (mg/l)	APHA 3111B/ASTM D3561	0. 1
Sodium (mg/l)	APHA 3111B/ASTM D3561	0.1
Lead (mg/l)	APHA 3111B	0.20
Total Iron (mg/l)	APHA 3111B	0.05
Copper (mg/l)	APHA 3111B	0.05
Polychlorinated biphenyls (PCBs)	EPA8082A	0.1
Zinc (mg/l)	APHA 3111B	0.05
Manganese (mg/l)	APHA 3111B	0.10
Cadmium (mg/l)	APHA 3111B	0.02
Total Chromium (mg/l)	APHA 3111B	0.10
Mercury (mg/l)	APHA 3112B	0.0002
Arsenic (mg/l)	APHA 3030B/3114B	0.001
Soil samples		
pH (H_2O)	ASTM D4972	-
TOC/TOM (mg/kg)	BS 1377	-
Conductivity (mg/kg)	APHA 2510B	-
THC (mg/kg)	ASTM D3921	10.0
Nitrate (mg/kg)	EPA 352.1	0.02
Phosphate (mg/kg)	APHA 4500-P D/CAEM	0.002
Sulphate (mg/kg)	EPA 9038	1.0
PSD (mg/kg)	ASTM D422	-
Calcium (mg/kg)	APHA 3111D	0.1
Magnesium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Potassium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Sodium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Zinc (mg/kg)	ASTM D5198/APHA 3111B	0.05
Lead (mg/kg)	ASTM D3111B /D5198	0.20
Mercury (mg/kg)	APHA 3112B/ASTM D 3223	0.0002
Arsenic (mg/kg)	APHA 3030F/3114B	0.001
Total Iron (mg/kg)	APHA 3111B/ASTM D5198	0.05
Copper (mg/kg)	APHA 3111B/ASTM D5198	0.05
Cadmium (mg/kg)	APHA 3111D/ASTM D5198	0.02
Polychlorinated biphenyls (PCBs)	EPA 9078	0.5
Total Chromium (mg/kg)	APHA 3111B/ASTM D5198	0.10

4.3.5 Ambient Air and Noise

The data gathering exercise was undertaken on the between 17th August through 4th September 2020 for air quality, field meteorology, noise levels, heavy metal content and bio-aerosols studies for the environmental impact assessment of the proposed Flyover/Road Construction Project. seven (7) sampling locations were established and the coordinates of each location was recorded as shown in Table 4.3 and Figure 4.3. Highly sensitive, digital portable meters were used for the measurements of NO_2, SO_2, H_2S, HCN, NH_3, Cl_2, CO, $PM_{2.5}$, PM_{10}, TVOC, CH_4 and CH_2O as indicated in Table 4.5. Bio-aerosols,

heavy metal content, field meteorological and noise level measurements were taken alongside air quality.

Table 4.3: Coordinates of Sampling Stations

Sample Code	Description	Northing	Easting	Elevation (m)	Sample taken
AQ_1	GRA Area Close to Federal Secretariat Complex	04°49'38.8"	007°00'19.4"	38	Air, bio-aerosol
AQ_2	GRA Junction	04°49'28.7"	007°00'21.5"	23	Air, bio-aerosol, groundwater
AQ_3	Tombia Extension	04°49'12.9"	007°58'58.9"	19	Air, soil, groundwater
AQ_4	Polo Park, Tombia Road	04°49'23.8"	007°00'08.2"	20	Air, soil
AQ_5	Ezimgbu Road, Off Stadium Road	04°49'33.1"	007°00'39.2"	21	Air, soil, groundwater
AQ_6	Ezimgbu Junction, Off Stadium Road	04°49'37.9"	007°00'55.4"	17	Air, soil
AQ_7	Rumuola Fly-Over	04°50'05.2"	007°00'30.7"	11	Air, bio-aerosol, groundwater, soil

Source: Resourcefield 2020

4.3.6 Precaution/Quality Assurance/Quality Control (QA/QC)

In marking sampling location, special preference was given to the following:

- Accessibility
- Availability of open space with good configuration free from shed
- Meteorological consideration of upward and downward directions
- Areas with minimal local influence from vehicular moment.
- In sampling, consideration was given to: sensitivity and stability of equipment used
- Re-calibration of equipment
- Reproducibility of results.

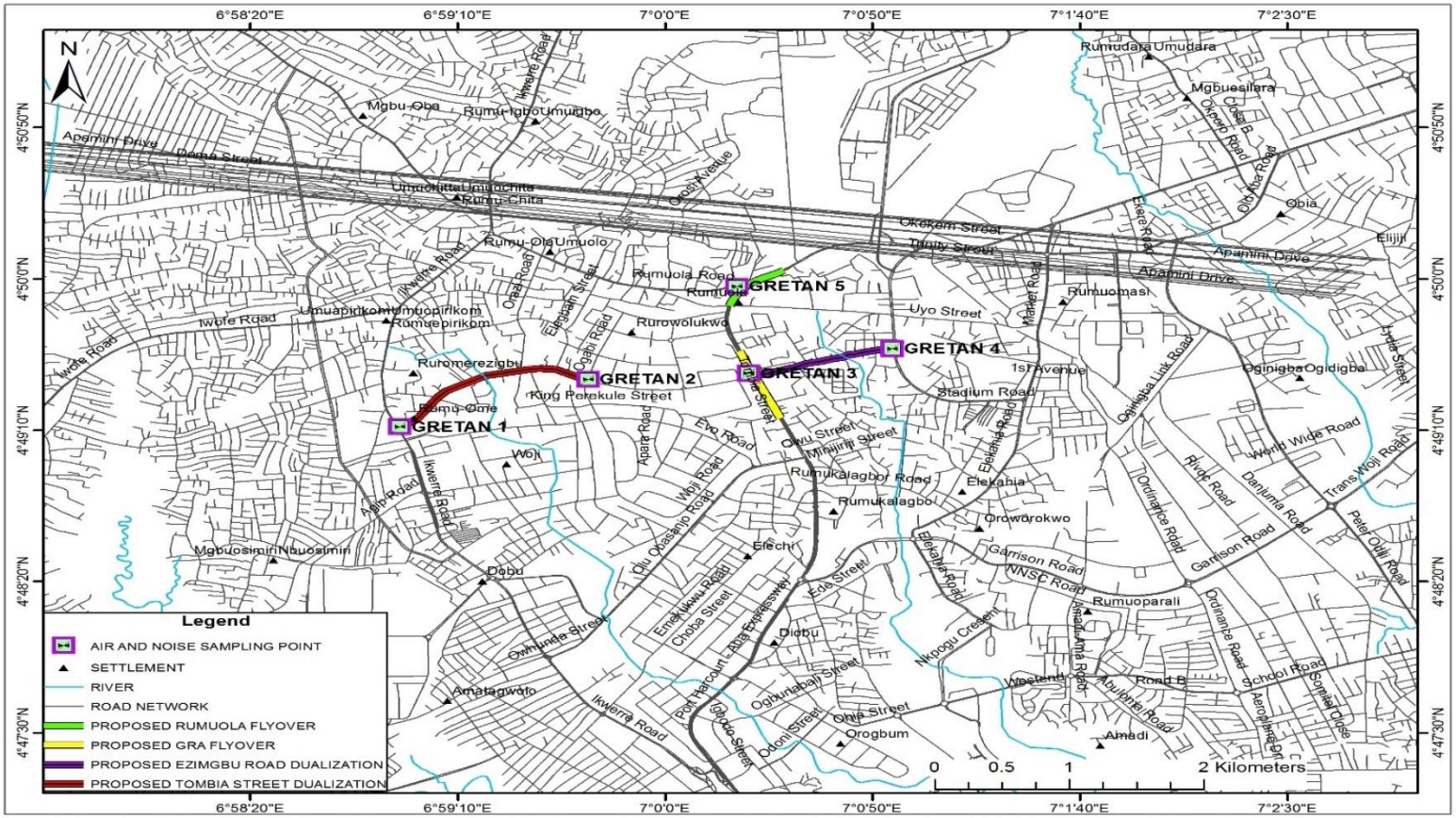


Figure 4.3: Air/Noise sample location map

4.3.7 Meteorological Data Acquisition

The existing meteorological and climatic data from Port Harcourt meteorological station are used for the write-up. However, additional field data were collected for atmospheric pressure, relative humidity, temperature, wind speed and wind direction. The measurements were taken at 7 stations comprising GRA Junction, Rumuola Flyover and Tombia-Ezimgbu Road. The measurements of the meteorological parameters were carried out using in situ portable pieces of equipment as given in table 4.4 and demonstrated in plates 4.1.

Plate 4.1: Measurements of field meteorological and air quality parameters by Resourcefield personnel

Table 4.4: Meteorological Instruments

Parameter	Equipment
Atmospheric pressure, Relative humidity, Temperature	Multipurpose Hygro, Baro and Thermo (Hygro 20-100%, Thermo 10-50^{o}C, Baro 740-777mmHg Model:- Baro, Germany
Wind speed	Portable wind vane Model:- Deuta Anemo Wind speed indicator (0-35m/s)
Wind direction	Digital compass

Source: Resourcefield 2020

4.3.8 Gaseous Emission Data Acquisition

Concentrations of air pollutants were measured at 7 locations. Highly sensitive digital portable meters were used for the measurement of NO_2, SO_2, H_2S, HCN, CH_4, NH_3 Cl_2 CO and SPM. The portable meters used in the measurement of gaseous pollutants are presented in table 4.5.

Table 4.5: Gaseous Emissions and Noise Measuring Instruments

Parameter	Equipment	Range	Alarm levels
Sulphur dioxide (SO_2)	SO_2 Crowcon Gasman S/N: 19648H	0-10ppm	2.0ppm
Nitrogen dioxide (NO_2)	NO_2 Crowcon Gasman S/N: 19831N	0-10ppm	3.0ppm
Hydrogen sulphide (H_2S)	H_2S Crowcon Gasman S/N: 19502H	0-50ppm	10ppm
Carbon monoxide (CO)	CO Crowcon Gasman S/N: 19252H	0-500ppm	50ppm

Parameter	Equipment	Range	Alarm levels
Ammonia (NH_3)	NH_3 Crowcon Gasman S/N: 19730H	0-50ppm	25ppm
Chlorine (Cl_2)	Cl_2 Crowcon Gasman S/N: 19812H	0-5ppm	0.5ppm
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	0-25ppm	5ppm
Methane (CH_4)	XP-3160	0-5,000 ppm	250 or 500 ppm
Suspended particulate monitor (SPM)	Haz-Dust TM 10µg/m^3 particulate monitor	0.1-200 10µg/m^3	+1-0.0210µg/m^3
Noise Level Meter	NM 102	Auto Ranging (30-130dB)	-

Source: Resourcefield 2020

Unit for gaseous pollutants is ppm.

4 4.3.9 Enumeration of Microbial Loads of the Study Area

Sedimentation (or settle plate) method described by Downes and Ito (2001) was employed. It is an apparatus-free method that is based on deposition of viable particles (bio-aerosols) on the surface of a solid medium per a given exposure time (APHA, 1992). The numbers of aerobic bacteria count and fungi (yeast and molds) were determined using Nutrient Agar (NA), MacConkey agar (MCA), Eosin Methylene Blue agar (EMB) and Saboraud dextrose agar (SDA) respectively, according to methods proposed by APHA (1992) and Downes and Ito (2001). The media was fortified with Chloramphenicol (-µg/ml) and a combination of 100 µg/ml Cycloheximide & 50 µg/ml Benomyl respectively for the selective enumeration and isolation of fungi and bacteria. Also enumerated were the densities of coliforms using MacConkey Agar as the analytical medium.

Plate 4.2: Sampling of bio-aerosols at the study area

5 4.3.10 Sampling Procedure for Heavy Metal Content in Air

Description of IOM Sampler is a head that houses a reusable two-part filter cassette with specified 25 mm filter for the collection of inhalable dust particles. The filter and cassette assembly are pre and post-weighed as a single unit for gravimetric analysis. A newly loaded cassette was removed from its transport clip to remove the cassette cover. It was ensured that the O-rings were fitted correctly inside the sampler housing body. The front plate was screwed into the housing body. The sampler was clipped onto my lab coat's lapel. The outlet of the sampler was connected using flexible tube with the inlet of a sample pump calibrated to 2 l/min. The cover was removed and the pump was switched on and then sampled for 2 min. After sampling, the pump was put off. The front plate was unscrewed from the housing body to remove the cassette from the sampler. Sterile forceps and hand gloves were used to avoid contaminant

of interest. The cover was placed on the cassette and the external surface of the cassette was wiped with clean lint-free paper. The cassette cover was placed on the cassette and loaded it into the transport clip.

4.4 Results and Discussion

The results of the air quality, noise levels, sensitive receptors, field meteorology, bio-aerosols and heavy metal content in the study area are presented in tables 4.6 – 4.11

Table 4.6: Air Quality Measurements

Sample code	NO_2 (ppm)	SO_2 (ppm)	H_2S (ppm)	CO (ppm)	CO_2 (ppm)	NH_3 (ppm)	Cl_2 (ppm)	HCN (ppm)	TVOC (mg/m^3)	CH_2O (mg/m3)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	CH_4 (PPM)
AQ_1	0.2	0.2	<0.1	8	902	2	0.1	1	1.549	0.192	68	118	0.1
AQ_2	0.2	0.3	<0.1	10	536	2	0.3	2	0.275	0.036	62	110	0.1
AQ_3	0.1	0.1	<0.1	5	529	1	0.2	2	0.232	0.029	35	62	0.5
AQ_4	0.1	0.2	<0.1	4	527	2	0.2	1	0.122	0.017	61	112	0.1
AQ_5	0.1	0.1	<0.1	4	632	2	0.2	1	0.661	0.078	57	97	0.2
AQ_6	0.1	0.1	<0.1	5	593	3	0.2	2	0.763	0.132	63	105	0.1
AQ_7	0.2	0.2	<0.1	4	677	3	0.1	1	0.822	0.064	71	123	0.2
AQ_8	0.2	0.2	<0.1	9	782	2	0.2	1	0.848	0.115	57	116	0.2
Mean	**0.15**	**0.18**	**<0.1**	**6.13**	**647.25**	**2.13**	**0.19**	**1.38**	**0.659**	**0.083**	**59.25**	**105.38**	**0.19**
Range	**0.1-0.2**	**0.1-0.2**	**<0.1-0.2**	**4.0-10.0**	**527-902**	**1.0-3.0**	**0.1-0.3**	**1.0-2.0**	**0.122-0.848**	**0.017-0.192**	**35-71**	**62-123**	**0.1-0.5**
SD	**0.05**	**0.07**	**<0.1**	**2.47**	**135.19**	**0.64**	**0.06**	**0.52**	**0.46**	**0.06**	**10.94**	**19.27**	**0.14**
FME limits	**0.04-0.06**	**0.01-0.1**	**-**	**10.0-20.0**		**200**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Source: Resourcefield 2020

Table 4.7: Measurements of Noise Levels

Sample code	Noise level [dB(A)]	Minimum noise level [dB(A)]	Maximum noise level [dB(A)]
AQ_1	85.9	67.7	88.5
AQ_2	72.1	55.8	74.4
AQ_3	75.8	60.1	79.1
AQ_4	73.5	58.6	77.8
AQ_5	87	71.2	90.3
AQ_6	80.1	62.7	83.2
AQ_7	85.4	68.2	91.4
AQ_8	76.7	57.8	78.8
Mean	**79.56**	**62.76**	**82.94**
Range	**72.1-85.9**	**55.8-71.2**	**74.4-91.4**
SD	**5.91**	**5.64**	**6.41**
FME limit	**90 [dB(A)]**		

Source: Resourcefield 2020

Table 4.8: Field Meteorological Measurements

Sample code	Temperature (°C)	Rel. Humidity (%)	Pressure (kpa)	Wind Direction	Wind Speed (m/s)
AQ_1	26.1	76.2	1011.3	125° E	2
AQ_2	27.4	76.3	1011.4	105° E	0.87
AQ_3	35.2	62.5	1011.7	140° E	1.72
AQ_4	35.3	53.7	1011.7	240° SW	2.73
AQ_5	34.5	50.2	1011.9	230° SW	1.77
AQ_6	33.3	54.7	1012.2	110° E	1.00
AQ_7	32.6	54.8	1012.4	240° W	1.63
AQ_8	33.7	52.8	1012.5	280° SW	0.37
Mean	**32.26**	**60.15**	**1011.89**	**-**	**1.51**
Range	**26.1-35.3**	**50.2-76.3**	**1011.3-1012.5**	**-**	**0.37-2.73**
SD	**3.54**	**10.54**	**0.45**	**-**	**0.57**

Source: Resourcefield 2020

Table 4.9: Viable Counts of Microorganisms isolated in Ambient Air of the Study Area

Location	Bacteria (cfu/m³)	Fungi (cfu/m³)
AQ_1	4.2×10^5	4.5×10^5
AQ_2	4.0×10^5	4.4×10^5
AQ_7	4.7×10^5	5.2×10^5

*AQ1= GRA Area Close. *AQ_2=GRA Junction. *AQ_7= Rumuola Fly- over

Source: Resourcefield 2020

Table 4.10: Distribution and Occurrence of Microorganisms isolated from Ambient Air

Isolate	Sampling Location			% Occurrence
	AQ-1	AQ-2	AQ-7	
Bacteria				
Staphylococcus aureus	+	+	-	67
Streptococcus faecalis	+	-	-	33
Bacillus subtilis	-	+	-	33
Escherichia coli	-	-	+	33
Micrococcus sp	-	+	+	67
Acetobacter sp.	+	-	-	33
Pseudomonas aeruginosa	-	-	+	33
Proteus sp.	-	-	+	33
Fungi				
Aspergillus niger	+	-	+	67

Isolate	Sampling Location			% Occurrence
	AQ-1	AQ-2	AQ-7	
Aspergillus utilis	-	-	+	33
Cladosporium sp	-	+	-	33
Pichia sp	+	+	-	67
Alternaria sp	+	-	-	33
Candida tropicalis	+	+	+	100
Aspergillus flavus	-	-	+	33
Eurotium sp	-	-	+	33
Aspergillus fumigatus	+	+	-	67

*AQ1= GRA Area Close. *AQ_2=GRA Junction. *AQ_7= Rumuola Fly- over. + = Present - = Absent

Source: Resourcefield 2020

Table 4.11: Heavy Metal Content in Ambient Air

Parameter	Sampling Location							Mean	Range	SD
	AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7			
Lead (mg/m^3)	0.601	1.008	0.622	1.121	1.114	1.121	0.721	0.901	0.622-1.121	0.24
Arsenic (mg/m^3)	0.018	0.021	0.014	0.011	0.023	0.025	0.017	0.018	0.011-0.025	0.005
Chromium (mg/m^3)	0.232	0.237	0.231	0.245	0.252	0.222	0.227	0.235	0.222-0.252	0.01
Mercury (mg/m^3)	ND	ND	ND	ND	ND	ND	ND	-	-	-
Cadmium (mg/m^3)	2.343	2.326	2.337	2.323	2.351	2.344	2.34	2.338	2.323-2.351	0.1
Nickel (mg/m^3)	0.31	0.313	0.318	0.311	0.313	0.321	0.315	0.314	0.310-0.321	0.04
Vanadium (mg/m^3)	0.001	0.004	0.001	0.003	0.007	0.001	0.008	0.004	0.001-0.008	0.003

Source: Resourcefield 2020

4.4.1 Rainfall Pattern

The study area is situated within the tropical wet climatic belt. In this belt, rainfall variation is the most important parameter for the determination of season. In general, two seasons are characteristic of the climate in the region, namely the dry and wet seasons. In wet season, the annual distribution starts with the initial rains in March, which ceases in late November. Typically, there are two major seasons, sometimes, heavier rainfall than usual may occur and the rain is extended into the dry season and often the August break may not even occur. Rainfall is the most important element of climate change and

water resources potential. It impacts almost all areas of human life such as agriculture, health, transportation etc. The amount and distribution of rainfall in the study area is such that it plays an important role in moving pollutants from the atmosphere to other spheres of the environment. The mean annual rainfall for the study environment is above 2300mm. The data retrieved from close meteorological station and shown in Table 4.12, present the mean monthly rainfall distribution for 30 years (1985-2015) in the study area. Average highest rainfall peaks were attained in September (370mm), July (364mm) and August (325mm). Lowest rainfall values were attained in January (15.3mm) and December (19.2mm). It should be noted that rainfall is very important in managing construction projects since it may cause erosion and erode soil particles from ground level surfaces.

4.4.2 Air Temperature

Analysis from the macro data shows that the months of July-September recorded lower temperatures (28-29 ^{o}C) due to rainy periods while the months December to March recorded higher temperatures (32-34^{o}C) due to intense solar radiation prevalent in the dry season (Uko and Tamunobereton-Ari, (2013) noted that the average maximum and minimum temperatures during the dry and wet seasons are within 31-33 ^{o}C and 21-23 ^{o}C as well as 25-33 ^{o}C and 18 23^{o}C respectively. The degree of air temperature is dependent on the amount of solar radiation received, atmospheric conditions, such as cloud cover and humidity, which trap heat and this impacts on the stability pattern of the atmosphere in the area. Port Harcourt exhibit a very stable stability class F at nights that inhibits emission dispersion and slightly unstable/moderate stability classes C-B during the day periods that enhances emission dispersions (Edokpa and Nwagbara 2017). Air temperature also affects nearly all other weather parameters. For instance, air temperature affects: the rate of evaporation, wind speed and direction, precipitation patterns as well as the unstable, stable and neutral conditions of the atmospheric environment. Measuring air temperature is critical to the proper identification of the micro and macro environment of living organisms. It is especially critical for researchers in the animal and biological sciences since ambient temperature can influence their physiological, nutritional and behavioral status. The study environment is bounded heavily by open vegetation areas and this modifies ambient temperature. Ansari (2003) noted that the major parts of a healthy environment are vegetation associated with area. He emphasized that vegetation improves the environment by lowering the maximum temperature and increasing the minimum temperature most especially in locations of increased elevation. When air passes through vegetation it cools and obtains moisture which when mixed with the open environment reduces temperature thereby generating was is referred to as local precipitation (Ansari, 2003). Ayoade (2004) highlighted that the features which impact the distribution of temperature at any location include: the amount of insulation received, nature of the surface, distance from water bodies, relief, nature of prevailing winds and ocean currents. Figures 4.4 to 4.8 shows the processed satellite data for average surface temperature for 0000, 0600, 1200 and 1800 hours in the study environment for July 2017.

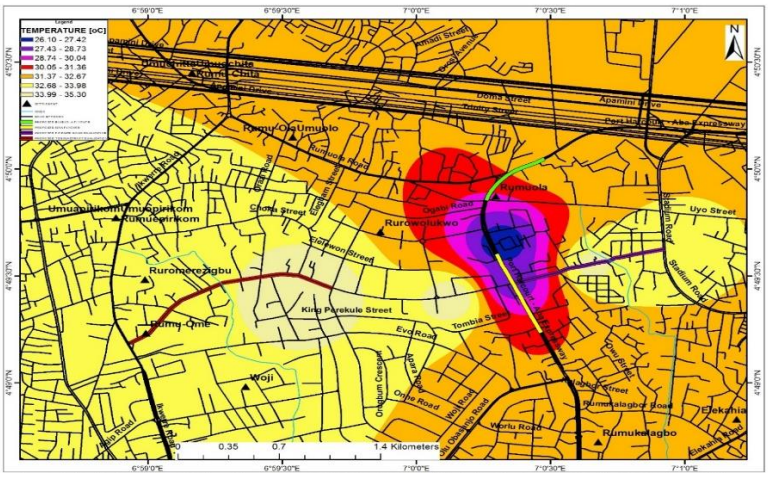


Figure 4.4: Map showing spatial dispersion of the recorded air temperature

The least temperature was recorded at GRA flyover. The temperature was observed to increase with increase in distance away from the flyover ranging from 26.10-28.37 °C. Rumuola flyover axis recorded a slice increase in temperature ranging from 28.74-31.36 °C. The highest temperature was measured along Tombia road and east of Ezimgbu road ranging from 31.37-35.30 °C.

4.4.3 Relative Humidity

As ambient temperature increases, percentage humidity decreases and vice-versa. Relative humidity which measures water vapour in the atmosphere is noted to be low during dry season and high during the peak of rainy season due to the influence of moisture laden north- Westerly winds as seen from the macro average monthly results. A 30-year mean monthly relative humidity analysis shows that the study environment has high relative humidity throughout the year with peaks during the wet season. Oluyole *et al*., (2013) disclosed that average annual relative humidity for the area is above 80%. Due to the moist nature of the atmospheric environment in the study area, relative humidity is always high throughout the years.

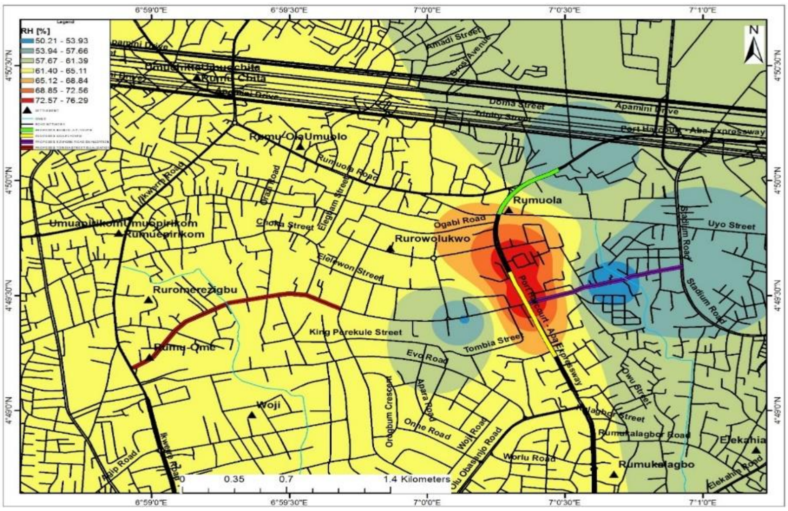


Fig. 4.5: Map showing spatial dispersion of the recorded relative humidity

Relative humidity (RH) was moderate across the entire Tombia road and its surroundings falling between 61.40 % and 65.11 %. GRA and some part of Rumuola flyover recorded the highest RH ranging from 65.12-76.29 %. Lowest RH was captured in part of Ezimgbu road close to Stadium road and north of Rumuola flyover ranging from 50.21-61.39 %.

Table 4.12: Average Weather Trend for Port Harcourt (1985-2015)

S/N	Month	Average Temp (°C)	Rainfall (mm)	Pressure (kpa)	Relative Humidity (%)	Wind Speed (m/s)
1	January	33.5	15.3	1006.5	72	2.8
2	February	34.1	7.4	1005.8	77	2.5
3	March	33.7	92.7	1005.6	81	3.6
4	April	32.6	143	1005.7	83	3.6
5	May	32.1	247.4	1007.4	87	3.7
6	June	30.4	310	1008.4	89	3.8
7	July	28.3	364	1009.7	91	4.2
8	August	29.0	325	1009.6	91	4.1
9	September	28.6	370	1008.9	91	4.3
10	October	30.8	242	1007.7	88	3.5
11	November	32.1	72.8	1006.8	84	2.6
12	December	33.4	19.2	1006.7	73	2.4

Source: NIMET, Port Harcourt (EIA Report, 2017)

4.4.4 Wind Speed/Direction

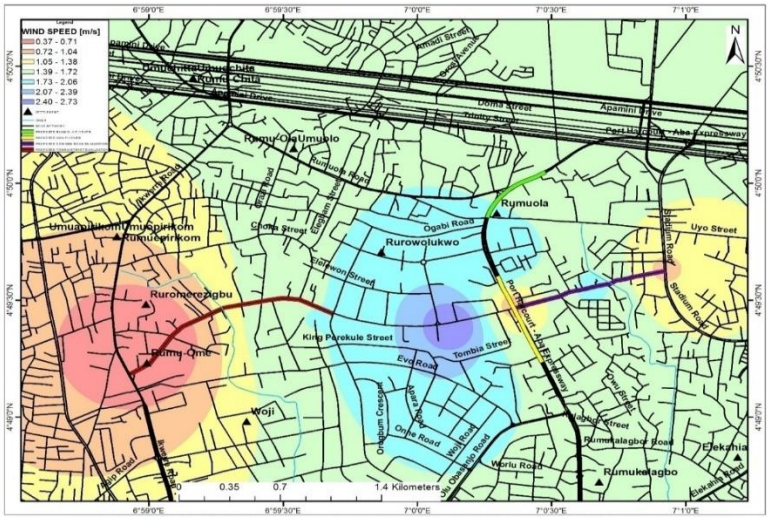


Fig. 4.6: Map showing spatial dispersion of the measured wind speed

Wind speed was observed to be very low along Tombia road by Ikwerre junction, east of Ezimgbu road as well as GRA flyover ranging from 0.37-1.38 m/s. Wind speed increases a little towards Rumuola flyover and extreme east of Tombia road ranging between 1.39-2.73 m/s.

The prevailing wind direction was the easterly and south-westerly winds as presented in the wind rose below (Figure 4.5). This implies that any released air emissions will be blown towards the west and north-east direction of the study environment. It is however the period of calm that is of importance in evaluating emissions (8.33%). If the air is calm, pollutants cannot disperse, and then the concentration of these pollutants will build up. On the other hand, when strong, turbulent winds blow, pollutants disperse quickly, resulting in lower pollutant concentrations. In pollution, meteorology calms are associated with inversions (temperature increasing with height). Inversion may result in fumigation; meaning that emissions are trapped at ground level close to their source as against other situations where it is dispersed and diluted much more easily. Inversion is widely known to be frequent during the early hours of the day. A 30-year mean macro data shows that wind speed over the study environment is generally minimal and this signifies a low to moderate dispersive potential of the local atmosphere.

Table 4.13: Wind Speed for Wind Rose

Wind Direction	Wind Sped (m/s)		
	0 – 1.50	**1.51 – 2.50**	**2.51 – 3.50**
N	0 = 0 %	0 = 0 %	0 = 0 %
NE	1.22 = 18 %	2.18 = 13 %	0 = 0 %
NNE	0 = 0 %	1.75 = 10 %	2.57 = 11 %
E	1.00 = 15 %	2.37 = 14 %	3.09 = 13 %
SE	0.93 = 14 %	0 = 0 %	3.43 = 14 %
SSE	0.18 = 3 %	1.86 = 11 %	0 = 0 %

Wind Direction	Wind Sped (m/s)		
S	0 = 0 %	0 = 0 %	2.68 = 11 %
SW	0.75 = 11 %	2.04 = 12 %	2.93 = 12 %
WSW	0 = 0 %	2.31 = 14 %	3.34 = 14 %
W	1.09 = 17 %	2.43 = 14 %	3.50 = 14 %
NW	0 = 0 %	1.93 = 11 %	2.75 = 11 %
NNW	1.43 = 22 %	0 = 0 %	0 = 0 %

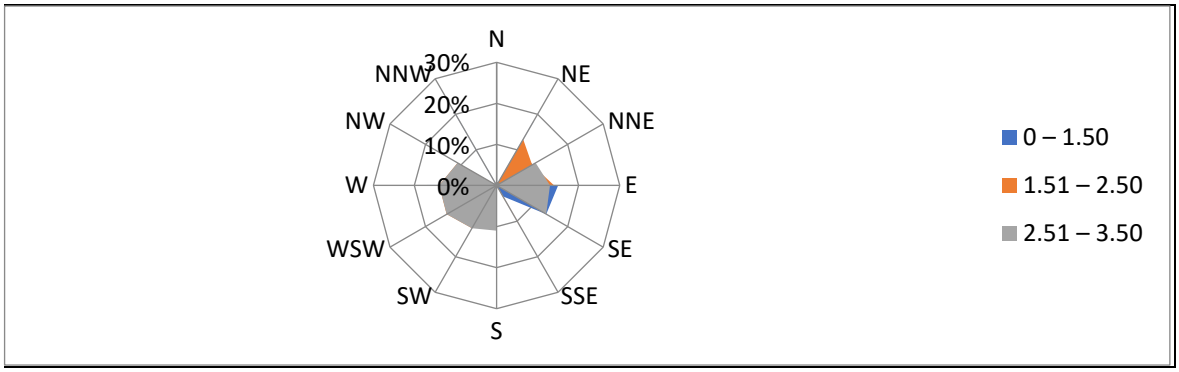


Figure 4.7: Wind Rose for Proposed Area Based on Microclimatic Data

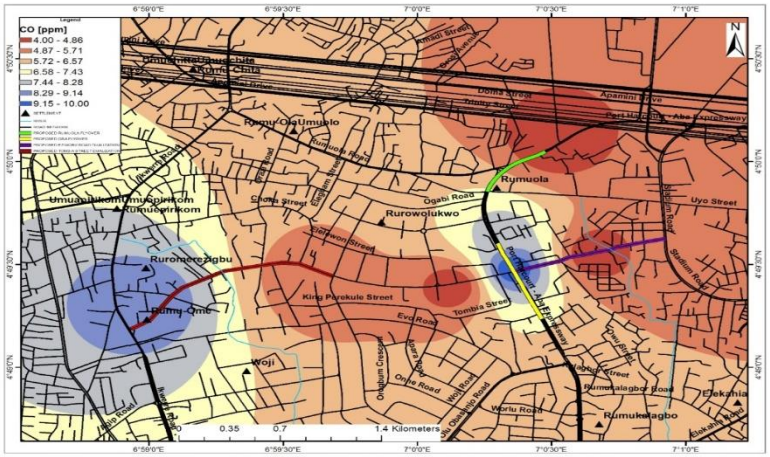


Figure 4.9: Map indicating spatial dispersion of Carbon monoxide (CO)

A wind rose gives a very succinct but information-laden view of how wind speed and direction are typically disturbed at a particular location. Presented in a circular format, the wind rose shows the frequency of winds blowing from the particular directions. The length of each "spoke" around the circle is related to the frequency of time that the wind blows from a particular direction. Each concentric circle represents a different frequency, emanating from zero at the centre to increasing frequency at the outer circles. The frequency categories that show the percentage of time that winds blow from a particular direction and at certain speed ranges.

In figure 4.7 above, wind speeds are indicated by colour. Here, the winds blew mostly at the wind speed denoted by the colours. For the blue section of the "spoke" which indicates winds at 0-1.50. The blue section is between 10 % and 0 %, subtracting these two numbers is equal to 10 %. This means that winds blew from the east (E) and south-east at 0-1.50m/s for 10 % of the time. For red section, winds blew

from the north-east at speeds between 1.51-2.50m/s for 10 % of the time. For green section, winds blew between w and WSW at speeds between 2.51-3.50 m/s for 10 % of the time.

4.5 Noise level

Noise level at Tombia road and GRA flyover axis was the lowest ranging from 72.11-78.49 [d(B)A]. On the other hand, Rumuola flyover and Ezimgbu road recorded highest noise level ranging from 80.63-87.00[d(B)A].

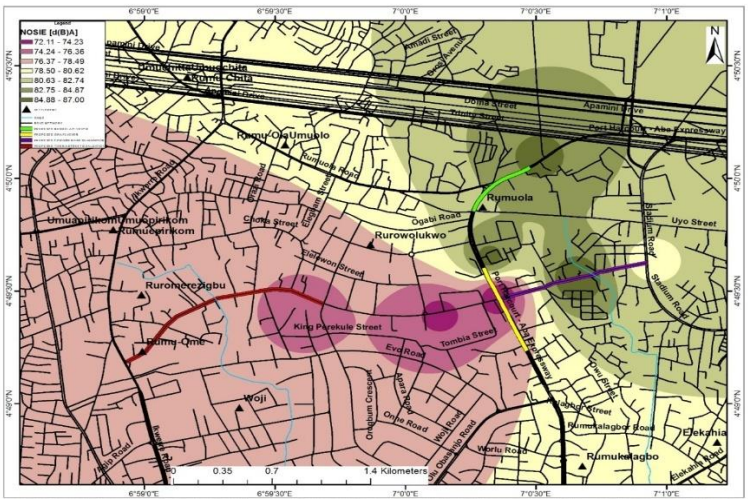


Figure 4.8: Map indicating spatial dispersion of noise level

However, the noise values recorded were lower than threshold limits of FMENV standard of 90 dB A for 8 hourly exposure.

4.6 Air quality

- **Carbon Monoxide**

Proposed GRA flyover area and Tombia Road (by Ikwerre junction) are the two points observed to have recorded highest concentration of CO (though not exceeding the required standard) ranging from 7.44-10.00 ppm. The lowest concentration was observed towards north of Rumuola, east of Tombia road and east of Ezimgbu road ranging from 4.00-5.71 ppm. The concentration was moderate towards south of the area covering Rumuokalagbo, Woji settlements ranging from 5.72-7.43 ppm. Other settlements with moderate concentration include Rurorolukwo, Elekahia, among others.

However, CO is within the FMENV limit of 10.0 – 20.0ppm. Long term exposure of CO, no matter the concentration, could result in adverse impact on human health which could lead to instant death. The presence of the gas in the ambient air of the study area was largely due to vehicular emissions, domestic and industrial activities.

- **Sulphur dioxide**

Moderate concentration of SO_2 was observed across proposed Rumuola flyover and part of Tombia road by Ikwerre junction ranging from 0.20-0.21ppm. The highest concentration was captured within the proposed GRA flyover (0.22-0.30 ppm) while its lowest point was captured mostly along Ezimgbu road towards stadium road and Tombia road by Polo park ranging from 0.10-0.16 ppm.

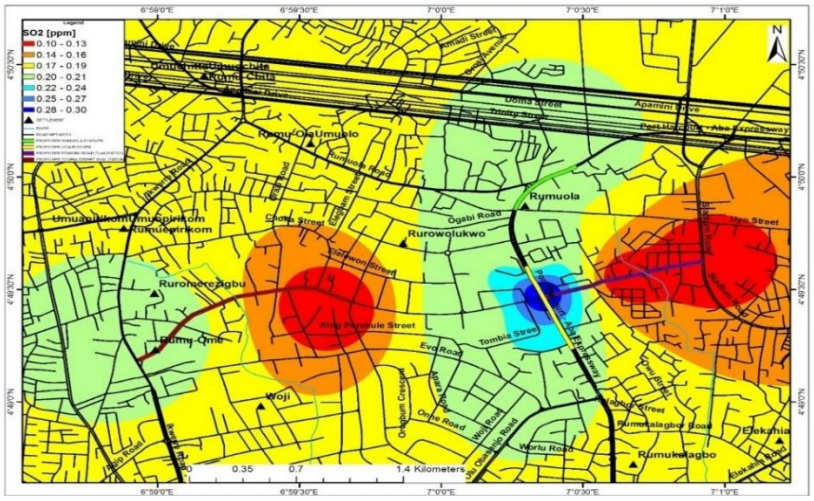


Figure 4.10: Map indicating spatial dispersion of sulphur dioxide (SO_2)

The recorded levels of SO_2 were above the FMENV regulatory limits of 0.01ppm – 0.1ppm for daily average of 8-hourly values in Nigeria. Almost every activity at the project area had the potential to generate considerable amounts of sulfur dioxide.

- **Hydrogen sulphide (H_2S)**

The concentration of H_2S was the same across the entire study area (<0.1 ppm).

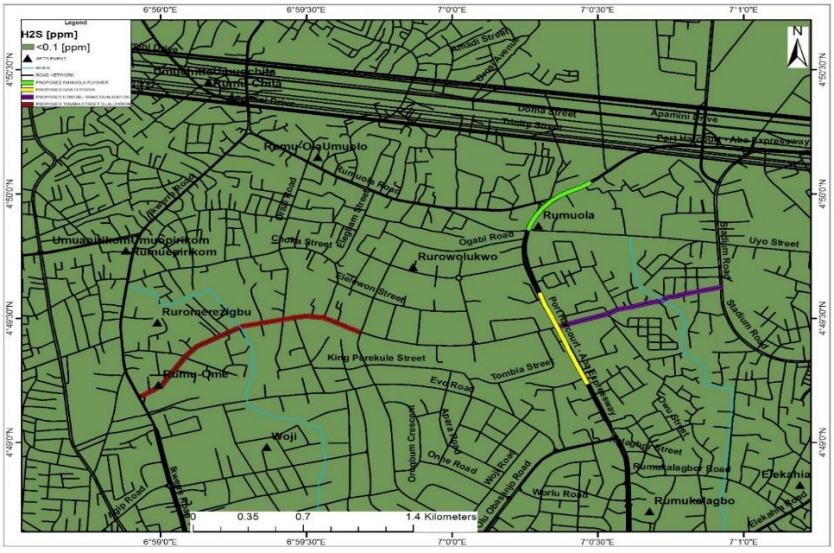


Figure 4.11: Map indicating spatial dispersion of hydrogen sulphide (H_2S)

No permissible value for H_2S has been given by Federal Ministry of Environment.

- **Nitrogen dioxide**

NO_2 as indicated in the model recorded highest concentration toward the proposed Tombia road construction project by Ikwerre junction, proposed GRA flyover by Rumuola and Rumuola flyover toward Aba road recorded not less than 0.20 ppm. The concentration reduced with increase in distance from the afore-mentioned axis. Its least concentration was observed toward Tombia road as well as Ezimgbu road off stadium road ranging from 0.10-0.13 ppm.

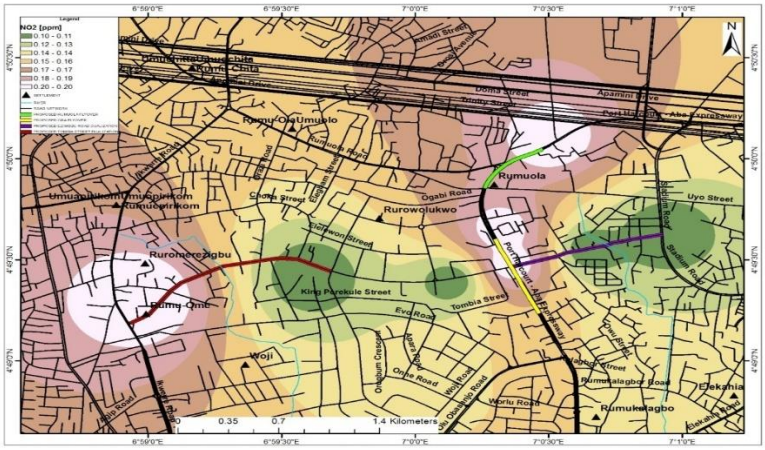


Fig. 4.12: Map showing spatial dispersion of nitrogen dioxide (NO_2)

However, the recorded values were all above the Federal Ministry of Environment's limits of 0.04 - 0.06 ppm. Generators, vehicular traffic, industrial boilers, etc contributed to the emissions of this gaseous pollutant.

- **Hydrogen cyanide (HCN)**

A great dynamic model was observed in the concentration of HCN across the study area. Peak concentration was observed around GRA flyover axis, east of Tombia and Ezimgbu road (1.58-2.00 ppm). Tombia extension by Ikwerre road, middle of Ezimgbu road and the entire Rumuola flyover and its environs recorded the lowest concentration ranging from 1.00-1.29 from ppm.

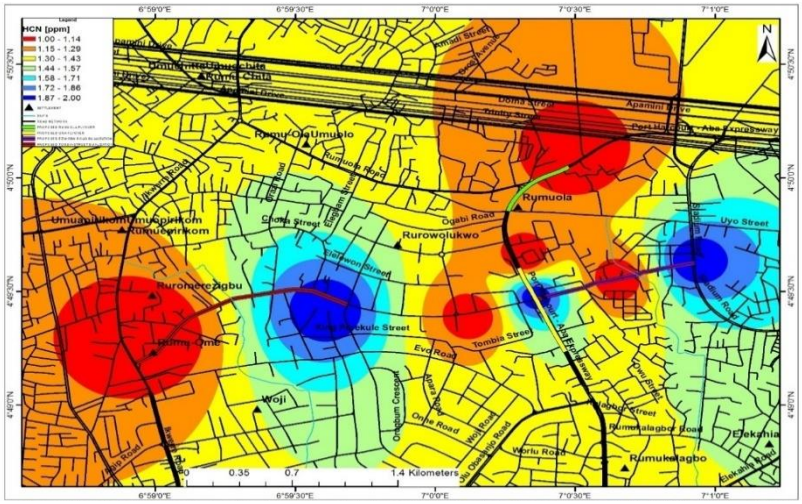


Fig. 4.13: Map indicating spatial dispersion of hydrogen cyanide (HCN)

However, the FMENV has no limit for HCN.

- **Ammonia (NH_3)**

The dispersion model indicated that NH_3 concentration was moderate in not less than 47 % of the study area ranging from 1.87-2.14 ppm which covered the entire GRA flyover, part of Tombia road and Ezimgbu road. A slight increase was recorded at the extreme of Tombia road by Polo Park. However, the peak concentration of NH_3 was recorded toward Rumuola flyover axis recording between 2.15 ppm and 3.00 ppm.

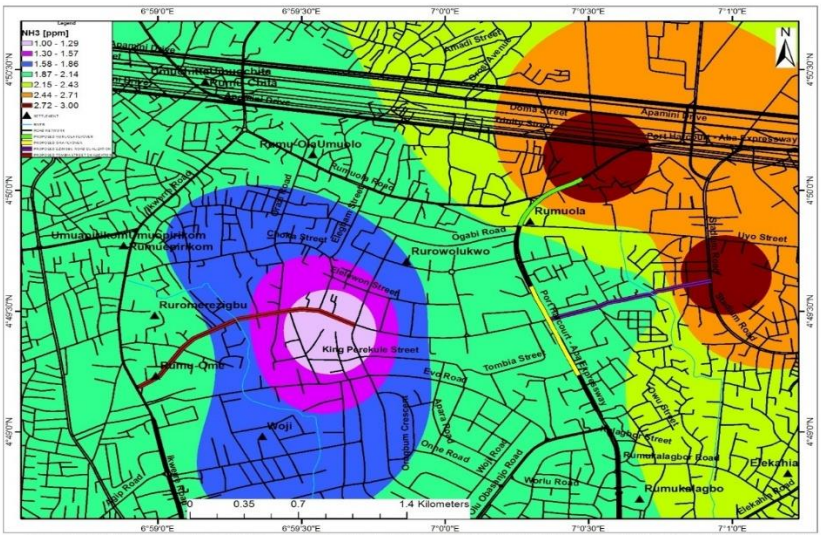


Fig. 4.14: Map showing spatial dispersion of ammonia (NH_3)

The recorded levels of ammonia were below FMENV limits of 200ppm. Detection of ammonia in the study area may be due to vehicular traffic, cow dung, glass cleaning agents, disinfectants, etc., used within the study.

- **Chlorine (Cl_2)**

Cl_2 recorded moderate concentration across Tombia and Ezimgbu road ranging from 0.20-0.21 ppm. The highest concentration was recorded toward GRA flyover ranging from 0.22-0.30 ppm. The least concentration was recorded around Rumuola flyover and northern part of the study area ranging from 0.13-0.19 ppm.

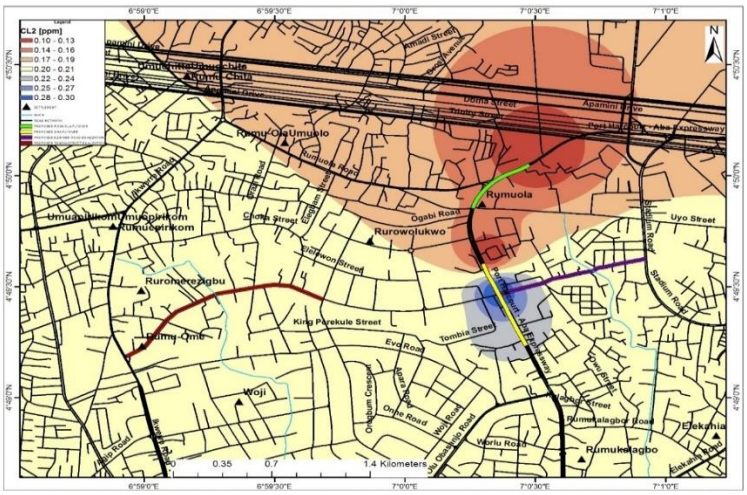


Fig. 4.15: Map indicating spatial dispersion of chlorine (Cl_2)

Federal Ministry of Environment has not given permissible value for Cl_2. Its presence in the study site might be attributed to transportation, cleaning agent, disinfectant, preservative agents, production or utilization of chemicals, etc.

- **Particulate Matter $PM_{2.5}$**

PM2.5 recorded least concentration towards east of Tombia road with concentration less than 45.29 µg/m^3. However, peak concentration was recorded north of Rumuola and north of GRA flyover ranging from 65.86-70.99 µg/m3. The remaining part of the study area recorded moderate concentration ranging from 45.30-60.71 µg/m^3 as observed along Ezimgbu road, Tombia road by Ikwerre junction, among others.

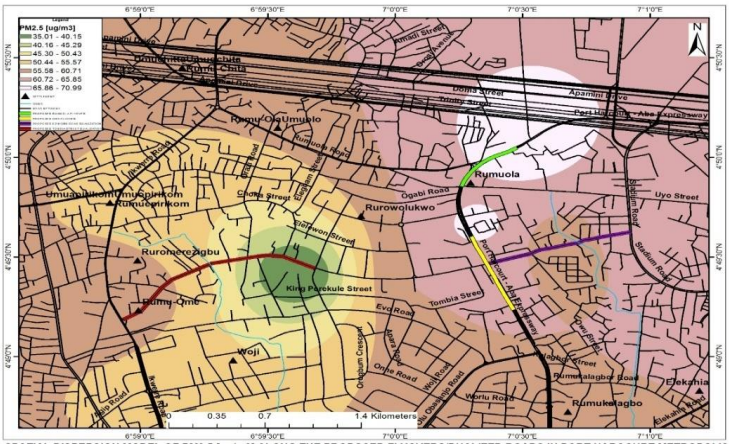


Fig. 4.16: Map indicating spatial dispersion of $PM_{2.5}$

- **Particulate Matter PM_{10}**

PM10 as shown in the dispersion model recorded least concentration at the extreme east of Tombia road ranging from 62.01-79.43 µg/m^3. The highest concentration was recorded around Rumuola and GRA flyovers as well as extreme west of Tombia road and the adjoining Ikwerre road ranging from

105.58-122.99 µg/m^3. The concentration around Ezimgbu road towards stadium road was in moderation ranging between 88.16-96.86 µg/m^3.

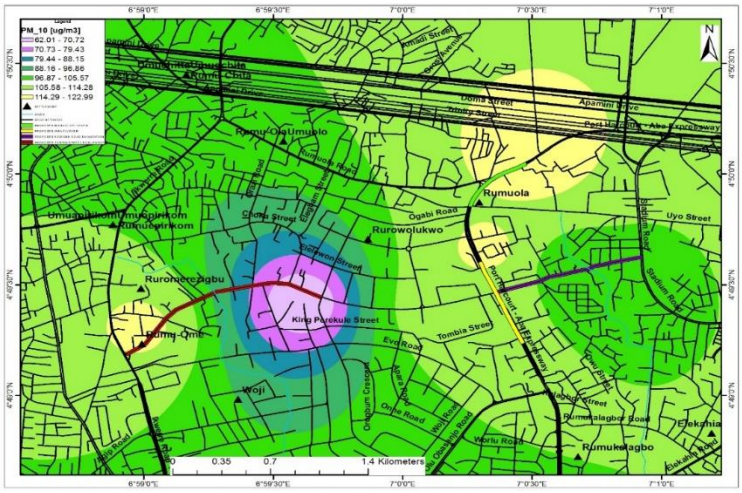


Fig. 4.17: Map showing spatial dispersion of PM_{10}

- **Total Volatile Organic Compounds (TVOC)**

TVOC measured in mg/m^3 was observed to have highest concentration along Port-Harcourt-Aba Expressway (in between Rumuola and GRA flyover) recording between 0.95 and 1.55 mg/m^3. Moderate concentration was capture along Rumuola flyover and part of Tombia road by Ikwerre road read between 0.74 and 0.94 mg/m^3. The southern and north-western part of the study area recorded lowest concentration ranging from 0.12-0.53mg/m^3.

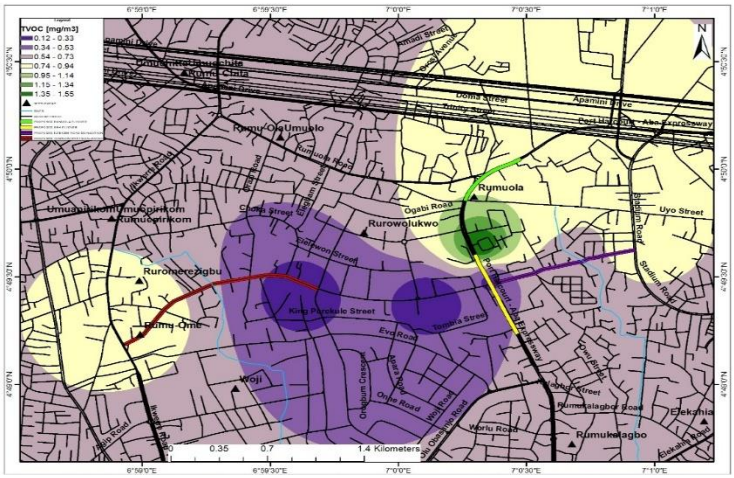


Fig. 4.18: Map indicating spatial dispersion of total organic compound (TVOC)

- **Formaldehyde (CH_2O)**

The highest point of CH_2O concentration was found in-between the two flyovers ranging from 0.118-0.192 ppm. The concentration was in moderation (0.093-0.117ppm) towards east of Ezimgbu road and

toward Tombia Road by Ikwerre axis. The lowest concentration (0.017-0.092 ppm) was recorded across the GRA flyover and eastern part of Tombia Road.

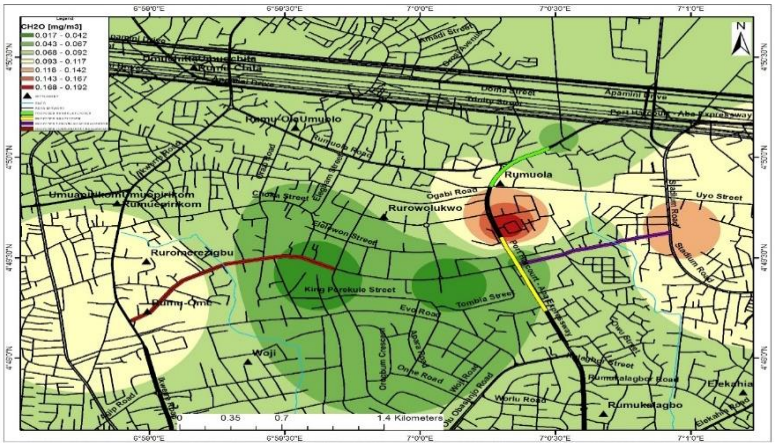


Fig. 4.19: Spatial dispersion map of formaldehyde (CH_2O)

Methane (CH_4)

The entire area of GRA and Rumuola flyover, Ezimgbu Road and extreme west of Tombia Road recorded the lowest CH_4 concentration which ranged from 0.100-0.214 ppm. The peak concentration was found towards Tombia Road by Polo Park and the immediate surroundings ranging from 0.272-0.498 ppm.

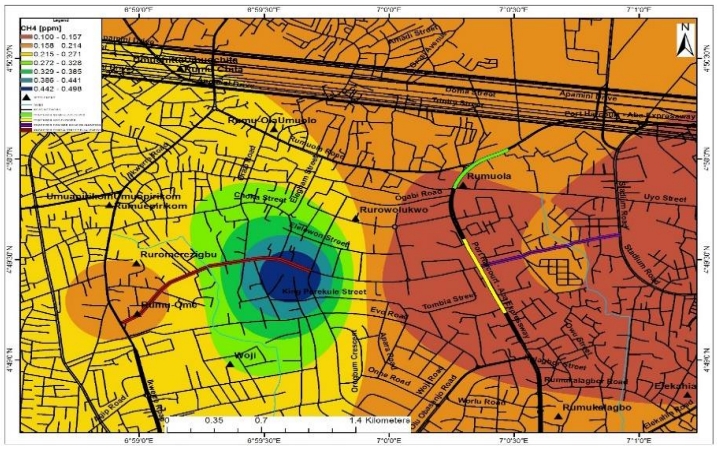


Fig. 4.20: Spatial dispersion map of methane (CH_4)

- **Carbon Dioxide (CO_2)**

CO_2 was observed to record highest along Tombia Road by Ikwerre axis same with zone in between Rumuola and GRA flyovers with its concentration ranging from 667.70-901.83 ppm. Lowest was recorded south of the study area including Ezimgbu Road and part of Tombia Road ranging from 527.09-634.16 ppm. A slight increase in CO_2 concentration was recorded north of the study area ranging from 634.17-687.69 ppm.

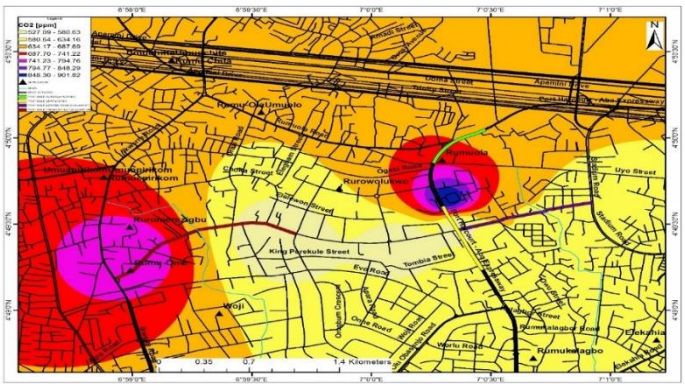


Fig. 4.21: Spatial dispersion map of Carbon (IV) oxide (CO_2)

- **Bio-aerosols (Bacteria and Fungi)**

Bacteria recorded lowest at the south of the study area including GRA flyover, Tombia and Ezimgbu Road which ranged from 4.11×10^5- 4.30×10^5 cfu/m^3 while the highest bacteria count was captured along Rumuola flyover point ranging from 4.41×10^5– 4.70×10^5 cfu/m^3.

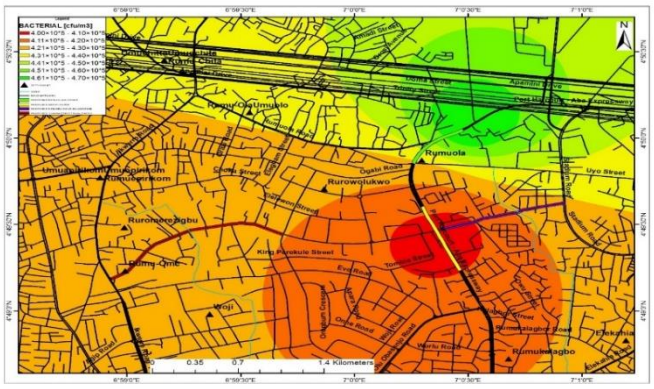


Fig. 4.22: Enumeration of bacteria in air

- **Fungi**

Fungal counts in the model showed that lower concentration was observed toward GRA flyover, Tombia and Ezimgbu Road 4.40×10^5 - 4.63×10^5 cfu/m^3, while the peak fungal load was captured around Rumuola axis ranging from 4.87×10^5- 5.20×10^5 cfu/m^3.

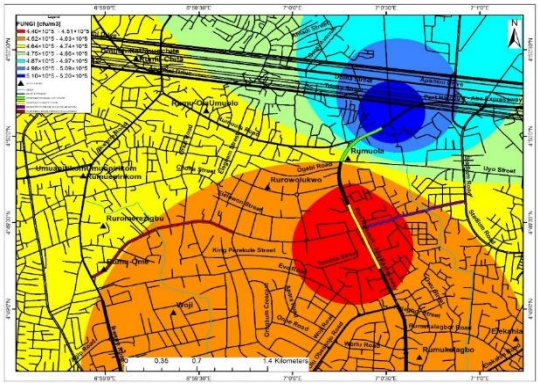


Fig. 4.23: Enumeration of fungi in air

This study has revealed that the study area is laden with microbial contaminants. The level and quality of microbial contamination however varied with the sample location. The high incidence of the microbial isolates may be associated with indiscriminate disposal of solid wastes especially domestic ones in the city centers and public drains. Improved waste management approaches may help in curtailing the discharge of microbial contaminants into the atmosphere. In other word, bio-aerosols will have significant impact on the proposed fly-over project. To check microbial attack associated with concrete structures, control measures stated in literature review above shall be followed.

- **Heavy Metal Content in Air**

The recorded concentration of lead ranged from 0.622 – 1.121 mg/m^3 with the mean of 0.901±0.24 mg/m^3. The measured concentrations of arsenic ranged from 0.011 – 0.025 mg/m^3 with the mean of 0.018±0.005 mg/m^3. The amount of chromium found in air ranged from 0.222 – 0.252 mg/m^3 with the mean of 0.235±0.01 mg/m^3. The recorded concentration of cadmium ranged from 2.323 – 2.351 mg/m^3 with the mean of 2.338±0.1 mg/m^3. Nickel found in ambient air ranged from 0.310 – 0.321 mg/m^3 with the mean of 0.314±0.04 mg/m^3, while vanadium was found in the range of 0.001 – 0.008 mg/m^3 with the mean of 0.004±0.003 mg/m^3.

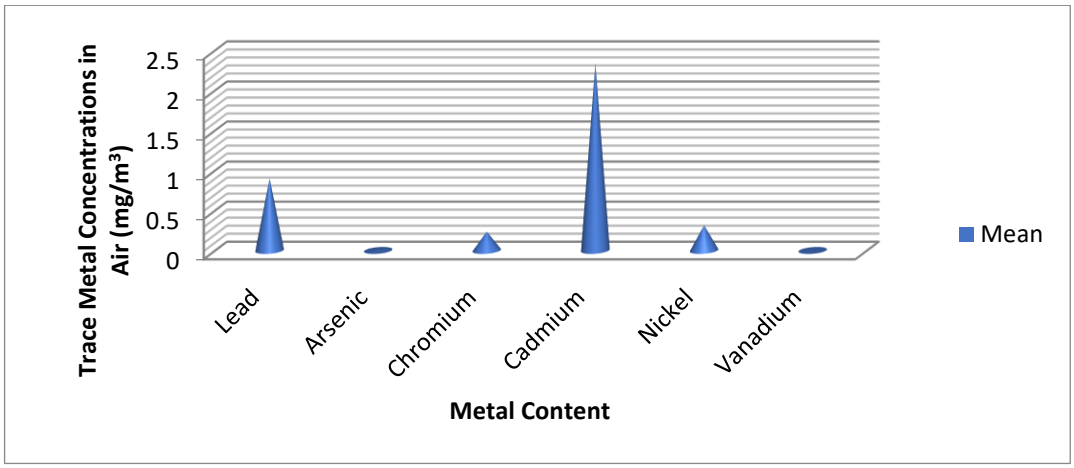


Figure 4.24: Chart showing heavy metal content in air

4.7 Geoscience

4.7.1 Methodology

The study areas fall within the tertiary sedimentary basin of Niger Delta as shown in fig 4.25. Thus, the methodology adopted for this study includes field studies and high impact approved papers of previous research carried out within the geologic terrain from the Department of Geology, University of Port Harcourt. These researches addressed various aspects such as basin evolution and tectonics, biostratigraphy, sedimentology, sequence stratigraphy etc.

Figure 4.25: Geologic map of Nigeria showing Niger delta basin

4.7.2 Regional Geology

The Tertiary Niger Delta Basin located in southern Nigeria at the inland margin of the Gulf of Guinea and is situated at the southernmost part of the intra-continental Benue Trough as shown in above (fig. 4.25). The basin which was formed at a recognized triple junction of the south Atlantic rifting (Delhaya et al, 2009), is bounded by the Calabar Flank to the east, Benin Flank to the west, Gulf of Guinea to the south and to the north by the Anambra Basin and Afikpo Syncline (Tuttle et al. 1999). The Niger delta basin is one of the largest subaerial basins in Africa. It has a total area of 300,000 km^2, and a sediment fill of 500,000 km^3 (Fatoke, 2010).

The evolution of the Niger delta is controlled by pre- and syn-sedimentary tectonics described by Brooks, 1990. The tectonic framework is controlled by cretaceous fracture zones expressed as trenches and ridges in the deep Atlantic. The fracture zone ridges subdivide the continental margin into individual basins, and in Nigeria, form the boundary faults of the cretaceous Benue-Abakaliki trough, which cuts far into the West African shield.
The trough represents a failed arm of a rift triple junction which led to the formation of Niger delta basin and is composed of different geologic Formations.

Throughout its history, the delta has been fed by the Niger, Benue and Cross rivers, which between them drain more than 10^6 km^2 of continental lowland savannah. Its present morphology is that of a wave-dominated delta, with a smoothly seaward-convex coastline transverse by distributary channel (Brook J., 1990).

The formation of the Niger Delta began in the early Palaeocene times and was as a result, buildup of fine – grained sediment eroded and transported by the River Niger and its tributaries.

4.7.3 Local Geology

The study area has a flat topography and its elevation varies between 30m to 60m above sea level. thus, no outcrop was observed within the study area. The study area consists of alluvial and fluvial sediment deposits of sandstone and clay in which sand percentage increases as observed from the lithologs during the geotechnical investigations in Rumuola junction (Plate 4.3).

Plate 4.3: Geotechnical investigations at Rumuola Junction

According to Etu-Efeotor et al, 1990 the Niger Delta is composed of three subsurface lithostratigraphic units (Akata, Agbada and Benin formations overlain by various deposits of Quaternary Age. The Benin formation (2100m thick) is the most prolific aquifer in the region and constitutes over ninety percent (90%) massive, porous sands with localized clay/shale interbeds.

The quaternary deposits (40 – 150m thick) generally consist of rapidly alternating sequences of sand and silt/clay, with the latter becoming increasing more prominent seawards. The Agbada formation underlies the Benin formation and was deposited under transitional environment, makeup of sands and shales.

However, increasing clay may occur with depth. Underlying the Agbada formation is the Akata formation, which was deposited, in marine environment. It consists of marine clays, silts and shales with occasional turbidite sand lenses. The formation is rich in organic matter and is the source rock of oil in the Niger Delta. It has a relative thickness of 20,000ft (5882m).

Table 4.14: Geologic units of Niger delta (Short & Stauble 1967)

Geologic Units	Lithology	Age
Alluvium (general)	Gravel, sand, clay, silt	Quaternary
Fresh water back swamp meander belt	Sand, clay, some silt, gravel	Quaternary
Mangrove and salt water/back swamps	Medium fine sands clay & some silt	Quaternary
Active & abandoned beach ridges	Sand, clay and some silt	Quaternary
Sombreiro-Warri Deltaic Plain	Sand, clay and some silt	Quaternary
Benin Formation (coastal plain sand)	Coarse to medium sand with subordinate silt & clay	Miocene
Agbada Formation	Mixture of sand, clay & silt	Eocene
Akata Formation	Clay	Palaeocene

4.7.4 Soil and Flood Potential

The soils of the study area are part of the coastal soils. Edet, A.E. 1993 had earlier stated that coastal soils are composed of coastal sand deposits originally laid down at or near sea level in Oligocene to Pleistocene times.

The soils are dark to brown in colour. coarse grained, locally fine grained, poorly sorted, subangular to well rounded (Omatsola, 1990). Olobaniyi et al (2006) stated that the genesis of these soils has resulted from cycles of soil formation which alternated with cycles of erosion in the mid tertiary to Holocene era in Nigeria.

Soil consistency as observed during the field exercise were between wet (slightly sticky and non-sticky) and moist (friable), while soil colour were between black, Dark red and Brown as shown in fig 4.26.

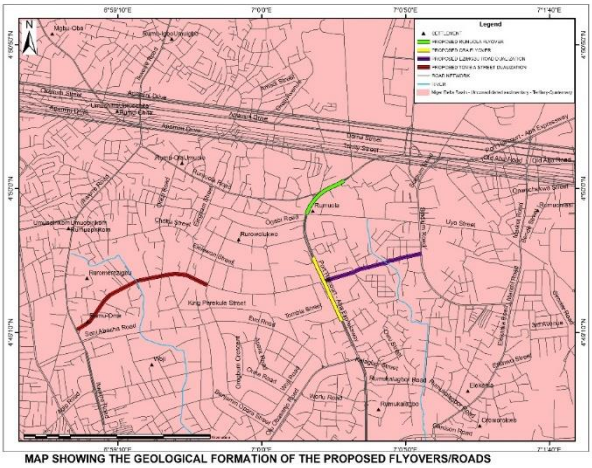


Figure 4.26: Geologic Map of the study Area

According to Atipko et al, 2018, the soil in the Port-Harcourt are poorly graded and implies a relatively high permeability potential. The high proportion of silty clay size fractions in the soil indicates a considerable amount of compressibility. The strength properties of the soil evaluated based on CBR reveals that the soil materials are suitable for subbase and subgrade materials.

4.7.5 Soil Characteristics

The soil of the project area belongs to the Entisols soil class (Lindbo and Mannes, 2008; Lindbo, 2012; Broch and Klein, 2017) and is consistent with study reports of the soil in the area (Brady and Weil, 2008). Typical of Entisols, soil of the project area shows no well-defined profile development. The schematic soil profile description of the area is presented in Figure 4.27. The description was based on United State Department of Agriculture (USDA) classification of soils (1975) and Standard Soil Colour Charts (1967).

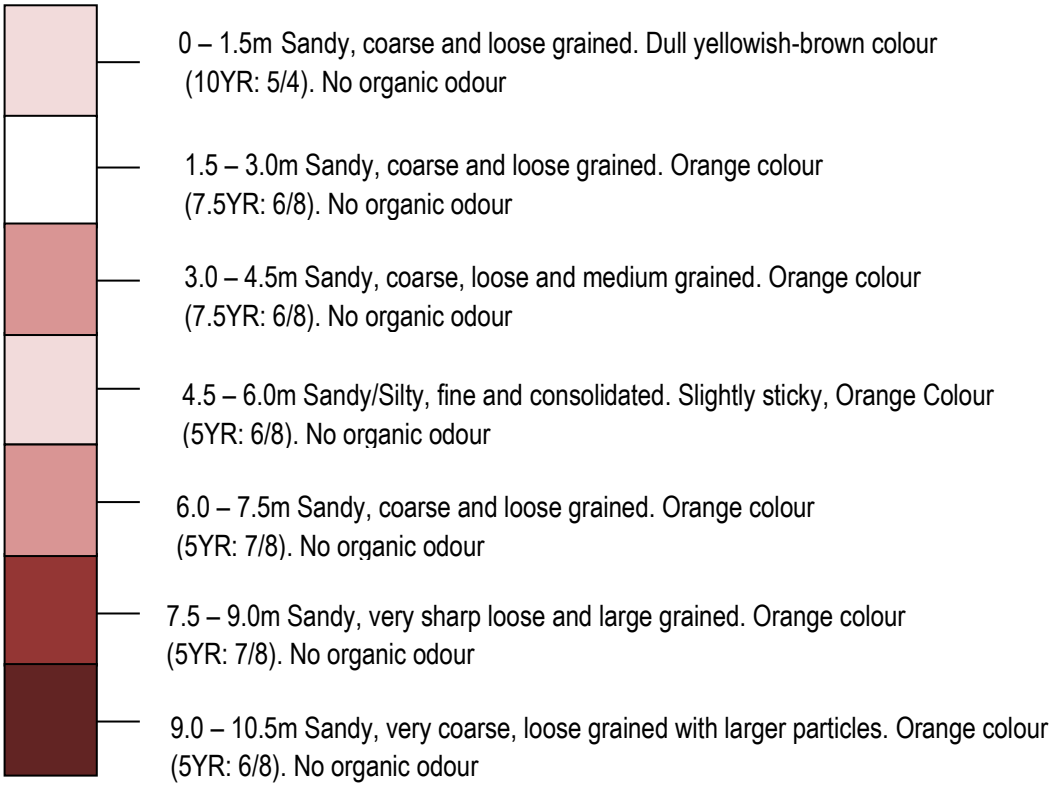


Figure 4.27: Schematic Section of Soil Profile at the Study Area

Due to the flat topography and human activities within the study area, the area is prone to flooding and inundation hazards. Low lying areas suffer the most from flooding because during intensive storm rainfall, the basin receives more than it could transfer as surface water in a short period of time (Zekai, 2018).

The closer the urban land use to the main channel stream, the more prone is to flood, and consequently, drainage cross sections that have not been prone to flood hazard before, may become under the threat of flood danger (Akpokodje, 2007).

Using rainfall data, soil texture and other factors Chiadikobi et al 2011 conducted flood risk assessment within the study area and the result of the study showed that there is risk of occurrence of potentially damaging floods with increasing rainfall intensity and increase in urbanization.

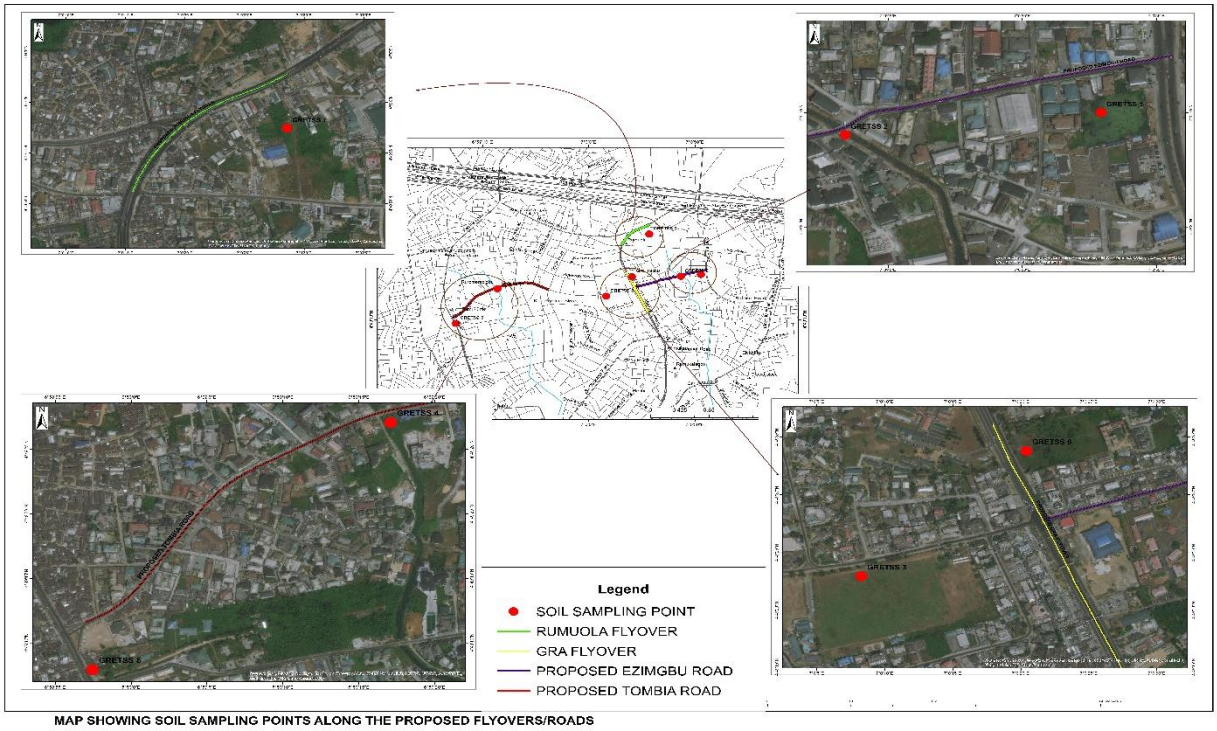


Figure 4.28: Soil map of the study area

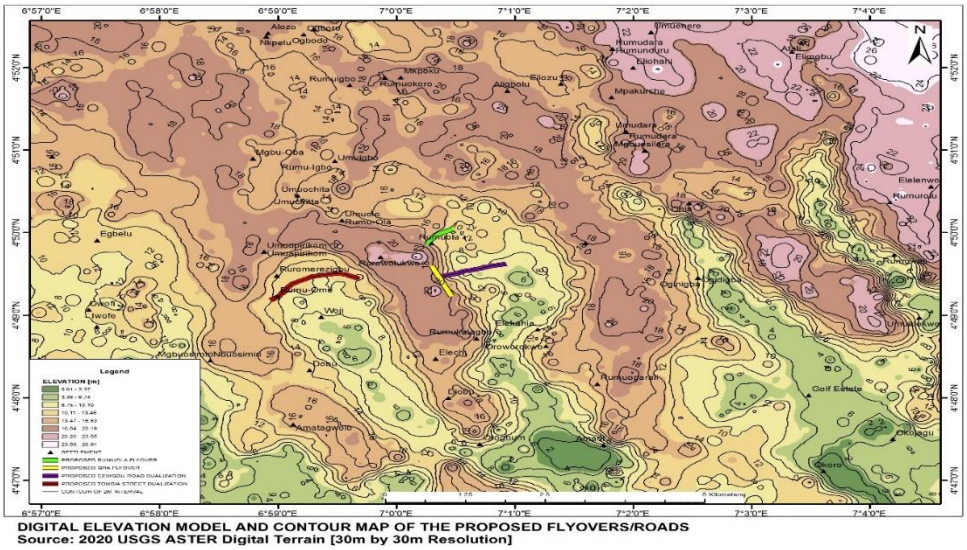


Figure 4.29: Topographic map of the study area

4.7.6 Soil Sampling

Each soil sample within the study area was composite of the top and subsoil. Hand auger was made up of a semi-cylindrical bore of uniform cross-section, and marked at 15 cm intervals. Sampling was carried out by augering to a depth of 30 cm. The surface sample (0 –15 cm) was separated from the subsurface (15 – 30 cm) samples and geo-referenced before been placed in labelled polythene bags.

The use of the auger ensured that reproducible units of soil samples were collected, which guaranteed high quality data collection. Surface litter of non-decomposed plant materials was removed before sampling to ensure that only soil samples were collected.
Soil samples were collected in appropriately labelled and sealed polythene bags in accordance with the quality assurance criteria as contained in the Federal Ministry of Environmental Guidelines and Standards (FMEnv, 1991).

A total of 8 soil samples were collected from the project sites using soil auger into sterile zip locked bags. Samples were transported to the laboratory within 24 hours of collection and air-dried for extraction/digestion for actual assay. Table 4.16 is a summary of the physico-chemical results for soil sample (see appendix V(b) for detailed result).

- **Quality Assurance and Quality Control**

This was an integral part of the studies and it covered all aspects of the study. The quality assurance programme conformed to FMEnv. The programme covered sample collection during fieldwork, transportation to the laboratory and handling of laboratory analyses, data verification / communication. Documentation of actual sample storage, treatment and laboratory analyses was handled by the use of chain of custody procedures. The sampling procedures/strategies considered are:

i. Obtaining a representative portion of the material concerned
ii. Obtaining a sufficient volume of the samples for analyses
iii. Sampling of the ecological components
iv. Establishment of numbering system and proper labelling of containers
v. Use of appropriate field recording forms, and
vi. Regular meeting during fieldwork to assess progress and performance.

The sampling rationale took into consideration the possible principal sources of bias, e.g., inaccuracy and imprecision and establishment of sampling points and sampling collection were carefully selected by proven methods to remove systematic error. Representative sampling (composite samples) ensured high quality data collection.

- **Sample Collection and Handling**

Sample collection and handling methods used are those specified in the FMEnv Guidelines. Samples collected were properly sealed and labelled. The following information was provided on each of the samples:

i. Identification code or sample number,
ii. Date and time of sampling,
iii. Description of sample, and

- **Methods of sampling**

A duplicate copy of this information was sent along with the sample collected when the samples were being sent to the laboratory for examination. Movement of the samples, sample identification and other information were recorded on sample chain of custody form.

- **Moisture Content in Soil**

Procedure

i. Weigh moisture sample immediately and record as “wet weight of sample”

ii. Dry the wet sample to a constant weight, at a temperature not exceeding 239º F (115º C) using the suitable drying equipment.

iii. Allow the sample to cool.

iv. Weigh the cooled sample again, and record as the “dry weight of sample”

Calculation

The moisture content of the sample is calculated using the following equation:

$$\%W = \frac{A - B}{B} \times 100$$

Where:

%W = Percentage of moisture in the sample,

A = Weight of wet sample (grams), and

B = Weight of dry sample (grams)

Report the moisture content to the nearest tenth of one percent.

- **Porosity**

Procedure

i. Fill one measuring cup to 200 ml with sand, the second cup with 200 ml of clay and the third with 200 ml with small pebbles.

ii. Fill a graduated cylinder to 100 ml with water.

iii. Slowly and carefully pour the water into the first cup until the water just reaches the top of the sand.

iv. Pour slowly so no water spills out of the measuring cup. Record exactly how much water was used.

v. Use the formula below to calculate the percent porosity for the sand:

vi. Repeat the same procedure with the clay and the pebbles.

vii. Record the results in a table similar to the one shown

Table 4.15: Porosity analysis

Soil Type	Total sample volume	Amount of water added to sample	Porosity
Sand	200 ml		%
Clay	200 ml		%
Pebbles	200 ml		%

Porosity = (Amount of water added to sample ÷ Total sample volume) x 100

- **Permeability**

Procedure

i. Fill one graduated cylinder to the 500 ml mark with gravel, one with sand, and one with a gravel and sand mixture.

ii. As one lab partner begins pouring water into a cylinder, another starts the stopwatch. When water reaches the bottom of the cylinder stop the watch and note the time.

iii. Measure the height in centimetres of the cylinder from the bottom to the 500 ml mark. Use these figures to determine the flow rate in centimetres per second (cm/sec).

iv. Repeat for the other two cylinders and record your data in the chart below.

- **Bulk Density**

i. Drive Ring into Soil

- Using the hand sledge and block of wood, drive the 3-inch diameter ring, beveled edge down, to a depth of 3 inches.
- The exact depth of the ring must be determined for accurate measurement of soil volume. To do this, the height of the ring above the soil should be measured. Take four measurements (evenly spaced) of the height from the soil surface to the top of the ring and calculate the average. Record the average on the Soil Data worksheet.

ii. Remove 3-inch Ring

- Dig around the ring and with the trowel underneath it, carefully lift it out to prevent any loss of soil.

iii. Remove Excess Soil

- Remove excess soil from the sample with a flat bladed knife. The bottom of the sample should be flat and even with the edges of the ring**.**

iv. Place Sample in Bag and Label

- Touch the sample as little as possible. Using the flat bladed knife, push out the sample into a plastic sealable bag. Make sure the entire sample is placed in the plastic bag. Seal and label the bag.

v. Weigh and Record Sample

- Weigh the soil sample in its bag. [If the sample is too heavy for the scale, transfer about half of the sample to another plastic bag. The weights of the two sample bags will need to be added together. Enter the weight (sum of two bags, if applicable) on the Soil Data worksheet.
- Weigh an empty plastic bag to account for the weight of the bag. Enter the weight (sum of two bags, if applicable) on the Soil Data worksheet.

vi. Extract Subsample to Determine Water Content and Dry Soil Weight

- Mix sample thoroughly in the bag by kneading it with your fingers.
- Take a 1/8-cup level scoop subsample of loose soil (not packed down) from the plastic bag and place it in a paper cup (a glass or ceramic cup may be used).

vii. Weigh and Record Subsample

- Weigh the soil subsample in its paper cup. Enter the weight on the Soil Data worksheet. Weigh an empty paper cup to account for its weight. Enter the weight on the Soil Data worksheet.

viii. Dry Subsample

- Place the paper cup containing the subsample in a microwave and dry for two or more four-minute cycles at full power. Open the microwave door for one minute between cycles to allow venting. Weigh the dry subsample in its paper cup and enter the weight on the Soil Data works.

4.7.7 Soil Quality

The physico chemical parameters of soil samples within the study area is summarized in Table 4.16.

Table 4.16: Summarized of physico chemical parameters of soil

Parameter	Range	Mean	FMEnv/WHO Limits
Permeability (%)	46.8-54.6	49.43	-
Porosity (%)	67.3-74.8	70.34	-
Bulk density (mg/kg)	0.2-1.3	0.71	-
% Sand	55-68	60.75	-
% Silt	23-40	31.13	-
% Clay	6.0-10	8.13	-
Ph	4.82-5.67	5.33	6-8
Conductivity (dS/m)	88.4-100.4	94.2	-
Moisture content (%)	40.3-46.7	42.69	-
Nitrate (mg/kg)	7.38-8.24	7.83	-

Parameter	Range	Mean	FMEnv/WHO Limits
Phosphate (mg/kg)	1.08-1.42	1.28	-
Sulphate (mg/kg)	2.28-2.56	2.44	500
Calcium (mg/kg)	23.7-28.8	26.19	-
Magnesium (mg/kg)	1.50-2.15	1.87	-
Potassium (mg/kg)	0.76-1.27	1.07	-
Sodium (mg/kg)	0.18-0.43	0.28	-
THC (mg/kg)	<0.001	<0.001	30
Vanadium (mg/kg)	<0.001	<0.001	-
Nickel (mg/kg)	0.04-0.17	0.111	35
Iron (mg/kg)	41.7-50.8	46.91	45
Lead (mg/kg)	0.005-0.018	0.015	85
Copper (mg/kg)	0.47-0.71	0.61	45
Zinc (mg/kg)	3.24-3.8	3.47	140

Source: Resourcefield 2020

Note: All parameters analyzed were within WHO/FMEnv permissible limits.

- **Moisture Content**

The moisture content of soil also referred to as water content is an indicator of the amount of water present in soil. By definition, moisture content is the ratio of the mass of water in a sample to the mass of solids in the sample, expressed as a percentage. Soils normally contains a finite amount of water, which can be expressed as the "soil moisture content." This moisture exists within the pore spaces in between soil aggregates (inter-aggregate pore space) and within soil aggregates (intra-aggregate pore space). Normally this pore space is occupied by air and/or water. If all the pores are occupied by air, the soil is completely dry. If all the pores are filled with water, the soil is said to be saturated.

The moisture content of the soil ranged from 40.3 – 46.7 % with the mean of 42.69 %. No recorded WHO/FMEnv permissible limit exist for moisture content.

- **Permeability**

The permeability is a measurement of how easily liquid flows through a material (or soil). Both porosity and permeability are important to ground water. The permeability of the soil ranged from 46.8 – 54.6 % with the mean of 49.43. WHO/FMEnv permissible limit do not exist for soil permeability

- **Porosity**

The porosity of a material is a measurement of how much of its volume is open space (also called pore space). Porosity is usually expressed as a percentage of the material's total volume. The porosity of the soil ranged from 67.3 – 74.8 % with the mean of 70.34%. No WHO/FMEnv permissible limit available for the porosity of soil.

- **Bulk Density**

Bulk density is the weight of soil for a given volume. It is used to measure compaction. Generally, the greater the density, the less pore space for water movement, root growth and penetration, and seedling germination. The bulk density of the soil ranged from 0.2 - 1.3mg/kg with the mean of 0.71mg/kg. WHO/FMEnv permissible limit no available.

- **pH**

This is an indication of the acidity, neutrality or alkalinity of a particular soil and indicates the availability of exchangeable cations (e.g., Ca^{2+}, Mg^{2+}, K^{+} etc). Factors influencing soil pH include organic matter decomposition, NH4+ fertilizers, weathering of minerals, parent material, climate and land management practices. The pH values of a soil have effects on plants by influencing the availability of macro and micro-nutrients, which are building blocks of sugars and proteins needed by plants. Soil pH of 4.8 is regarded as the lower limit for optimum growth of crops while pH of 9.5 is regarded as the upper limit of alkalinity beyond which crops become stressed. The pH values of the soil of the project area ranged from 4.82-5.67 with the mean of 5.33, which is below WHO/FMEnv permissible limit of 6-8.

- **Soil Nutrients**

The nitrate, phosphate and sulphate ions (NO_3^-, PO_4^{3-}, and SO_4^{2-}) are the ionic and utilizable forms of nitrogen, phosphorus and sulphur, which are essential plant nutrients present in the soil. Nitrogen is most often the limiting element in plant growth and is a constituent of chlorophyll, plant proteins, and nucleic acids. Also, phosphorus compounds form an essential part of nucleo-proteins in plant cells and these control cell division and growth. Soils usually have low total plant available phosphate supplies because mineral phosphate forms are readily not soluble. Sulphur on the other hand, occurs in proteins and is required for plant vitamin synthesis. In acidic soils, sulphur comes from mineralization of organic matter, particularly weathered soil.

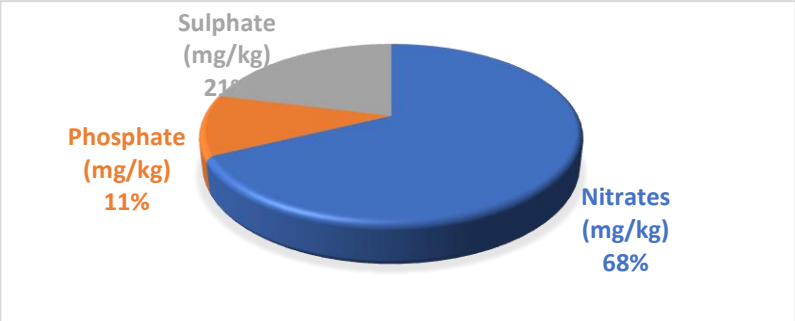


Figure 4.30: Soil nutrients

The nitrates, phosphates, and sulphates levels in soils of the project area were as shown in Table 4.16. The results obtained showed no significant variation. It also compared well with results of similar studies in the region. The ranges for nitrate, phosphate and Sulphate were 7.38 – 8.24 mg/kg with the

mean of 7.83mg/kg; 1.08– 1.42 mg/kg averaging 1.28 mg/kg; and 2.28 – 2.56 mg/kg with the mean of 2.44 mg/kg respectively.

In Figure 4.30, nitrate accounted for 68 % of the soil nutrient followed by sulphate 21 % and the least phosphate 11 %.

- **Particulate Size Distribution**

Soils are composed of particles of varying aggregates. The soil particles sizes comprise sand (the coarse), silt and clay (the smallest) fractions. The relative proportion of the soil separates in a particular soil determines its texture. The texture in turn determines the water intake rates (absorption), water storage, the ease of tilling, and the amount of aeration as well as influences the soil fertility. The name and sizes of soil particle classes are provided in Table 4.17 as defined by the United State Department of Agriculture (USDA) and International Society of Soil Science (ISSS).

Table 4.17: Classification of Soil Particle Sizes

Particle Fraction Name	USDA (mm)	ISSS (mm)
Gravel	>2	>2
Very Coarse Sand	1 – 2	-
Coarse Sand	0.5 – 1.0	0.2 -2.0
Medium Sand	0.25 -0.50	-
Fine Sand	0.10 -0.25	0.02-0.20
Very Fine Sand	0.05 – 0.10	-
Silt	0.002 – 0.05	0.002 – 0.020
Clay	<0.002	<0.002

Source: Boyd *et al* 2002

Data obtained for PSD indicated that the soils of the sample area were predominantly sandy loam with silt on the surface and sandy-silt to clay on the sub-surface. The colour varied between dull reddish brown and reddish grey. The recorded percentage for clay, silt and sand were as indicated in Table 4.16. These percentages represent a conservative ratio of 1:1:3.5 for clay, silt and sand respectively (Table 4.17). These results are however consistent with the values recorded in previous soil study of the area.

- **Cation Exchangeable Capacity (CEC)**

CEC is a measure of the ability of the soil to adsorb cations. Plants are primarily able to take up the ionic form of nutrients via their roots. Many of these nutrients are taken up as cations (remember, these are positive ions). Most soils have at least some ability to hold onto cations at negatively charged sites, called exchange sites, on soil particles. The cations are held loosely to the edges (adsorbed) such that they can be easily replaced with similarly charged cations. The total amount of the cations that the soil can hold adsorb is the cation exchange capacity (CEC). Measurement: CEC is measured as milliequivalents (meq) per 100g of soil or centimoles (cmol) per kg.

The exchangeable cations: magnesium, potassium, sodium and calcium are positively charged ions usually absorbed by electrostatic or columbic attraction to soil surface colloids. The plant nutrients calcium, magnesium and potassium are supplied to plants in large measures in exchangeable forms (Brady and Weil, 2008). Calcium deficiency in plants is indicated by deformation of young leaves and death of grow out points while magnesium deficiency is indicated by yellowing of older leaves between veins while younger leaves die and fall off.

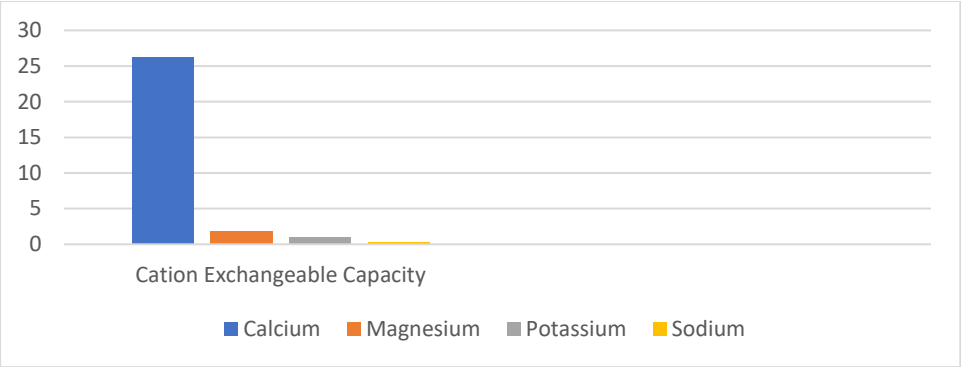


Figure 4.31: Mean Concentrations of Soil Exchangeable Cations

i. Magnesium

The concentration of magnesium recorded in the soil ranged from 1.50 mg/kg to 2.15 mg/kg with the mean of 1.87 mg/kg. Soils values obtained were fairly consistent across the study area.

ii. Potassium

The potassium in soils of the study area ranged from 0.76mg/kg to 1.27mg/kg with the average of 1.07 mg/kg. The potassium levels were consistent across the sampling stations, and also with the reported values recorded within the region.

iii. Sodium

The sodium concentrations in soils of the study area ranged 0.18 mg/kg to 0.43mg/kg with the average of 0.28 mg/kg.

iv. Calcium

The concentrations for the soil of the area ranged from 23.7 mg/kg to 28.8 mg/kg averaging 26.19mg/kg. Generally, the exchangeable cations concentrations were consistent with recorded values in similar environment within the region. However, the implementation of the proposed project will not affect the exchangeable cations in the project site. Hence, no foreseeable effect on the baseline concentrations of the exchangeable cations in the area is envisaged.

- **Heavy Metals**

The heavy metals analysed include vanadium, nickel, iron, lead, copper and zinc. Out of all the heavy metals analysed, only vanadium below equipment detection limit of <0.001. The mean concentration value of nickel (0.111 mg/kg), iron (46.91mg/kg), lead (0.015mg/kg), copper (0.61mg/kg), zinc (0.61mg/kg), were all within the FMEnv/WHO permissible limits of 35 mg/kg, 45mg/kg, 85 mg/kg, 45 mg/kg and 140mg/kg respectively.

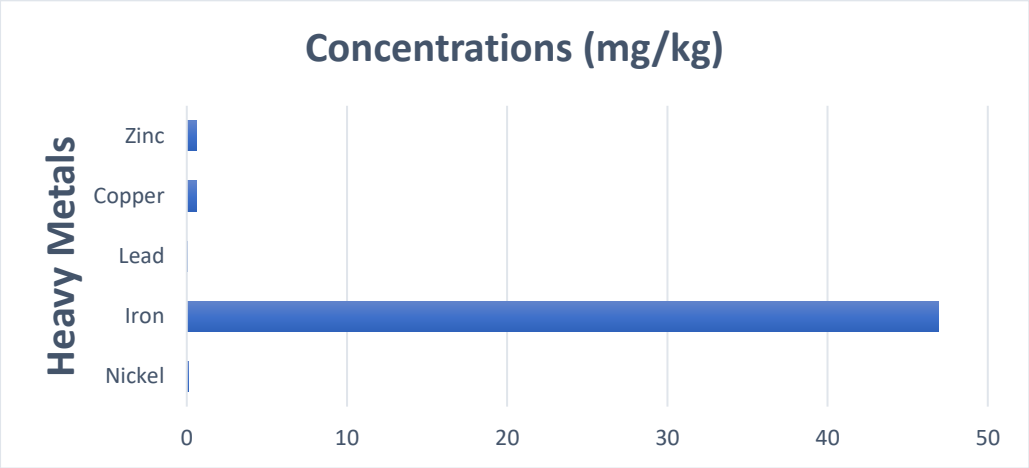


Figure 4.32: Mean concentrations of heavy metals in soil samples

Some case studies on bio-accumulation include the early 1970's Minamata disease, which revealed the potential for bio-magnification of mercury and other heavy metals in living tissues (Leke *et al*., 2011), and Ita-Ita disease caused by accumulation of cadmium in human tissue, also Chinwe *et al*. (2010) showed that some spent lead shot ingested by swans in Ireland ended up in the nucleus of the kidney cells (Lokhande *et al*., 2011). The values of heavy metals content in soil samples were as indicated in Table 4.16. These concentrations are consistent with previous studies in the region soils, soils.

4.7.7.1 Soil Microbiology

Generally, soil biology is the scientific study of life in and on the soil. This entails the study of various kinds of micro-organisms; those studied are bacteria and fungi, which are most important organic matter decomposers in the soil. They form symbiotic and mutual relationships in which two different organisms live together and benefit from each other. The summary of microbial organisms of the study area is presented in **Table 4.18.** Total heterotrophic bacteria (cfu/g) ranged between 1.8×10^5 and 3.1×10^5; Total heterotrophic fungi (cfu/g) ranged between 2.4×10^5 and 3.5×10^5; Hydrocarbon utilizing bacteria (cfu/g) ranged between 1.0×10^5 and 1.6×10^5, and Hydrocarbon utilizing fungi (cfu/g) ranged between 1.3×10^5 and 1.7×10^5. 36 genera of microorganisms were isolated, out of which 19 were bacteria and 17 fungi.

i. Microbiology

The results of the microbiological analysis of all samples collected are as presented in table 4.18. The estimated number of bacteria and fungi in soil and estimated number of hydrocarbon degraders as shown in Table 4.18. The number of heterotrophic bacteria (THB) reported in table 4.18 ranged from 2.5 x 10^5 to 4.8 x 10^5 $cfug^{-1}$ while the fungal counts (THF) ranged for 2.1 x 10^5 to 4.7 x 10^5 $cfug^{-1}$. The number of hydrocarbon utilizing bacteria (HUB) ranged from 1.2 x 10^5 to 2.7 x 10^5 $cfug^{-1}$ while the hydrocarbon utilizing fungi (HUF) ranged for 2.0 x 10^5 to 3.3 x 10^5 $cfug^{-1}$.

Tables 4.19 indicated the bacteria and fungi genera isolated from the soil. The soil organisms were abundant in number and types. In the soil environment, bacteria and fungi are useful for the purpose of biodegradation and soil fertility. Fungi are active in decomposing major constituents of plant tissues, namely cellulose, lignin and pectin and their mycelia are useful for the crumble structure of good agricultural soil (Gaikwad and Sonawane, 2012). Some bacteria genera known to be useful in non-symbiotic nitrogen fixation such as *Escherichia* coli, *Enterobacter aerogenes* as well as *Bacillus* and *Clostridium* spp. were among those identified. Many of the actinomycetes and fungi genera isolated such as *Streptomycetes* and *Penicillium* are known to have the ability to synthesize and excrete antibiotics (Bredholt *et al*., 2008).

Most of the bacteria identified are commensal, but there are a few genera which are of public health significance such as *Staphylococcus aureus*, *Streptococcus faecalis*, *Aspergillus niger*, *Corynebacterium* sp. and *Candida* sp. in the soil and water.

The information on microbial number and types here documented will be useful for monitoring and assessment throughout the construction and operation phases of the project. It will also be useful to the proponents for the purpose of environmental management and protection and also in policy formulation and development concerns; taking into consideration the needs and priorities of all stakeholder

Table 4.18: Microbial characteristics of soil samples

Parameter	SS_1		SS_2		SS_3		SS_4	
	TS	SS	TP	SS	TP	SS	TP	SS
THB (cfu/g)	2.8×10^5	3.1×10^5	1.8×10^5	2.2×10^5	2.8×10^5	3.1×10^5	2.5×10^5	2.8×10^5
THF (cfu/g)	3.0×10^5	3.3×10^5	2.4×10^5	2.7×10^5	3.2×10^5	3.5×10^5	2.7×10^5	3.0×10^5
HUB (cfu/g)	1.1×10^5	1.5×10^5	1.4×10^5	1.6×10^5	1.2×10^5	1.0×10^5	1.3×10^5	1.1×10^5
HUF (cfu/g)	1.4×10^5	1.6×10^5	1.7×10^5	1.7×10^5	1.3×10^5	1.5×10^5	1.7×10^5	1.5×10^5

Source: Resourcefield Survey, 2020

Table 4.19: Microbial Characteristics of Soil Samples

Sample Code	Microorganisms identified	
	Bacteria	Fungi
SS_1	*Staphylococcus aureus*, *Micrococcus* sp, *Pseudomonas aeruginosa*,	*Aspergillus fumigatus*, *Fusarium* sp, *Aspergillus niger*, *Candida albicans*.
SS_2	*Proteus* sp, *Micrococcus* sp, *Pseudomonas aeruginosa*, *Enterobacter aerogenes, Clostridium* sp.	*Fusarium* sp, *Aspergillus niger*, **Candida tropicalis*.

SS_3	*Klebsiella* sp, **Micrococcus* sp, **Pseudomonas* sp, *Bacillus brevis*, *Enterobacter faecium*.	**Penicillium* sp, **Candida tropicalis*, *Aspergillus niger*, *Fusarium* sp, **Candida albicans.*
SS_4	**Bacillus* sp, *Achromobacter* sp, *Bacteroids* sp, *Acinetobacter* sp, **Bacillus* subtilis, *Streptococcus faecalis*,	*Alternaria* sp, *Geotricum* sp, **Penicillium* sp, *Aspergillus niger*, **Candida* sp,

*Hydrocarbon degrader Source: Resourcefield Survey, 2020

4.8 Hydrogeology and Hydrology

Geologically, the site is underlain by the coastal plain sands, overlain by firm – stiff clay/sandy clay sediments belonging to the pleistocenic formation. The area essentially reflects the influence of movements of water runoff in their search for lines of flow to the sea with consequent deposition of transported sediments.

Given the permeability of sands (from medium to high), they are excellent reservoir rock. The clayey intercalations, when present acts as aquitard or aquiclude, depending on the thickness, areal

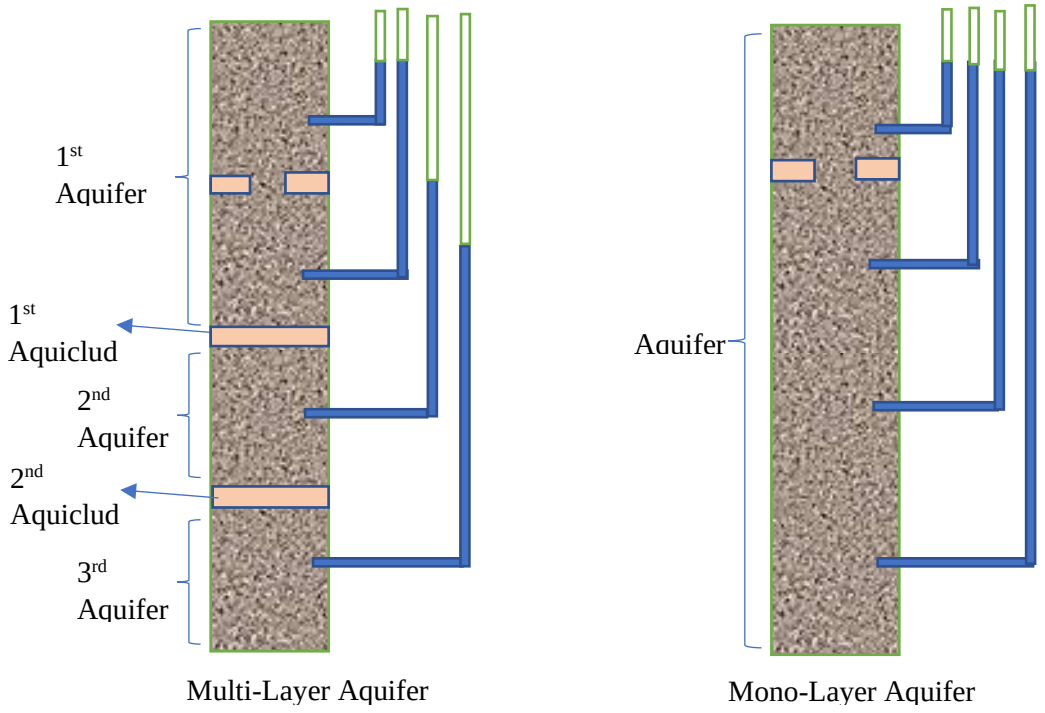


Figure 4.34: Examples of Multi-layer and Mono-layer Aquifer

continuity and permeability of the layer. The litho-stratigraphic succession described above indicates the existence of a powerful alluvial aquifer hosted in sandy deposits.

Given the variability of the sedimentary deposition and energy of the surface waterway flows, the existence of two types of aquifers (Multilayer and Monolayer aquifers) can be hypothesized.

A multi-layer aquifer is made up of several overlapping water bearing layers, hydraulically separated by less permeable clayey layers. Figure 4.34 gives an example of an alluvial aquifer of the multi-layer type, with continuous impermeable strata which defines a hydraulic separation.

The sedimentary Formations hosts several strata hydraulically separated by impermeable strata as seen in the figure 4.34 by the various piezometric loads with hypothetical measuring pipes positioned at various depths. Thus, a Monolayer aquifer is made up of one sedimentary body in which there is absence of less- permeable separation strata; the sedimentary body hosts a single water-bearing layer. In this case, the hydraulic loads measured at different levels are identical. In the case of multi-layer aquifer, the supply to the 1st aquifer is given by the direct recharge produced by rainfall in the area where the clayey cover is absent and by the exchange with surface waterways. The groundwater circulation of the 1st aquifer is strictly connected to the fluvial regime.

Depending on the season, the Niger river may drain or be drained by the groundwater of the 1st aquifer. The mono-layer aquifer is fed by direct recharging due to rainfall and by the exchange with the surface waterways.

According to Owamah et al, 2018, the constant head method was used to determine the hydraulic conductivity of the soil due to its sandy nature from five sample boreholes. *The* hydraulic conductivity values obtained for borehole 1 to borehole 5 were$1.5x10^{-1}$, $2.4x10^{-1}$, $3.5x10^{-1}$, $3.5x10^{-1}$, and $3.5x10^{-1}$cm/sec respectively.

These high hydraulic conductivity values indicate fine to medium sandy soil. The implication of high hydraulic conductivity values is that the aquifer system within the study area is prolific (Etu-Efeotor, 2000).

4.8.1 Ground Water Quality

Ground water samples were obtained from 5 boreholes. These include 3 stations as sampling point in close proximity to the study area and 2 stations as control point as shown in Table 4.20 and these were analysed for physico-chemical and microbiological properties.

Table 4.20: Ground water sampling locations.

Sample Code	Coordinate	
	Northing	Easting
GRET- GW-1	4°49'53.91"N	7°0'17.89"E
GRET-GW-2	4°49'34.95"N	7°0'58.24"E
GRET-GW-3	4°49'27.34"N	7°0'22.87"E
GRET-GW-C1	4°49'53.91"N	7°0'17.89"E
GRET-GW-C2	4°49'53.91"N	7°0'17.89"E

Source: Resourcefield 2020.

i. Sampling Methodology and Results

The boreholes were sampled using Niskin bottle. The Niskin bottle was flushed with distilled water before used at every station.

The results of the physical and chemical characteristics of ground water sample obtained from the boreholes within the spatial influence of the project area are summarized in Table 4.21.

Table 4.21: Summarised Ground water Physico-chemical parameters

Parameter	Range	Mean	WHO Limit	FMEnv Limit
Color (Pt Co Units NCASI)	1.26-1.44	1.37	5-15	-
Ph	6.62-6.75	6.68	6.5-8.5	6.5-9.0
Temperature (oC)	28.1-29.4	28.66	-	-
Turbidity (NTU)	0.46-0.52	0.49	5	5
Salinity (ppt)	0.007-0.008	0.007	-	-
Hardness (mg/l)	12.6	25.44	250	250
Conductivity (µS/cm)	14.7-15.2	14.92	1000	400
Dissolved Oxygen (mg/l)	0.13-0.17	0.62	5	>4.0
Biological Oxygen Demand (mg/l)	<0.01	<0.01	-	-
Chemical Oxygen Demand (mg/l)	<0.01	<0.01	-	150
Total Hydrocarbon Content (mg/l)	<0.01	<0.01	-	-
Phosphate (mg/l)	0.01-0.10	0.058	-	-
Sulphate (mg/l)	0.33-0.40	0.021	250	250
Nitrate (mg/l)	0.18-0.25	0.214	10	10
Total Dissolved Solids (mg/l)	7.4-7.55	7.46	1000	1000
Total Suspended Solids (mg/l)	0.19-0.22	0.204	-	-
Copper (mg/l)	0.033-0.042	0.037	1	0.01
Iron (mg/l)	0.26-0.32	0.294	0.36	0.36
Lead (mg/l)	<0.001	<0.001	0.05	<1.0
Zinc (mg/l)	0.63-0.71	0.674	3	<1.0
Cadmium (mg/l)	0.024-0.035	0.03	0.003	<1.0
Chromium (mg/l)	<0.0001	<0.0001	0.05	0.05
Potassium (mg/l)	0.03-0.07	0.05	-	-
Barium (mg/l)	0.02-0.08	0.046	-	-

Source: Resourcefield 2020

Appearance

The presence of dissolved and suspended organic materials and compounds of calcium and iron (Shelton, 1991) can cause colour in drinking water. However, the water samples collected from the project sites a were all clear in appearance.

All samples conformed to WHO recommended standard for any water suitable for drinking.

- **Odour**

All samples collected had no odour and therefore were in accordance to the recommended FMEnv/WHO standard.

- **pH**

Water pH is widely used to express the intensity of acidity or alkalinity of water. The pH plays an important role in all chemical reactions associated with formation, alteration and de-solution of minerals in water. Recorded pH values for groundwater ranged from 6.62-6.75with the mean of 6.68 ±0.03. This observed pH values are within the WHO/FMEnv permissible limits of 6.5-8.5 and 6.5-9.0 respectively.

- **Turbidity (NTU) and Total Dissolved Solids (TDS) (mgl^{-1})**

Turbidity values for groundwater ranged from 0.46-0.52NTU with the mean of 0.49±0.03 NTU. The recorded values of turbidity for groundwater were lower than the WHO and the FMEnv permissible limits of 5 NTU.

Total dissolved solids (TDS) are the aggregate of dissolved mineral salts in water. Excess TDS is of concern due to their potential for causing unfavourable physiological reactions in humans and livestock. TDS is a good indicator of the mineralized character of water (KWW, 2001). TDS values ranged from 7.4-7.55mg/l with the mean of 7.46±0.11 mg/l. These concentrations were acceptable for potable water quality as they were below the WHO/FMEnv permissible limits of 1000mg/l.

- **Electrical Conductivity (µS/cm)**

Conductivity is the ability of water to conduct an electrical current, and dissolved ion are conductors. Electrical conductivity values ranged from 14.7-15.2µS/cm with the mean of 14.92±0.23 µS/cm. This recorded value is below WHO and FMEnv permissible limits of 1000 µS/cm and 400µS/cm.

- **Basic Cations and Salinity**

Salinity that is defined as the degree of saltiness of water is directly related to the basic cations such as calcium, magnesium, potassium and sodium, which confer salinity to water. These basic nutrients

may not have human health problems; however, the excess contents of basic cations above their threshold values may impart unacceptable taste to water. From the results obtained, although the allowable limit for salinity is not given, it can be seen that none of the cations exceeded their limits.

- **Total Hardness, mg/l**

Hardness is the concentration of multivalent metallic cations in solution. Dissolved calcium and magnesium ions are the major sources of hardness in water whereas minor contribution is made by the ions of aluminium, barium, manganese, iron, zinc, etc. Increased hardness can decrease lather formation of soaps and increase of scale formation on hot water. Ground water found around the study area are not hard as values recorded for hardness and calcium ions were below the allowable limits for drinking water quality. The mean value of total hardness is 25.44mgl^{-1} for ground waters. These range of values are low when compared with 250 mgl^{-1} allowable limit for drinking water quality by WHO. While soft water with a hardness of less than 100 mgl^{-1} can enhance corrosion in water pipes due to a low buffering capacity, a hardness of water above 200 mgl^{-1} may cause scale deposition in the distribution system.

- **Mineral Oil and Grease**

Mineral Oil and Grease also called Total Hydrocarbon is a term used for any mixture of hydrocarbons that are found in crude oil. Chemicals that occur in THC include hexane, benzene, toluene, xylenes, naphthalene, and fluorine, other constituents of gasoline, of jet fuels, of mineral oils, and of other petroleum products. THC is released to the environment through accidents, as releases from industries, or as by products from commercial or private uses. THC released to the soil may move through the soil to the groundwater. Health effects from exposure to THC depend on many factors. These include the types of chemical compounds present in the THC, how long the exposure lasts, and the amount of the chemicals contacted. THC compounds have been documented to cause impairment of the central nervous system, fatigue, headache, nausea/ drowsiness, numbness in the feet and legs /paralysis, immune system failure, liver, spleen, kidneys diseases, impairment of developing foetus and even death.

However, during investigations, the amounts of THC in the ground water samples were below the equipment detection limit of 1.00mg/l; hence assumed to be zero and therefore within the WHO regulatory limit of < 0.01.

- **Biochemical Oxygen Demand (BOD) (mg/l)**

Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic materials present in a given water sample at certain temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water (Clair N et al., 2003). It is widely used as an indication of the organic quality of water. The measured value of BOD level (<0.01) was less than

equipment detection level. There is however, no recommended WHO/FMEnv permissible limit for BOD in drinking water.

- **Dissolved Oxygen (DO), mg/l**

Dissolved oxygen (DO) is a measure of the amount of oxygen in water that is available for chemical reactions and for use by aquatic organisms. In the aquatic ecosystem, dissolved oxygen balance in water is important for the survival of certain microorganisms and higher organisms. Most of the oxygen in water is derived from the atmosphere by mechanical mixing (churning action of water as it flows). (CEES, 2010). DO can decrease in water due to microbial activity, respiratory and organic decay and its value tends to depict an inverse relationship with water temperature. The deficiency of oxygen in the water can be a shelter for bacteria and other pathogens, which are anaerobic and injurious to human health. The DO values for ground water ranged from 0.13-0.17mg/l with the mean of 0.62±0.11 mg/l. These values are within WHO/FMEnv permissible limits of <5 mgl^{-1} and <4 mgl^{-1} respectively.

- **Nitrate (NO_3^-) mg/l**

Nitrate contents are naturally occupying ions that are part of the nitrogen cycle. For the water samples collected from the project area, the mean concentrations of nitrates recorded was 0.214mgl^{-1} for ground water samples. This value is within 10mgl^{-1} permissible limit allowed by WHO/FMEnv.

- **Phosphate (PO_4^-) mg/l**

High phosphate concentrations in ground water could be related to perennial locked up inputs from terrestrial environments. The concentration across the ground water samples suggest low phosphate presence of mean concentration value of 0.058mgl^{-1}. At this concentration, eutrophication potential in the groundwater is low.

- **Sulphate (SO_2^{-4}) mg/l**

Sulphate concentration is known not to pose problems generally for structures except when treated with calcium-based stabilizers and subjected to moistures (Tack *et al.,* 1997). High level of sulphate in groundwater could be attributed to failing septic systems, excessive use of agriculture fertilizers, leachable from refuse dumps and industrial discharges. However, the recorded mean concentration value of 0.021mgl^{-1} revealed the concentration is below 250mgl^{-1} WHO/FMEnv permissible limits.

- **Heavy Metals**

The availability of metals in water depends on the interplay between several factors including pH, redox potentials, and CO_2 levels. Metal are of environmental health concerns because it has the potential to accumulate or concentrate in biotas. They enter the food chain in the process and can affect man. Besides, metal exhibits a wide range of toxicity effects including cancer, impairment of

reproductive and nervous system, cardiovascular and renal system disorder, lung damage, skin problem etc (Iwegbue *et al.,* 2016). The heavy metals investigated in the ground water samples include copper, iron, lead, zinc, cadmium, chromium, and barium. Both lead and chromium were less than equipment detection level. The mean concentration value of copper (0.037mgl^{-1}), iron (0.294mgl^{-1}), zinc (0.674mgl^{-1}), cadmium (0.03mgl^{-1}) and barium (0.046mgl^{-1}) were all within WHO/FMEnv permissible limits of 0.01-1mgl^{-1}, 0.36mgl^{-1}, <1.0-3mgl^{-1} and <1.0-0.003mgl^{-1} respectively.

4.8.2. Microbial Analysis of Groundwater

More than 95 percent of the world's available fresh water (excluding ice caps and glaciers) is groundwater. This ground water is valuable as a source of drinking water for most communities in the world, especially small ones. The groundwater in a drinking-water well may contain a wide variety of microbes without presenting a public health risk. However, groundwater in some areas becomes contaminated by the faecal material of humans and other animals. This is a cause for concern because faecal material may contain pathogenic (disease-causing) microbes that can infect the intestinal tract of humans. Faecal pathogens may be bacterial, viral, or protozoan. Water containing faecal material may seep into the groundwater from the land surface or from underground sources of contamination. Major surface sources include, wastewater and bio solids from sewage treatment facilities that have been applied to land as a soil conditioner; seepage from shallow artificial ponds (lagoons) used for processing sewage; seepage from contaminated lakes and other surface-water bodies; urban runoff; faeces from cattle and other livestock operations; and improperly constructed sanitary landfills where trash and garbage are disposed. Faecal contamination also can reach the groundwater from underground sources, such as improperly functioning septic tank systems, underground reservoirs for liquid household sewage (cesspools), or leaking underground sewer lines.

The summary of results and findings of the groundwater microbial analysis are presented in Table 4.22. Both total coliform and faecal coliform bacteria (Escherichia coli) were not detected in the samples. except for total plate count which though present, but had count within NIS554:2007 Reference Standard. From the result presented in Table 4.22, there exist a lower or no chance of pathogenic contamination in the sampled water.

Table 4.22: Microbiological Analysis of Groundwater Samples

Parameter	Groundwater samples					Mean	Range	SD	WHO Limit	FMENV Limit
	GW1	GW2	GW3	GW4	GW5					
Total coliform Count (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
E. coli (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Streptococcus faecalis (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Clostridium perfrigens (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Total Viable Plate Count (cfu/ml)	5	8	10	7	6	7.2	5.0-10.0	1.72	100	100

Source: Resourcefield 2020

4.9 Land use

Land use within the study area is largely affected by large extent of human activities such as industrialization, municipal and agricultural activities. High Municipal human activities, which is at its peak within the area has resulted to visible reduction in agricultural activity of the study area. The notable land use within the study area included fuel stations, shopping mall, shopping plaza and road infrastructure network.

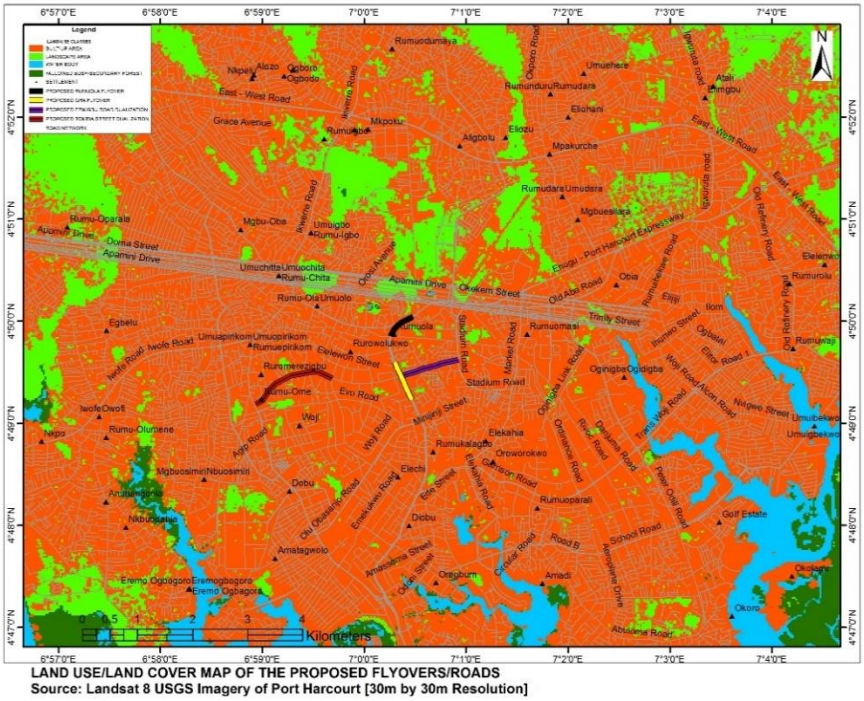


Figure 4.35: Land use Map of the study area

4.10 Socio-economics

The socio-economic survey collated baseline socio-cultural, economic, and infrastructural indices of the study areas, while the consultation process elicited responses on stakeholders' concerns and expectations from the proposed project. This study is an integral part of the environmental and social impacts management and overall sustainable development arrangement.

Objectives of the socio-economic survey include:

- The study and documentation of the socio-economic and the cultural situation of the project area.
- determining the impacts of the project on settlements, cultural treasures, population, social and physical infrastructures, predominant economic structures, and the baseline health status of the people.

- documenting the views of the affected population, industries, and other relevant institutions/agencies in terms of environmental problems, perceived community problems and needs; and
- the engage stakeholders, with a view:

  - to enabling the stakeholders, understand the project processes and cycle;
  - to consider the views and opinions of stakeholders concerning the construction, operation, and decommissioning of the flyover.
  - to developing and maintaining a robust relationship among the Government of Rivers State, EPC Contractor, and the project affected communities

to prevent any form of social unrest among various levels of stakeholders that might arise from the development of the proposed project.

Scope of the Study

The study was conducted in the four host communities of Rumuola, Rumuadaolu, Rumuomoi, and Rumuepirikom in Obio/Akpor Local Government Council, Rivers State. It covered the socio-cultural resources of these communities, demographic issues including population and growth, age and sex distribution, and adult literacy. Others were such indicators of the quality of life of the residents as the quality of housing, access to potable water, availability of functional infrastructural amenities, livelihood activities and patterns, and income levels. Health facilities and their patronage, disease prevalence and disease vectors, water and sanitation, and nutrition were also studied. Additionally, the study discusses the perceptions, concerns, and expectations of members and residents of these communities, and establishes the proposed project's potential impacts, impact enhancement, and mitigation measures.

Table 4.23: Project-affected Communities

S/N	Community	Local Government Area
1	Rumuola	Obio/Akpor Local Government Council
2	Rumuadaolu	Obio/Akpor Local Government Council
3	Rumuepirikom	Obio/Akpor Local Government Council
4	Rumuomoi	Obio/Akpor Local Government Council

Source: Resourcefield Fieldwork, 2020

Study Approach and Methodology

The EIA guideline has made it mandatory to consult communities on the possible impact of a proposed project. It is also binding to integrate community views at the project design stage. Socio-economic and community health impact assessment tools are designed to integrate the desires and aspirations of the community with those of the project proponent. In line with the EIA objectives, wide consultations were held and community aspirations were recorded.

Public forums were held to create more awareness of the proposed project and to prompt community support. The views expressed at the public forums are also an integral part of this report. The photographs were taken at the forums and the attendance list is attached to this report as Appendix III.

This phase of the study consisted of data collation on the baseline social and economic indices of the study area. Relevant data were presented under various subheadings, including social environment (Socio-cultural/psychological environment, demography, education, and literacy, quality of life, poverty and inequality, human development indices); economic survey (production factors, labour force participation, employment/unemployment, and market survey).

Study Methodology

Sampling Procedure and Data Collection Techniques

In obtaining socio-economic data of the project host community, the exploratory survey method was adopted. This involved key informant interviews and village-level group interviews using structured questionnaires. A "key informant" is generally a person adjudged to have good knowledge of the community under study such as a CLO, community leader, youth leader, a traditional ruler, an opinion leader, etc. the questionnaire used in obtaining socio-economic data employed a combination of "open-ended" and "closed" questionnaire format. Open-ended questions are more suitable for qualitative data while closed questions are more suitable for quantitative data. Simple random and purposive or sampling techniques were employed in the sampling of the population of the study area.

Qualitative data were generated through informed meetings and also observations in small groups of stakeholders in the various communities with diverse socio-economic backgrounds and interests. Such groups include; Age grade, Farmers group, Market women, and Youth Associations. Each group meeting focused first on the political/administrative structure of the community/population characteristics, ethnic composition, and existing infrastructural facilities, predominant occupation as well as cultural practice and treasures.

Sources of Data

Primary and secondary sources were used for the survey. The research instruments employed for the survey were basically:

i. Desk reviews of available secondary data
ii. Direct Observation
iii. Individual Interview
iv. Questionnaire Administration
v. Focus Group discussion and
vi. Maps and published works of literature (journals)

5.1 Primary Sources

The administered questionnaires were employed to gather quantitative information concerning household and communal characteristics; while the direct observation, individual interviews, and focus group discussions were employed to assess the concerns of the community inhabitants on matters bordering on the social, economic, and health implications of the proposed flyover project in their community as well as their collective expectations from the proponent and government.

5.2 Secondary Sources

In instances where primary sources could not provide the required data, secondary data sources were relied upon. At the community level, such secondary data was sought from desk reviews which provided official and published information on the community including population figures and records revealed by other existing structures such as local government records and hospitals for baseline records. Information was also obtained from existing national data sources including the National Population Commission (NPC), National Bureau of Statistics (NBS), Electronic maps, and the website of Rivers State Government. Some other data were collected from international sources such as the World Bank, the United Nations (UN), and the African Development Bank (AfDB).

Analytical Techniques

Descriptive statistics were utilized to analyze collated data. These included means, percentages, frequency tables, and charts. Data collected on various socio-economic parameters from all the communities were also analyzed using different tools as appropriate.

The questionnaire survey involved sampling households within the community using a set of questionnaires. Two hundred (200) Questionnaires were administered in the four project communities, 173 were returned for analysis.

Field Study Strategy

The field study comprised the following operations:

i. Pre-testing of questionnaires;
ii. Household listing;
iii. Field identification of households selected for interviews;
iv. Questionnaire administration and interview of key informants;

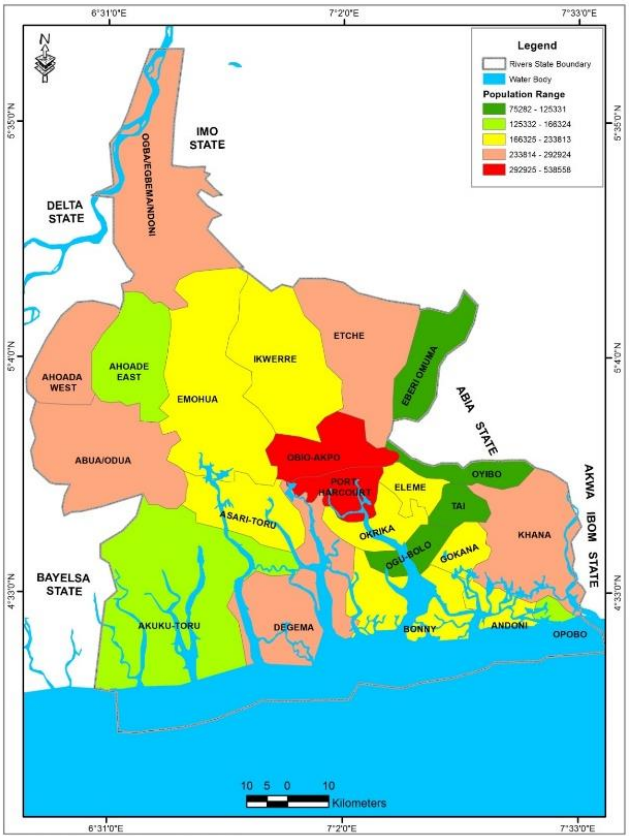


Figure 4.35: Demographic Map of Rivers State showing the project area

v. Focus group discussions; and
vi. Photography

Demographics

Population Size, age distribution, and Growth

Rivers State is an oil-producing state of Nigeria, situated in the region known as the South-South geo-political zone with a population of 5,198,716, making it the sixth-most populous state in the country.

The Capital of Rivers State is Port Harcourt and it is also called Pitakwa. Port Harcourt is the largest city of Rivers State, Nigeria. It lies along the Bonny River and is located in the Niger Delta.

The area that became Port Harcourt in 1912 was part of Fishing settlements (fishing ports) also called Borokiri in Okrika language and the farmlands of the Diobu village group of the Ikwerre, an ethnic group in the larger Igbo nation. The colonial administration of Nigeria created the port to export coal from the collieries of Enugu located 243 kilometers (151 mi) north of Port Harcourt, to which it was linked by a railway called the Eastern Line, also built by the British.

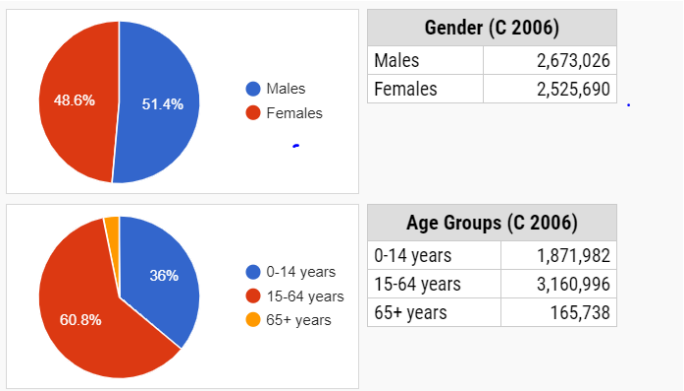
In 1956 crude oil was discovered in commercial quantities at Oloibiri, an Ijaw settlement, and Port Harcourt's economy turned to petroleum when the first shipment of Nigerian crude oil was exported through the city in 1958. Through the benefits of the Nigerian petroleum industry, Port Harcourt was further developed, with aspects of modernization such as overpasses, city blocks, taller and more substantial buildings. Oil firms that currently have offices in the city include Royal Dutch Shell and Chevron.

There are several institutions of tertiary education in Port Harcourt, mostly government-owned. These institutions include Rivers State University, University of Port Harcourt, Kenule Besor Wiwa Polytechnic, Captain Elechi Amadi Polytechnic, Ignatius Ajuru University, and Rivers State College of Health Science and Technology. The current mayor is Victor Ihunwo. Port Harcourt's primary airport is Port Harcourt International Airport, located on the outskirts of the city.

Port Harcourt Local Council is situated 52 kilometers (32 mi) southeast of Ahoada and about 40 kilometers (25 mi) northwest of Bori. It is bounded to the south by Okrika, to the east by Eleme, to the

north by Obio/Akpor, and to the west by Degema. It has a total size of 109 square kilometers (42 sq mi). The total population in the area was last recorded at 538,558 in 2006

Obio/Akpor is a local government area in the metropolis of Port Harcourt, one of the major centres of economic activities in Nigeria, and one of the major cities of the Niger Delta, located in Rivers State. The local government area covers 260 km2 and at the 2006 Census held a population of 464,789. Its postal code or ZIP code is 500102. Obio/Akpor has its headquarters at Rumuodomaya. Obio/Akpor is bounded by Port Harcourt (local government area) to the south, Oyigbo and Eleme to the east, Ikwerre and Etche to the north, and Emohua to the west. It is located between latitudes 4°45'N and 4°60'N and longitudes 6°50'E and 8°00'E.



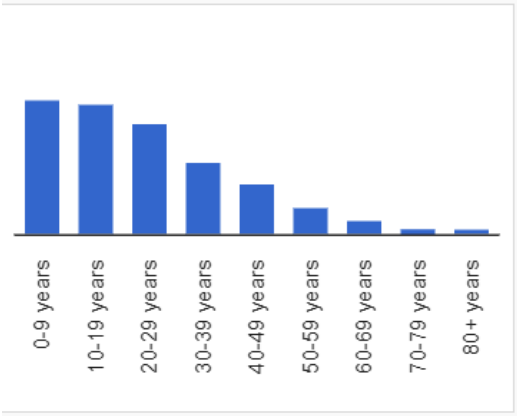
Gender (C 2006)	
Males	2,673,026
Females	2,525,690

Age Groups (C 2006)	
0-14 years	1,871,982
15-64 years	3,160,996
65+ years	165,738

Figure 4.36: Population Structure of Rivers State (NPC: 2006)

Table 4.24: Projected population of the project affected LGA (using 2006 NPC population figure and 3.0% population growth)

Year	Obio/Akpor Local Government Area
2006	464,789
2007	478,732
2008	493,093
2009	507,885
2010	523,121
2011	538,814
2012	554,978
2013	571,627
2014	588,775
2015	606,438
2016	624,631
2017	643,369
2018	662,670
2019	682,550
2020	703,026



Age Distribution (C 2006)	
0-9 years	1,262,446
10-19 years	1,214,221
20-29 years	1,036,110
30-39 years	681,847
40-49 years	472,846
50-59 years	265,117
60-69 years	149,058
70-79 years	67,059
80+ years	50,012

Figure 4.37: Age Distribution of Rivers State (NPC: 2006)

Household Composition, Structure, and Size

The size of families differs from community to community, influenced in large measure by the cultural attitude of the people, the economy of the settlement, and educational status/awareness of the resident population amongst other factors. A total of 3,919,364 households were enumerated during the preparation of the Niger Delta Regional Master Plan Development with an average household size of 7.46, but with more than 70% of them having an average of 8 occupants. Large households were found more prevalent in rural areas (NDDC 2006).

The typical household unit in the study area has a head and several members. In many cases, the head is the father and members include his wife, children, and wards. The wards are often children of relations and, in some cases, friends. These are usually fed and generally catered for from the resources of the household. Members of the household are not necessarily related biologically. The household could also be composed of members who are not related but have agreed to live together under a common household head. This latter type of household group is not common in the study area.

From questionnaire responses, the mean household sizes obtained were 6.4 for the surveyed areas.

Dependency Ratio

The dependency ratio shows the proportion of the economically dependent segment of the population (children aged 0-14 years and the elderly, 65 years and above) to the economically active (those aged 15-64 years). It is an indication of the burden of providing for the dependent in the economy. It is assumed that the potential workforce (those aged 15-64 years) bear the economic burden of the dependent. The higher the dependency ratio, the lower the labour input per capita. In the LGA, the dependency ratio obtained is about 0.8. The ratio obtained is indicative of a low economic burden and it implies that significant portions of the resources of communities are not dedicated to the care of children and the elderly. Typically, this would mean less investment in the provision of education, health, social welfare, and other services required by these two groups.

Fertility, Mortality and Life Expectancy

During FGDs in the project affected areas, groups interviewed indicated that factors that enhance fertility among them include general acceptance of the marriage institution, relatively early sexual activity and marriage, and polygamy. Fertility is best measured by the Total Fertility Rate (TFR) which is an indication of the total number of children a woman is estimated to have in her reproductive lifetime. The existence of precise estimates of the TFR values for this LGA could not be ascertained and no values were available, but the National Bureau of Statistics (NBS) estimates the value for South-South geo-political region is 4.1 while the national average is 5.7 (Annual Abstract of Statistics, 2016).

These values of TFR show that the rate of fertility in the South-South states is lower than the national average. Another measure of fertility is the Crude Birth Rate (CBR) which the NBS estimates at about 37.37 per 1000 in Rivers State and 42 per 1000 as the national CBR. (The Nigerian Statistical Fact Sheets on Economic and Social Development, 2016)

These rates indicate that, relatively, the region does not have high fertility.

Available mortality measures include the Neonatal Mortality Rate (NMR), Infant Mortality Rate (IMR), and Under Five Mortality Rate. The NMR, IMR, and Under Five Mortality Rate for the Niger Delta states are 53 per 1000, 120 per 1000, and 176 per 1000, respectively. The national averages are NMR 48 per 1000, IMR 100 per 1000 and Under Five Mortality Rate 201 per 1000 (Annual Abstract of Statistics, 2016). The NMR and IMR indicate that there are more deaths among neonates and infants in the Niger Delta states than what obtains generally in Nigeria. However, Under Five Mortality is lower in the Niger Delta region than the average in Nigeria.

Table 4.25: Under 5 Mortality and Maternal Mortality Ratio (MMR) per 100,000 in the various geopolitical zones of Nigeria

Geopolitical Zones	Number Under 5 Mortality per 1,000 children	Number Maternal Mortality Ratio (MMR) per 100,000 women
North West zone	269	1549
North East zone	260	1026
South West zone	176	286
South South zone	103	165

Source: UNICEF Child Malnutrition and Mortality in Nigeria Report, 2013

Life Expectancy estimates for Rivers State is the same as the national estimates. The World Health Organization (WHO) in its World Health Statistics 2016 estimated that life expectancy for men in Nigeria is 42 years and 47 years for women.

Educational characteristics of respondents

Education is a key determinant of the lifestyle and societal status an individual enjoys. Studies have consistently shown that educational attainment has a strong effect on health behaviours and attitudes. Education in Nigeria has evolved over a long time, with a series of policy changes. As a result, there have been increases in the enrolment of children and the number of educational institutions

both in the public and private sectors. The 1976 National Policy on UPE gives every child the right to free primary education. Later the 6-3-3-4 systems were introduced with 6 years for primary, 3 for junior secondary, another three years for senior, and 4 years for the university/polytechnic education respectively. Subsequently, the national literacy programme for adults was launched, followed by the establishment of nomadic education to address the needs of children of migrant cattle herders and fishing people in the riverine areas. With the inception of the present democratic dispensation in 1999, the Universal Basic Education (UBE) was again launched, making it compulsory for every child to be educated free up to the junior secondary school level.

A large proportion of the sampled population has received some formal educational training indicating a sufficiently literate society with minor variations between the three sampled communities. Almost an equal proportion (33.9% and 37.7%) of the sampled population reported possessing both the tertiary and post-primary (secondary) educational attainment. Some 11.5% have primary education, while approximately 3% have no formal education (NFE) while some 20.4% indicated having tertiary education. The proportion of the population that indicated possessing some technical/vocational educational training amounted to 14%, indicating the availability of some employable skills in the project affected communities. Respondents at Rumuola were found to have a higher percentage of tertiary education (43.7%) while those from Okoro-Nu-Odo possessed more of secondary education (55.6%).

A National Literacy Survey (2010) conducted by the National Bureau of Statistics in Nigeria estimates the adult literacy rate as 56.9 percent, with huge variations between states (Lagos 92.0 % and Borno only 14.5%), regions (urban 74.6 % and rural 48.7%,) and sex (male 65.1% and female 48.6%). More importantly, statistics from the Federal Ministry of Education indicate that only 500,000 of the 40 million adult illiterates are enrolled in adult learning classes. There are also 3.5 million nomadic school-aged children with only 450,000 of them accessing any form of schooling. Nigeria is further saddled with the largest number of out-of-school-children estimated at over 7 million (10 percent of the global total). The Nigerian Government recognizes that literacy education will help equip individuals with the knowledge, skills, and attitudes needed for economic self-sufficiency, poverty reduction, and sustainable development, and is therefore making efforts to address the illiteracy challenge.

Rivers State has a higher literacy rate compared to most states in the South-South geopolitical zone. Its male literacy as of 2006 was 52.3% while the female literacy rate was 47.7%, putting the state above the national average. Approximately 18% of men and 26% of women over the age of six have no formal schooling; while approximately 15% and 14% of both men and women have finished nursery school and almost the same percentage (15.1% and 15.8%) have finished primary school (NPC, 2009).

Rivers State has been long recognized as an educationally advantaged State as was confirmed by the human development index (HDI) report of the UNDP (2006). The State's overall HDI of 0.615 was found highest in the Niger Delta and the educational index of 0.636 came second only after that of Akwa Ibom (UNDP 2006, The Guardian of September 2, 2006). Statistical estimates have put the proportion of children attending primary school in the Niger Delta region at 80 percent (which compares

favourably with the estimated national average of 54 percent) (UNDP 2006). The adult literacy level of the population is 78.7%.

Table 4.26: Education-Current conditions in the Niger Delta states

STATE	Adult Literacy (%)	Attainment of Primary School (%)	Attainment of Secondary School (%)	Attainment of post-secondary education (%)	No. of Jobs in Sector 2000 (Teachers)
Abia	84.1	39.6	43.6	16.8	7276
Akwa Ibom	76.3	54.4	44.4	8.3	13,683
Bayelsa	78.7	38.8	49.3	11.9	3,515
Cross River	82.2	44.6	42.8	12.6	11,425
Delta	77.4	37.9	43.6	18.5	15720
Edo	69.7	49.3	38.8	11.9	10959
Imo	79.3	46.1	42.7	11.2	14,145
Ondo	78.8	45.0	44.2	10.8	12342
Rivers	79.9	33.3	49.5	17.1	4,011
The Region	78.7	43.3	43.2	13.5	95076

Source: Niger Delta Regional Development Master Plan (NDDC 2006)

Migration Trend

There were no existing records and actual figures on migration in the communities, however, it was possible to examine and determine the trend and pattern. Many residents indicated they were born in the communities of their residence or had lived in them for more than ten years. Those who were born in or had lived in the communities for more than ten years were considered non-migrant while those who had lived for less than ten years were considered migrants. The result shows that between 65% and 80% of respondents were non-migrant. This trend was not entirely unexpected given that the communities are rural areas. However, there were also indications that some household members had relocated over the years for various reasons. The most common reasons for relocation were marriage, school, and work, and the most affected age groups were those between 10 and 44 years. Those who relocated went mostly to cities in Nigeria, like Asaba, Onitsha, Kaduna, Abuja, and Lagos.

Socio-cultural Resources

Language, Marriage, and Family

The people of the study area are dominant of Ikwerre (natively known as Iwhuruọha ethnic extraction. They are considered a part of the larger Igbo ethnic group, although many Ikwerre does not consider themselves Igbo, a distinct ethnic nationality. They speak Ikwerre, an Igbo dialect, now considered a separate language in the Igboid family, as a result of the quest for Ikwerre's recognition as a separate ethnic nationality.

The Ikwerre exists in well-delineated clans, with each clan having its paramount king. The Ikwerre does not have an overall paramount ruler or king, but designated kings, rulers, or leaders are mostly

approved by their constituents. However, all paramount rulers in Ikwerre are united in what is known as Ogbakor Ikwerre, which was formed in 1963 as an umbrella socio-cultural organization of the Ikwerre people

According to a theory of Ikwerre origin held by some Igbo scholars, they would be descendants from an Igbo migration from Awka and Orlu areas towards the south. Igbo scholars take the Ikwerre as part of the Southern Igbo. Amadi, an Ikwerre scholar, says that the Igbo origin theory has support even among the Ikwerre themselves, with Ikwerre as descendants of migration of Arochukwu Igbo, and Okpo Nwagidi being the leader of the Ikwerre tribe. Before the civil war, there had been dissident voices that claimed that Ikwerre could have migrated from Owerri, Ohaji, Ngwa, and Etche areas of Igboland.[14] But when Port Harcourt was conquered by Nigeria during the Biafran War and the Igbo people from other parts of Igboland fled the territory, a UN report says that the Ikwerre decided to claim that the Ikwerre were non-Igbo for convenience. The Ikwerre are recognized officially as a separate group in the 1979 Nigerian Constitution.

Recently, the Benin theory of origin has become more widely accepted among the Ikwerre. The Benin theory has so many versions. The first suggests that Ikwerre was the third son of Akalaka, the father of Ogba and Ekpeye who migrated from an area in the multiethnic Benin empire in the 15th century. It is said that Iwhuruohna, the progenitor of the Ikwerre, had seven sons which became the Ikwerre asa.

Another version holds that Akalaka migrated with Ochichi who settled at Elele and was the father of Elele, Isiokpo, Egbeda, and Omerelu. The Benin theory is rejected by many Ikwerre who believe that the Ikwerre did not migrate from Benin or descend from one progenitor. The Ikwerre is far larger than the Ogba and Ekpeye groups. The Akalaka legend originally mentioned the Ogba and Ekpeye as the only descendants of Akalaka but the inclusion of Ikwerre has gained ground as of recent time. Ikwerre people do not share any linguistic or cultural grounds with the Benin people.

The assumption of Benin's origin of Ikwerre could also be traced to the wars and raids of the Aboh kingdom on Ogba land, with the help of the Benin officers which triggered a migration of Ogba and Ekpeye people into what is today's Ikwerre land. These people met existing communities there. Rumuekpe, Ibaa, Ndele, and the Odegu clan are communities that could have possibly be founded by this migration. A section of the Obio clan is said to have migrated from the Aboh (Ukwuani) area of Delta state which was under the influence of the Benin Empire in the 16th century.

The Aro first came into the Ikwerre area through Ozuzu-Etche, settling at Isiokpo, Igwuruta, Omagwa, etc. As expected of pre-literate African societies, the history of the people is wrapped in myth and mystery. This presupposes that historians may have to resort to oral tradition for the justifiable/credible reconstruction of the people's history. From the post-colonial dispensation to the present, professional historians and other personals have attempted to reconstruct the history of the people. For instance, the works of Elechi Amadi, especially The Concubine, The Great Ponds, The Slave (novels), and Isiburu (a verse play) are a literary attempt at reconstructing a semblance of the Ikwerre society in the pre-colonial era.

In the absence of valid historical records, historians accept oral tradition as a primary source of writing African history, the defects associated with this method notwithstanding. The history of the origin of the people is traceable to the waves of migrations from the lower Niger and delta regions.

Ikwerre people are found in the Niger Delta region of Nigeria. They are within the rainforest belt which receives high annual rainfall. Some parts are blessed with creeks that crisscross Rivers State. There is also abundant raffia forest. These features, coupled with adequate sunshine, have made the soil in Ikwerre adequate for the cultivation of palm produce, cassava, yams, vegetables, etc. and the distillation of palm wine into gin (kai kai, ogogoro, akamere, manya beknu).

The Riverine Ikwerre villagers engage in fishing in addition to the general occupations of farming and trading. The marriage institution is accepted and revered in all the communities. Marriages are contracted between adult males and adult females; there are no accounts of either same-sex or juvenile marriages. Monogamy and polygamy are practiced but local sources say that polygamy is on the decline. Traditional Marriage in Ikwerre is highly revered just like every other ethnic group in Nigeria. It involves the man going for a formal introduction called “Door Knocking.” This is done by the groom who takes a few elders of his family to the girl’s family for the introduction. Palm wine and dry gin (okamme) are brought as gifts by the man during the introduction.

The traditional marriage which follows is always elaborate and the traditional attires are elegant. Men adorn a loose-end wrapper on top of etibo (flowing shirt) with a hat to match. Hand staff/walking stick completes the men’s attire while the females adorn wrapper with some traditional top. Beads are an essential part of the females’ dressing. It is worn on the head, neck, and wrists. There are no known marriage restrictions based on religion or culture in any of the communities.

Festival wrestling is an important part of people’s culture. During the wrestling competition, different types of drums are used, such as Ikwiriku, Ekwenkalu, Ngele, Mbamba, which are of different types, shapes, and sizes. Wrestling is one of the most celebrated cultures of the Ikwerre people, especially in the Elimgbu community of Obio/Akpor Local Government Area of Rivers State of Nigeria. Wrestling is dialectically known as " Egelege " both in Elimgbu and Otah and other parts of the Ikwerre communities. It is one of the physical calisthenics that tends to foster unity amongst the people. The idea is to situate the (Egelege) wrestling contest as a typical traditional theatre.

Other cultural activities include the Eregbu cultural dance, Ekpo, and Ekpe masquerades are also important features of their tradition. The Ikwerres also have a lot of cuisines such as oha soup, okpotoro and okasi soup, vegetable soup, periwinkle soup, and others. Periwinkles (isam) are important parts of their dishes.

The family is recognized as a very important social unit and both nuclear and extended families exist in the communities. The typical nuclear family is headed by the father, with the mother and children. The extended family includes members who are not biological offspring of the same parents but relations. A nuclear family where the father was dead could be headed by the mother if the children are juveniles or by the eldest son if he is a grown man and able to bear the financial responsibility of taking care of the family. The extended family is always headed by a male member.

Considering that all the communities are used to non-indigenous residents, members can communicate in Pidgin English and the communities in some way have an accommodating social attitude. This attitude could be valuable for the proposed project, given that itinerant workers and camp followers would be attracted to the communities and this kind of social attitude would foster healthy cross-cultural exchanges. This can also help in some way to limit conflicts that arise when people of different cultural backgrounds live together, thereby reducing the potentials for tension and social upheavals during the project.

Social Structure and Organization

The studied communities share a lot in common concerning social structures and organizations. Membership of socio-cultural groups (CDCs, women's groups, youth groups, CBOs, cultural groups, and social welfare groups) by household members is quite common. The roles played by these groups are distinct and significant. A group like the Community Development Committee (CDC) is set up purely to perform local administrative roles and also to liaise between the communities and all external bodies, and other communities. Similarly, a lot of the social clubs and CBOs actively participate in improving the welfare conditions of their members. The cultural groups mainly performed at cultural festivals, thereby ensuring the preservation of their cultural heritage.

Apart from these socio-cultural groups, the communities are also made up of compounds. This structure that incorporates compounds allows the compounds some level of autonomy in their daily administration. The compounds are made up of extended families and their affairs are directly overseen by their appointed chiefs.

- **Traditional Governance**

The communities have distinct but similar traditional administrative structures. The structure comprises the traditional ruler assisted by chiefs and a Community Development Committee (CDC)with the youth and women groups.

The traditional heads are elected from eligible males. Eligibility is determined by age (minimum of 35 years) and standing/integrity. Occupants hold office for life except where they are deposed by the community. They could be deposed by the community or government if they are believed to be working against the communities' interests if they committed a heinous crime or became incapacitated by ill health. The Chiefs are appointed by their respective compounds to oversee the affairs of the compounds and represent them in community matters. They also have the role of advising the traditional heads. Chiefs are also all adult males and they remained in office for life, except removed by the compound. Each council of chiefs has a Chairman.

The communities also have CDCs which are headed by a Chairman and assisted by a Secretary in the day to day running of the committee. They are often referred to as community Chairman and Secretary. Membership of the CDC executive is by election among adult males from the compounds. Members of the CDC serve a fixed term of four years. The CDC is the administrative organ that has responsibility for the day-to-day running of the communities, liaison with external bodies and

agencies, and development planning. They report directly to the traditional head. Other groups that make up the traditional administrative structure include the women and youth and both report to the CDC. Both are also headed by executive committees which include the President, Vice President, Secretary, among others. The executive committees are elected. Across the study area, while the youth executives serve for one or two years, the women leaders usually do not have a fixed term in office. All adult female members of each community are eligible for membership in the women's group in their respective communities. Membership of the youth groups is similarly open to adult community members of both sexes who are between 18 and 40 years.

The roles of these organs of society are clearly defined and there were no indications of role conflicts. These organs could play significant roles in information dissemination and community mobilization before, during, and after the proposed project.

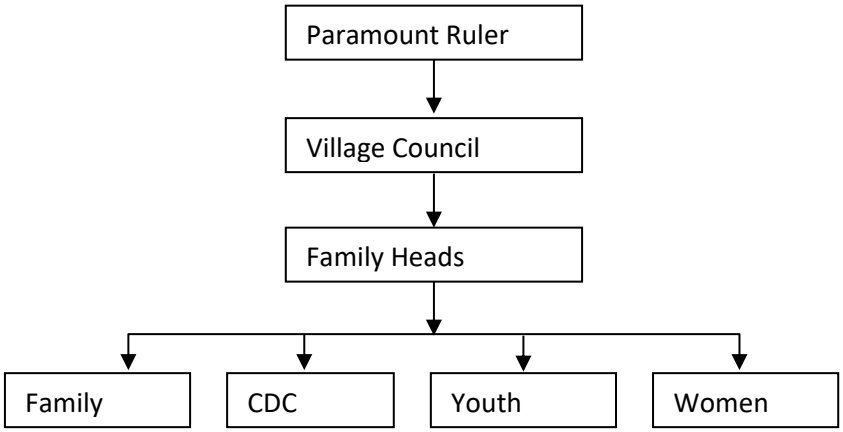


Figure 4.38: Hierarchy of Leadership/Governance in the Study Area

- **Roles of Women and Youth in Community Development**

The women and youth groups play important roles in the communities and serve to bring their members together as well as intervene in their welfare. The women's primary role is to advise the CDC and the council of Chiefs on matters concerning women in the communities. During the survey, it was noted that culturally women could not, lead the communities, head the key organs of traditional administration, seat, or participate with the men in making community decisions. They had their separate meetings and their decisions were transmitted to the CDCs and traditional councils. This cultural inhibition is a clear indication of gender inequality in the communities. Gender inequality across Rivers State was captured by the use of the Gender Empowerment Measure (GEM) which is an indicator of the opportunities women have in any socio-economic environment. GEM measures gender inequality in the three areas of political participation, economic participation, and control of economic resources. The GEM value for Rivers State is quite low at 0.25, higher than the Niger Delta regional average of 0.22, but at par with the national average (Delta Facts, 2016).

The youth, on the other hand, has become a strong force in the communities. Their roles include ensuring internal and external security, enforcing law and order, and development planning. Youth

leadership, especially the President and Secretary are regularly invited to community meetings with the traditional councils and CDC, where decisions about development and security are taken. They are also responsible (with the CDC) for liaison with companies and other organizations that have any business in the communities.

- **Lifestyle and Social Indulgent Practices**

Lifestyle and practices raised and discussed during FGDs and interviews included, drinking alcohol, cigarette smoking, and the use of hard drugs, prostitution, teenage pregnancy, and child labour. Residents confirmed that the use of spirits and alcoholic beverages is quite rampant among them. Most residents, of both genders, had been drinking since their teenage and several since they were children. The local gin 'kai-kai' which is most popular is brewed in the communities, and therefore, is quite readily available. Cigarette smoking is also quite common among teenage and adult males. Most residents also believe that some of the youth smoke hemp.

Teenage pregnancies, on the other hand, are experienced quite commonly in all the communities. Child labour, another of the social vices, is not common. Children usually assist their parents in running their shops. This type of work does not attract any salaries or wages.

Residents expressed fears that the proposed project would further encourage some of these vices if construction workers and camp followers take up residence among them. Drinking, smoking, the use of hard drugs, teenage pregnancies, and prostitution were particularly mentioned by residents.

- **Belief Systems and Practices**

Rivers State, with its diverse ethnic and linguistic groups, is also very rich in culture and the arts. Several cultural bonds exist among ethnic groups, particularly in music, dances, plays, and masquerades which are very dependent on socio-cultural and religious backgrounds.

Christianity with the long historical origin is predominant among the Delta Igbos, herein includes the Ikwerre ethnic group as in other parts of Rivers State, although there are strong influences from traditional religious beliefs. It is safer to say that the religious persuasions of the majority of the population are '' mixed''. For the practicing Christians, religious houses, i.e., churches of various denominations and sects of Christendom abound in the area, including those of the orthodox and Pentecostal denominations, dominated by the Pentecostal Church with gigantic structures as is seen in almost all the streets of the study area.

The most cultural heritage of the people remains their festivals, which are tied to their way of life and livelihood, i.e. the seasons. Culturally, therefore, the subsisting festivals relate to either the fertility of the land and waters or the blessings of the ''gods''. Their celebrations, therefore, coincide mostly with the beginning of the farming/planting and harvest seasons. As Christian communities, Easter and Christmas celebrations are part of their cultural heritage. There is a wide variety but the same commonality of festivals still celebrated by the PACs, with marked periods of celebrations and some, have serious strictures attached to them. These annual festivals are considered important for warding off evil, promoting fertility in marriages, and profitable enterprise with farming and other activities.

The reality on the ground, however, is that traditional worship is rooted in the culture of the communities and even acclaimed Christians participate in the festivals at different levels of commitment.

Other belief systems revolve around the communal social life of the inhabitants in the affected communities. Social maladies such as incest, adultery, stealing fighting with cutlass, bottles, or guns and in the bush or mating with a woman in the bush are amongst the customs and beliefs, which are seriously frowned at. Violators are dealt with by either being physically beaten up and subjected to some punishment or asked to pay some fine, including the appeasement of the offended deity and/or ancestors.

FGDs revealed that 94% of the people are adherents to the Christian faith, while 5% and 1% are traditional worshippers and Muslims respectively.

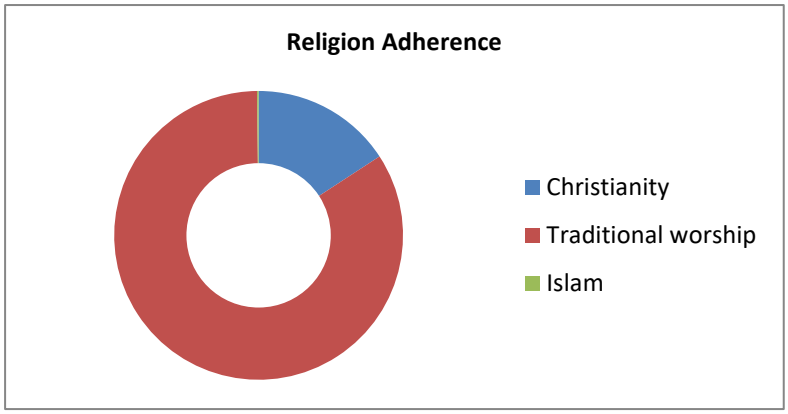


Figure 4.39: Religion adherence in the study area.

There are no communal restrictions on religious beliefs and worship. Residents are at liberty to pursue their religious beliefs and interests.

- **Conflict Management and Security**

Throughout the world, dispute is a common phenomenon in human relations. Covertly or overtly, humans tend vested interest. Therefore, at any point one individual or group crosses the prescribed boundaries of the accepted cordial relationship, dispute ensues. Without overstating the obvious, the concept of dispute resolution is predicated on the assumption that an equitable society can only be brought about by an equitable decision. Conflict is one of the inevitable phenomena of every human society. However, what exemplifies the greatness or quality of life in any society is how much society can administer their affairs.

The study area is part of the Niger Delta region which has experienced several conflicts with violent outcomes. In particular, there was the issue of militancy in the region. The conflicts that gave rise to militancy involved the youth more than any other group. Many of them have become violence-prone

and even social misfits. The youth will be a group to watch and also dialogue within the course of the proposed flyover construction project in the area.

Conflicts do not always have violent outcomes; in fact, many conflict situations are resolved daily. In the study area, such non-violent conflicts also arise and there are traditional ways of resolving them. These communities have various organs of society traditionally involved in resolving conflicts. These organs include the social organizations to which household members belong to, like the women organizations, the compound chiefs, and the CDC. However, at the apex of the traditional conflict resolution process in each community are the traditional leadership. Their decisions on intra communal conflict issues are usually binding on all parties.

Family crises are first reported to the most elderly person in the family who settles them, but should he fail to achieve the needed peace, the case is referred to the members of the traditional council. The traditional council invites all the parties involved, listens to them, and passes judgment. People found guilty are punished with penalties ranging from payment of fine and public apology, depending on the gravity of the crime committed. Formal law enforcement agencies are rarely contacted to adjudicate on contentious communal issues. They are only called in when traditional conflict resolution mechanisms do not achieve desired effects.

Quality of Life

Settlement Pattern and Housing Conditions

In general, communities in the study area are relatively large to medium-sized. Going by NPC's definition of a town as a settlement with a population of 20,000 or more, all three are qualify as a town.

All the communities have the characteristics of both linear and nuclear settlements. The linear characteristics derive from the concentration of houses along the main streets and lanes in the settlements. Their nuclear characteristics derive from the clustering of houses. Houses are built in clusters which in some cases may identify family lineages and kindred groups. Development and limited access to land have generally encouraged this clustering of houses. Spacing between houses is not definite and could range from one or two meters to about six meters.

The houses are quite diverse in their design and construction materials. Some houses have modern designs and they are built with utilities like kitchen, toilet, and bath, in-house. These modern houses are also constructed with stable and permanent materials like cement blocks and roofed with corrugated iron and aluminium sheets. A majority of the houses in the communities are family bungalows and tenement (rooming) houses. Housing attributes in the study area is presented in Table 4.27.

Table 4.27 Housing Attributes

Housing Attributes	Rumuola (%)	Rumuadaolu (%)	Rumuomoi (%)	Rumuepirikom
Type of House				
Family bungalow	27.0	4.0	27.0	4.0
Tenement house	37.0	52.0	67.0	52.0
Storey building	33.0	41.0	5.0	41.0
Flats	3.0	3.0	2.0	3.0
	100.0	100.0	100.0	100.00
Construction Material (Roofing)				
Thatch	0.0	0.0	0.0	0.0
Corrugated iron sheets (zinc)	15.0	40.0	46.0	40.0
Asbestos	5.0	8.0	9.0	8.0
Aluminium	80.0	52.0	45.0	52.0
	100.0	100.0	100.0	100.0
Waste Disposal (Refuse)				
Dumping in open space	15.0	20.0	18.0	15.0
Dumping in the bush	85.0	80.0	82.0	85.0
	100.0	100.0	100.0	100.0
Waste Disposal (Sewage)				
Water closet	77.0	85.0	87.0	87.0
Pier Toilet	23.0	15.0	13.0	13.0
	100.0	100.0	100.0	100.0
Sources of Water for Domestic Use				
River/Creek	0.0	0.0	0.0	0.0
Rain	5.0	4.0	3.0	4.0
Borehole	95.0	86.0	97.0	86.0
	100.0	100.0	100.0	100.0
Energy Source for Household				
Cooking	2.0	1.0	6.0	2.0
Firewood	33.0	28.0	35.0	33.0
Kerosene	65	71	59	65
Cooking gas	100.0	100.0	100.0	100.0
Energy Source for Household				
Lighting	55.0	50.0	40.0	55.0
Kerosene	20.0	25.0	18.0	20.0
Public electricity	25.0	25.0	42.0	25.0
Private electricity generator	100.0	100.0	100.0	100.0

Source: Resourcefield fieldwork, 2020

Livelihood Activities

Livelihood activities across the surveyed communities are similar. The identified activities are mainly commerce and provision of services like petty trading, artisanship practices, and employment in the civil/public services. The largest proportion of household members in all the communities are engaged in trading. Artisanship practices inclusive of electrical repairs, boat building, tailoring, etc are significant in the study area. Civil/public service employees in the communities are limited mostly to

Local Government workers, teachers, and health workers. Others are inclusive of a few residents who are employed in oil companies and those involved in contracting.

There are small household-based shops for the sale of groceries, and supermarkets, where durable and non-durable consumer items are sold and bought. Consumer services like barbing and hairdressing salons, motor vehicle and bicycle repairing, laundries, etc, are also present in the area. Many restaurants cater to the needs of the area. Small grocery stores are a ubiquitous feature of the main streets of the area.

Employment Situation in Households

Unemployment was experienced in several households in the communities. Results obtained from the discussion and interview sessions indicated that 72% of households across the communities had one or two unemployed members. Unemployment was determined as being ready and looking for work but unable to secure one in the last 6 months preceding this study and only household members who were 15-64 years and not full-time students were considered.

- **Household Expenditure Patterns**

The major items of expenditure in the households are food, health care, purchase of household items including utilities (kerosene, petrol, etc), transportation, and clothing.

Table 4.28: Items of expenditure

Items of expenditure	Percentages
Clothing	10%
Transportation	12%
Health	18%
Household Items	20%
Food	40%

Source: Resourcefield fieldwork, 2020

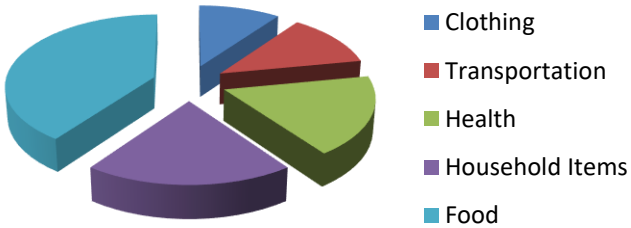


Figure 4.40: Household Expenditure Pattern

The major food items are mainly those that are not grown locally, beef, and also beverages. Expenditure on health care by households is quite significant because most households take their sick

members to expensive hospitals to access functional orthodox health care facilities. Apart from these household members also spend considerable sums of money on drug purchases from drug stores ('chemists') in their communities.

Households also spend considerably on the purchase of kerosene for their lanterns and cooking stoves, and petrol for their private electricity generators. Expenditure on food and health accounts for 58% of total household expenditure. Community sources across the study area generally affirmed that for most households, expenditure on food, accessing higher education services, obtaining health care, purchase of household items, transportation, and clothing account for between 70% and 80% of their monthly earnings.

Health Facilities and Services

The study area has both orthodox and non-orthodox health care providers and facilities. Distribution of these facilities and services including the status of general basic infrastructures across the study area is presented in Table 4.30.

The General Hospital in the area provides first aid, serves as an HIV/AIDS counseling center and treatment for minor ailments, as well as immunization services for children and women of childbearing age. The antigens they give include BCG, OPV, DPT, Measles, TT, YF, and HBV.

Apart from the orthodox facility, there are drug stores (chemists) located in all the communities. There are also hawkers (individuals who carry drugs, especially malaria drugs, analgesics, antibiotics, and various creams and balms) hawking drugs from one settlement to another. The number and the quality of drugs being distributed could not determine during the study.

In all the study communities, there are Traditional Birth Attendants and those who provide herbal remedies. In most cases, these groups do not offer their services on a full-time basis. Those who practice treatment with herbs, in particular, offer advice on herbs and roots within the environment which they believe bring relief to certain ailments.

Table 4.29: State of Infrastructural Facilities in the Study Area

Communities	Infrastructural Facilities							
	Roads	Telecoms	Water	Education	Health	Electricity	Market	Police
Rumuola	Connected to Port Harcourt Metropolis by a good asphalt road network with paved streets and lanes	GSM services by all major service providers.	Borehole	1 public primary school; 1 public secondary school.	PHC and multiple private clinics	Connected to PHEDC	Daily market	Divisional Police station
Rumuadaolu	Connected to Port Harcourt Metropolis by a good asphalt road network with paved streets and lanes	GSM services by all major service providers.	Borehole	1 public primary school; 2 public secondary school.	PHC, multiple private clinics	Connected to PHEDC	Daily market	Police Post
Rumuomoi	Connected to Port Harcourt Metropolis by a good asphalt road network with paved streets and lanes	GSM services by all major service providers.	Borehole	2 public primary schools; 1 public secondary school.	General Hospital with multiple private clinics	Connected to PHEDC	Daily market	Divisional Police station
Rumuepirikom	Connected to Port Harcourt Metropolis by a good asphalt road network with paved streets and lanes	GSM services by all major service providers.	Borehole	1 public primary school; 2 public secondary school.	PHC and multiple private clinics	Connected to PHEDC	Daily market	Divisional Police station

Source: Resourcefield fieldwork 2020

6 4.10.1 Utilization of Health Services

The patronage of available orthodox and non-orthodox health care service providers across the three communities is presented in Table 4.30.

Table 4.30: Patronage of Health Services in the Study area

Available Health Care Service Providers	Frequency (%)
Hospitals/Health Centres	30.0
Chemists/Drug Stores	50.0
Herbalists/Traditional Medicine Practitioners	7.0
Churches/Spiritual Healing Homes	13.0
Total	100.0

Source: Resourcefield Fieldwork, 2020

Traditional Birth Attendants (TBAs) are very popular with women of childbearing age. The staff of the Primary Health center in the Rumuola community noted that even when some of the women attend an antenatal clinic in the orthodox facility, they prefer to give birth with TBAs, and they attribute this to the preference for the traditional body massage given by TBAs after child delivery. The utilization rate of the General Hospital is relatively low at 30% by respondents. The services of herbalists and spiritual healing homes are not common among the residents of the communities. Given these conditions and the level of patronage of drug stores, it is possible to deduce that many residents indulge in self-medication.

Water and Sanitation

The sources of water used in households in the study area include water from rainwater, well and water from public and private boreholes.

In the surveyed area many households avoid the use of rainwater as a result of their belief that rainwater is being polluted by gaseous emissions from flares from oil and gas activities in and around their communities. For this reason, also, the use of rainwater is mostly limited to the washing of clothes and other things and not for cooking.

Waste Management Practices

Waste disposal practices in the project-affected communities are quite similar. Refuse is, unfortunately, mostly deposited by the roadside and medians by households, for eventual collection and disposal by Rivers State Waste Management Agency, instead of the waste holding facility provided by RIMAWA (Plate 4.4). Port Harcourt – Aba Road does not experience this ugly trend but the East-West Road is not as lucky. Similarly, two methods of sewage disposal practices are the use of pier system toilets and water closet toilets. About 91% of households in the study communities dump their refuse in open space awaiting the government to evacuate, while 32% use the pit toilets.

There are six designated solid waste dumpsites as shown in Figure 4.42(a) and Table 4.31 (a). The compactors and trucks that collect the wastes from the various points in the city dump them in any of these sites.

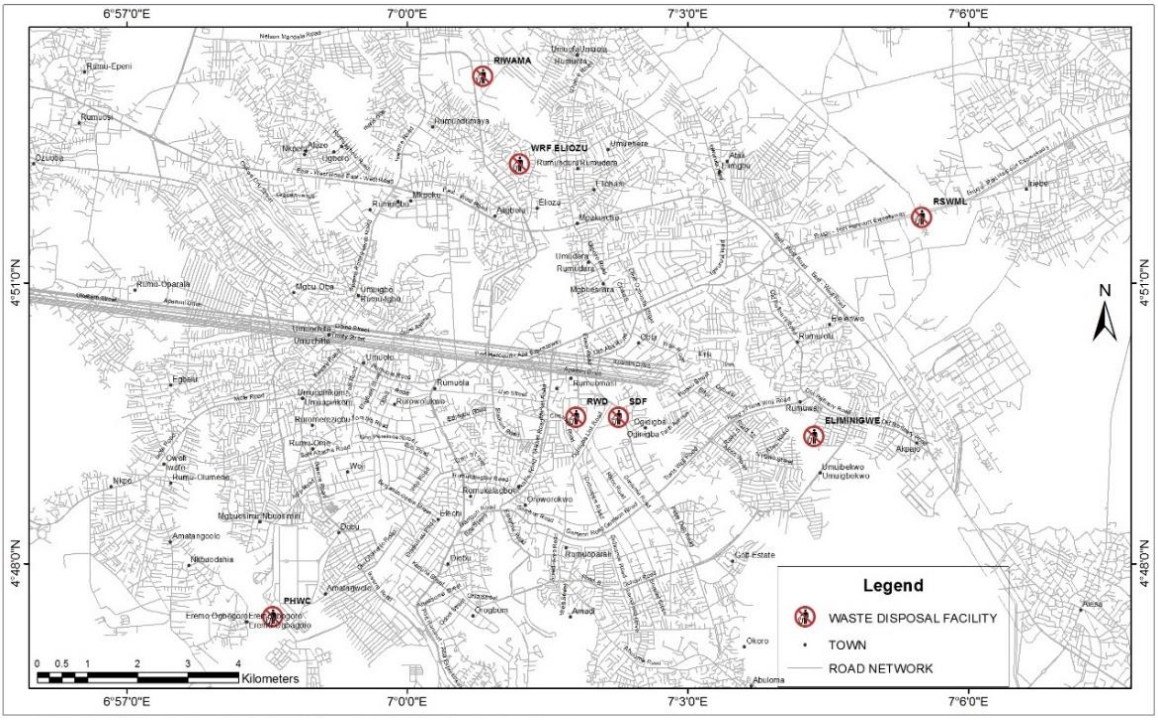


Figure 4.41(a): Six Designated Solid Waste Dumpsites in Port Harcourt

Table 4.31(a): Six Designated Solid Waste Dumpsites in Port Harcourt

S/N	Name	Location description
1	Rivers State waste management landfill (RSWML)	Obigbo by Enugu –PH expressway
2	RIWAMA refuse dumpsite	Allu
3	RWD	Rumuomasi, PH
4	Waste Receptacle facility (WRF), Eliozu	Off new Airport Road, Aligbolu, PH
5	Rivers State sewage management facility (PHWC wastewater treatment plant)	Eagle Island, PH
6	SDF	184C Trans-Amadi layout road, Trans-Amadi, PH.
7	Eliminigwe Phase 2, Waterside	Rumuwaji, PH

Plate 4.4: Existing Waste Disposal Practices in the area (a Indiscriminate waste dumping; b. Waste collection and disposal compactors delivering waste at RIWAMA refuse dumpsite, Aluu).

The common refuse and sewage disposal practices in communities across the study area are not modern, hygienic, or safe. Considering the terrain of the communities, most of these wastes eventually end up in the water bodies around the area or are carried downstream and deposited in other communities. Although those that are easily biodegradable (including sewage), decompose and also provide nutrients for plants and fishes, they are still sources of pollution and constitute a health hazard. Those that are not easily degradable (especially metals and plastics) are always visible and obvious pollutants and litter around the environment.

Nutrition

The average household in the study area can provide two meals daily for its members. The meals consist predominantly of carbohydrate and protein. Commonly available sources of protein are fish and seafood, especially periwinkles, oysters, prawns, and crayfish. These proteins are always available in the soups with which garri (the staple and most common food) is eaten. Other foods eaten include yam, rice, cocoa yam, sweet potato, and beans. Although during interviews several residents complained about the nutritional value of the meals, they can provide for their households, medical records from the visited health centers did not collaborate that malnutrition was a common ailment in the communities.

Prevalent Diseases and Disease Vectors

Interviews in households and with health workers in the proposed project communities revealed that the most frequently reported diseases are malaria, diarrhoeal diseases, and respiratory tract infections (RTI).

Disease vectors identified in the area are presented in Table 4.32. The commonest is the mosquito which transmits Plasmodium which causes malaria in humans. Others are house flies and rodents. The environment around the project communities provides the necessary breeding grounds for these disease vectors.

Table 4.32: Common Disease Vectors in the Study Area

Disease Vector(s)	Common Habitat	Parasite(s) Transmitted and Disease(s) Caused
Mosquito (Anopheles and Culex).	Stagnant water	Plasmodium causes malaria.
Housefly and Latrine fly (Musca domestica and Fannia canicularis).	Toilets, refuse heaps, and dumps	Diarrhoeal diseases.
Tsetse fly (Glossina sp).	Toilets, refuse heaps, and dumps	Trypanosoma causes sleeping sickness.
Rats	A variety of places including houses drains, Toilets, refuse heaps, and dumps	A variety of diseases including laser fever, although there was no report of laser fever in the period before and after the study.

Source: Resourcefield fieldwork 2020

- **HIV/AIDS Prevalence and Awareness**

Sub-Saharan Africa is one of the hardest-hit regions by the HIV/AIDS pandemic. Presently, it is hosting about 24.5 million people living with the virus. The medico-social consequences of this high HIV/AIDS prevalence in the region cannot be overemphasized. It has contributed to high orphan rates, high numbers of HIV positive infants, high rates of opportunistic infections, high school drop-out rates, societal discrimination, and stigmatization.

Nigeria with over 160million people is the most populous country in Africa and ranked fourth-worst affected by HIV/AIDS in the world based on the total number of cases reported (NACA, 2011). The HIV prevalence in Nigeria indicates a fluctuating trend from 1.8% in 1991 to 5.8% in 2001, before a decline to 5% in 2003 to 4.4% in 2005, 4.6%, and 4.1 as at 2010 end. (NACA, 2011).

There is a low prevalence of HIV/AIDS among the population. According to the national sentinel study on HIV/AIDs (2011), Rivers state where the project is situated has a prevalence of 4.1-6.0%. This figure is not too far from the national average (4.4%) and corresponds to the lower tier of prevalence in Nigeria. It is noted however that a good amount of awareness education and advocacy on the disease and its prevention is ongoing and from interviews, these are beginning to yield the desired results.

The federal and state governments spend billions of naira yearly to create awareness on the grave negative effects of the scourge. This awareness seems to be yielding positive results in the area as over 99% of the respondents claim to know about HIV/AIDS and its means of transmission and prevention. Collaborating this, drug vendors locally referred to as chemists in the area said there is an increase in the number of condoms sold daily. However, the FGD revealed that a quarter of respondents acknowledged that they often had unsafe sex with high-risk partners.

Knowledge, Practices, and Behaviour on Sexually Transmitted Infections (STIs) and General Health

Previously called venereal diseases (VDs), sexually transmitted infections (STIs) or Sexually Transmitted Diseases (STDs) are diseases primarily transmitted by sexual contact. They can be classified according to the causative agents (bacteria, viruses, chlamydia, parasites, fungi). Its incidence is increasing globally with both poor socio-economic and socio-cultural factors playing significant roles besides other factors such as industrialization and urbanization, labour migration, ignorance, and contraception.

Table 4.33 shows unmarried respondents engaged in sexual activity. From this table, 25.7% had a sexual relationship with persons they were not married to, while 74.3% did not.

Table 4.33 Extra-Marital Partners

Extra-Marital Partners		Total
Yes	No	
25.7%	74.3%	100.0

Source: Resourcefield survey, 2020

Table 4.34 Awareness of Sexually Transmitted Infections (STIs)

Awareness of Sexually Transmitted Infections		Total
Yes	No	
100.0	0.0	100.0

Source: Resourcefield survey, 2020

Physically and Mentally Challenged Persons

Some surveyed households (2%) in the area have cases of physically/mentally challenged individuals, the majority of whom do not attend schools. No government or non-governmental organization (NGO) assistance has ever been offered to them, and their families/kindred who do not have enough to cater for them. This group of persons is however not discriminated against since they are familiar faces who reside with their kith and kin who largely understand them. They are however cautioned and restricted when they get out of hand occasionally.

Commercial Sex Trade

Questionnaire analysis, FGD, and informal interaction in the area revealed that commercial sex trade is practiced. Without a doubt, the trade would boom especially during the construction phase of the project given that the workforce is usually predominantly male who work away from home and their women.

Plate 4.5a: Community Town hall in Rumuadaolu

Plate 4.4b: PHEDC facility in Rumuadaolu

Land Ownership and Tenure

Land in all the project communities is primarily owned by families. Ownership rights over lands are handed down from one generation to another within the extended family. Such inherited land is put

to any use as desired by the owner(s). These are the lands on which family members build their houses and are allocated for businesses. Land could be bought from owners who were willing to sell. Apart from the family, individuals and organisations also owned some land.

Any intentions to obtain land for corporate or industrial use are initiated through the CDCs and various councils of chiefs which are in the best position to offer proper guidance concerning ownership. This condition is important whether the required land is owned by a family, individuals, and organisations. This approach to obtaining land helps avoid intra/ inter-communal conflicts over ownership of any land that may be required for any project.

Infrastructural Base

Classification of Infrastructure

Infrastructure is classified as physical, social, and institutional. Physical forms include; transportation facilities (roads, railways, bridges, ferry services, canals, and foot-paths); storage facilities (silos), warehouses, cribs, open-air facilities, etc); processing facilities (machinery, equipment, building, etc.); irrigation, flood control, and water resources development facilities; and soil conservation facilities.

Social infrastructure comprises housing, leisure and recreational facilities, health facilities (hospitals, dispensaries, maternities, and health centres, etc); educational facilities (primary schools, teacher training colleges, secondary schools, technical schools, vocational schools, adult educational facilities, etc); and utilities (electricity, water supply, sanitation facilities, etc.). The main components of the institutional infrastructure are co-operative societies; farmer's unions/groups, community development projects, financial institutions; agricultural extension, research and training facilities; and post and telecommunications facilities (post offices, postal agencies, telephones, etc.).

It has been reported by the UNDP (2015) that infrastructural and social services in the Niger Delta are generally deplorable and grossly inadequate for an estimated regional population of about 30 million people. The case is not different for many parts of the study area. The Rivers State Government, the project affected Local Government authorities, and some industrial and multinational companies and international agencies have been contributing different quota to the development of the social infrastructures in the study area. The state government, over the last four years, has embarked on a lot of developmental projects bothering on roads/bridges/culverts rehabilitation and/or construction; provision and rehabilitation of educational and health facilities; and provision of electricity and potable water sources.

Available Infrastructure and Their Functional Status

Public access to the project-affected communities is by roads with most of the communities having paved internal link streets and lanes. Additionally, telecommunication services from GSM service providers are received in all parts of the communities.

Education facilities in the LGA consist mainly of public primary, junior and senior secondary schools and an array of private schools. The infrastructures in many of the schools are inadequate. The students' desks and chairs are broken and insufficient, classrooms are also insufficient, and some of

their ceilings, windows, doors, and floors are broken. Most of the schools do not have decent utilities like toilets and they also do not have equipped libraries and laboratories. The student to teacher ratio in the public primary schools is high, as much as 50:1. Teachers in secondary schools are not enough to cover all the subject areas, and subjects like Mathematics, Physics, Introductory Technology, Agricultural Science, English Language, and Home Economics are often taught by teachers who did not study these core subjects in the universities.

The cumulative effect of these inadequacies is a lack of interest in schooling among many children in the area despite the free education policy of the state government. Parents who are interested in their children being properly educated and who can afford the cost send their children and wards to private schools in the area. Local sources estimate that 2% to 3% of children of school age are not in school because of truancy or have dropped out.

There is generally a dearth of functional orthodox **health facilities** in the entire study area. The basic problems of government hospitals and PHC are inadequate staffing, broken down and unmaintained equipment, and lack of drugs. The situation is such that households generally do not have confidence in them and would rather 'consult' drug stores or take their members requiring medical attention to a private hospital.

Public water and electrification are very much dysfunctional in the communities. Several water boreholes have been constructed in the communities but most of them are not working largely because the water produced is deemed unfit for consumption by community residents, usually because of colouration. Similarly, **electricity** in the area is generally characterized by a frequent blackout and poor voltage.

In terms of trading opportunities, all the surveyed communities can boast of small, functional but poorly infrastructures a makeshift marketing facility that deals with foodstuff basically from which the people may procure their essential needs.

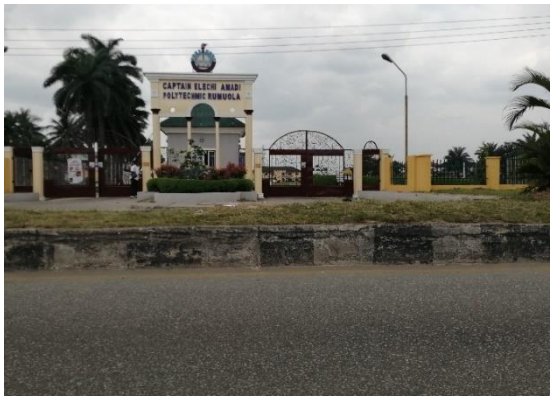


Plate 4.6: Captain Amadi Elechi Polytechnic,

Plate 4.7: A public Borehole in Rumuadaolu

Plate 4.8: Road network in Rumuomoi

Plate 4.9: Community Secondary School Rumuepirikom

Vulnerable Groups

Some groups in the communities have been identified as potentially vulnerable to the likely impacts of the proposed project. Their vulnerability derives from several different factors, including the inability to cope with certain envisaged changes in the society and economy. A key vulnerable group is adolescent youths. Within this group, it is also possible to differentiate between the adolescent male and the adolescent female. For the male adolescent, there is a tendency to abscond or drop out of school to seek casual employment at the project site. This temptation to drop out of school is re-enforced by the state of educational institutions, particularly the poor staffing which makes schooling uninteresting. The adolescent male will be faced with a situation of giving in to peer pressure and groups that encourage truancy and school dropout if these groups come into the communities as itinerant workers or camp followers.

The teenage girl on the other hand is faced with managing her sexuality in an environment where there will be considerable exposure to sexual excesses and the continuous advances by older and more experienced working-class males whose income would be an effective instrument to lure the girls. Again, with this group, there will be the likelihood of school dropout and teenage pregnancy. Teenage pregnancy had in some societies led to the stigmatization of the girls. Many of the teenage mothers may not be able to return to complete their schooling or embark on any academic pursuits, even after they would have given birth to their babies.

Another vulnerable group is the elderly. In any economy, the elderly usually requires special attention which includes health care and welfare, but the required facilities for the provision of these social services are not available across the study communities.

Additionally, widows and single mothers will have an uphill task providing for their households in an environment where there are construction workers who earn salaries higher than what generally obtains in the community.

Socio-economic Indices Interrelationships

Socio-economic baseline situations in the communities have significant multispectral links. In Table 4.35, key socio-economic conditions, their sectoral links, and implications, as identified in the study, are summarized.

Table 4.35: Socio-Economic and Health Indices Linkages

Key Environmental Factors.	Associated Sectors and Conditions.	Socio-economic and Health Outcome.	Required Intervention.	Monitoring Indicators.
Poor Infrastructural Framework.	Water-lack/limited access to safe potable water. Education-lack of facilities and materials. Inadequate staffing. Health-lack of access and equipment. Inadequate staffing.	Incidence of diarrheal diseases and other forms of water-borne diseases; Poor diagnoses and inadequate health intervention; Incidence of avoidable deaths. Poor academic performance; lack of interest in schooling; low student enrolment; poor school attendance; increased unemployment and miscreant behaviour. Lack of access to functional facilities for residents.	Provision of safe potable water in all settlements; rehabilitation of existing water facilities. Improved staffing and regular training of education and health staff and provision of equipment (laboratories, libraries, diagnostic equipment) in education and health facilities.	The number of treated boreholes provided in the communities. The number of subject areas for which there are adequately trained teachers in public schools. Increased school enrolment. Functional laboratories. Functional public library. The number of essential medical equipment (eg X-ray and ECG) and Personnel to man them in the hospitals and health centers.
Domestic Waste and Sewage Management; and Indoor Air Pollution.	Housing-Poor design (no provisions for utilities). Poor construction materials (use of non-durable walling materials).	Pollution of the rivers and physical environment as sewage and waste is discharged into the environment; harm to aquatic life; health problems for humans. Indoor pollution from smoke (stoves and	Regulate and enforce the use of water closets or covered pit toilets in houses, by LGA. Regular sanitary inspection by LGA health inspection staff. LGA approval by of only properly designed houses with durable	The number of properly designed houses approved and construction monitored by LGA.

Key Environmental Factors.	Associated Sectors and Conditions.	Socio-economic and Health Outcome.	Required Intervention.	Monitoring Indicators.
		lamps); spread of respiratory problems.	construction materials and with the proper and adequate location of utilities like toilet, bath, and kitchen.	
Gender Equality	Public Administration-traditional practices that limit women's participation in communal decision making.	Limited opportunities for women.	Without requiring a change in the composition of traditional decision-making bodies, certain offices in the CDU can be reserved for women like those of CDU Vice-Chairman or Secretary. This will facilitate their participation in communal decision making.	The number of women playing prominent roles in CBOs, and the number of women in the CDU.
Human Capital Development.	Technical Education-lack of facilities. Micro Finance- Poor access to credit; nonavailability of venture capital. Employment-existence of high unemployment rates in the communities.	Inadequate technical manpower and limitations on the economy (very few skilled workers); limited employment opportunities; low investments; stifling of entrepreneurial ability; low living standards.	Introduce, equip, and staff technical education units within existing schools. Enlighten business persons about the importance of financial services in growing their business. Identify and eliminate bottlenecks in the lending process.	Number and utilization of credit for start-up ventures, and to grow existing investments.

Source: Resourcefield 2020

4.11 Traffic Survey

This traffic study was carried out to analyze the traffic characteristics in the selected routes. This study helps in deciding the geometric design features for traffic control for safe and efficient traffic movement. The study was to determine the number of vehicles crossing sections of roads proposed for flyover per unit time at any selected period and also to quantify the measure of flow. The units used are vehicles/day or vehicles/hour

Methodology

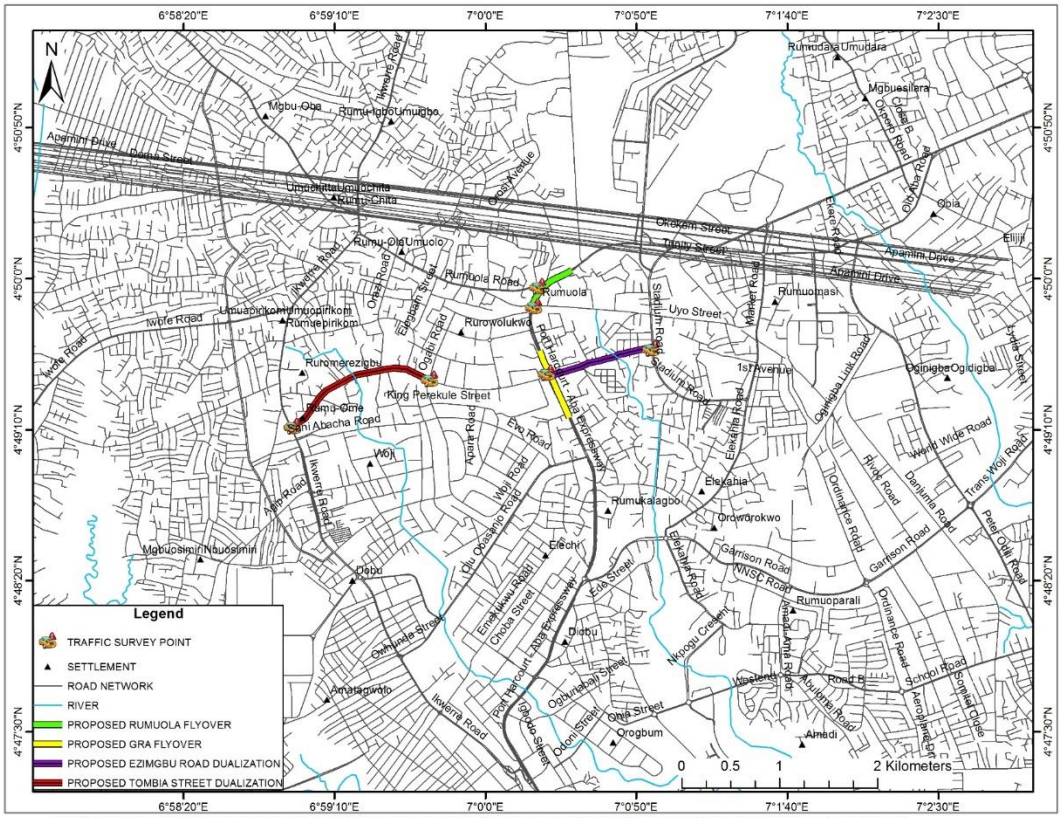
A manual classified count (MCC) was employed for this study. MCC involves counting all the vehicles passing a selected location on a road for a pre-determined period. The count records individual vehicles by categories (i.e. a truck or car/bus) and the direction they are traveling in. This is the reason it is called a 'classified count'.

Every urban or regional area is unique in terms of intra-city modes of transportation. Often, travel patterns and mode choices reflect spatial planning policies, urban form, city size, cultural factors, and economic profile. Given the foregoing, and given that during the construction of the flyover traffic will be affected at points of the road crossing, a traffic survey was carried out at the Rumuokoro, Rumuogba (Artillery), and Rebisi (Garrison) junctions in Port Harcourt, to ascertain the following:

- major modes of transportation
- volume of traffic
- variation in travel patterns
- the peak periods
- traffic flow patterns

To achieve these objectives, sampling points (Figure 4.42) were established at;

i. Garrison from Trans-Amadi towards PH town
ii. Garrison from Waterlines towards PH town
iii. Garrison from PH town towards Waterlines
iv. Artillery by Okporo- – (from town towards Aba)
v. Artillery by CIWA – (from Aba into town)
vi. Artillery by CIWA (Old Aba Road)
vii. Rumuokoro (from Eleme Junction towards Choba)
viii. Rumuokoro (from Choba towards Eleme junction)
ix. Rumuokoro (from Rumuokwuta towards Airport road) and;
x. Rumuokoro (from Airport road towards Rumuokuta)



MAP SHOWING ROAD TRAFFIC SURVEY POINTS ALONG THE PROPOSED FLYOVERS/DUALIZED ROADS

Figure 4.42: Map showing Traffic Survey Points

Many urban cities in Nigeria are bedevilled with traffic congestion which tends to defy various remedial measures adopted by different governments over the years. Journey times from one point to another within a town have remained unreliable and residents have continued to face disturbing inconveniences in transportation. These are accompanied by noise and air pollution and the high costs associated with the burning of fuels from stationary vehicles.

- **Major Modes of Transportation**

This study reveals the predominant use of cars as a means of transportation for short shuttles within the state capital and neighbouring LGAs. The recent burgeoning growth in the commercial cars in Port Harcourt could generally be attributed to its inherent advantages of door-to-door service, manoeuvrability during traffic congestion, and ease of responsiveness to demand.

- **Temporal Variation in Travel Pattern**

Usually, some of the vehicles are traveling toward and from Bayelsa, Imo, Abia, or the Akwa Ibom States. Others, which seem to be the majority, are commuting within the city (Figures 4.43 – 4.53). Hence, the peak periods vary from one point to another.

- **Traffic analysis of the location**

Traffic situations in these areas both during weekends and weekdays are similar. One domination in the area is that there are more cars and buses on the routes than trucks, and tricycles popularly known as Keke and motorcycles are not allowed access to these routes.

- **Volume of Traffic**

Data obtained from the field shows that Waterline to PH town route of the project site has more traffic flow than others with 20,636 vehicles plying the route from 7 am to 6 pm on a weekend (Figure 4.43 – 4.53) and it is followed by PH town to Waterline route with 15,460 vehicles plying the route between 7 am to 6 pm on a weekend. 5610 cars were recorded on Waterlines to the PH town route on a Thursday between 3-4 pm representing 25% of the total vehicle recorded on that day. The proposed project sites serve as both intra and interstate transportation routes and account for a large proportion of traffic flow in the state. The multipurpose nature of these routes makes determining peak days and time difficult as it changes regularly depending on other variables like school sessions, events, and functions in and around Port Harcourt.

Figure 4.43: Variation in traffic Pattern: Waterlines towards PH town (Weekdays)

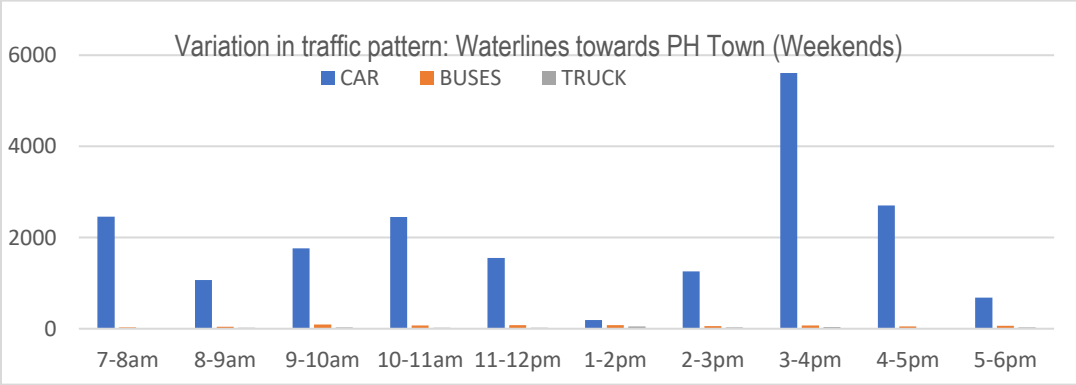


Figure 4.44: Variation in traffic pattern: Waterlines Junction towards PH Town (Weekends)

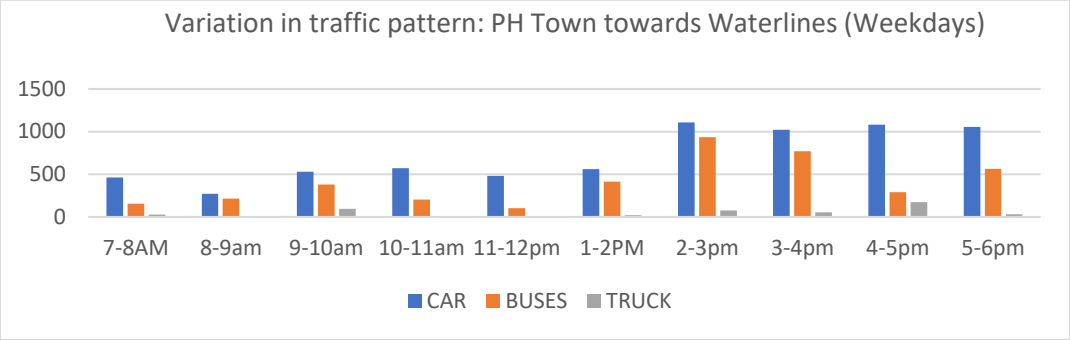


Figure 4.45: Variation in traffic pattern: PH Town towards Waterlines (Weekdays)

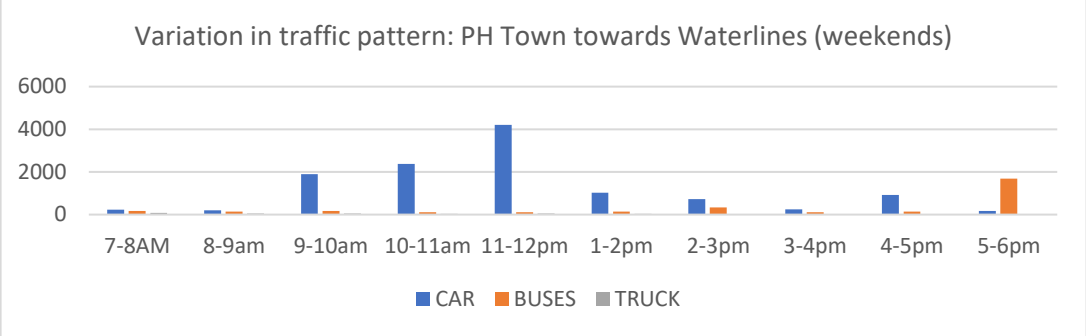


Figure 4.46: Variation in traffic pattern: PH Town towards Waterlines (Weekends)

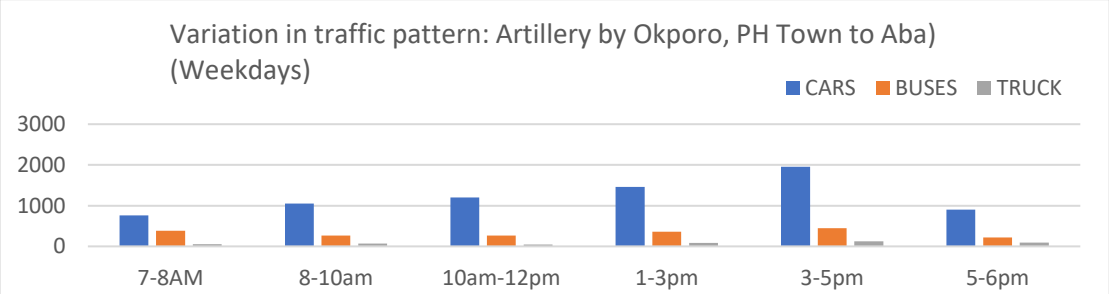


Figure 4.47: Variation in traffic pattern: Artillery by Okporo, PH Town to Aba

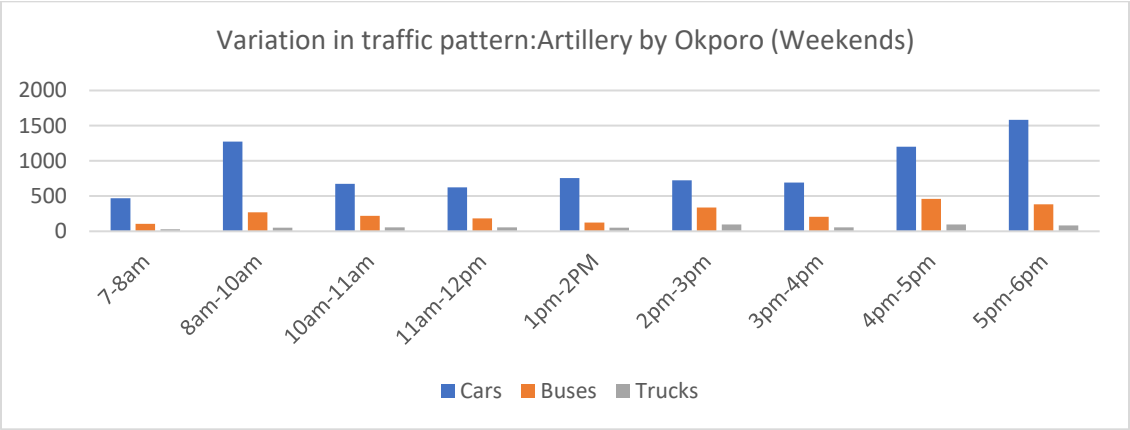


Figure 4.48: Variation in traffic pattern: Artillery by Okporo (Weekends)

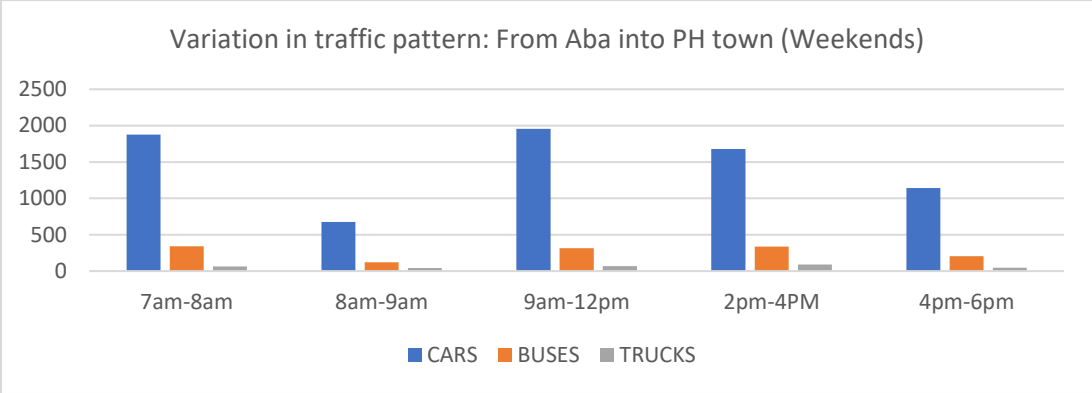


Figure 4.49: Variation in traffic pattern: From Aba into PH town (Weekends)

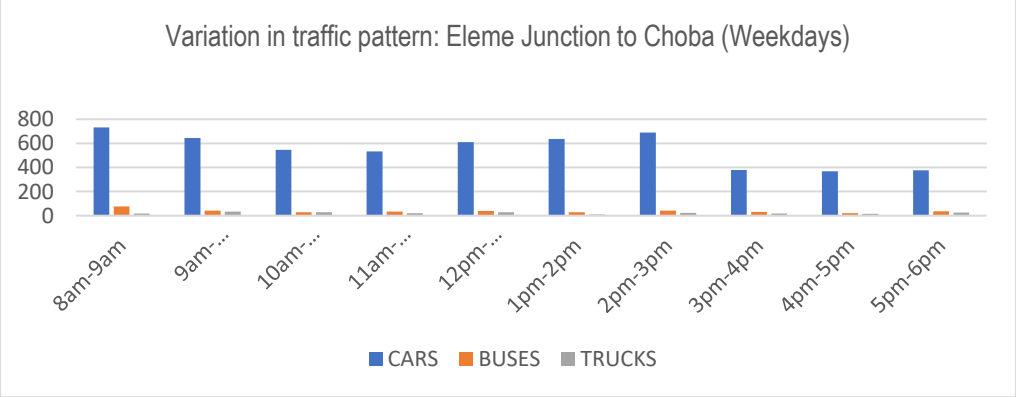


Figure 4.50: Variation in traffic pattern: Eleme Junction to Choba (Weekdays)

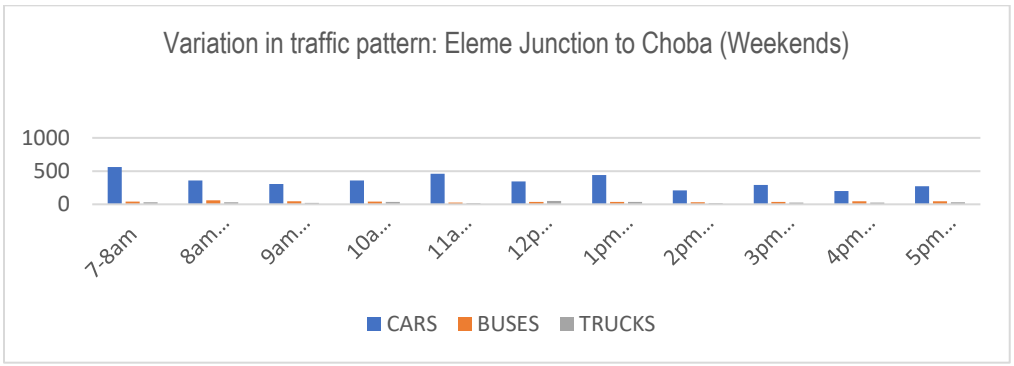


Figure 4.51: Variation in traffic pattern: Eleme Junction to Choba (Weekends)

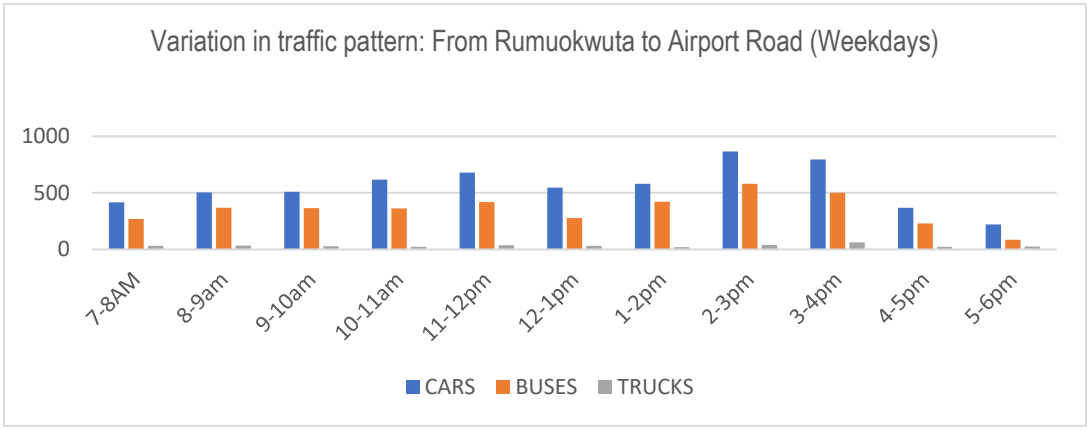


Figure 4.52: Variation in traffic pattern: From Rumuokwuta to Airport Road (Weekdays)

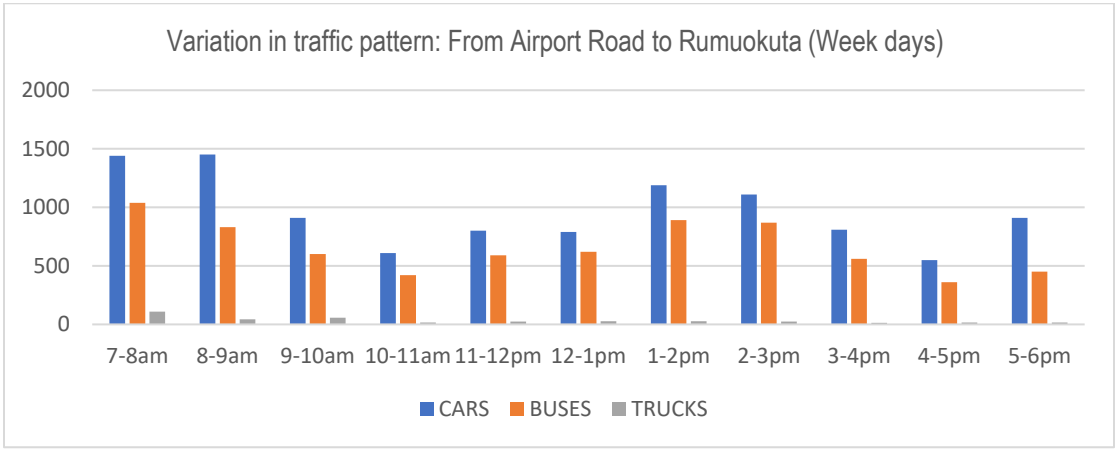
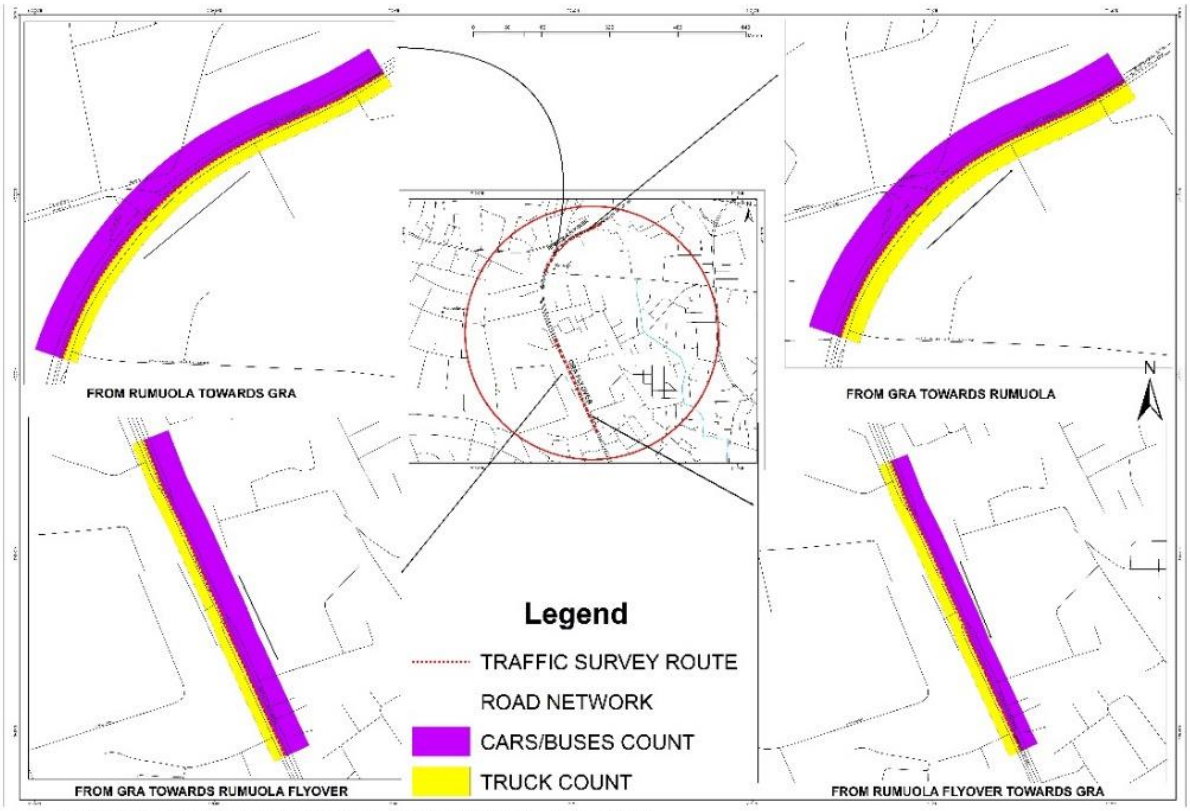


Figure 4: 53: Variation in traffic pattern: From Airport Road to Rumuokuta (Weekdays)



TRAFFIC SURVEY MAP OF PROPOSED GRA AND RUMUOLA FLYOVERS

vehicles on the route

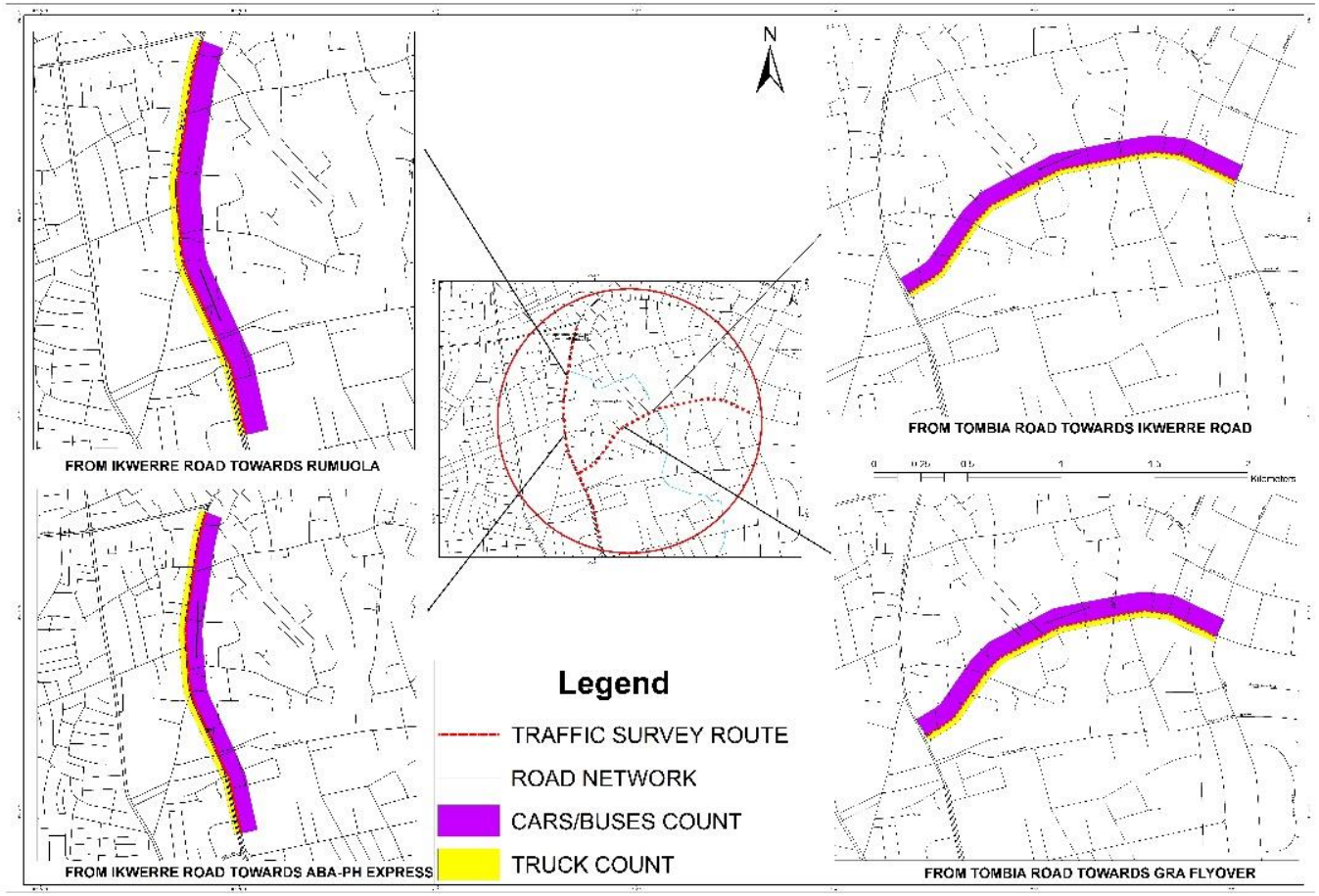


Figure 4.51: Map of the study area showing Tombia Extension showing types and percentages of vehicles on the route

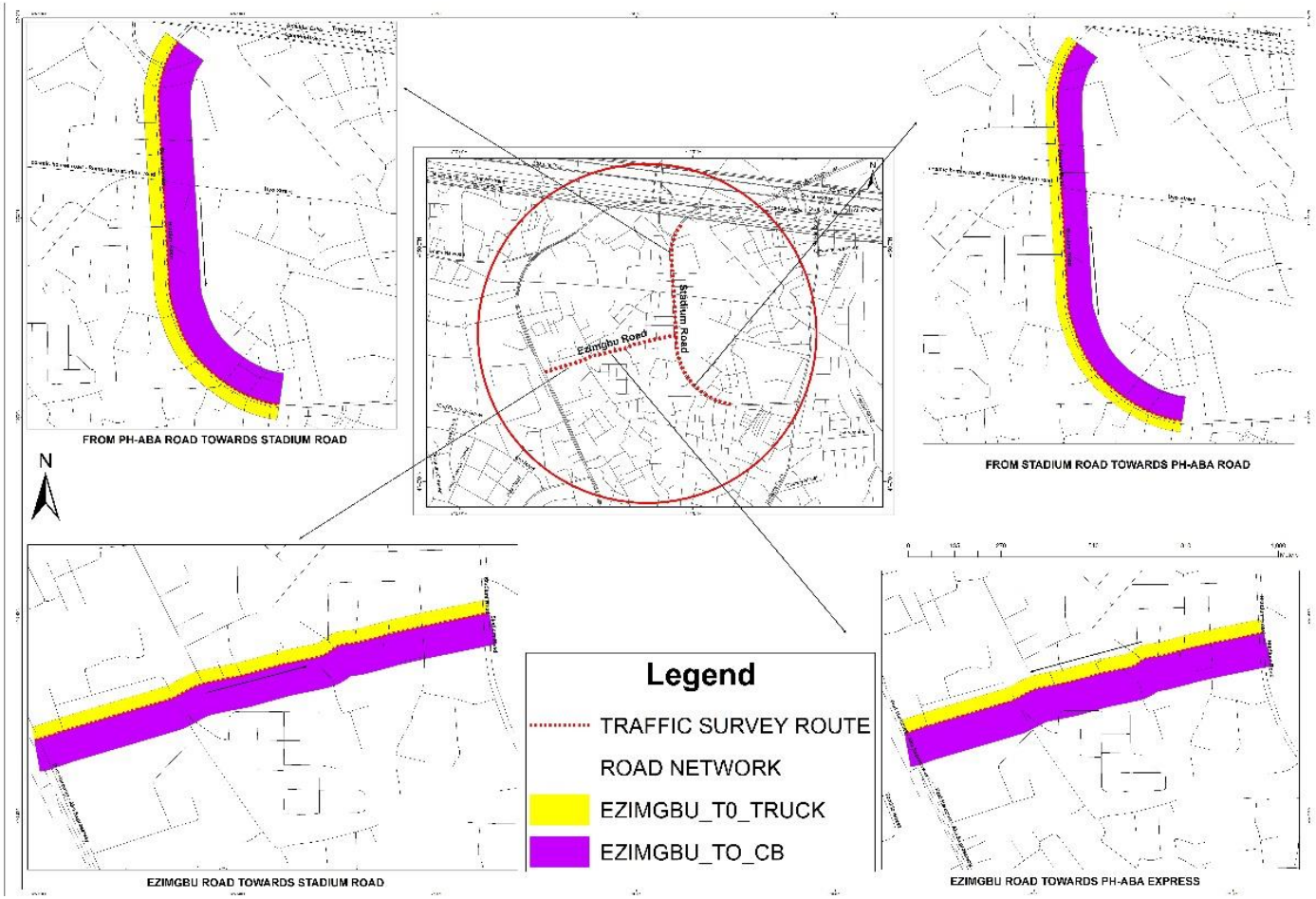


Figure 4.52: Map of the study area showing Ezimgbu Road, types and percentages of vehicles on the route

5

Stakeholders Engagement

5.1 Introduction

Principle 10 of the Declaration of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (Brazil, 1992) emphasizes that environmental issues are best handled with the participation of all concerned citizens, at the relevant level. Agenda 21 adopted by United Nations Conference on Environment and Development (UNCED) recognized the important role of public participation in environmental impact assessment (EIA) in achieving sustainable development (item 23.2 of Agenda 21). The World Summit on Sustainable Development in Johannesburg (South Africa, 2002) developed further these provisions. The principles promoted by these conferences are fully integrated into the provisions of the UNCED Convention on Environmental Impact Assessment in a Transboundary Context, which came into force in 1997 (hereinafter referred to as the Convention). When project proponents enable the public to participate in decision-making, they help meet society's goal of sustainable and environmentally sound development. Public participation in environmental decision-making and, in particular, in EIA, may lead to some benefits in these processes. As a result of public participation, the process of decision-making, up to and including the final decision, becomes more transparent and legitimate. Public debate on proposed activities among all interested groups at an early stage of decision-making may prevent or mitigate conflicts and adverse environmental consequences of the decisions with impacts.

The proponent considers consultation as a major feature of its operations; the thrust of the consultation programme for the flyover and roads projects is to promote mutually beneficial relationships with all the stakeholders through close contacts and regular consultations and also to notify the stakeholders of the nature, scale, and timing of the proposed project, thereby eliminating any fears or apprehension. The process was also used to facilitate information gathering between the EIA consulting team/proponent and the other stakeholders. The consultation exercise commenced at the very early stage of the environmental impact process and it is planned to continue throughout the project duration.

The Stakeholders Engagement process has been designed to comply with regulatory requirements set out in Nigerian environmental legislation and, where possible, implement international good practice guidelines, for example, those of the IFC. The process provides stakeholders with an opportunity to evaluate the proposed project and to submit comments for enhancing project benefits while minimizing the project's adverse effects. The Stakeholder Engagement process aims to achieve the following:

- To ensure that stakeholders are well informed about the proposed project;

- To provide stakeholders with sufficient opportunity to engage and provide input and suggestions on the proposed project;
- To verify that stakeholder comments have been considered and addressed;
- To draw on local knowledge in the process of identifying environmental and social concerns associated with the proposed project, and to involve stakeholders in identifying ways in which these can be addressed;
- To comply with the local legislative requirements; and
- To incorporate international good practice.

5.2 Public Consultation process

The methodology employed for the public consultation process considered the following aspects:

- The Nigerian legislative requirements;
- International Stakeholder Engagement practice guidelines;
- Local cultural requirements such as language proficiencies;
- Social sensitivities associated with the proposed project; and
- The geographical location of communities.

The consultation team has sought to ensure that all identified stakeholders, including the project impacted communities, are aware of the proposed Project and the EIA process through extensive community consultation. The stakeholder engagement strategy was designed to attain meaningful participation and involvement that enabled stakeholders and the community to actively contribute to the development of new ideas and options as the Project is planned and developed.

The Stakeholder/Public Engagement methodology is summarised and depicted graphically in Figure 5.1; the same approach was used during the Scoping and ESIA phases.

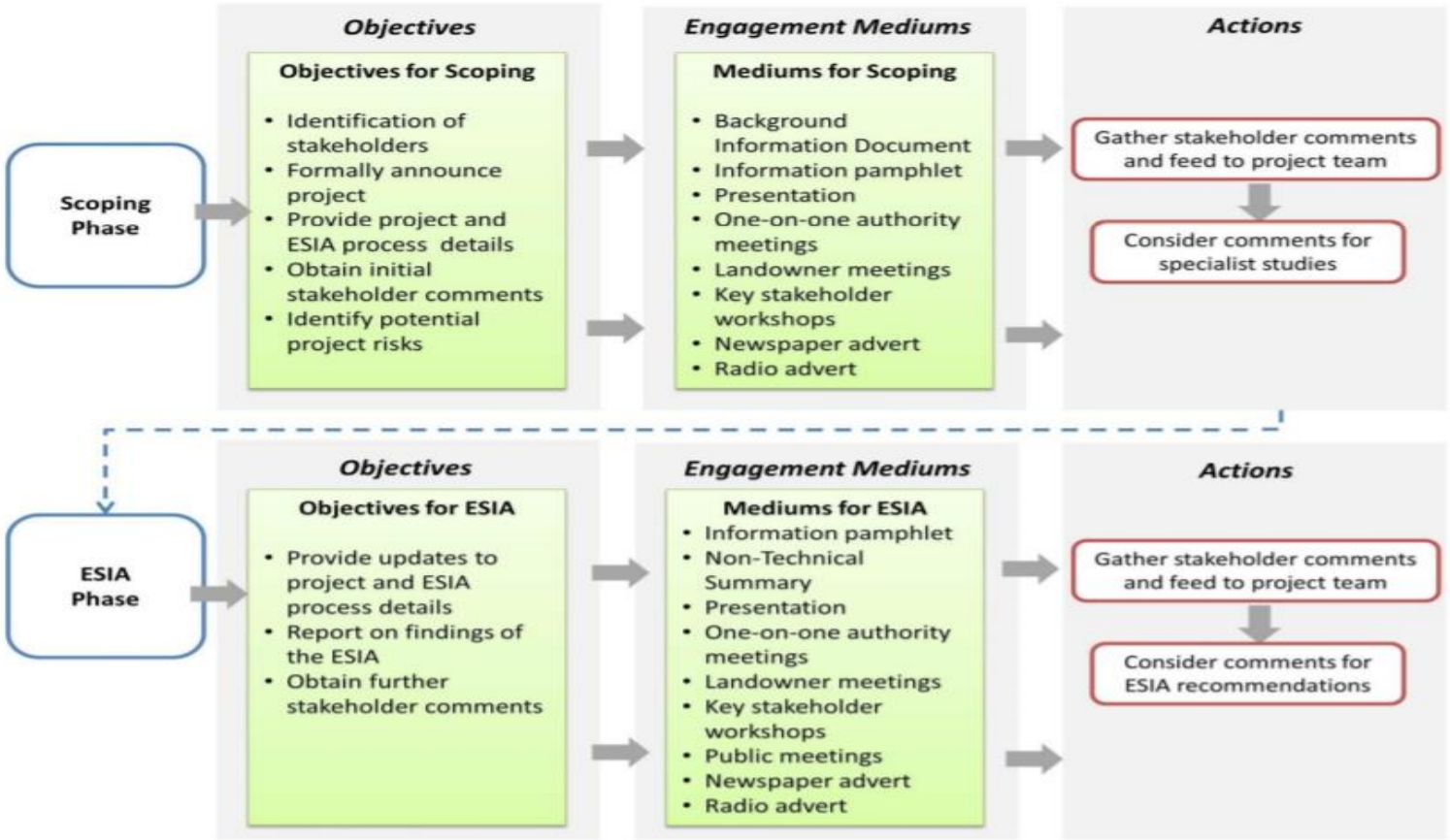


Figure 5.1: Stakeholders engagement methodology

5.3 levels of Consultation

Two levels of consultations, as are generally recognized in the ESIA process, were held. These are institutional and Project affected communities (PACs) involvement. The subject of this section relied heavily on both, though with emphasis on PACs involvement, ie. getting the public, host communities, all other stakeholders that may be directly or indirectly affected by the project to participate in assessing the project.

The public forum with Project Affected Communities, NGOs, and CBOs, youth groups, Women organizations, religious organizations, and traditional bodies held between 24-29 August 2020 in the project-affected communities with the various village heads and traditional rulers in attendance and also with major institutional stakeholders on 27 August 2020 in Port Harcourt.

In all the consultation meetings, a brief on the project concerning the following was given by the ESIA consultant.

- Purpose of the Public Fora
- Background to the project
- Project description
- Benefit description
- The benefits of the project
- Environmental Management
- Community Affairs and relations.

At the end of the presentation, participants were given ample opportunity to ask questions and/or make comments on the project. They were unanimous in praising the proponent for considering them suitable to host the project and promised to accord the proponent all the needed support. Proceedings of meetings presented in Appendix 5.

5.4 Identification of Stakeholders

The proponent's policy makes it mandatory to consult with stakeholders and relevant authorities in all activities. In preparing this ESIA report the consultation process is implanted at three (3) levels: The first level of consultation identifies the social and economic issues in the project area and ensures visible management commitment to addressing them. This level starts with the project conception.

The second level streamlines the issues and makes plans for specific actions. This level recognizes various phases of engagements among project proponent, host communities, village council, women/men's groups, and youth organization. The third level ensures regular communication with stakeholders throughout the project's life; the second and third levels of consultation commence at project inception and continue through the life span of the project.

The key stakeholders identified and consulted for the proposed construction of fly over and infrastructures at Port Harcourt are:

i. Federal Ministry of Environment
ii. Federal Ministry of Works and Housing (Controller)
iii. State Coordinator, National Environmental Standard Regulation Enforcement Agency (NESREA), Rivers State Office
iv. Nigerian Civil Aviation Authority (NCAA)
v. Nigerian Airspace Management Agency (NAMA)
vi. Transmission Company of Nigeria (TCN)
vii. Port Harcourt Electricity Distribution Company (PHEDC)
viii. GOC, 6 Division, Nigerian Army, Port Harcourt
ix. Sector Commander, Federal Road Safety Corps (FRSC), Rivers State Command
x. Commandant, Nigeria Security and Civil Defense Corps (NSCDC), Rivers State Command
xi. Commissioner of Police, Nigeria Police Force (NP), Rivers State Command
xii. The Director, Directorate of State Service (DSS), Rivers State Command
xiii. Rivers State Ministry of Works
xiv. Rivers State Ministry of Environment
xv. Rivers State Ministry of Lands & Physical Planning
xvi. Rivers State Ministry of Women Affairs
xvii. Rivers State Ministry of Urban Development
xviii. Rivers State Ministry of Employment and Empowerment
xix. Rivers State Ministry of Health
xx. Rivers State Ministry of Transport
xxi. Rivers State Waste Management Agency (RIWAMA)
xxii. Vehicle Inspection Office, VIO, Port Harcourt
xxiii. Obio/Akpor Local Government Council
xxiv. Rumuola Community
xxv. Rumuadaolu Community
xxvi. Rumuomoi Community
xxvii. Nigeria Society of Engineers (Rivers State Chapter)
xxviii. Nigeria Union of Road Transport Workers (Port Harcourt branch)
xxix. Road Transport Employers Association (Rivers State Chapter)
xxx. The Association of Environmental Impact Assessment of Nigeria (AEIAN)
xxxi. Institute of Natural Resources and Environmental Studies (INRES), University of Port Harcourt
xxxii. Institute of Natural Resources and Environmental Studies (INRES), University of Port Harcourt
xxxiii. National Inland Waterways Authority (NIWA), HQ, Lokoja
xxxiv. The Commanding Officer, NAF Base, Port Harcourt

In the course of planning, the project proponent has established a close working relationship and a sense of partnership with those key stakeholders and the host communities and shall maintain these throughout the project life.

Table 5.1: List of Project Stakeholders and Engagement Activities

Stakeholder Group and interest in the project	Stakeholder Name	Stakeholder Level				Engagement Activity	
		International	National	State	Local	Meeting	Letter
Government Authorities: National, the regional, and local government of primary political importance to the Project with permitting requirements that must be met by the Project.	Federal Ministry of Environment (FMEnv)		X			X	X
	Ministry of Niger Delta Affairs		X			X	X
	Rivers State Ministry of Lands and Survey		X			X	X
	Federal Ministry of Works and Housing		X			X	X
	Rivers State Ministry of Environment			X		X	X
	Obio /Akpor LGA				X	X	X
	Federal Ministry of Environment				X	X	X
	Rivers State Ministry of Rural Development		X			X	X
	Office of the Surveyor-General of the state			X		X	X
	Nigeria Police, Rivers State Command			X		X	X
	NCDSC, Rivers State Command			x		X	X
	Rivers State Ministry of Health			X		X	X
	FRSC, Rivers State Command		X			X	X
	Rivers State Ministry of Works			X		X	X
	Rivers State Office of the Secretary to the State Government			x		X	X
	Rivers State Government		X			X	X
	Department of State Services (DSS)		X			X	X
Professional Bodies / Academia	AEIAN		X			X	X
	University of Port Harcourt		X			X	X
Local Community(ies) and Neighbouring Land Users	Rumuola				X	X	X
	Rumuadaolu				X	X	X
	Rumuomoi				x	X	X
Non-Government and Community Based Organisations (NGOs and CBOs)	NSE		X			X	X
	AEIAN		X			X	X

Table 5.2: Schedule of Meetings and Interviews

Groups Met	Date	Issues Discussed
Members of Rumuola community leaders	29/08/2020	Traditional governance, belief systems, conflict management procedures, social structures, infrastructural network, livelihoods, environmental problems, and community efforts at solving them, perceptions and concerns about the proposed project, suggested mitigation and enhancement measures, community, needs, and development prospects.
Rumuoadaolu CDA executives	25/08/2020	Traditional governance, belief systems, conflict management procedures, social structures infrastructural network, livelihoods, perceptions, and concerns about the proposed project, community's needs, and development prospects.
Rumuomoi community	30/08/2020	Developmental roles of women and the youth, conflict management procedures, infrastructural network, livelihoods, income levels, and expenditure patterns, employment situations in households, perceptions, and concerns about the proposed project, community needs, and expectations, and development prospects.
Rivers State Ministry of Environment	27/08/2020	Regulatory requirements and involvement
Federal Ministry of Environment, Port Harcourt	27/08/2020	Regulatory requirements and involvement

Source: Resourcefield fieldwork 2020

Plate 5.1: Consultation with Rivers State Authorities and FMEnv Teams in the office of The FMEnv

Table 5.3: Consultation Schedule

Stakeholder Group	Stakeholder Name	Done	Ongoing	To be consulted
Government Authorities: National, the regional, and local government of primary political importance to the Project with permitting requirements that must be met by the Project.	Federal Ministry of Environment (FMEnv)	X	X	X
	Ministry of Niger Delta Affairs	X		
	Federal Ministry of Lands and Survey	X	X	
	Federal Ministry of Works and Housing	X	X	
	Rivers State Ministry of Environment	X	X	
	Obio Akpor LGA	X	X	X
	Rivers State Ministry of Rural Development	X	X	
	Office of the Surveyor-General of the state	X		X
	Nigeria Police, Rivers State Command	X		X
	NCDSC, Rivers State Command	X		X
	Rivers State Ministry of Health, Rivers State	X		X
	FRSC, Rivers State Command	X	X	
	Rivers State Ministry of Works	X		X
	Rivers State Office of the Secretary to the State Government	X		X
	Rivers State Government	X	X	X
	Department of State Services (DSS)	X	X	
Local Community(ies) and Neighbouring Land Users	Rumuola	X		X
	Rumuadaolu	X		X
	Rumuomoi	X		X
Non-Government and Community Based Organisations (NGOs and CBOs)	NSE	X		
	AEIAN	X		

5.5 Public Disclosure

As part of the formal regulatory and consultation process, when the draft EIA report is submitted to FMEnv, FMEnv will make a public notice of the opportunity for information and comment on the draft EIA report for the project. This notification is typically done through a newspaper and radio announcement.

The notification will provide:

- a brief description of the project;
- a list of venues where the EIA report is on display and available for viewing;
- duration of the display period; and
- contact information for comments.

The FMEnv generally requires a twenty-one (21) working day display period. Display venues will be decided by FMEnv but could be expected to include:

- FMEnv offices in Abuja;
- Rivers State Environmental Protection Agency (or the Rivers State Ministry of Environment) in Port Harcourt; and
- Obio Akpor Local Government headquarters.

Once the draft EIA report has been submitted to the FMEnv, it will likely be subjected to a review by a panel of experts constituted by FMEnv. The panel would likely comprise experts from within FMEnv as well as external specialists included for their expertise on the specific environmental or social topic. Following the review period, the findings will be presented to the panel, likely to be in the form of a public hearing. The project will then need to take appropriate actions to address these findings and comments received from the panel members on the EIA report. This may include additional studies; revision to the EIA report text to correct or clarify content; or development of additional mitigation measures or management actions.

Upon satisfactory completion of the actions required to address the findings, the draft EIA report will be finalized and the FMEnv will issue the EIA certification/authorization.

5.5 Outcomes of communities' Consultation

The concerns expressed by the host communities are listed below, evidence of consultation with host communities and other stakeholders are also presented in appendix 4 in form of attendance. Some of the photographs taken during socio-economic and community consultation are presented in this section too. At the project consultation/field data gathering meetings with various community stakeholders, community leaders, and members and FGDs several questions, issues and concerns were raised and certain expectations were also discussed by community members across the project impact communities.

Communities' Concerns

- Environmental damage: Most communities fear that the construction activities will destroy the vegetation, cause turbidity in the rivers and affect the water that is used by households for drinking and other purposes.

- Social problems: Introduction and increase in vices like drug use and prostitution, teenage pregnancy, school dropout, and insecurity during project construction.

- Health problems: Increase in the occurrence of STDs and HIV/AIDs.

- Payment of compensation: All compensation due to families and communities for loss of property should be adequately paid before the commencement of the project.

Community Expectations

Expectations of the communities consist mainly of human capital development and the development of infrastructural facilities. They include the following:

- Creation of employment opportunities for residents of the communities.

- Empowerment of community members through skills acquisition, an award of contracts, and provision of scholarships.

- Infrastructural development in communities in terms of provision of potable water, electricity, functional orthodox health care facilities, renovation, and equipping schools, and erosion control projects.

Plate 5.2: consultation with CDA leaders in Rumuadaolu.

Plate 5.3: Group photograph with the Eze of Rumuola

5.6 Institutional consultation

Major stakeholders were also consulted for this project on the 27 August 2020 at Hotel DMATEL in Port Harcourt, Rivers State.

Table 5.3: Specific Expectations from Stakeholders elicited during consultations

ORGANISATION/ GROUPS	Role In Project	Information got from the meeting
FMEnv, NESREA, RSMEnv, and Obio/ Akpor LGA	Regulators defined in the EIA Act	✓ Adequacy of measures ✓ Commitment to support the project or otherwise ✓ Suggestions and recommendations
Rivers State Min of Lands Office of Surveyor-General, Rivers State Physical & Regional Planning	✓ Acquisition of Land ✓ PAP Entitlements ✓ Approval of Building Plans	✓ The land acquisition process for the public project ✓ Commitment to support the project or otherwise ✓ Suggestions and recommendations
Nigeria Police, DSS, and NSCDC	Security and intelligence	✓ The process to ensure the security of personnel, equipment and materials are secured during project Implementation
Federal Road Safety Corps Rivers State Fire Service Vehicle Inspection Office	Ensure traffic flow during mobilization and construction Ensure adequacy of fire preventing and fighting resources	✓ Required permits ✓ Transport management requirements etc ✓ Fire management requirements
Rumuadaola, Rumuola, and Rumuomoi communities	Host Communities (Land, security, etc)	✓ Concerns, fears, and expectations
Rivers State Environmental Protection Agency Rivers State Waste Management Agency	Infrastructure, amenities, and services upgrade and expansion	✓ Adequacy of measures ✓ Commitment to support the project or otherwise ✓ Suggestions and recommendations
Rivers State Ministry of Works	To determine the capacity of existing road networks	✓ The design capacity of the road and bridges
NGOs, CBOs (NSE, AEIAN) Academia	Observance and EIA process witnessing	✓ Adequacy of measures ✓ Commitment to support the project or otherwise ✓ Suggestions and recommendations

Table 5.4: Initial Consultations' Findings

Stakeholder Group	Issues	Solutions
Government authorities	Employment and local benefits	• The Project should provide employment opportunities for local communities who are willing and ready to work as construction workers. • Encourage the communities to work together for long term benefits for all community members.
	Resettlement	• There is a need to pay compensation to property owners who will be affected by the proposed construction.
	Waste	• Develop comprehensive plans for water use and wastewater discharge.
	Scope of the EIA	• The EIA should address the potential health impacts of the project on local communities.
Local communities	Employment and local benefits	• Opportunities in terms of employment and procurement, particularly for local communities and the appointment of CLOs from the project communities
	Community H&S	• The Project will need to plan for the community health risks related to the construction and operation of the projects.
	Livelihoods and resettlement	• The Project needs to thoroughly understand the livelihoods within the area of influence to understand the impacts of the project on local communities

Plate 5.4: A cross-section of stakeholders during community and institutional stakeholders' consultation workshop in Port Harcourt

Plate 5.5: Community consultation with women and men in Rumuomoi community

5.7 GRIEVANCE MECHANISMS

5.7.1 Introduction

During the implementation of the project activities, disputes/disagreements between the project developer and the PAPs may occur especially in terms of compensation, boundaries, etc.

There are great challenges associated with grievance redress especially in a project of this magnitude. The practice of grievance arbitration over resettlement issues in Nigeria is conducted within the framework of the Land Use Act (LUA) of 1978, reviewed under Cap 202, 1990. Two stages have been identified in the grievance procedure: customary mediation and judiciary hearings.

A grievance procedure based on community grievance committees, one per community, will be established for resolution of the disputes and complaints.

5.7.2 CUSTOMARY MEDIATION

Procedures for grievances will be clearly explained during community meetings. At the village levels, a series of customary avenues exist to deal with dispute resolutions. Those avenues should be employed, when and where it is relevant as a "court of first appeal". Such customary avenues will provide a first culturally and amicable grievance procedure that will facilitate formal and/or informal grievance resolution for grievances such as:

- Wrongly recorded personal or community details;
- Wrongly recorded assets including land details and/or affected acreage;
- Change of recipient due to recent death or disability;
- Recent change of asset ownership;
- Wrong computation of compensation;
- Name missed out of register, etc.

A Customary Grievance Redress Committee shall be set up by the project proponent in each community to address complaints from project implementation. This committee will be assisted by the project proponent.

PAPs' complaints should first be lodged verbally or in writing through this process. It is expected that the committee will deal with the grievances they receive within three days of receipt of the complaint. If the complaint cannot be resolved at this level, or if the plaintiff is not satisfied with the settlement proposed, the plaintiff will then be referred to the official legal procedures.

5.7.2 **COURTS OF LAW**

The judicial process under applicable laws will be followed and the law courts will pass binding judgment on the matter.

Figure 10.1 illustrates this grievance redress mechanism.

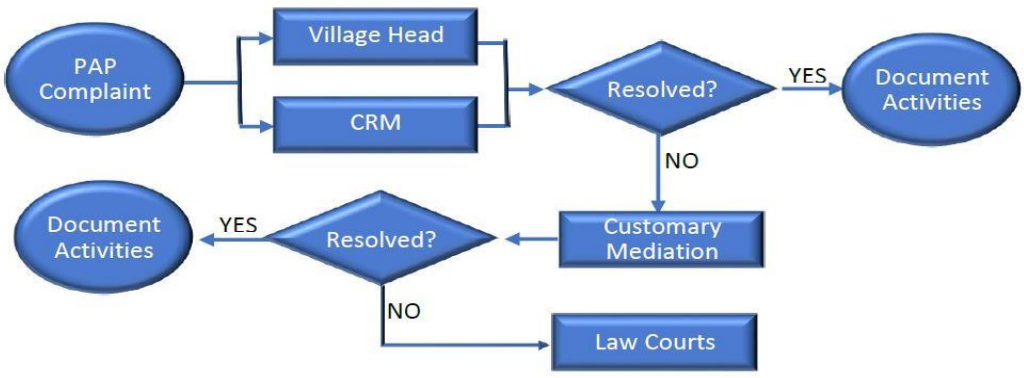


Figure 5.2 Grievance Resolution Procedure

5.8 Future Consultations

The proponent shall continue to consult with the regulatory agencies, the host communities, all stakeholders, and other relevant parties concerned with or are likely to be affected by the project at all stages of project development. At the approval of this ESIA to commence the construction activities, a detailed Memorandum of Understanding (MoU) shall be signed with the affected communities.

5.9 CONCLUSIONS

The community and stakeholder engagement undertaken by the Project fulfils the requirements of the Terms of Reference and is undertaken according to the strategy prepared by the Project. A variety of communication activities and tools were used to seek broad and informed communities and stakeholders' responses, and the issues and opportunities identified through stakeholders' engagement informed the development of the EIA. Specific communication activities undertaken to facilitate effective two-way communications included the Community Information Session, briefings of key stakeholders including government agencies and NGOs, and community-based groups. Throughout the project design and data gathering process, multiple avenues were provided for stakeholders to access information and provide comments and/or ask questions and receive answers. The engagement program engaged the community by:

- attracting approximately major community members to the Community Information Session
- providing briefings to government agencies and Community-Based Organisations (CBOs) and NGOs.
- generating feedback from community leaders and institutional stakeholders.

6

IMPACTS AND MITIGATION MEASURES

6.1 Introduction

This impact assessment involves steps that assess the manner of interaction between the components of the physical, biological, cultural and human environmental receptors/resources and the proposed flyover project, collectively, to produce impacts to these receptors/resources. The impact assessment processes involved in the impact assessment are described in the following sections.

6.2 Impact Assessment

6.2.1 Impact Prediction

The impact assessment process predicts and describes, qualitatively and quantitatively, impacts that are expected to occur for different phases of the proposed flyover/roads project.

The significance of each impact is evaluated by defining and evaluating two key aspects:

- The magnitude of the impact; and
- The sensitivity of the feature or receptor that will be impacted.

6.2.2 Impact Magnitude

Magnitude describes the degree of the change that is predicted to occur in the receptor/resource as a result of the impact. A magnitude rating reflects a combination of the size of an area that may be affected, the size, degree or scale of the impact, and the duration of the impact.

Magnitude of positive socio-economic impacts is usually categorized as Positive except there is enough information available to support a more robust qualification and quantification of magnitude as Small, Medium or Large. For instance, if the number and volume of contracts to be reserved for the local community members is confirmed or if the size or value of those contracts will contribute to the national, State or Local economy is known then a magnitude rating of Small, Medium or Large can be assigned. Otherwise, the significance rating will be based on the sensitivity of the feature impacted by a specific activity or change.

Magnitude encompasses all the characteristics of the predicted impact as defined and designated in Table 6.1.

Table 6.1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	The relationship of the impact with the Project (describes the cause and effect).	Direct Indirect Induced
Extent	The "spread" of the impact (e.g., a long distance of several kilometres or confined to a small space within the Project footprint, etc.).	Local Regional International
Duration	The time over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	a numerical value: no fixed designations
Frequency	A measure of the periodicity or constancy of the given impact.	a numerical value: no fixed designations

Source: Resourcefield, 2020

The evaluation of pre-mitigation impact significance considers control measures that have been built-in into the project design. This avoids the situation where an impact is assigned a magnitude based on a theoretical account of the project that considers none of the built-in controls that are defined as part of the project description. These built-in controls could include sound lessening measures around noisy equipment and buffer requirements the development is obliged to implement and is part of the layout. Additional mitigation measures to further reduce the significance of 'residual' impacts are appropriately proposed where necessary.

In the case of type, the designations are defined generally (i.e., the same definitions apply to all receptors/resources and associated impacts) as provided in Table 6.2.

Table 6.2 Definitions of Designation

Designation	Definition
Type	
Direct	Impacts that result from a direct connection between the Project and a Receptor / resource (e.g., between land-take and the affected structures).
Indirect	Impacts that trail the direct connections between the Project and its environment as a result of subsequent contacts within the environment (e.g., suitability if a traffic diversion route resulting from closure of section of roads as a result of the Project activities in that section of the road).
Induced	Impacts that result from other activities that occur as a result of the Project (e.g., influx of camp followers resulting from the mobilization of a large Project workforce).

Designation	Definition
Extent	
Local	Impacts that affect an area close to the development area within the area of influence of a receptor/resource.
Regional	Impacts occurring at a regional (interstate) scale as determined by political boundaries or which affect regionally important resources or ecosystems.
International	Impacts that transcend national boundaries or affect resources or areas protected by international treaties or conventions.
Duration	
Temporary	Impacts are predicted to be of short duration (in the order of days) and/or intermittent /occasional (e.g., traffic congestion during equipment haulage to site, traffic diversions, increased noise and gaseous emissions from construction equipment).
Short term	Impacts that are predicted to last only for the duration of the construction period - for about 5 years.
Medium term	Impacts that will continue for a period of 5 to 10 years following the commissioning of the project (e.g., where the impact may reverse or affected resources or receptors recover within this period of time).
Long term	Impacts that will continue for the life of the Project, but will cease when the Project either stops operating or is decommissioned, or where the impact may reverse or the affected resource / receptor recovers after 10 or within 20 years following the commissioning of the project.
Permanent	Impacts that cause a permanent change in the affected receptor / resource that lasts beyond 20 years following the commissioning of the project.

For scale and frequency, the features are not allotted standing descriptions, as they are typically numerical measurements (e.g., number of hectares affected, number of times per hour, day, week or month, etc.).

The terminology and descriptions are given for uniformity when these features are described in an impact assessment deliverable. However, it is not a requirement that each of these features be discussed for each identified impact.

To derive the magnitude rating of unintended events (e.g., accidental release of hazardous materials), the likelihood of the occurrence of an impact is considered and it is expressed as a probability and is designated using a qualitative scale (or semi-quantitative, where appropriate data are available), following the qualities described in Table 6.3.

Table 6.3 Likelihood Designations for unplanned events

Likelihood	Definition
Likely	The event will inevitably occur during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.

Likelihood is projected on the basis of experience and/or evidence that such an outcome has previously occurred under similar condition or situation.

Likelihood is a measure of the degree to which the unplanned event is expected to occur, not the degree to which an impact or effect is expected to occur as a result of the unplanned event, and therefore is qualitative and not quantitative.

For impacts from unplanned events, the same receptor/resource-specific approach to arriving at magnitude description is adopted, but the 'likelihood' factor is considered, alongside the other impact features, when assigning a magnitude description.

It is quite tasking to discuss impacts resulting from Project activities and those resulting from unplanned events. This methodology, based on professional judgment, and assisted by quantitative data, incorporates likelihood into the magnitude description (i.e., in parallel with consideration of the other impact characteristics), so that the likelihood-factored magnitude can then be considered with the receptor/resource sensitivity/susceptibility /importance in order to assign impact significance.

Once the impact characteristics are understood, they are used to allot each impact a magnitude. Magnitude is a function of the following impact features:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood.

Magnitude essentially describes the degree of change that the impact is likely to impart upon the receptor/resource. As in the case of extent and duration, the magnitude descriptions themselves (i.e., negligible, small, medium, large) are universally used and across receptors/resources, but the definitions for these descriptions will vary on a receptor/resource basis, as is discussed further below. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;

- Medium; and
- Large.

The magnitude of impacts considers all the various dimensions of a particular impact in order to make a determination as to where the impact falls on the range (in the case of adverse impacts) from negligible to large. Some impacts cause inestimable or imperceptible alterations to the environment or remain within the range of normal natural variations. Such changes can be regarded as having no impact, and are been characterized as having a negligible magnitude.

Sensitivity

The other principal step necessary to allot significance for a given impact is to define the importance/ susceptibility/sensitivity of the impacted receptor/resource to the type of proposed activity (e.g., ROW acquisition, excavation, etc.) or the consequences of a Project activity (e.g., dust, noise and gaseous emissions, traffic diversion, or induced population influx). This requires a range of biophysical, social factors to be considered and may also include other factors such as legal protection, government policy, public perception and economic value.

Classification of sensitivity for a biophysical resource or receptor (e.g., air quality or parameter) considers importance (on a local, national and international scale), its susceptibility to disturbance, and its resilience to recover or withstand a specific impact or type of impact. Where the receptor is social or cultural, the value of that social and cultural heritage receptor/s and its susceptibility to the impact is considered, taking into account the receptor's resilience, including ability to adapt to alteration or employ alternatives where available.

As in the case of magnitude, the sensitivity/susceptibility/importance designations themselves are universally consistent, but the definitions for these designations will vary on a receptor/resource basis. The universal sensitivity/susceptibility/importance designations are:

- Low;
- Medium; and
- High.

Assessing Significance

When the magnitude of impact and sensitivity/susceptibility/importance of receptor/resource has been characterized, the significance of the impact is assigned using the impact significance matrix shown in Table 6.4.

This methodology applies to impacts from unplanned events (e.g., a major oil spill or other event that cannot be reasonably predicted), but likelihood is also considered when assigning the magnitude designation, as classified in Table 6.4.

Table 6.4 Impact Significances

Assessment of Significance		Sensitivity/Susceptibility/Importance of Receptor/resource		
		Low	Medium	High
Magnitude of Impact	Negative Impacts			
	Negligible	Negligible	Negligible	Minor
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Critical
	Positive Impacts			
	Positive	Minor	Moderate	High

The matrix applies to all receptors/resources, and all impacts to these receptors/resources, as the receptor/resource or impact-specific considerations are factored into the description of magnitude and sensitivity descriptions that enter into the matrix. Box 6.1 provides a context for what the various impact significance ratings signify.

The predicted impacts to the physical environment as a result of the flyover project are described In this section.

6.2.2.1 Residual Impacts Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

6.2.2.2 Cumulative Impacts/Effects

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects.

The impact assessment process will predict cumulative impacts/effects to which the Project may contribute. The approach for assessing cumulative impacts and effects resulting from the Project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the 'other' activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

An impact of negligible significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of minor significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude shall be well within applicable standards.

An impact of Moderate significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of Major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e., ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

- Air Quality Impact Assessment
- Impacts on Air Quality Related to Construction Equipment Emissions
- Impacts on Noise and Vibration During the Operational Phase
- Noise and Vibration Impact Assessment

Impacts on Air Quality Related to Construction Dust Emissions

Description of the Baseline Environment

PM10 concentrations (the respirable fraction of dust) measured in the area ranged between 62µg/m3 and 123µg/m3 which exceed the WHO/IFC guideline and FMEnv. emission limits of 50µg/m3 and 60 - 90µg/m3 respectively. The flyover construction activities will increase the levels of dust and related impacts in the environment.

Project Activities

Dust will be generated from the following construction activities:

- Earthworks and ground preparation;

- ❖ On-site concrete batching, handling of friable materials and stockpiling; and
- ❖ Movement of vehicles over open ground, on paved roads and on the surrounding road network.

Demolition of buildings located in the path of the flyover ROW might also result in the generation of toxic materials like asbestos and cement used in their construction.

Dust generation during the operations phase of the project will likely not be significant.

Sensitive Resource / Receptors

During construction, impacts from increased dust levels are expected across the axes of the flyover (at a distance of about 0.2km). The dispersion area of dust emissions will be contingent on the volume and height of aggregated materials stockpile, concentration of machinery and equipment at the site and the capacity of their engines.

Significance of Impact (Pre-mitigation)

From the foregoing, the impact on air quality from construction dust and fumes is a **"Major Negative Impact**" pre-mitigation (refer to Table 6.5).

Residual Impact (Post-mitigation)

Based on the implementation of the proffered mitigation measures the significance of the impact on air quality from construction dust emissions will be a "**Minor Negative Impact**" post mitigation (Table 6.5).

Table 6.5: Rating of Impacts Related to Construction Dust Emissions (Pre – and Post – Migration)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Affect an area in proximity to the construction area	**Emissions associated with transportation of raw materials** • Reducing and / or optimizing the quantities of construction material transported. Management of transport logistics to ensure efficient haulage of raw materials. • Management of voids and compaction of loads to ensure maximum safe payloads are transported. • Reducing vehicle idling times through focus on scheduling of construction operations. • Consider sourcing of materials from suppliers closest to the construction site • Prioritize the use of fuel-efficient transportation vehicles and ensure regular maintenance of vehicles • Consider using a less carbon intensive fuel (e.g., a biofuel blend), although this needs to be considered in the context of availability.	Local	The extent of the impact will not change.
Duration	Short term	Expected to last during the construction period		Temporary	Reduced levels and exposure
Scale	Unknown	Dispersion and coverage area depend on other factors such as wind speed and direction		Unknown	Mitigations will minimize exposure
Likelihood	Will occur	Construction will involve movement of earthworks and using paved roads		Will still occur	Reduced levels and exposure

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			Provide efficient driving guidelines to transportation vehicle drivers, to promote fuel efficiency. **Emissions associated with construction activity** Prioritize the use of fuel-efficient construction vehicles and ensure regular maintenance of vehicles Provide efficient working guidelines to construction vehicle drivers, to promote fuel efficiency. Reducing vehicle idling times through focus on scheduling of construction operations. Consider using less carbon intensive fuel (eg a biofuel blend), although this needs to be considered in the context of availability. Ensuring that on-site power generation is designed, sized and operated for emissions performance as well as reliability. **Operational Mitigation Measures** VIO to enforce the use of fuel-efficient and optimally maintained vehicles in the city		

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Major Magnitude				Minor Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
Moderate Sensitivity Impacts on air quality related to construction dust emissions is considered to have high sensitivity to health of the workers and surrounding communities					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Major Impact				Minor Impact	

Source: Resourcefield 2020

7 6.3.2 Impacts on Air Quality Related to Construction Equipment Emissions

Description of the Baseline Environment

The values of gaseous emissions were below their respective standards with the exception of SO2 and NO_2 which is a product of incomplete combustion of organic materials. The flyover project may cause the increase in concentration of these gases through its fuel combustion engines for power generators or heavy equipment, during the construction phase. Construction activities are expected to contribute to the increase in the levels of these emissions.

Project Activities

Construction Phase

The flyover project construction will likely contribute to combustion air emissions from construction equipment. The construction sites, which will host the construction work force, may be another additional source of air emission, both from onsite generators and during workers shuttle to and from sites.

Operational Phase

The assessment of operational impacts focuses on the potential negative effects of emissions from operational vehicles at sensitive receptor locations surrounding the proposed alignment.

Sensitive Resource / Receptors

The flyover/road project is within a homogenous urban setting of Port Harcourt City. Sensitive receptors include human receptors and buildings in the area.

From the foregoing, the impact on air quality from construction gaseous emissions will be a “Major Negative Impact” pre-mitigation (refer to Table 6.6).

Residual Impact (Post-mitigation)

Based on the implementation of the proffered mitigation measures the significance of the impact on air quality from construction gaseous emissions will be a “Moderate Negative Impact” post mitigation (refer to Table 6.6).

Table 6.6 Rating of impacts Related to Construction Equipment Gaseous Emissions (Pre- and post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Regional	Potential to affect regionally important resources or ecosystems	• JBN shall use vehicles that are compliant with recent emission standards (e.g., EURO Tier 3) shall be used where possible and reasonable and maintain in excellent working condition. • JBN shall ensure that vehicle engines are not idled but turned off, when not in use. • JBN shall audit fuel stations for quality and ensure vehicles are refuelled only from designated fuel stations; • JBN shall ensure machines and engines are maintained and serviced off-site.	Regional	The extent of the impact will not change
Duration	Short term	Expected to last during the construction period)		Temporary	Reduced levels and exposure
Scale	Unknown	Dispersion and coverage area depend on other factors such as wind speed and direction		Unknown	Minimized exposure due to mitigations
Likelihood	Will occur	Construction will involve movement of earthworks		Will still occur	Reduced levels and exposure
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Medium Magnitude				Minor Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
Moderate Sensitivity					
Impacts on air quality related to construction dust emissions is considered to have high sensitivity to health of the workers and surrounding communities					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Major Impact				Moderate Impact	

Source: Resourcefield 2020

Noise and Vibration Impact Assessment

Impacts on Noise and Vibration from Construction Activities

Description of the Baseline Environment

Noise measurements show that the daytime noise levels ranged between 72.1dB (A) and 85.9 dB(A). FMEnv. Standard limits and WHO/IFC guidelines require noise emission levels to be less than 45 dBA during the night (11pm to 7am) and 55 dBA during the day (7am to 11pm) within mixed residential areas. Average noise levels recorded at all the points were generally in exceedance of these standards.

However, during the movement of equipment and machinery, the noise level may exceed 90 dB (A), but this is of short duration.

Project Activities

Noise and vibration impact during the construction phase will arise primarily from the activities at the following locations:

i Active work sites around the flyover project site;

ii Marshalling yards.

Noise and ground vibration impacts can be caused by noise emissions from construction equipment (earthmovers, etc.), and construction vehicles carrying materials and spoil to and from the above-mentioned locations.

Piling, operation of vibratory equipment (e.g., rock borers/drillers and compactors) and blasting are the main sources of vibration during the construction phase. Vibration is likely to disturb the residents of houses that are located near the flyover project alignment, and in extreme situations, risk of damage to the structure of adjacent properties.

The maximum permissible noise levels for quarries, as provided for in the FMEnv is 109 dB(C) for residential buildings and 114 dB(C) for areas of industry, commerce or small-scale production.

Sensitive Resource / Receptors

Receptors include mainly residential buildings, but also other noise sensitive receptors such as health facilities, educational institutions, homes for disabled etc. in surrounding communities which are at varying distances from the construction sites and the ROW throughout the entire flyover alignment.

Significance of Impact (Pre-mitigation)

Following above, the impact from noise and vibration will be a “Moderate Negative Impact” pre-mitigation (Table 6.7).

Residual Impact (Post-mitigation)

Implementation of the proffered mitigation measures will reduce the significance of the impact from Noise and Vibration to a “Minor Negative Impact” post mitigation (refer to Table 6.7).

Table 6.7 Rating of Impacts Related to Noise and Vibration from Construction (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Area potentially affected will be a maximum of about 200m from the flyover sites.	• JBN shall avoid dropping materials from height, where this is possible; JBN shall avoid metal-to-metal contact on equipment, where possible. JBN shall avoid gathering mobile plant near residences and other sensitive receptors; JBN shall provide intermissions in the event of inevitable maximum noise level events; these respite periods shall be negotiated with the relevant local stakeholders. • JBN shall conduct systematic inspection and maintenance of all machinery and vehicles. JBN shall install silencers or acoustic enclosures on machinery, e.g., suitable mufflers on engine exhausts and compressor components; JBN shall resort to the use of hydraulic or electric-controlled units, where possible, as alternatives to diesel and petrol engines;	Local	Area potentially affected will be less than under the unmitigated scenario.
Duration	Short term	Expected to last during the construction period		Short term	Expected to last during the construction period
Scale	Local	Noise impacts will be local but will depend on many factors, such as noise baseline, construction activities, topography and locality of NSRs		Local	Area potentially affected will be less than under the unmitigated scenario.
Likelihood	Likely	Construction noise will occur from construction machinery and equipment.		Likely	Construction noise will occur from construction machinery and equipment.

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			➢ JBN shall when possible, reduce the throttle settings on plant and machinery; and turn off equipment and plant when they are idle; ➢ JBN shall implement speed limits for project vehicles and avoid project traffic routing through community areas; ➢ JBN shall restrict hours of operation for specific equipment or operations; ➢ JBN shall limit noise levels from longer term construction activities to 60 dB LAeq during the daytime, and 35 dB LAeq at night as far as is practicable; ➢ JBN shall inform the public of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for an appropriate representative that could be contacted in the event of a complaint. All complaints shall be managed as part of the flyover projects external feedback and grievance mechanism; ➢ JBN shall monitor noise levels against the set performance criteria;		

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
Magnitude	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			✓ JBN shall provide and enforce the use of appropriate hearing protection personal protective equipment (PPE) to all personnel working in noisy zones; ✓ JBN shall periodically monitor work site and nearby residences (or other sensitive land uses) for noise related issues so that solutions can be efficiently and timeously applied. ✓ JBN shall implement the grievance procedure in the event of any noise complaints being received.		
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Medium Magnitude				Minor Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
High Sensitivity Noise and vibration impacts are considered to have a high sensitivity to noise-sensitive receptors (residential dwellings, hospitals/clinics, schools, churches, etc.), and to nearby structures around the flyover sites					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Moderate Impact				Minor Impact	

Source: Resourcefield 2020

Impacts to the Social Environment

This section assesses the predicted socio-economic, health and (social) impacts (both positive and negative) associated with the flyover project. These include the following:

- Impacts on Land Acquisition and Physical and Economic Displacement;
- Impacts associated with Construction and Operations Traffic Movement;
- Impacts associated with Community Safety and Security;
- Impacts associated with Transmission of Sexually Transmitted Infections;
- Impacts associated with Social Cohesion; and
- Impacts on Labour and Working Conditions.

Impacts on Land Acquisition and Physical and Economic Displacement

Description of the Baseline Environment

The flyover project locations are within the Port Harcourt metropolis. The communities in the study area engage in casual and formal employment, business (trading), land-based income generation comes from property sales, rentals and leases.

Project Activities

Minimal land take is required for the construction of the flyover/road ROW at some points. Some permanent structures will be affected (Plate 6.1). Temporary land take will be required for construction yards and work sites/offices along or near the flyover alignment, and space for storing plant, materials during construction phase. Julius Berger Nigeria PLCs will use its existing facilities for concrete batching plants, aggregate crushing facilities, haulage routes, labour & workforce accommodation, and construction laydown areas and other such facilities. During the operational phase, no land acquisition and physical and economic displacement activities are required.

Plate 6.1: Some affected structures, marked for acquisition for the Flyover/road ROW

Sensitive Resource / Receptors

The legal procedure (valuation of properties and disclosure) for permanent land take is ongoing and compensations shall be paid to eligible asset owners.

Land acquisition for the flyover/road project construction will trigger physical and economic displacement of those land users, causing significant losses of infrastructures, as well as, income generation sources which range from casual employment, formal employment, business (trading).

Significance of Impact (Pre-mitigation)

Households residing in the 5 metre of existing RoW are “Directly” and “Negatively” impacted physical and economic displacement resulting from land acquisition required by the Project.

The acquisition of land is once-off while physical and economic displacement impacts are long-term.

The impact magnitude is considered as “Small”, and receptors sensitivity “High”, considering that, a small proportion of the population are impacted physically and economically.

Given the foregoing, the impact from land acquisition and physical and economic displacement is a “Major Negative Impact” pre-mitigation (Table 6.8).

Residual Impact (Post-mitigation)

Despite the implementation of the proffered mitigation measures the significance of the impact from land acquisition and physical and economic displacement will remain “Minor Negative Impact” post mitigation.

Table 6.8 Rating of Impacts Related to Land Acquisition and Physical and Economic Displacement (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Land users and households within 5 meters of the existing ROW.	• Assessment of alternatives to minimize or avoid displacement; • Identification of affected households and land users that will be affected by physical and / or economic displacement. This shall include a comprehensive mapping process to identify affected areas; • Vulnerability assessment to identify vulnerable households and individuals that may require assistance; • Census and asset inventory to assess compensation measures for those affected and to act as a basis to monitor the success of the RAP;	Local	The impact will be experienced by the land users and resident households along the Project direct footprint. Development and implementation of a Resettlement Action Plan (RAP) developed in line with (Land Acquisition and Resettlement), will target those affected by physical and economic displacement.
Duration	Long-term	While the acquisition of land will be one-off, physical and economic displacement impacts will be long-term.		Temporary	With the implementation of the proffered mitigation measures, affected land users and households will be supported to move to alternative locations as well as receive livelihood restoration support. As such, with RAP implementation, impacts will be experienced temporarily.
Scale	Low	The Project requires land acquisition of less than one-hectare displacing about 50		High	The RAP will target about 500 PAPs (owners and tenants)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
		commercial properties.	• Assessment of eligibility and entitlements for those affected; • Identification of host sites for housing and farmland; • Participatory physical planning for housing, including design of structures, access to water points, sanitation etc.; • Identification of gender differentiated and sustainable livelihood improvement and / or restoration measures (these may include but are not limited to financial literacy training, training on improved farming practices etc.); • Provisional implementation budgets and provisional schedule; and • Reporting and monitoring and evaluation requirements.		
Frequency	Constant	While the acquisition of land will be one-off, impacts will occur permanently for the duration of the land take and physical and economic displacement.		One-off	The compensation was implemented once. Monitoring is required to ensure that households have not become impoverished as a result of displacement.

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Likelihood	Likely	Land acquisition and physical and economic displacement will likely occur.		Likely	The RAP is being implemented by a team of experts in line with national requirements, after a period of time; those affected will adjust to their new locations and benefit from livelihood support measures.
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Small Magnitude				Low Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource High Sensitivity					
A small portion of affected people will be physically displaced. Displacement could lead to long-term hardship and impoverishment if not managed effectively.					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Major negative Impact				Minor Negative Impact	

Source: Resourcefield 2020

6.3 Impacts associated with Transmission of Sexually Transmitted Infections

Description of the Baseline Environment

The annual incidence of HIV in Nigeria among adults, ages 15 to 64 years, is 0.29% (0.40% among females and 0.17% among males). This corresponds to approximately 81,000 new cases of HIV annually among adults, ages 15 to 64 years, in the country.

Also, prevalence of HIV among adults, ages 15 to 64 years, in Nigeria is 5.0% (6.5% among females and 3.5% among males). This corresponds to approximately 1.4 million people living with HIV (PLHIV), ages 15 to 64 years in Nigeria.

The HIV/AIDs prevalence rate is 4.7% for Rivers State.

Project Activities

It is anticipated that during the construction period, the necessary workforce will comprise up to 7,000 people, to be accommodated in construction sites disbursed around the flyover sites.

Construction Phase

The flyover project could result in increased transmission of STIs including HIV/AIDS during construction due to:

In-migration, resulting in the mixing of people with higher HIV/AIDS or STI prevalence rates than the host community, which may promote the transmission of the disease.

Engagement in casual high-risk sexual activity by transport drivers along their routes and at their end destination. Transport drivers typically have higher rates of STIs and HIV/AIDS than the general population.

Increased numbers of CSWs, who may have higher infection rates of STIs and HIV, near construction sites and construction sites.

Presence of a mainly male workforce, with higher purchasing power, who may engage in high risk sexual activities with Commercial Sex Workers (CSWs), in urban centres and close to construction sites.

Workers establishing casual relationships with young girls in communities near the construction sites. This may result in transactional sex or circumstances where the women think they are in some serious pre-marital relationships.

Rise in the prevalence of STIs and/or HIV/AIDS around the flyover sites is a risk to the health of especially the sexually active community, through vertical transmission pathways.

While there is access to treatment for STIs including HIV/AIDS in the communities, it is limited in terms of quality. Also, there are significant taboos around STIs, which may influence people's willingness to access treatment. Lack of access to treatment could affect the long-term health of those who contract STIs other than HIV, including fertility, damage to internal organs and long-term disability or even death.

Increased transmission of STIs including HIV/AIDS has the potential to affect households around the flyover sites but in particular near to the construction sites. However, impacts could spread regionally due to vehicle movements and the presence of CSWs in other towns.

The rise in risk of STIs including HIV/AIDS is long-term, as it can take time for prevalence/ incident rates to return to baseline levels. Furthermore, those infected with HIV/AIDS will have health effects, which will outlive the construction period.

Operations Phase

Once operational, the risk of transmission of sexually transmitted diseases is likely to return to baseline incidence rates although the prevalence rates may remain higher due to any increase in disease transmission during construction.

Sensitive Resource / Receptors

The presence of the workforce and expectations regarding job opportunities creating influx of workers has the potential to create an increase in STI/HIV and other sexual related diseases prevalence in the communities, due to worker-community interactions with young women seeking to better their lives through income generation, or relationships with the workforce (expatriates or Nigerians).

Significance of Impact (Pre-mitigation)

The presence of workforce and the potential for influx are likely to influence an increase in HIV/AIDS and other sexual related diseases, representing a “Negative” impact to the potentially affected people/communities.

This impact is likely to be experienced “Temporarily” during construction phase, affecting local communities around the flyover/road sites. The risk for increased HIV/AIDS and other sexual related diseases is considered “Occasional”.

Being the Project workforce accommodated in campsites distributed along the proposed flyovers/road during the construction phase, it is expected to have the potential to create a significant increase on HIV/AIDS and other sexual related diseases prevalence.

Therefore, the impact magnitude is considered “Large”, considering the direct footprint of the Project. Community sensitivity is also considered “High”.

From the foregoing, the impact from increases in HIV/AIDS and other sexual related diseases will be a “Critical Negative Impact” pre-mitigation (Table 6.9).

Residual Impact (Post-mitigation).

Implementation of the proffered mitigation measures will reduce the significance of the impact from “Critical Negative Impact” to “Major Negative Impact” post mitigation (Table 6.9).

Table 6.9 Rating of Impacts Related to Increased HIV/AIDS and Other Sexual Related Diseases (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Impacts are likely to affect people in communities affected by the proposed flyover project, where the majority of construction activities will occur.	• JBN shall partner with NGOs and CBOs to support the provision of information, education and communication campaigns around safe sexual practices and transmission of STDs. These activities shall be focused in locations where construction sites are located or where drivers (construction and supplier drivers) rest. • As part of STI Management Plan, information shall be provided to workers on STI prevalence rates in Nigeria and/ or the relevant Authorities as well as the expectations of local communities if a woman is made pregnant by a worker (e.g. marriage, financial implications etc.). • Workers shall have access to confidential health care for the treatment of STIs through medical facilities/ health care at flyover project sites. • JBN shall consult with local leaders such as Chiefs and village elders, amongst others. The consultations shall be aimed at finding ways of ensuring social vices such as prostitution are minimized either through punitive or rehabilitative measures for the CSWs and their clients.	Local	Impacts are likely to affect people in communities affected by the proposed flyover project., where the majority of construction activities will occur.
Duration	Temporary	Impacts are likely only to be experienced during peak construction periods, when the number of workers and activities is at the highest.		Temporary	Impacts are likely only to be experienced during peak construction periods, when the number of workers and activities is at the highest.
Scale	High	The impact is likely to affect a significate number of people in communities affected by the proposed flyover project.		Medium	With the implementation of the proffered mitigation measures, the impact is unlikely to affect a significate number of people in communities affected by the proposed flyover project.
Frequency	Occasional	The risk for increased HIV/AIDS and other sexual related diseases will be constant		Occasional	The risk for increased HIV/AIDS and other sexual related diseases will be constant throughout the

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
		throughout the construction. However, it is likely to occur occasionally.	Development of a Code of Conduct / rules for worker-community interaction and on-site behaviour.		construction. However, it is likely to occur occasionally.
Likelihood	Likely	The risk for increased HIV/AIDS and other sexual related diseases is likely to occur during construction phase, affecting communities and Project workforce.	• JBN shall develop an STI Management Plan designed to minimize the spread of HIV infection and other STIs. The plan shall be prepared with the assistance of a specialist in sexually transmitted diseases. A typical plan would include, among other things, the following measures: a. An HIV/AIDS training course and on-going education on transmission of HIV/AIDS and STDs, to employees, through workshops, posters and informal information sessions; b. Encouragement of employees to determine their HIV status; c. Supply of condoms/ femidoms at the construction site(s); and d. Development of a comprehensive Construction Camp Management Plan, including rules for on-site behaviour, entrance and exit policies and prohibition of sex workers on site.	Unlikely	With the implementation of the proffered mitigation measures the increase on HIV/AIDS and other related diseases is unlikely to be experienced by communities and Project workforce

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			• A Grievance Mechanism shall be developed, whereby affected people can raise issues and concerns associated with social vices, prostitution and the behaviour of workers and drivers.		
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Large Magnitude				Medium Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
High Sensitivity The impact of increased HIV/AIDS and other sexual related diseases have the potential to affect a significant number of people around the flyover sites.					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Critical Negative Impact				Minor Negative Impact	

Source: Resourcefield 2020

6.4 Impacts associated with Community Health and Safety and Security, including Construction and Operations Traffic Movement

Description of the Baseline Environment

Crime incidents include non-violent property crime and non-violent street crime. Street crime is rampant in urban areas. Most incidents of crimes are opportunistic, targeting people carrying bags, backpacks, smart phones, computer cases, cameras, or pocketbooks.

Around the flyover project sites, common crimes include burglary, mugging and theft of cars, and kidnapping for ransom were also reported. High-risk areas for most crimes are within crowded locations. In-migration, lack of employment and idleness particularly in the youth, as well as the high levels of poverty were blamed for most of the crimes.

Project Activities

There is the potential for protest against the flyover/road project in the future, should the community perceive their expectations have not been met (such as employment opportunities) or dissatisfaction with elements of the project (such as land acquisition).

There is a potential risk of site trespass at work fronts for the duration of construction. Work fronts will not be fenced routinely although signage will be erected. Site trespass could result in accidents leading to injuries or even fatalities especially due to the presence of large pieces of machinery. Also, there is a risk/temptation of theft due to the relatively poor economic situation in the communities. Young people and children are most likely to trespass onto sites and are most at risk of getting injured.

Security personnel will be deployed at the site to protect assets and prevent unauthorized persons entering restricted areas. In the event of protests, trespass or other actions by community members or other stakeholders there is the potential for unlawful or abusive interaction between security guards and community members especially if site security personnel are not adequately trained.

Sensitive Resource / Receptors.

Community safety and security risks have the potential to impact project workforce and communities on the direct footprint of the flyover/road project in the LGAs.

Significance of Impact (Pre-mitigation)

From the foregoing, the impact from community safety and security incidents will be a “Moderate Negative Impact” pre-mitigation (Table 6.10).

Residual Impact (Post-mitigation)

Implementation of the proffered mitigation measures will reduce the significance of the impact from the significance of the impact to community safety and security to a “Minor Negative Impact” post mitigation (Table 6.10).

Table 6.10 Rating of Impacts Related to Community Safety and Security (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Impacts are likely to affect workforce and communities around the flyover sites, where the majority of construction activities will occur.	• Driving rules (e.g., speed limits, hours of driving, required breaks, carrying passengers and use of mobile phones/ radios); • Driver qualifications and selection (e.g., defensive driving courses, accident history and 'practical' interviews to test skills); • Driver education and training (awareness raising, information on required standards and review of incidents); • Vehicle inspection and maintenance (in line with international standards for vehicle roadworthiness); • Accident/ incident reporting and investigation; and -disciplinary procedures. **JBN shall ensure that all driver candidates meet specific requirements, including but not limited to:** • Possessing a valid license to drive each type/class of vehicle required; • Minimum 2 years driving experience; • An accident-free driving record; • Pass an eye chart exam; and	Local	Impacts are likely to affect workforce and communities around the flyover sites, where the majority of construction activities will occur.
Duration	Long-term	Impacts are likely to be experienced during Project construction and operational phases.		Long-term	Impacts are likely to be experienced during Project construction and operational phases.
Scale	Medium	The impact is likely to affect a significant number of workforce and communities around the flyover sites		Low	With implementation of the proffered mitigation, measures such impacts will have the potential to affect a small

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			• Attend and complete the EPC Contractor driver safety education and training course. • During the construction phase, arrangements and routes for unusual/ wide loads (if required) shall be agreed in advanced with the relevant authorities, and the appropriate permit shall be obtained for the use of public roads. **Community Traffic Awareness:** • JBN shall conduct a continuing traffic safety awareness campaign during the construction period, particularly in those communities where construction vehicles will be most active. The awareness training shall be repeated in communities as construction moves into their areas. • JBN shall undertake mass transport of workers in the safest way possible; this will include movement of workers to construction areas as part of mobilization and daily movements from camps to worksites. **Injuries to Community Members:**		portion of workforce and in communities affected by the proposed flyover project.
Frequency	Occasional	The number of incidents that can occur are likely to be occasional.		Occasional	The number of incidents that can occur are likely to be occasional.
Likelihood	Likely	Community safety and security incidents are likely to occur during construction and operational phases of the Project.		Unlikely	With the implementation of the proffered mitigation measures, community safety and security, incidents are unlikely to occur during construction and operational

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			• In the event of an accident in which a community member is harmed, JBN shall assume the responsibility for transporting the injured person to an appropriate health facility capable of dealing with the injuries, and shall cover the cost of the person's medical treatment. • Accident reporting and investigation procedures shall be developed to determine root causes and identify corrective measures to reduce the risk of the accident happening again. • A Grievance Mechanism shall be developed, whereby affected people can raise issues and concerns associated with vehicle movements, driver behaviours and report accidents or damage to property they feel are caused by flyover project vehicles. • JBN security shall comply with Nigerian laws and regulations as well as the requirements of the Voluntary Principles for Security and Human Rights. The security shall include, among other things, selection or personnel based on a careful background screening, training with regards to human rights requirements, and monitoring of performance. • JBN shall implement a Security Management Plan containing measures to protect the flyover/road project		phases of the Project.

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			facilities and personnel against potential violent protest or social unrest and to train security personnel in safeguarding of community human rights. • High-risk or value elements of construction sites shall be fenced to minimize the risk of trespass and robbery. In addition, clear and visible signage shall be put in place where appropriate to advise community members of the risk of site trespass. • Sensitize local community members prior to the commencement of the construction phase so that they are aware of presence and role of security guards, the risk of site trespass and how to interact with the flyover/road project in the event of any concerns or issues. • JBN shall consult with local leaders such as Area Chiefs and village elders. The consultations shall be aimed at finding ways of ensuring site trespass and robbery are minimized either through punitive or rehabilitative measures. • JBN shall implement the grievance mechanism to address any security and safety related grievances. Raise awareness to communities regarding the Grievance		

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			Mechanism to deal with community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the Community Liaison Officers (CLOs) who will be present at the flyover project sites pre and during construction.		
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Medium Magnitude				Small Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
Medium Sensitivity A significate number of the populace and Project workers along the proposed flyover, could potentially experience impacts on community safety and security.					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Moderate Negative Impact				Minor Negative Impact	

Source: Resourcefield 2020

6.5 Impacts associated with Social Cohesion

Description of the Baseline Environment

Development of infrastructure such as the flyover/road attracts an influx of people from different parts of the country and from outside the country, to play their diverse roles in the project. The people within the State also move for different reasons, such as better business opportunities, job opportunities etc.

Project Activities

The flyover/road project will require a workforce for its construction activities. It is anticipated that during the construction period the workforce will comprise up to 180 people, skilled and unskilled. It is currently estimated that 80% of the workforce will be local Nigerians and 20% expatriates. The presence of the Project will attract Nigerians from different States and communities in the pursuit of employment opportunities.

Non-local workers, both Nigerian and third-party nationals are brought into the flyover/road construction sites through a managed process of recruitment and transportation. In addition to the directly hired project labour, it is also possible that people would move towards the construction sites in the hope of finding work directly with the Project, or to gain benefit from the indirect economic opportunities that the Project may bring, such as selling goods or services to the Project or its workforce. Such influx would be unmanaged but is unlikely to be significant due to its relatively short construction phase in any one location; and proactive recruitment and local content measures.

Notwithstanding, any migration is likely to place additional pressure on the limited services and infrastructure in the local settlements and can also contribute to the expansion of negative social vices (alcoholism, use of drugs) and petty crime (theft).

There is a high degree of hope that the flyover project will bring local, state and national benefits. The main expectation for benefits is access to employment opportunities, improvements to infrastructure, and delivery of Corporate Social Responsibility (CSR) Projects. Due to the extent of these expectations, there is potential for unmet expectations especially if workers from other parts of Nigeria are on site. Moreover, employment will need to be shared between communities around the flyover sites and that any CSR activities will be proportionate to the scale of the Project.

Infrastructure Projects often raise intracommunity and intercommunity conflicts. The causes of such tensions include:

- Absence of adequate community engagements with, guaranteeing that everyone has access to information, and not just community leaders;
- Actual or perceived inequitable distribution of negative impacts and / or benefits;
- Land take and compensation payments especially where there are unclear boundaries and perceptions of winners and losers; and

- The simple stress of change and of interacting within the community and with the Project. Often factors such as short timelines for decisions, lack of information, or lack of clarity of such information exacerbate these tensions.

Despite limited tensions and conflicts being reported as part of the baseline, going forward there is potential for increased tension with the Project and between communities, in particular around benefits and access to compensation. This will be particularly true if there appear to be gatekeepers controlling access to benefits, which may include those who are supposed to represent their communities.

Sensitive Resource / Receptors

Within the general context of susceptibility some households are more vulnerable and include:

- Single person households composed of widows and/or elderly women;
- Persons with disabilities or incapacitating diseases;

These groups would be less able to adapt to changes in social cohesion and are less likely to be able to access development benefits associated with the Project.

Significance of Impact (Pre-mitigation)

The impact on influx/ community cohesion will be “Direct” and “Negative” affecting the communities along the direct footprint of the Project.

The impact will be “Short-term” lasting during the construction phase. With that, the impact magnitude on influx is considered “Medium” and receptors sensitivity is considered “High”. From the foregoing, the impact from influx/community cohesion will be a “Moderate Negative Impact” pre-mitigation (Table 6.11).

Residual Impact (Post-mitigation)

Implementation of the proffered mitigation measures maintain the significance of the impact from influx/ community cohesion as a “Low Negative Impact” post mitigation (Table 6.11).

Table 6.11 Rating of Impacts Related to Influx / Community Cohesion (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	The impact will affect communities along the Project direct footprint.	• JBN shall consult with local leaders such as Chiefs and village elders, amongst others. The consultations shall be aimed at finding ways of ensuring social cohesion is maintained and that people have equal access to development benefits. • JBN shall implement the grievance mechanism to address any grievances related to social cohesion and equitable sharing of benefits including recruitment of employees. • **Information Meetings:** Information meetings shall be held with Local Government and community leadership, explaining the negative impacts of population influx, the company's recruitment policy and verification process for appointing only local people for unskilled work, harnessing their support to reduce influx of work and opportunity seekers. • All unskilled employment shall be from affected communities. Fair and transparent selection processes shall be developed and communicated. • Community leaders and residents may have expectations that the proposed flyover/road project will play a supporting and developmental role within the area and that JBN shall have other positive economic benefits. To encourage realistic expectations, close communication shall be maintained between local communities and the flyover/road project to manage such expectations; and	Local	The host communities of the proposed flyovers will experience the impact.
Duration	Short-term	Impacts of influx/ community cohesion will be felt mainly during the construction phase, where influx of people looking for employment opportunities can be verified.		Short-term	With the implementation of the proffered mitigation measures potential affected communities, will be supported to ensure that such impacts will be experienced in a reduced scale.
Scale	Medium	People influx have the potential to interfere with current socioeconomic conditions along the communities crossed by the flyover alignment.		Medium	With the implementation of the proffered mitigation measures such impacts will only be experience in a reduced scale.
Frequency	constant	The impact will be constant mainly during the construction phase as a result of people		Occasional	The impact will be occasional mainly during the construction phase because of people

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
		looking for employment opportunities.	• JBN shall communicate its recruitment strategy early and broadly to minimize opportunistic migration this shall include: A. No hiring of job seekers on site or at the gate; B. No procurement on site or at the gate; C. Employment selection shall involve local leadership to verify people are from the area; and D. Maximizing local content in procurement i.e. from local people and towns, whenever possible, and whenever project requirements are met.		looking for employment opportunities.
Likelihood	Likely	Influx and its effects on community cohesion are likely to occur.		Unlikely	With the implementation of the proffered mitigation measures, negative impacts from people influx and its effects on community cohesion are unlikely to occur.
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Medium Magnitude				Small Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
High Sensitivity Communities crossed by the proposed flyovers have the potential to suffer impacts from influx of people looking for employment opportunities during the construction phase.					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Moderate Impact				Minor Negative Impact	

Source: Resourcefield 2020

6.6 Impacts on Labour and Working Conditions

Description of the Baseline Environment

According to the European Foundation for the Improvement of Living and Working Conditions (2012), whilst labour laws have influence in Nigeria with regards to minimum standards, the actual working conditions are often not in line with the legal provisions. The substance of labour law is often undermined and employees are subjected to conditions well below the specified minimum working conditions.

Project Activities

Construction Phase

Workers' rights including occupational health and safety are considered, to avoid accidents and injuries, loss of man-hours, labour abuses and to ensure fair treatment, remuneration and working and living conditions. These issues are considered not only for those who are directly employed by the Project, but also their sub-contractors and those within the supply chain.

Worker Health and Safety

Worker health and safety is a significant hazard area with the potential for accidents that may result in injuries and potentially fatalities as well as lost manhours. Employees working informally and those with limited or without awareness of their rights, like new labour market entrants, are most likely to suffer. Many national companies may currently not meet international safety requirements and standards but it is expected that reputable Julius Berger Nigeria PLCs, if monitored, will meet these conditions for the local labour force, as they do for expatriates.

Worker Rights

The labour laws in Nigeria are generally in line with international labour laws and Nigeria has ratified the eight cores International Labour Organisation (ILO) conventions:

i. Forced Labour Convention, 1930 (No. 29);
ii. Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87);
iii. Right to Organize and Collective Bargaining Convention, 1949 (No. 98);
iv. Equal Remuneration Convention, 1951 (No. 100);
v. Abolition of Forced Labour Convention, 1957 (No. 105);
vi. Discrimination (Employment and Occupation) Convention, 1958 (No. 111);
vii. Minimum Age Convention, 1973 (No. 138); and
viii. Worst Forms of Child Labour Convention, 1999 (No. 182).

However, the implementation of workers' rights is unlikely to be fully aligned with these requirements. Enforcement of laws is also often limited. There is therefore a risk that some subcontractors/ suppliers on the flyover project alignment may not be fully compliant with Nigerian legal requirements related to labour conditions.

Child- and forced labour may happen in the supply chain mainly in provision of food supplies although they are unlikely to occur with Julius Berger Nigeria PLCs and the subcontractors. However, gender discrimination is likely to occur as women are generally not employed in construction activities and may not be selected by contractors.

Sensitive Resource / Receptors

Sensitive receptors for this impact will be mostly unskilled Project employees who have a poor understanding of Occupational Health and Safety (OHS) standards and their labour rights as provided in the law.

Significance of Impact (Pre-mitigation)

During construction and operation phases, workforce can be subject to poor labour and working conditions representing a “Negative” impact, if not properly managed. Poor labour and working conditions have the ability to create delays to the project, cause reputational risk and create poor worker.

Additionally, poor occupational health and safety can cause injury or fatalities. The impact is “Local” and remains throughout the Project development, being a “Long-term” impact.

The workforce will comprise up to 180 workers during its construction phase; therefore, the magnitude is considered “Large”. Receptors susceptibility is considered “High”. From the foregoing, the impact from labour and working conditions will be a “Major Negative Impact” pre-mitigation (Table 6.12).

Residual Impact (Post-mitigation)

Implementation of the proffered mitigation measures will reduce the significance of the impact on labour and working conditions to a “Moderate Negative Impact” post mitigation (Table 6.12).

Table 6.12: Rating of Impacts Related to Labour and Working Conditions (Pre- and Post-Mitigation)

Type of Impact					
Direct Negative Impact					
Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Non-compliant labour and working conditions can cause delays to the project, cause reputational risk and create poor worker. Also, poor occupational health and safety can cause injury or fatalities.	**Sub-Contractor and Supplier Management** • Subcontractor and Supplier Contracts shall make explicit reference to the need to abide by Nigerian law, international standards (in particular IFC PS 2) and the ratified ILO conventions and the RMW's policies relating to health and safety, labour and welfare standards. • As part of the subcontractor and supplier selection process, EPC Contractor shall take into consideration performance with regard to worker management, worker rights, health and safety as outlined in Nigerian law, international standards and the Proponent's policies. • JBN shall provide support to sub-contractors and suppliers to ensure that labour and working conditions are in line with Nigerian legislation, awareness raising and information provision, as necessary. • Regular checks / audits by JBN shall be undertaken to ensure the relevant labour laws are adhered to at all times. **Workers' Rights**	Local	Non-compliant labour and working conditions has the ability to create delays to the project, cause reputational risk and create poor worker. Additionally, poor occupational health and safety can cause injury or fatalities.

Type of Impact					
Direct Negative Impact					
Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Duration	Short-term	The risk will last only during the construction period of 12 months.	• EPC Contractor shall ensure no employee or job applicant is discriminated against on the basis of his or her gender, marital status, nationality, ethnicity, age, religion or sexual orientation. • All workers (including those of subcontractors) shall, as part of their induction, receive training on worker rights in line with Nigerian legislation to ensure that positive benefits around understanding labour rights are enhanced. This process shall be formalized within the Code of Conduct that would be provided by JBN. • All workers (including those of subcontractors and suppliers) shall have contracts, which clearly state the terms and conditions of their employment and their legal rights. These contracts shall be aligned with Nigerian labour law, the ILO core conventions and the requirements of IFC PS2. Contracts shall be verbally explained to all workers where this is necessary to ensure that workers understand their rights. Contracts shall be in place prior to workers leaving their home location if applicable. • JBN shall put in place a worker grievance mechanism that shall be accessible to all workers, whether permanent or temporary, directly or indirectly employed. The worker grievance mechanism shall be open to JBN and the subcontractor workforce in the event that their grievance is not	Short-term	The risk will remain only during the construction period of 12 months.
Scale	Medium	The impact is likely to affect significant proportion of the workforce.		Low	With implementation of the proffered mitigation measures, such impacts will have the potential to affect a small portion of workforce.
Frequency	Constant	The risks associated with poor labour and working		Occasional	The number of incidents that occur are likely

Type of Impact					
Direct Negative Impact					
Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
		conditions could be constant.	adequately resolved by their direct employer. JBN would then have the authority to act to resolve this grievance. • All workers (including those of JBN and the subcontractor) shall have access to training on communicable diseases and STIs and community interactions in general. • Accommodation shall be provided to workers in accordance with international good practice on workers' accommodation, including IFC standards to prevent transmission of diseases associated with poor living conditions. • JBN shall undertake surveillance and assurance that no children or forced labour is employed directly, and to the extent possible by third parties related to the flyover project and primary suppliers where such risk may exist. • JBN shall develop and implement a program of up-skilling, training and development for workers to assist them in accessing opportunities associated with the flyover project and in finding work following completion of their contracts.		to be occasional with the implementation of the proffered mitigation measures.
Likelihood	Likely	Community safety and security incidents are likely to occur during construction and operational phases of the Project.		Unlikely	With the implementation of the proffered mitigation measures, community safety and security, incidents are unlikely to occur during construction and operational

Type of Impact					
Direct Negative Impact					
Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
					phases of the Project.
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	
Large Magnitude				Low Magnitude	
Sensitivity/Susceptibility/Importance of the Receptor/resource					
Medium Sensitivity The estimated workforce of the project comprises up to 180 workers. Those workers can be largely impacted if no proper labour and working conditions are in place.					
Significant Rating Before Mitigation					
Pre-mitigation				Post-mitigation (Residual)	
Major negative Impact				Moderate Negative Impact	

Source: Resourcefield 2020

Royalties, Taxes and Inflation during Construction

The establishment of independent worker housing will restrict the negative economic impacts associated with construction projects, such as inflation in local housing prices or the cost of basic goods.

The impacts of royalties, taxes and profit-sharing are positive impacts to net economic contribution: the flyover/road project will pay a number of permitting fees and taxes during the construction phase and most of the monetary benefits from taxes and fees accrue at the national, state and LG levels.

Skills Upgrade during the Construction Phase

During construction, there will be opportunity for construction workers and subcontracting firms to have on-the-job training which would boost individual and corporate competence, experience, expertise and skills upgrades and this would qualify them for similar or more demanding jobs in future.

Employment and Economic Benefits during the Operations Phase

Employment opportunities, though limited, will be created during operation of the flyover/road, at stations, and in the maintenance of the flyover project, with potential localized benefits. Also, there will be reduced travel and haulage times for passengers and goods, with the attendant economic benefits.

Sensitive Resource / Receptors

The host communities are considered to be highly favourable as they have the basic qualifications to work in the Project.

Those who will be least able to take advantage of opportunities include the elderly who are less able to carry out the tasks required, and women.

Economic and employment opportunities have the potential to impact communities and local suppliers on the direct footprint of the flyover/road project.

Significance of Impact (Pre-mitigation)

During construction the use of local workforce, as well as, local goods and services suppliers will create a “Positive” impact on local individuals, households and business.

The impact will “Directly” have a positive effect where individuals that are hired through Project or Julius Berger Nigeria PLC, and an induced impact on local businesses catering for the needs of the workforce.

The impact will be “Short-term” mainly felt during construction phase, according to the need for workers, goods and services. Considering the creation of up to 180 job opportunities the magnitude is classified as “Large” and the receptors sensitivity “High”.

From the foregoing, the impact from economic and employment opportunities will be a “High Positive Impact” pre-mitigation (Table 6.13).

Residual Impact (Post-mitigation)

Implementation of the proffered mitigation measures will retain the significance of the impact on economy and employment opportunities as a “High Positive Impact” post mitigation (Table 6.13).

Table 6.13 Rating of Impacts Related to Economy and Employment (Pre – and Post Mitigation)

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Design ation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Extent	Local	Job creation and use of local suppliers of goods and services will create a positive impact on some individuals, households and businesses in the local communities crossed by the flyover alignment.	•JBN shall prioritize the recruitment of workers and procurement of goods and services locally, then nationally. This will not apply to the provision of highly technical equipment. •JBN shall develop a fair and transparent employment and procurement policy and processes to avoid any potential for nepotism or favouritism. The policy shall be shared with the local community members and leadership. •A Local Recruitment Procedure shall be developed by JBN which outlines the percentage of skilled, semi-skilled and unskilled employment that shall be sourced from the communities and LGAs around the flyover sites. For unskilled workers, this target shall be set as high as possible, i.e., at least 90%. The procedure will also include requirements for recruitment of	Local	With the implementation of the proposed enhancement measures, impacts will be better reflected in the local individuals, households and businesses.
Duration	Short-term	The impact will be felt mainly during the construction phase.		Short-term	With the implementation of the proposed enhancement measures, impacts will be better

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Design ation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
			vulnerable groups (women, indigenous people and disabled workers) to ensure equal opportunities, involvement of local Chiefs in ensuring local employment is achieved, no hiring of workers at the gate etc. The requirements of this procedure will form part of the Conditions of Contract with sub-contractors. •JBN will notify identified representatives of the Local Government (i.e. the Location Chiefs) of the specific jobs and the skills required for the flyover/road project, prior to the commencement of construction phase. This will give the local population time to prepare and apply for the available job opportunities on time. This is mainly applicable to unskilled and semi-skilled workers who will be locally sourced.		reflected in the local individuals, households and businesses.
Scale	Local	The impact will be felt in some households in local communities and business around the flyover sites.		Local	The impact will be felt in some households in local communities and business around the flyover sites. The implementation of the proposed measures will enhance their effects.

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Designation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
Frequency	Occasional	Benefits will be experienced mainly during construction phase, as the need for workers, goods and services will be high. During operational it will be experienced in a reduced scale.	•Employment and procurement opportunities will be publicly advertised in appropriate newspapers, public libraries, Local Government Council secretariats, and Chiefs' Offices and in all relevant languages in a timely manner, to allow fair competition. •There will be no requirement for applicants to make payments for applying for, or securing employment on the proposed flyover project. •JBN shall ensure that recruitment procedures are transparent and monitored to ensure that those recruited present their actual experience, geographical location, health status, and age and that requirements for local employment are being met. •JBN shall develop and implement a program of up-skilling, training and development for workers to assist them in	Occasional	The implementation of the proposed measures will enhance the benefits from economic and employment opportunities.
Extent	Local	Job creation and use of local suppliers of goods and services will create a positive impact on some individuals, households and businesses in the local communities		Likely	Implementation of the proposed measures will enhance Project benefits on individuals, households and business.

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Design ation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
		crossed by the flyover alignment.	accessing opportunities associated with the flyover project and in finding work following completion of their contracts. •JBN shall provide training on health and safety and quality standards required by the flyover/road project for provision of goods and services to the flyover/road project to ensure that local businesses have the opportunity to benefit. •JBN shall ensure that contracts are unbundled to allow a number of small businesses to provide goods and services rather than the supply being monopolized by one larger sub-contractor.		
Magnitude					
Pre-mitigation				Post-mitigation (Residual)	Pre-mitigation
Large Magnitude				Large Magnitude	Large Magnitude
Sensitivity/Susceptibility/Importance of the Receptor/resource					
High Sensitivity					

Type of Impact					
Direct Negative Impact					
Rating of Impacts					
	Pre – mitigation			Post – Mitigation (Residual)	
	Design ation	Summary of Reasoning	Mitigative Measures	Designation	Summary of Reasoning
The project will create up to 180 employment opportunities during its construction phase, creating linkages with local economy by the supply of goods and services.					The project will create up to 120 employment opportunities during its construction phase, creating linkages with local economy by the supply of goods and services.
Significant Rating Before Mitigation					Significant Rating Before Mitigation
Pre-mitigation				Post-mitigation (Residual)	Pre-mitigation

Source: Resourcefield, 2020

7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 Introduction

An EMP is an organizational programme used in the management of operations to ensure environmental sustainability. It is the component of an EIA that provides the procedures and processes that can be incorporated into an organization's activities to measure and check on a continuous mode, the compliance with statutory requirements and the effectiveness of mitigation measures recommended for the identified negative impacts of a project.

This EIA, having identified the key environmental and socioeconomic aspects, potential impacts and mitigation measures associated with the project, will serve as a basis for the Environmental Management Plan (EMP).

This EMP is based on ISO 14001 standards and is divided into the following sections:

i. Leadership and Commitment.
ii. Training, Awareness and Competence.
iii. Communication.
iv. Operational Control.
v. Environmental and Waste Management Approach.
vi. Safety and Health.
vii. Emergency preparedness and response.
viii. Management of Socio-Economic Impacts.
ix. Institutional Arrangement for EMP.
x. Monitoring and Measurement.
xi. Environmental Audit.

7.2 Leadership and Commitment.

RVSG is committed to the implementation of the EMP of the proposed flyover/road project. They shall demonstrate visible commitment to HSE management to enhance the credibility of the HSE policies and objectives. This commitment means providing resources to develop, operate and maintain the HSE-MS and to adhere to the policy and achieve objectives.

7.3 Training Awareness and Competence

RVSG shall pay deliberate attention to Training, awareness and competence of staff. They shall identify training needs and ensure that all personnel whose work has impact on the environment receive appropriate training on a continual basis knowing that real progress is possible only when everyone is kept informed of the policy and trained to implement required actions.

With regard to the training of all categories of staff on environmental awareness and competence, RVSG, shall put the following arrangements in place:

- Training of Heads of Departments who in turn shall train their functional heads and supervisors, who shall in turn train the operators
- Budgetary provision for participation of staff in periodic seminars organized by environmental consultants, government agencies and similar bodies.

7.4 Communication

With regard to the dissemination of information relating to the environment between the various levels and functions of the corporation, RVSG will establish and maintain information, in paper and/or electronic form, to describe the core elements of its policy on environment, and make the retrieval of such information available to all concerned staff.

RVSG recognizes effective communication as an HSE management tool aimed at:

- Informing staff, sub-contractor staff and others about the company HSE policy, objectives and target
- Emphasizing the importance to staff of complying with the HSE policy and objectives and other individual roles and responsibility in achieving it.
- Disseminating information about HSE risk and hazard.
- Obtaining feedback as evidence of implementation and as a tool for corrective action and improvement.

Communication shall be carried in appropriate language to achieve understanding. The Project Management Team shall maintain external communication with relevant stakeholders/governmental agencies. Daily toolbox meetings, weekly operational meeting, monthly and quarterly HSE meetings shall be the basic media of communication in addition to any other safe means of communication that may be adopted.

7.5 Operational Control

The Project Manager shall have overall responsibility for environmental matters and shall be assisted by the Project HSE Officer. There shall be an Environmental Unit consisting of personnel from departments/sections whose activities have a bearing on the environment. The Unit shall meet periodically to review the environmental performance of the flyover/road project.

8 7.5.1 Accidents and Contingency Plan

The Project Manager shall be responsible for all emergencies and contingency response. All emergencies shall be addressed to him or, in his absence, to **the HSE Officer.** The Project Manager shall telephone the nearest State Emergency Response Agency, the Fire Service, the Police Command, FMEnv, and the National Environmental Standards and Regulations Enforcement Agency (NESREA) as the case at hand may require.

9 7.5.2 Monitoring of Operations

a. **The Project Manager** assisted by the HSE Officer shall monitor and measure on a regular basis the key environmental characteristics of the proposed project.

b. He shall keep a record of the status of the projects' compliance with national environmental legislations and regulations.

c. He shall establish and maintain a periodic programme of "checks and corrective action".

d. He shall periodically disseminate information relating to the environment among all relevant departments of the Project implementation.

e. He shall store all data relevant to the environment so that they are easily retrievable.

7.6 Environmental / Waste Management Approach

10 7.6.1 Air quality, Dust and Noise

i. Construction Plan

Water shall be sprinkled on roads, cleared project right of way and spoils to control dust emissions. Air emission shall be limited by maintaining equipment's and vehicles in line with manufacture's recommendations to meet relevant international standards. Noise emission shall be limited by using noise abatement equipment where appropriate except where it unavoidable. Local resident shall receive prior notification of particularly noisy activities. Vehicles shall be used responsibly; machines shall not be left idling for long period if they are not in use.

11 7.6.5 Hazardous Material Management

i. Construction Plan

Personnel shall be trained in safe use and handling of hazardous materials.

A record shall be kept of all hazardous material on site and Material Safety Data Sheet (MSDS) maintained. Hazardous material shall only be stored within designated storage areas and using appropriate procedures (e.g. bonding, impermeable surface, secure drainage, limited access, labelling).

12 7.6.6 Solid Waste

i. Construction Plan

Secured waste storage sites shall be established in defined areas away from watercourse and drains. There shall be a prohibition on uncontrolled burning or burial of waste. Small quantities of domestic refuse from construction sites shall be collected and disposed in government approved sites.

ii. Operation Plan

Passengers shall not be allowed to litter garbage along the road; bins shall be provided in the vehicles to collect garbage.

7.7 GRIEVANCE REDRESS MECHANISM

During implementation of the project activities, it is possible that disputes/disagreements between the project developer and the PAPs will occur especially in terms of compensation, boundaries, ownership of crops or land, etc.

There are great challenges associated with grievance redress especially in a project of this magnitude.

The practice of grievance arbitration over resettlement issues in Nigeria is conducted within the framework of the Land Use Act (LUA) of 1978, reviewed under CAP 202, 1990. Two stages have been identified in the grievance procedure: customary mediation and judiciary hearings.

A grievance procedure based on community grievance committees, one per LGA, will be established for resolution of the disputes and complaints.

7.7.2 Customary Mediation

Procedures for grievances will be clearly explained during community meetings. At the village levels, a series of customary avenues exists to deal with dispute resolutions. Those avenues shall be employed, when and where it is relevant as a “court of first appeal”.

Such customary avenues shall provide a first culturally and amicable grievance procedure that will facilitate formal and/or informal grievance resolution for grievances such as:

- wrongly recorded personal or community details;
- wrongly recorded assets including land details and/or affected acreage;
- change of recipient due to recent death or disability;
- recent change of asset ownership;
- wrong computation of compensation; and
- name missed out of register, etc.

A Customary Grievance Redress Committee shall be set up in each LGA, by the RIC, to address complaints from RAP implementation. This committee will be assisted by the Project Engineer who will act as RVSG representative and its members will include;

- Representative of Rivers State Ministry for Lands
- Representative of the Local Government Area (s) (Member);
- Respected local Elders (Members);
- Representative of Village Head of affected village(s);
- Representative of the Eze covering the area;
- Representatives of the Witness NGO.

PAPs' complaints shall first be lodged verbally or in writing through this process.

It is expected that the committee will deal with the grievances they receive within three days of receipt of the complaint. If the complaint cannot be resolved at this level, or if the plaintiff is not satisfied with the settlement proposed, the plaintiff shall then be referred to the official legal procedures.

7.7.3 Courts of Law

The judicial process in accordance with applicable laws will be followed and the law courts will pass binding judgment on the matter.

7.7.4 Grievance Resolution Procedures

The first level is the Village Chief or the RAP/EMP Implementation Consultant (RIC)

The aggrieved person shall first report the matter to the Village Chief for resolution. Issues that can be resolved at this level include, ownership tussle, management of deceased property, boundary issues, etc.

The type of issues to report to the RIC for possible include, perceived wrong valuation, incorrect PAP data, inadequacy of compensation received, etc.

if the issue is not resolved at this stage, it can then be escalated to customary mediation and if still no acceptable resolution is achieved, the parties may choose to go to court of Arbitration in accordance with laws of the Federal Republic of Nigeria. Figure 7.1 illustrates this mechanism.

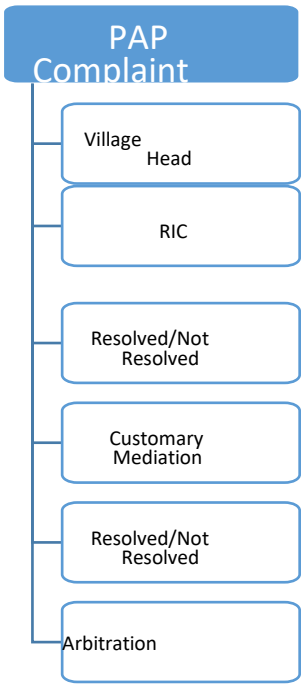


Figure 7.1: Grievance Resolution Procedure

7.8 Traffic Diversion Plan

7.8.2 General Project overview

Port Harcourt Flyover/road Project consists of construction of Flyovers and roads located in Port Harcourt Metropolis:

i. Dualization and rehabilitation of the flyover at Rumuola Junction
ii. Construction of a new flyover at GRA Junction
iii. Dualization of Tombia Extension to meet Ezimgbu Road

7.8.3 Main TrafficRoutes

7.8.3.5 Main TrafficRoutes RiversState

The Main Overland Traffic Routes of RiversState for the North-South Axis are:

- Elelenwo-Igrita Road
- Rumu Chita-Afara-Umaturu Road
- The Main Overland Traffic Routes of RiversState for the East-West Axis are:
- East-West Road
- Warri-Patani Road
- Port Harcourt Aba Expressway
- Elele-Isokpo-Umueke Road

7.8.4 Main Traffic Routes Port Harcourt Metropolis

The Main Traffic Routes within Port Harcourt Metropolis Area for the North-South Axis are:

- lkwere Road
- Aba Expressway
- Obasanjo Bypass/Airforce Flyover
- Olusegun Obasanjo Way
- lgwuruta Road
- Elelenwo-lgrita Road

7.8.5 Directly affected Roads by Flyover/road Construction

Rumuola / GRA flyover and Tombia Extension /Ezimgbu Road

The directly affected Roads for the construction of the above Flyovers/roads are as follow:

- Port Harcourt Aba Expressway
- Ezimgbu Road
- Stadium Road
- Tombia Street
- Ikwerre Road

Rumuola Flyover

The directly affected Roads for the construction of the Rebisi Flyover are as follow:

- Port Harcourt Aba Expressway
- Rumuola Road

7.8.6 Traffic Diversion Plans

i. General arrangements for all work sites

To avoid unnecessary nuisance to the public, general arrangements and procedures shall be followed, furthermore closure of roads at work sites shall be done in steps to enable traffic participants get used to new traffic arrangements.

ii. Working steps:

- Installation of Main Warning sign boards demarcating construction sites ("Men at Work, Danger, Slow Down")

- Closure of left turning lanes and blocking of junctions to eliminate through traffic crossing the Dual Carriageways at junctions. Main traffic routes are not affected yet.
- Observation of traffic development for 2-5 days.
  - ✓ Meanwhile execution of preliminary works with limited impact where suitable (removal/relocation of street light and traffic light, breaking of median kerbs and removal of traffic island).
  - ✓ Installation of signage for traffic diversion at main light traffic and heavy-duty traffic.
- Radio announcements by Government Authorities with advance information about complete road closure of Main traffic routes, including advices to avoid construction sites wide-range.
- Final Step: Road closure at construction site as required per start of main works (piling).

7.5.2 Traffic Diversion Plan for Flyovers/road

Main Traffic Diversion Routes are shown in Figure 7.2.

7.8 Safety & Health

(A) Operational Code

7.8.1 Safety Management System

RVSG knows that safety on every project is essential. Site safety is a primary concern for senior management of the company. RVSG operates its own safety management system. This system sets out corporate safety standards, safety management plans, implementation guidelines etc. The system is implemented for every project and it is audited internally by the company.

7.8.2 General Safety Wear

Safety wears such as overalls, head gears, boots, nose covers, hand gloves, eye goggles, safety shoes shall be supplied wherever their use is essential. Workers shall be made to wear them.

7.8.3 Safety Awareness

The Project Manager or in his absence the HSE Officer are basically the custodians of safety. All Management and Staff are expected to be highly conscious of safety and hence any hazard shall be reported promptly. Reporting accidents that almost happened" enhances safety awareness. Prevention is always better than cure.

7.8.4 Public Health and Safety

i. Construction Plan

RVSG shall provide a mobile health team that will conduct regular health checks of construction workers. The construction sites and construction workers' dormitories shall be disinfected regularly.

Training on safety procedures and precautions shall be provided to workers especially machinery operations. Safety officers shall be appointed to conduct regular safety inspection of the construction sites.

ii. Operation Plan

Road safety education campaign shall be conduct among locals of surrounding communities. RVSG shall collaborate with local school authorities and community leaders to find ways of integrating flyover/road safety into their curricula and local people's daily living practices. Advance warning sign shall be set up at major intersections together with staffed safety booths and barricades. Pedestrian walkways shall be provided at the culverts for use by people and animals to reduce the risk of accidents.

7.9 Emergency Preparedness and Response

7.9.1 Contingency Plan and Emergency Procedures

The Project's site camps/offices during construction and the stations during the operational phase shall be equipped with:

(a) An internal communication/alarm system capable of providing immediate emergency instructions to all personnel;
(b) Telephones capable of summoning emergency assistance from the police/security organizations and fire service department:
(c) Portable fire extinguishers, fire control equipment, spill control equipment.

(i) Water at adequate volume and pressure to supply water hose streams, automatic sprinklers, or water spray systems.
(ii) First aid materials in boxes.
(iii) Emergency assembly points within the premises.
(iv) Emergency response arrangement containing details of response bodies and their contact details.

All the above equipment shall be maintained regularly, and tested periodically to ensure steady effectiveness.

7.9.2 Emergency Co-Coordinator (EC)

The official who shall have over-all responsibility for coordinating all emergency response measures shall be the Project Manager during construction or the Station Manager during operations and shall be designated Emergency Coordinator (EC). He/she shall be assisted by the Security Manager and the HSE Officer. The emergency coordinator (EC) shall have the authority to commit the resources needed to carry out the contingency plan.

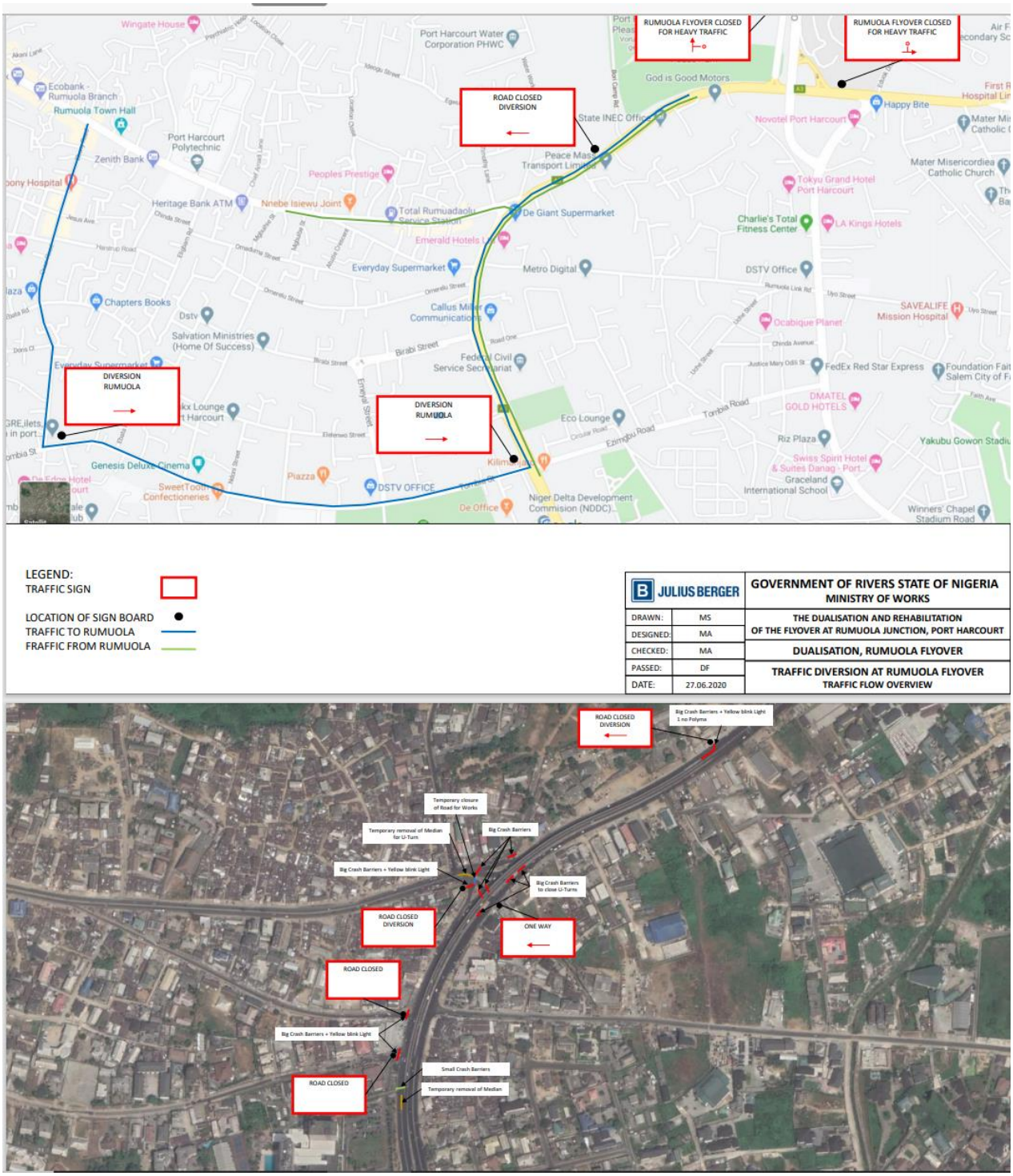


Figure 7.2: Traffic Diversion Plan for Rumuola Flyover

7.9.3 Emergency coordinator's response

(a) The emergency coordinator (or his assistant in his absence) shall immediately activate the internal company alarms or communication systems to notify all company personnel, and, in the case of fire, the nearest municipal fire-fighting service, if needed.

(b) Concurrently all the emergency response arrangement should be brought to bear on the particular problem on hand.

(c) If the emergency involved an incident that could threaten human health or the environment outside the facility, the emergency coordinator must submit a report of his findings to NESREA and Federal Ministry of Environment office.

7.10 Management of Socio-economic Impacts

Socio-economic impacts that have been identified relate not only to the aspect of the project but also to individual and communities' perception and attitude towards these aspects, gleaned through the consultation process.

The addition of perception and community attitudes toward the issues means that the impact will vary according to the individuals or community involved. Socio-economic issues that were identified and relate to the project construction are:

- Local employment and procurement opportunities
- Land acquisition and land-based livelihood
- Local infrastructure and services
- Community relations, management of construction workers and camps.

The managements measure that shall be put in place by RVSG in each component include: -

7.10.1 Employment and Local Sourcing Opportunities

Preference shall be given to suitably qualified and experienced application from communities along the project route.

1. Recruitment procedures shall be developed that will be transparent and fair.
2. A training programme for local workers shall be developed and implemented.
3. To maximize local sourcing opportunities, a plan shall be developed for implementation.

7.10.2 Land and Land Based Livelihoods.

A fair, adequate and transparent compensation process shall be developed for land owners and land users. Consultation on land acquisition entitlements and compensation shall be held with land owners and users along the route. Land owners and users shall be allowed continued access (with restriction) to the route corridor after constructions

7.10.3 Infrastructure and Services

There shall be upgrade of some existing roads and construction of new access roads. Roads used by the project shall be maintained during construction and any damage to roads caused by the project

shall be rectified. All roads shall be restored to a condition at least as good as that existing before the project.

7.10.4 Community Relations

- All workers shall receive cultural sensitivity and health awareness training where appropriate
- Code of conduct for camp workers shall be established to facilitate relationships with communities during construction phase.
- A community liaison team shall be established to facilitate relationships with community during construction phase.

The operational phase of the project is expected to bring about positive impacts to communities. The communities expect improved commercial activities to result from the project.

7.11 Institutional Arrangement for EMP

RVSG is committed to ensuring that the project is integrated harmoniously into the host environment and that the project operation shall provide an opportunity to play active parts in national development. The HSE unit of RVSG during operations shall be responsible for ensuring that the overall environmental targets are achieved and that the environmental responsibilities and obligation of the project are satisfied during project implementation.

In each station and section, an environmental officer shall be appointed, who shall monitor the implementation of the environmental management and monitoring plan in the field. Initiatives shall be taken to ensure that each person identified to implement specific aspects of the EMP fulfil their responsibilities as part of their activities. The Project Manager shall ensure that the implementation of the EMP occurs in a structured and formal manner and that employees identified to assist in performing tasks defined in the EMP has the necessary skills to manage the environmental aspect of their work. The JBN's project organogram is shown in Figure 7.4.

Environmental awareness training for the team is an integral part of a comprehensive environmental management policy. RVSG shall be responsible for training and awareness seminars to all staff. JBN shall present all result of environmental monitoring to the regulatory agencies and shall indicate which specific member of the EMP team should be contracted for clarifications of issues outlined in the result presented. An accredited environmental consultant shall be retained to provide services that are critical to the effective implementation of the environmental management plan which includes laboratory services.

7.12 Monitoring and Measurement

The environmental Monitoring plan shall serve as an integral part of the construction and operational activities and is expected to generate the requisite information dissemination. The plan shall play a pivot role in ensuring that the trends for specific parameters are traced and also shall provide information on compliance with legislation norms, set guidelines or desirable operational limits; and

form basis for corrective action and modification of activities if necessary. Monitoring will require sampling and analysis of environmental components like soils, water and air emissions.

Monitoring will also involve community perception surveys, HIV/AIDS awareness, worker's health, availability of facilities/skills, etc so as to identify issues of discontent and address them before they escalate. The Environmental Monitoring Plan of the project is summarized in Table 7.1.

Table 7.1 Details of Environmental Monitoring Plan

Monitoring Scope	Parameter	Location	Frequency		Responsibility	Oversight
			Construction	Operation		
Air	TSP, NO_2, SO_2, CO, CH_4	Settlement areas, close to flyover sites	Weekly	-	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Noise	Sound level (dBA)	Sensitive spots, e.g., school, residential buildings close to flyovers	Weekly	-	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Solid waste	Ignitability, Corrosivity, Reactivity etc	Designated dump site	Monthly	-	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Public safety	Signs, culvert, incidence/ accident records	Flyover Locations	Monthly	Quarterly for the first year, then annually thereafter	JBN	FMEnv with RMEnv, Obio/Akpor LGC
Land acquisition and population and structures resettlement	Compensation, income, employment, social adaptation	Relocated families and receiving communities	Middle and end of land acquisition and resettlement		JBN	FMEnv with RMEnv, Obio/Akpor LGC

HSE Unit= Health, Safety and Environmental Unit, FMEnv = Federal Ministry of Environment

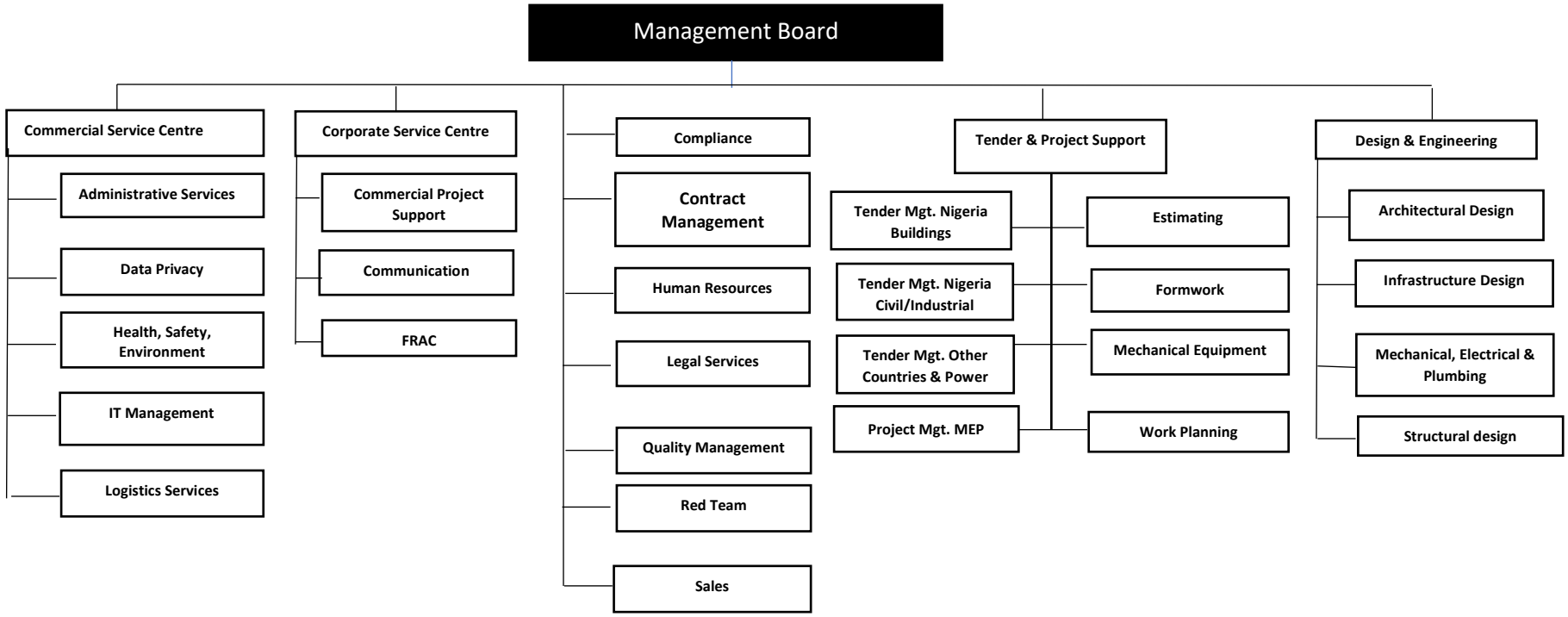


Figure 7.4: JBN's (JBN's) Project Organogram

7.13 Environmental Auditing

In line with the FMEnv requirements, the project shall be audited every three years, to check the prediction of the environmental assessment and assess the general performance of the project to ensure that environmental standards are maintained and environmental management and monitoring plan are followed. Environmental audit acts as an internal control process that ensures that environmental protection and management procedures are enforced. The audit objectives are to examine the line management system and procedures, facility operations and monitoring practices. It shall cover the following: Verification of prediction in the EIA.

- Verification of implementation of mitigating recommendations
- Review incident reporting and remedy schemes
- Identification of current and potential environmental problems
- Recommend necessary improvements to management operation practices
- Thorough documentation, feedback and implementation procedures

CONCLUSION AND RECOMMENDATION 8

8.1 Conclusion

The proposed flyovers / road will ease traffic flow at those points along the Port Harcourt – Aba Road, a primary road in Port Harcourt City and adjoining secondary roads; also, Ken Saro Wiwa Road and Ikwerre Road.

The proposed project consists of flyovers /road which are a part of the traffic system in the area of Port Harcourt in Rivers State. Flyovers with ramps have different number of spans: two bridges are 16 spans long and one - 23 with corresponding length of the main bridge part from 360 m to 517.5 m. Standard span length for the bridge part is 22.50 m, for ramps – 12.10 m.

The bridge parts of flyovers will be constructed using combined proven methods of precast reinforced concrete elements and in-situ concrete deck slab. Ramps will be made from concrete troughs and retaining walls.

The sustainability of this project stems from its social desirability, technical feasibility, environmental friendliness and economic viability.

The Environmental Impact Assessment (EIA) of the flyover/road has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This EIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the project's life cycle has also been put in place to assure environmental sustainability of the project.

The environmental baseline condition of the project area showed that the physical, chemical and biological characteristics as well as meteorological, climatic and hydrological characteristics were generally consistent with previous studies carried out within the environment with some few exceptions.

The identified adverse impacts of the proposed project include air pollution, soil, sediment, groundwater water and surface water contamination from accidental/ routine discharges of effluent, workplace accidents, improper waste management has been identified. Consequently,

cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable in order to ensure conservation of biodiversity in the area and enhance continual compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefits for Port Harcourt, Rivers State and Nigeria. The EMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation.

Socio economic consultations with the project host communities and other relevant stakeholders were also carried out and shall continue throughout the life cycle of the project

It is therefore hoped that all data/evidence contained in this report is sufficient in the development of an environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of project.

In consideration of the above therefore, there is no major environmental issue to impede the development of the proposed project.

8.2 Recommendation

We strongly recommend the proposed Flyover/road project for EIA Approval because the mitigation measures that have been proffered will adequately address the identified impacts from the project; and the RVSG is committed to ensuring strict implementation of the project's EMP.

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Appendices

Appendix 1: Rumuola Junction Geotech Report

Appendix 2a Design Manual of Rumuola Flyover

Appendix 2b Design Manual of GRA Flyover

Appendix 3a Rumuola foundation drawing-

Appendix 3b GRA FYO found. design report

Figure 3.4 Rumuola Layout

Figure 3.5 Sections -GRA Flyover-Model

Figure 3.5a Layout-GRA Flyover-Model

Appendix 4: Socio-economic Questionnaire

Appendix 5

Proceedings of Stakeholders Engagement Workshop

Rivers State Ministry of Works

PROCEEDINGS OF STAKEHOLDERS ENGAGEMENT WORKSHOP IN PORT HARCOURT, RIVERS STATE

Dates: 27th August, 2020

Venue: DMATEL Hotel, Stadium Road, Port, Harcourt, Rivers State

1. AGENDA

i. Arrival of Participants

ii. Opening Prayer/ Introduction

iii. Opening Remarks

iv. Project Presentation

v. Comments, Questions and Contribution

vi. Lunch

vii. Closing Remark/ Closing Prayer

viii. Departure of Participants

2. Participants: see attached registers of attendance

3. Highlights of the Workshop See Table

Table 1: Highlights of the Workshop

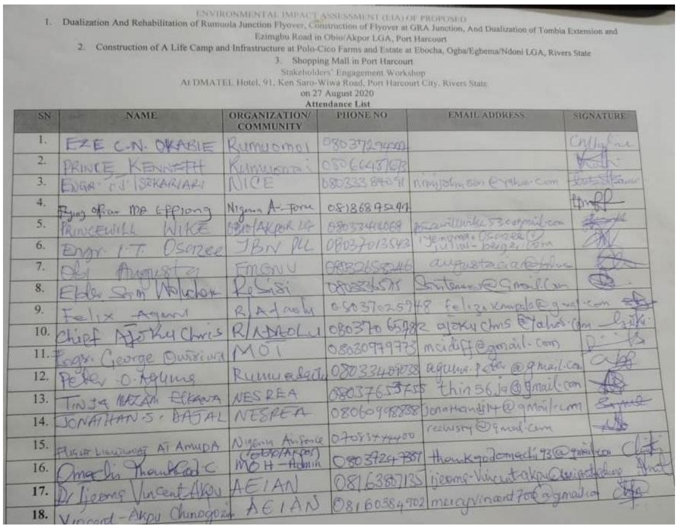
Table 2: Comments, Contributions, and Commitments

Rivers State Ministry of Works

Appendix 6: Register of Attendance

Attendance

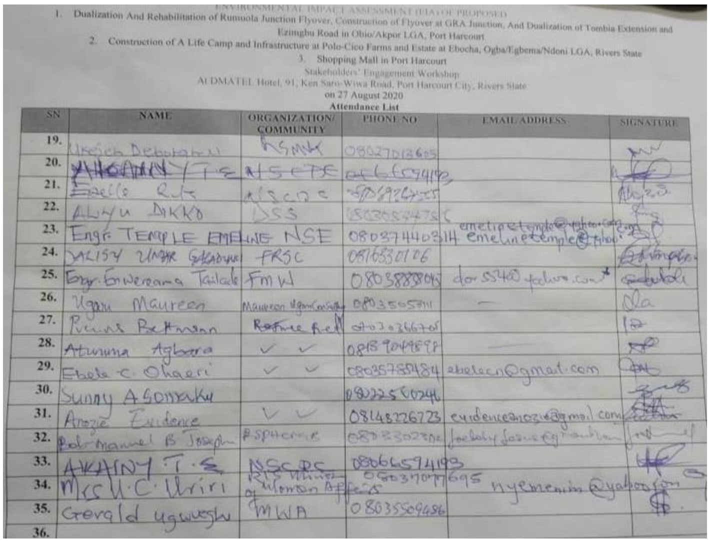
Appendix III: Register of Attendance



ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF PROPOSED
1. Dualization And Rehabilitation of Rumuola Junction Flyover, Construction of Flyover at GRA Junction, And Dualization of Tombia Extension and Ezimgbu Road in Obio/Akpor LGA, Port Harcourt
2. Construction of A Life Camp and Infrastructure at Polo-Cico Farms and Estate at Ebocha, Ogba/Egbema/Ndoni LGA, Rivers State
3. Shopping Mall in Port Harcourt

Stakeholders' Engagement Workshop
At DMATEL Hotel, 91, Ken Saro-Wiwa Road, Port Harcourt City, Rivers State
on 27 August 2020
Attendance List

SN	NAME	ORGANIZATION/ COMMUNITY	PHONE NO	EMAIL ADDRESS	SIGNATURE
1.	EZE C.N. OKABIE	Rumuomoi	[illegible]		[signature]
2.	PRINCE KENNETH	Rumuomoi	[illegible]		[signature]
3.	ENGR. I.J. ISEKARIARI	NICE	[illegible]	[illegible]	[signature]
4.	Flying officer MA Effiong	Nigerian Air Force	[illegible]		[signature]
5.	PRINCEWILL WIKE	Obio/Akpor LG	[illegible]	[illegible]	[signature]
6.	Engr. I.T. Osezee	JBN PLC	[illegible]	[illegible]	[signature]
7.	Obi Augusta	FMENV	[illegible]	[illegible]	[signature]
8.	Elder Sam Wolicker	Rebisi	[illegible]	[illegible]@Gmail.Com	[signature]
9.	Felix Agumi	R/Adaolu	[illegible]	[illegible]	[signature]
10.	Chief Ajoku Chris	R/Adaolu	[illegible]	ajoku chris @yahoo.com	[signature]
11.	Engr. George Owuiwa	MOI	[illegible]	mcidiff@gmail.com	[signature]
12.	Peter O. Agume	Rumuadaolu	[illegible]	agume.peter@gmail.com	[signature]
13.	TINJA MAZAN EKKAWA	NESREA	[illegible]	thin56.ja@gmail.com	[signature]
14.	JONATHAN S. BAJAL	NESREA	[illegible]	[illegible]@gmail.com	[signature]
15.	Flight Lieutenant AT AMUDA	Nigerian Air Force	[illegible]	[illegible]@gmail.com	[signature]
16.	Omachi Thankgod C	(Obio/Akpor) MOH - Admin	[illegible]	[illegible]	[signature]
17.	Dr Ijeoma Vincent Akpu	AEIAN	[illegible]	[illegible]	[signature]
18.	Vincent-Akpu Chinogozi	AEIAN	[illegible]	[illegible]	



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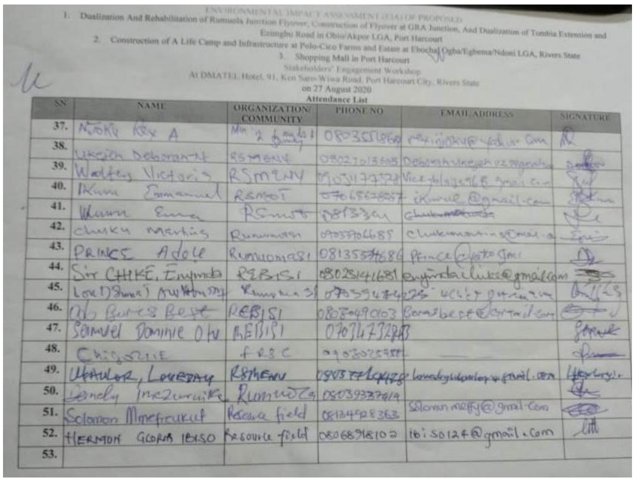
SN	NAME	ORGANIZATION/ COMMUNITY	PHONE NO	EMAIL ADDRESS	SIGNATURE
19.	Ukejeh Deborah N	RSMW	[illegible]		[signature]
20.	AKANNY T.S.	NSCDC	[illegible]		[signature]
21.	Ezelle R.K.	NSCDC	[illegible]		[signature]
22.	ALIYU DIKKO	DSS	[illegible]		[signature]
23.	Engr. TEMPLE EMELINE	NSE	[illegible]	[illegible]	[signature]
24.	[illegible] UMAR [illegible]	FRSC	[illegible]		[signature]
25.	Engr. Enwereama Tailade	FMW	[illegible]	[illegible]	[signature]
26.	Ugoru Maureen	[illegible]	[illegible]	—	[signature]
27.	[illegible]	Resource field	[illegible]		[signature]
28.	Atuma Agbara	✓ ✓	[illegible]	—	[signature]
29.	Ebele C. Ohaeri	✓ ✓	[illegible]	ebelecn@gmail.com	[signature]
30.	Sunny A Sonyaku		[illegible]		[signature]
31.	Anozie Evidence	✓ ✓	[illegible]	evidenceanozie@gmail.com	[signature]
32.	Bol-manuel B. Joseph	RSPHCMB	[illegible]	[illegible]	[signature]
33.	AKANNY T.S.	NSCDC	[illegible]		[signature]
34.	Mrs U.C. Uriri	RIS Ministry of Women Affairs	[illegible]	nyemenim@yahoo.com	[signature]
35.	Gerald Ugwuegbu	MWA	[illegible]		[signature]
36.					



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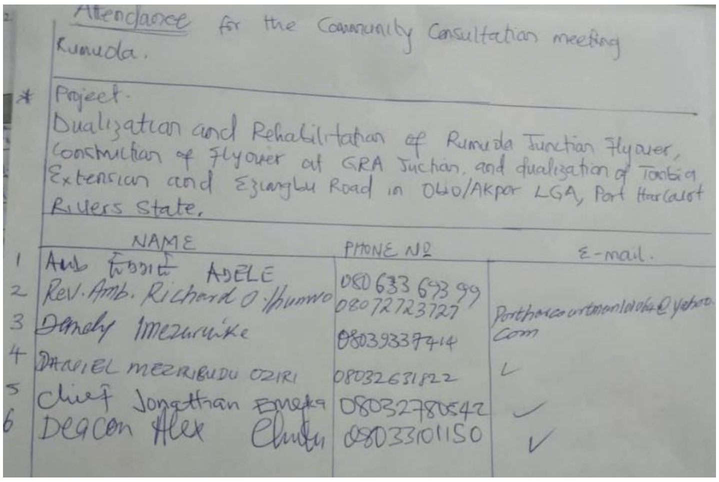
SN	NAME	ORGANIZATION/ COMMUNITY	PHONE NO	EMAIL ADDRESS	SIGNATURE
37.	Njoku Rex A	[illegible]	[illegible]	[illegible]	[signature]
38.	Ukejeh Deborah N	RSMENV	[illegible]	[illegible]	[signature]
39.	Walter Victoria	RSMENV	[illegible]	[illegible]	[signature]
40.	Ikwu Emmanuel	RSMOT	[illegible]	[illegible]@gmail.com	[signature]
41.	[illegible]	RSMWT	[illegible]	[illegible]	[signature]
42.	Chuku Martins	Rumuomasi	[illegible]	[illegible]	[signature]
43.	PRINCE Adole	Rumuomasi	[illegible]	[illegible]	[signature]
44.	Sir CHIKE, Enyinda	REBISI	[illegible]	[illegible]@gmail.com	[signature]
45.	[illegible]	[illegible]	[illegible]	[illegible]	[signature]
46.	[illegible] Bares Best	REBISI	[illegible]	[illegible]	[signature]
47.	Samuel Dominic Ohi	REBISI	[illegible]		[signature]
48.	Chigozie	FRSC	[illegible]	—	[signature]
49.	Ukaulor, Loveday	RSMENV	[illegible]	[illegible]	[signature]
50.	Dandy Imezurike	Rumuola	[illegible]		[signature]
51.	Solomon Mmefreukut	Resource field	[illegible]	Solomon.meffy@gmail.com	[signature]
52.	HERMON GLORIA IBISO	Resource field	[illegible]	ibiso124@gmail.com	[signature]
53.					



Attendance for the Community Consultation meeting Rumuola.

Project.
Dualization and Rehabilitation of Rumuola Junction Flyover, Construction of Flyover at GRA Junction, and dualization of Tombia Extension and Ezimgbu Road in Obio/Akpor LGA, Port Harcourt Rivers State.

	NAME	PHONE NO	E-mail.
1	Amb. Ezinne ADELE	[illegible]	
2	Rev. Amb. Richard O. Ifeanyi	[illegible]	Porthacourtmanlo@yahoo.com
3	Dandy Imezurike	[illegible]	
4	DANIEL MEZIRIBUDU OZIRI	[illegible]	✓
5	Chief Jonathan Emeka	[illegible]	✓
6	Deacon Alex Chidi	[illegible]	✓

Appendix 7: EIA TOR Approval Letter

Figures 7.2 Diversion for Rumuola Flyover

Appendix 8: Analyses Results

1. Physicochemical Characteristics of Groundwater Samples

Parameter	Groundwater samples					Mean	Range	SD	WHO Limit	FMENV Limit
	GW1	GW2	GW3	GW4	GW5					
Total coliform Count (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
E. coli (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Streptococcus faecalis (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Clostridium perfrigens (cfu/100ml)	0	0	0	0	0	0	0	0	0	0
Total Viable Plate Count (cfu/ml)	5	8	10	7	6	7.2	5.0-10.0	1.72	100	100

2. Source: field Work Laboratory Analysis 2020

3. Table 4.3: Microbial characteristics of soil samples

Parameter	**SS_1**		**SS_2**		**SS_3**		**SS_4**	
	TS	**SS**	**TP**	**SS**	**TP**	**SS**	**TP**	**SS**
THB (cfu/g)	2.8×10^5	3.1×10^5	1.8×10^5	2.2×10^5	2.8×10^5	3.1×10^5	2.5×10^5	2.8×10^5
THF (cfu/g)	3.0×10^5	3.3×10^5	2.4×10^5	2.7×10^5	3.2×10^5	3.5×10^5	2.7×10^5	3.0×10^5
HUB (cfu/g)	1.1×10^5	1.5×10^5	1.4×10^5	1.6×10^5	1.2×10^5	1.0×10^5	1.3×10^5	1.1×10^5
HUF (cfu/g)	1.4×10^5	1.6×10^5	1.7×10^5	1.7×10^5	1.3×10^5	1.5×10^5	1.7×10^5	1.5×10^5

4. Table 4.4: Microbial Characteristics of Soil Samples

Sample Code	**Microorganisms identified**	
	Bacteria	**Fungi**
SS_1	*Staphylococcus aureus*, *Micrococcus* sp, *Pseudomonas aeruginosa*,	*Aspergillus fumigatus*, *Fusarium* sp, *Aspergillus niger*, *Candida albicans*.
SS_2	*Proteus* sp, *Micrococcus* sp, *Pseudomonas aeruginosa*, *Enterobacter aerogenes*, *Clostridium* sp.	*Fusarium* sp, *Aspergillus niger*, **Candida tropicalis*.
SS_3	*Klebsiella* sp, **Micrococcus* sp, **Pseudomonas* sp, *Bacillus brevis*, *Enterobacter faecium*.	**Penicillium* sp, **Candida tropicalis*, *Aspergillus niger*, *Fusarium* sp, **Candida albicans.*
SS_4	**Bacillus* sp, *Achromobacter* sp, *Bacteroids* sp, *Acinetobacter* sp, **Bacillus* subtilis, *Streptococcus faecalis*,	*Alternaria* sp, *Geotricum* sp, **Penicillium* sp, *Aspergillus niger*, **Candida* sp,

5. *Hydrocarbon degrader

Source: Laboratory Analysis 2020

Appendix VI

JBN HSE Manual

JULIUS BERGER

Health, Safety and Environment Policy

Within Julius Berger Nigeria Plc, effectively managing Health, Safety and Environmental processes is a top priority. As such, HSE is fundamental to the company's corporate culture and a pre-requisite for achieving business objectives.

Such objectives are predicated on a "Responsible Growth" philosophy, which means protecting the health and safety of employees and customers, supporting communities where we do business and minimizing impact on the environment, while also maintaining the sustained growth and profitability of the company.

Julius Berger Nigeria Plc has adopted the principles laid out in the OHSAS 18001 standards and operates an HSE Management System that encourages continual improvement of our HSE performance. The governing principles of this system are:

- Setting HSE objectives and targets relevant to operations, working environment and customer's requirements.
- Monitoring HSE performances against objectives and targets and reviewing HSE strategy and approach accordingly.
- Communicating, training and educating employees on HSE matters at all level of the organization.
- Complying with statutory HSE requirements and adopting applicable Industry best practices.

The Managing Director is responsible for the overall Corporate HSE performance and has delegated responsibilities and authorities to each Business and Service Unit Manager for implementing the HSE Management System within their area of control.

All Julius Berger Nigeria Plc and subcontractor's employees are held accountable for their HSE performance and are encouraged to actively participate in shaping an incident free working environment.

Dr. Lars Richter
Managing Director

HSE.PO–01 Rev:4.2_16.10.2018 1 of 1

Substance Abuse Policy

Julius Berger Nigeria Plc is committed to eliminating the risks involved with the consumption of drugs, alcohol and other banned substances.

Julius Berger Nigeria Plc has therefore set the following rules and principles to be observed by all employees:

- The consumption or possession, sale or distribution of drugs and other banned substances are prohibited in all Julius Berger Nigeria Plc work sites and premises.
- The consumption of alcohol or being under the influence of alcohol is prohibited for all employees, subcontractors or third parties while performing duties on all Julius Berger Nigeria Plc work sites.

Julius Berger Nigeria Plc will monitor on a regular basis compliance with these principles through inspections and by the operation of drug and alcohol tests.

Where there is due suspicion that an employee may be under the influence of drugs or alcohol, Julius Berger Nigeria Plc reserve the right to conduct drug and alcohol testing on the employee.

In the event of an accident or incident, Julius Berger Nigeria Plc may require an employee to undergo drug and alcohol testing. In the event that the employee tests positive for drugs or alcohol then disciplinary action shall be taken.

Julius Berger Nigeria Plc policy in respect to Substance Abuse is one of ZERO tolerance.

Employees who are taking prescription medication whilst at work shall inform their Supervisor and shall only be allowed to continue working with the prior knowledge and agreement of a company doctor.

Dr. Lars Richter
Managing Director

Occupational Health Policy

Julius Berger Nigeria Plc is committed to the prevention of potential illness or adverse health effects to our employees arising from work with harmful substances or work in an environment harmful to health.

In order to prevent adverse effects on the health of its employees and other persons who may be affected by its activities Julius Berger Nigeria Plc shall:

- Conduct assessments to identify potential harmful substances and harmful environments to which its employees or other persons may be exposed.
- Conduct risk assessments for its activities and implement required control measures to eliminate or minimise potential health risks where practicable.
- Ensure that exposure to potential hazardous substances and atmospheres is minimised where practicable and ensure that necessary Personal Protective Equipment (PPE) is provided and its usage enforced wherever necessary.
- Ensure that medical examinations are conducted on all its employees in accordance with Julius Berger Nigeria Plc requirements.
- Ensure that Julius Berger Nigeria Plc health and hygiene standards are complied with at all work areas and facilities including offices.
- Ensure that qualified medical and first aid personnel and facilities are available to our staff at all locations.
- Conduct audits and monitor its occupational health performance.

Julius Berger Nigeria Plc is committed to achieving high standards of Health, Safety and welfare on behalf of its employees.

Dr. Lars Richter
Managing Director

HSE.PO–04 Rev:4.2_16.10.2018 1 of 1

Emergency Response Policy

Julius Berger Nigeria Plc is committed to ensuring that adequate resources and arrangements are in place to allow for an adequate level of response during foreseeable emergency situations.

Each Project or Business Unit Manager shall review the operations under his control and ensure that an adequate Risk Assessment of the potential risks involved has been conducted and that appropriate emergency arrangements are in place to minimize the risks during emergency situations.

Each Project or Business Unit Manager shall organize and conduct regular drills and/or exercises to test the validity of the systems or procedures in place.

Recovery measures for all identified potential emergencies shall be detailed together with the personnel responsible for implementing them in the BusinessUnit/Emergency Response Plan.

Personnel assigned key responsibilities under the Project/Business Unit Emergency Response Plan shall receive training to ensure their effectiveness in carrying out their responsibilities.

Emergency arrangements shall be advised to all personnel.

This Policy statement also applies to all Subcontractors working for Julius Berger Nigeria Plc.

Dr. Lars Richter
Managing Director

Community Affairs Policy

Julius Berger Nigeria Plc recognises the role of host communities and is committed to achieving and maintaining a good working relationship with communities throughout Nigeria, who may be impacted by company operations.

Julius Berger Nigeria Plc considers the maintenance of good working relationships with Community stakeholders essential to safeguard company interests. Observance of the highest standards of ethics and conduct is expected from all Julius Berger Nigeria Plc employees, in respect to interface with host communities.

Julius Berger Nigeria Plc will demonstrate its commitment to the establishment of equitable relations with host communities by:

- Maintaining the highest ethical standards.
- Minimising the risk of potential conflict that may impact upon community relations.
- Investigating complaints and identifying the underlying causes of misunderstanding so as to eliminate them.
- Preventing potential work stoppage through proactively building positive relationships with communities.
- Developing with the host communities mutually beneficial solutions to reducing the impact of company operations on the host community environment.
- Respecting the customs and traditions of host communities.

This Policy statement also applies to all Subcontractors working for Julius Berger Nigeria Plc.

Dr. Lars Richter
Managing Director

Road Safety Policy

Road transportation is a major activity associated with Julius Berger Plc operations.

Julius Berger Nigeria Plc is therefore committed to complying with Nigerian road traffic regulations and in continuous improvement of its road safety performance.

Julius Berger Nigeria Plc Business Unit Managers and Project Managers are responsible for implementing the Company's Road Safety Management Policy and Procedures.

Julius Berger Nigeria Plc drivers shall:

- Comply with the Company's driver recruitment and fitness to drive requirements.
- Comply with the Nigeria Highway Code and Julius Berger Nigeria Plc internal policies and procedures.
- Respect other road users and adopt defensive driving techniques at all times.
- Never drive under the influence of drugs, alcohol or other banned substances.

The implementation and enforcement of the Julius Berger Nigeria Plc Road Safety Policy and Road Safety Management Requirements is the responsibility of Business Unit and Project Management.

Every Company vehicle user (passenger and driver) will be held accountable for his/her performance related to road safety management.

Dr. Lars Richter
Managing Director

HSE.PO–07 Rev:4.2_16.10.2018 1 of 1