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ACKNOWLEDGEMENT

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LIST OF ACRONYMS AND ABBREVIATIONS

AAS	Atomic Absorption Spectrophotometry
ALARP	As Low as Reasonably Practicable
APHA -	American Public Health Association
ASTM	American Society for Testing and Materials
Ba	Barium
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
BOPD	Barrels of Oil Per Day
BPT	Best Practicable Control Technology
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Ca	Calcium
CBO -	Community-Based Organizations
Cd	Cadmium
CDC	Community Development Chairman
COD	Chemical Oxygen Demand
Cr	Chromium
Cu	Copper
DBH	Diameter at Breast Height
DSL	Delta Systematics Limited
DO	Dissolved Oxygen
EA	Environmental Assessment
EER	Environmental Evaluation Report
EES	Environmental Evaluation Study
EG&S	Environmental Guidelines and Standards
EGASPIN	Environmental Guidelines and Standards for the Petroleum Industry in Nigeria
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Agency

ESI	Environmental Sensitivity Index
EU	European Union
FCW	Full Control Well
Fe	Iron
FEPA	Federal Environmental Protection Agency
FMEnv	Federal Ministry of Environment
GIS	Geographic Information System
GPS	Global Positioning System
Hg	Mercury
HP	High Pressure
HSE	Health Safety and Environment
HUB	Hydrocarbon Utilizing Bacteria
HUF	Hydrocarbon Utilizing Fungi
ITD	Inter-Tropical-Discontinuity
IUCN	International Union for Conservation of Nature
K	Potassium
KO	Knock Out
KOD	Knock Out Drum
LCD	Liquid Crystal Display
LFN	Laws of the Federation of Nigeria
LP	Low Pressure
MDGs	Millennium Development Goals
Mg	Magnesium
Mn	Manganese
MOU	Memorandum of Understanding
MP	Medium Pressure
Na	Sodium
NAPIMS	National Petroleum Investment Management Services
NESREA	National Environmental Standards and Regulation Enforcement Agency
NIMET	Nigerian Meteorological Agency
NLNG	Nigerian Liquefied Natural Gas

NOSDRA	National Oil Spill Detection and Response
NUPRC	Nigerian Upstream Petroleum Regulatory Commission
OFS	Ogbogu Flowstation
OGP	Obite Gas Plant
OML	Oil Mining Lease
ONELGA	Ogba Ndoni Egbema Local Government Area
O.U.R.	Obite Ubeta Rumuji
OTC	Obite Treatment Cluster (Center)
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PFOA	Perfluorooctanoic Acid
PIA	Post Impact Assessment
PM	Particulate Matter
PNG	Piped Natural Gas
PPE	Personal Protection Equipment
PSD	Particle Size Distribution
PSV	Pressure Safety Valve
PTSD	Post-Traumatic Stress Disorder
QA/QC	Quality Assurance/Quality Control
QHSE	Quality, Health, Safety and Environment
RSEPA	Rivers State Environmental Protection Agency
RSMENV	Rivers State Ministry of Environment
SCSSV	Surface-Controlled Subsurface Safety Valve
SDV	Shutdown Valve
SPM	Suspended Particulate Matter
TAC	Total Aromatic Compounds
TDS	Total Dissolved Solids
TEG	Tri-Ethylene Glycol
TEPNG	Total Exploration and Production Nigeria Limited
THB	Total Heterotrophic Bacteria
THC	Total Hydrocarbon Content

THF	Total Heterotrophic Fungi
TLV	Threshold Limit Value
TOC	Total Organic Compound
TOR	Terms of Reference
TPI	Technology Partners International Nigeria Ltd.
TSS	Total Suspended Solids
UN	United Nations
UNEP	United Nations Environment Programme
UPC	Ubeta Production Center
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WCS	Western Canadian Select
WHO	World Health Organization
Zn	Zinc

LIST OF EIA STUDY TEAM

This EIA Report was prepared by a multidisciplinary team of consultants from Delta Systematics Limited. Valuable support and input was also provided by key Health Safety Environment (HSE) personnel from TotalEnergies EP Nigeria Limited.

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EXECUTIVE SUMMARY

ES 1.1 BACKGROUND

TotalEnergies delivers world-class energy solutions adds economic value to the country and promotes best practices in safety and environmental protection, business ethics and corporate social responsibility.

As part of effort to compensate for gas production decline at some TEPNG fields and increase the overall gas production in OML 58, to meet growing demand by Nigeria Liquefied Natural Gas (NLNG) and for domestic use; TEPNG plans to develop the Ubeta field. Ubeta is a gas condensate field located 12 Km South West of Obite Gas Plant in OML 58, onshore Nigeria. Ubeta Field Development Project is captured in the Year 2006 OML 58 Upgrade Field Development Plan. In the past, one exploratory well was drilled in 1964, and three appraisal wells were drilled in 1972, 1979 and 1984, resulting in the discovery of (10) Reservoirs, five (5) of which are currently considered for initial development.

As part of TEPNG's commitment to environment friendly operations, continuous environmental performance, compliance to local/international regulations and implementations of best practices, TEPNG engaged the services of Delta Systematics Limited to carry out an Environmental Impact Assessment (EIA) of the proposed Ubeta Field Development Project. Regulatory oversight of the EIA was be carried out by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and the Federal Ministry of Environment (FMEnv).

Delta Systematics conducted a field sampling survey for the dry season from the 14th to the 30th of December 2021. The survey consisted of the physical, chemical, biological, socioeconomics and health components.

ES 1.2 BENEFITS OF THE EIA

The benefits of the EIA include:

- Obtaining authorization; this is required by regulatory authorities before the commencement of any major development.
- Providing a forward planning tool; when environmental implications are taken into account with other design considerations at the conceptual design stage. It allows for 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 Ubeta Field Development Project and identification of key issues that require special consideration for effective environmental management and controls.

- Involving all stakeholders through consultation to address common problems, impacts and mitigating measures that might be proposed.
- Informing management with a view to achieving long-term management objectives and plans associated with specific activities, in order to minimize associated financial and environmental risks.

ES 1.3 STUDY AREA

The project location cuts across three Local Government Areas in Rivers State namely Ogba/Egbema/Ndoni, Ahoada East and Ahoada West. It is approximately 70 km Northwest of Port Harcourt, 12km Southwest of Obite Gas Plant and 8km Southwest of Ogbogu Flow Station.

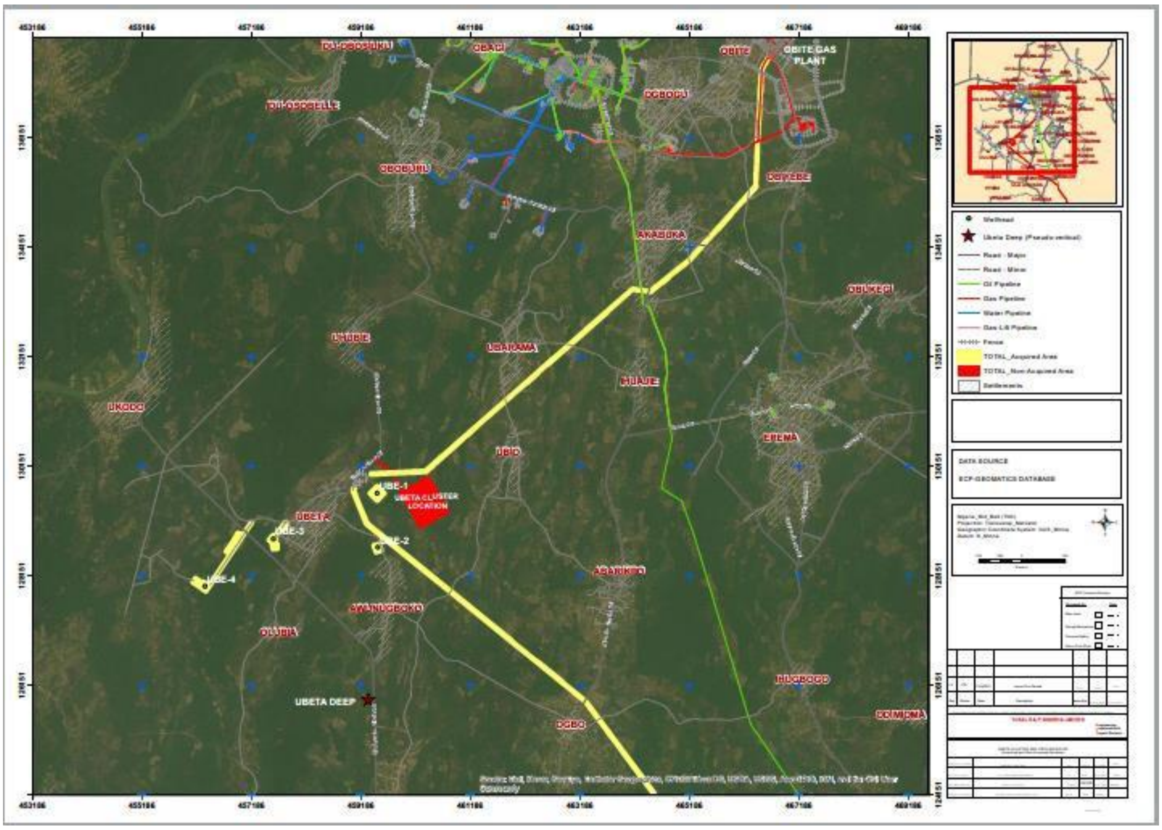


Fig ES1: Map Showing Ubeta Field Development Project Location

ES 1.4 OBJECTIVES OF THE EIA

The objectives of this study is to determine site specific environmental baseline data that will be used in addition to literature data to assess the impact of the Ubeta Field Development Project on the environment. Therefore, Delta Systematics Limited embarked on this study to:

- Determine environmental baseline conditions (i.e., physical, chemical, biological and Socio-economic and health status) at and around the Field Development Project area;
- Providing a reference point to evaluate future assessment of impacts; and to identify parameters within the ecosystem that may be sensitive to significant change.
- Identify and document any anticipated impact that may result from the field development, and in cases of detrimental effects, provide appropriate mitigation measures and remedial actions for identified impacts
- To develop an Environmental management plan for the implementation of the mitigation measures.

ES 1.5 SCOPE OF THE STUDY

The scope of work for the Ubeta field development project EIA includes the following:

1. A desktop review of available literature which include past environmental studies that have been carried out within OML 58 Block, and around the Ubeta Field.
2. Dry season field data gathering executed to obtain soil samples (0- 15cm, 15-30cm depths), Groundwater, Surface water and Sediment samples and Air quality sampling. Socioeconomic and Health data were also collected and analysed.
3. Performance of a review and evaluation of data acquired from literature and field samples, to ascertain lines of evidence that determine potential environmental impacts.
4. Development of recommendation for mitigation, monitoring and remedial measures for observed impacts.
5. Writing and issuance of an Environmental Impact Assessment Report for regulatory review and approval.

ES 1.6 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Operations and all forms of development activities in the Nigerian oil industry sector are regulated by several specific laws, guidelines, and standards. These statutes together with applicable International Conventions like International Union for Conservation of Nature and Natural Resources (IUCN) Guidelines 1996, United Nations Framework Convention on Climate Change (1992), Convention on Biological Diversity (Rio Summit) 1992, World Bank Guidelines on Environmental Assessment, 1991 and with Company health, safety and environment (HSE) Policy provide a basis for the Ubeta Field Development Project Environmental Impact Assessment. These regulations are contained in the following documents:

- Petroleum Industry Act, 2021, as published in the Federal Republic of Nigeria Official Gazette (Act No, 6 Petroleum Industry Act, 2021)

Environmental Impact Assessment Act CAP E12 LFN 2004.

- Environmental Guidelines and Standards for the Petroleum Industry in Nigeria, (EGASPIN), 2018 by the Department of Petroleum Resources (DPR)
- Department of Petroleum Resources (DPR) Mineral Oils Safety Regulations 1997
- S.I.8 National Environmental Protection (Effluent Limitation) Regulation 1991
- S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes Regulation), 1991.
- S.I.15 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations of 1991
- The Petroleum Act No. 51 of 1969
- The Petroleum Drilling and Production Regulations – 1969
- The Oil Pipeline Act and Oil and Gas Pipeline Regulation of 1995
- Endangered Species Control Act of 1985
- Land Use Act of 1978
- National Inland Waterways Authority (NIWA) Act 13 of 1997
- Factory Act, 1992
- Revised National Health Policy, 2004
- National Health Act, 2005
- National Guidelines and Standards for Environmental Protection 1991
- Nigerian Ports Authority Act No 38 of 1999
- Urban and Regional Planning Law, Decree 88 of 1992

ES 2.0 PROJECT JUSTIFICATION

ES 2.1 NEED FOR THE PROJECT

The Ubeta Field Development Project was conceived as part of effort to increase gas supply to satisfy the needs of Bonny Nigeria Liquefied Natural Gas (NLNG) plant and the domestic market. This is being undertaken in order to:

- Create additional opportunities for gas production in Nigeria for domestic consumption and export
- Enhance the efficiency of critical National Industries through the supply of more gas for power generation.
- increase the overall gas production in OML 58 and to meet growing demand by Nigeria Liquefied Natural Gas (NLNG),
- Increase the revenue base of Nigeria through increased sales of gas,
- Contribute to Nigeria’s ability to sustain its growing energy needs

- Offer job opportunities in various categories to a number of Nigerian professionals' skilled and semi-skilled craftsmen.

ES 2.2 BENEFITS OF THE PROJECT

The benefits of the proposed project to the economy of Nigeria and well being of Nigerians will be enormous. They include;

1. The purposeful utilisation of gas and foreign exchange earnings from its sale are positive signs of real development.
2. Income from employment of local labour will enhance the economic condition of the host communities.
3. Extension of electric power supply to the host communities, coupled with the community development activities associated with the project will boost the overall infrastructural status of the host communities.
4. The development projects will have multiplier effect on the quality of life in the host communities.
5. Supply of gas to the Federal Government Power Plants and thereby supporting the provision of a reliable power generation capacity for the Nigerian electricity grid.
6. Supporting the Nigerian economy by provision of gas to local industries.

ES 3.0 PROJECT DESCRIPTION

Ubeta Field Development Project entails Engineering design, Construction, Drilling and Commissioning of a Cluster of six (6) gas producing wells linked by 11.1 Km pipeline to the Obite Gas Plant/Obite Treatment Centre.

In summary the Ubeta cluster will consists of the following:

- Well cluster designed with 10 slots, of which 6 are dedicated to Ubeta gas development,
- 1 HP manifold,
- 1 test header and test separator for well testing and metering,
- 1 Pig Launcher for intelligent pigging (Pig receiver located at Obite TC),
- 1 technical building with electrical, instrumentation rooms and operation office and 1 security building for access control management,
- Chemicals Utilities (corrosion inhibitor & methanol injection package),
- 1 electrical cable for power supply and 1 fiber optics cable from Obite TC for data transmission & remote control / monitoring (telecom mast as radio back-up),
- UPS electricity is to be provided by battery packs,
- Potable water and sanitation water will be supplied by truck. Alternatively, a potable water borehole in-situ at Ubeta cluster can be built,

- ❖ Neither fixed firefighting system nor passive fire protection is required: mobile fire-fighting equipment is required at Ubeta cluster during periods of drilling, well intervention or any major hot works.
- ❖ 11.1 Km export gas pipeline between the Ubeta Cluster and the Obite Treatment facility, along the existing O.U.R. pipeline Right of Way between Obite and Ubeta.
- ❖ Construction and operation of the drilling camp within the cluster area which will accommodate approximately 100 workers, during the Field Development Project.
- ❖ Drilling of six wells using a single rig from the Ubeta Cluster; in a drilling campaign expected to last about 1.5 years from Quarter two of year 2026.
- ❖ Construction of an access road and various ancillary equipment (electric cable for power supply, storage area, water tanks, telecom mast and technical building).

Site preparation works are expected to start by early 2023, while all construction activities are expected to be completed by end of 2026.

ES 4.0 DESCRIPTION OF THE ENVIRONMENT

ES 4.1 Climate, Meteorology, Ambient Air Quality and Noise

The study area is within the humid tropical zone with defined dry and Wet seasons. The wet season is brought about by the South-West trade wind blowing across the Atlantic Ocean. This begins around April and stretches to October. September and October are the peak of flood in the area. The flood gradually recedes from November. The dry, dusty, and often cold North-East trade winds blowing across the Sahara Desert dominates the dry season and brings a short period of harmattan. This starts around November and terminates in March.

Relatively high atmospheric temperatures were measured in the study area during the fieldwork. At the sampling stations, atmospheric temperatures varied from 27.2 to 36.7°C with an average of 32.12°C while the control had values range from 30.2 to 34.6°C with mean of 31.9°C. Relative humidity ranged from 32 to 84.6% with a mean of 53.48%, while the control had a range of 30.2 to 34.6% with mean of 31.9%. Low wind velocities were observed during the sampling exercise with a range of 0.1 – 2.4 m/s at the sampling stations with a mean of 0.57 m/s. The control stations values ranged from 0.2 – 0.9 m/s with an average of 0.5 m/s.

During the study, baseline $PM_{2.5}$ concentrations was found to vary from 8.5 to 72.5 µg/m^3 with an average of 36.31 µg/m^3, while PM_{10} concentration varied from 43.8 to 477.8 µg/m^3 with an average value of 227.17 µg/m^3. The control stations recorded values ranging from 11.1-19.6 µg/m^3 with mean of 15.08 µg/m^3 for $PM_{2.5}$ while PM_{10} concentrations ranged from 41.6 to 129.2 µg/m^3 with mean of 86.03

µg/m^3. The $PM_{2.5}$ and PM_{10} concentrations recorded at the stations were below the FMEnv 250 µg/m^3 regulatory limit.

The gaseous pollutants studied during this study, were carbon monoxide (CO), Volatile Organic Compounds (VOCs), methane (CH_4), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and Carbon dioxide (CO_2). Only values for VOCs were detectable in the atmosphere within the Ubeta FDP area of focus and all were lower than values in the control sampling stations as well as very much below regulatory limits. The concentrations of Carbon monoxide (CO), methane (CH_4), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and Carbon dioxide (CO_2) in the atmosphere were too low to be captured by the handheld meter used for their measurement. The noise level varied from 29.4 dB(A) to 78.4 dB(A) at the sampling stations with a mean noise value of 51.96 dB(A). The control stations recorded a range of 34.6 – 70.4 dB(A) with an average of 53.76 dB(A).

ES 4.2 Groundwater Quality

Groundwater samples taken at eleven sampling stations within the study area and three control stations were analysed for physico-chemical, heavy metals and microbial characteristics. The pH values at Ubeta ranged from 4.94 to 5.49 (Average=5.23) while the control stations reported a range of pH values of 5.2 to 5.72 (Average=5.45). There was no significant difference between the mean station values and the control station results ($p<0.05$). Temperature values obtained from the ground water samples varied from 27.1 to 29.1 ^{0}C with an average of 27.72^{0}C. The value obtained from the control station ranged from 27.2 to 28.2^{0}C with average of 27.57^{0}C. There was no significant difference between the mean station values and the control station results ($p>0.05$). The turbidity values of the ground water collected ranged from 1 to 150 NTU with average of 19.43 NTU. The result from the control station ranged from 1.3 to 9.5 NTU, with an average value of 4.67 NTU.
However, the elevated turbidity value (150NTU) recorded in UBEGW17 (monitoring borehole) was as a result of the particles stirred up during the purging of the well which could not settle before the limited time allotted for sampling. However, there was no significant difference between the mean station values and the control station results ($P>0.05$).
The average values were greater than the 5.00 NTU guideline value for domestic water supply (FEPA, 1991; WHO, 2008).

The electrical conductivity ranged from 34 to 129 µS/cm with an average of 72.09 µS/cm. The control stations had a conductivity value ranged of 16 to 150 µS/cm with an average of 71.67 µS/cm. Total dissolved solids concentrations in the groundwater samples ranged from 17 to 65 mg/l with an average value of 36.55mg/l. The control stations had the total dissolved solids in the ground water recorded values ranging from 8 to 75 mg/l with average value of 36mg/l. There was no significant difference between the mean station values and the control station results ($p>0.05$). 1 to 51 mg/l with an average value of 6.55mg/l. The control ranged from 2 to 5 mg/l with average value of 3mgl/l. There was no significant difference between the mean station values and the control station results ($P>0.05$). The Biochemical Oxygen Demand level ranged from 5.74 to 14.9 mg/l with an average value of 11.37mg/l. while the control values ranged from 7.78 to 15.1 mg/l (average 11.56mg/l). However, there was no significant difference between the mean station values and the control station results ($p>0.05$). The Chemical Oxygen Demand level in the ground water recorded 7 to 46 mg/l with an average of 26.9 mg/l in the sampled. The control ranged from 9 to 48 mg/l with average of 25.33 mg/l. There was no significant difference between the mean station values and the control station values ($p>0.05$) According to WHO for drinking water BOD limit is less than < 5.0 mg/l at this limit BOD will not cause any harmful impacts on human body

Nutrients levels in the groundwater showed low nitrate (NO_3^-) concentrations ranging between 1.57 to 5.57mg/l with an average of 3.22mg/l, with control value ranging of 0.28 to 0.519mg/l with average of 0.39mg/l, while sulphate (SO_4^{2-}) ion concentrations in the groundwater samples ranged from 1.11 to 17.6mg/l with an average of 3.25mg/l with control value ranging from 1.13 to 2.3mg/l with average of 1.88mg/l. There was no significant difference between the mean station values and the control station results ($p>0.05$). Phosphate (PO_4^{3-}) ions concentrations were low ranging from 0.066 to 7.11 mg/l with an average value of 1mg/l, while the control values ranged of 0.171 to 2.15mg/l with average of 0.85mg/l. There was no significant difference between the mean station values and the control station results ($p>0.05$).

Exchangeable cations in the groundwater samples showed Ca^{2+} as the most predominant ion, and followed by Mg^{2+}. The calcium concentration in the ground water samples water ranged from 7.3 to 10.4mg/l with average of 8.61mg/l, control value ranged from 7.34 to 7.57mg/l with average of 7.46mg/l; while the magnesium concentration in the groundwater samples ranged from 3.64 to 4.54mg/l with average of 4.07mg/l, the control had value range of 3.83 to 4.25mg/l with average of 3.99mg/l. No significant differences were observed between the cations recorded in the sample stations and their respective controls.

Total hydrocarbon (THC) recorded in the groundwater was below the equipment detectable limit of <0.10mg/kg. The control recorded values below equipment detection limit of <0.10mg/kg. The TPH, PAH and BTEX (Benzene, Toluene, Xylene and Ethylbenzene) were below equipment detection limit of <0.01mg/kg, <0.001mg/kg and <0.001mg/kg respectively. Control station recorded values below equipment detection limit of <0.01mg/kg <0.001mg/kg and <0.001mg/kg respectively. The oil and grease concentrations were below equipment detection limit of <0.10mg/kg. The control recorded values below equipment detection limit of <0.10mg/kg.

Heavy metals determined in the samples only showed Fe and Zn with measurable concentrations, whilst the other metals including As, Cr, Cu, Co, Mn, Ba, Cd, Hg, Ni, and Pb recorded values below their detection limits. Zinc recorded the highest mean concentration of 2.78±0.6 mg/L, while the control recorded a mean concentration of 2.54mg/L. This is followed by Fe with mean concentration of 0.01 mg/L in the study station and 2.33 mg/l in the control station.

Total Heterotrophic bacteria (THB) count in the groundwater sample ranged from <1 to 38.50×10^3cfu/ml (average 9.45×10^3cfu/ml) while the control stations had an average value of 2.50×10^3cfu/ml. Hydrocarbon Utilizing Bacteria population in groundwater ranged from <1 to 21.50×10^2cfu/ml (average 5.05×10^2cfu/ml) while the control stations had an average value of 1.30×10^2cfu/ml. The results of Total Heterotrophic Fungi (THF) had values ranging from <1 to 2.50×10^2cfu/ml (mean 2.50×10^2cfu/ml) with the control station having an average value of 1.50×10^2cfu/ml. Hydrocarbon Utilizing Fungi population ranged from <1 to 1.50×10^2cfu/ml (mean 1.50×10^2cfu/ml) with the control station having a mean value of 0.50×10^2cfu/ml. The results of the Faecal Coliform and Sulphur Reducing Bacteria (SRB) were <2.00MPN/100ml and <1cfu/ml respectively showing no growth. The study revealed that the water sample were free of microbial contamination and so has no level of concern.

ES 4.3 Soil Quality

Soil samples taken at two depths (0 - 15 cm and 15 – 30 cm) from different locations within the study area were analysed for soil physico-chemical, heavy metals and microbiological characteristics. The textural classification of both the topsoil and subsoil was predominantly sand, silt and clay. The results of soil texture analysis at Ubeta FDP area showed that sand fractions had an average of 74.89%, silt content had an average of 21.41%, while clay content ranged from 1.3 to 10.6% with average of 3.69%. At the control stations, sand content had an average of 88.13%; silt 9.43% and clay 2.43% for the surface soil. For sub soil, sand had an average of 75.33%; silt 21.04% and clay 3.63%. At the control stations for the sub soil, sand recorded an average of 87.7%, silt 9.5% and clay 2.8%. The porosity ranged from 32 to 47 %with average of 37.61% for surface soil and 32 to 48% with average of 37.93%, for sub surface soil. The control stations had a value ranged from 32 to 35% with average of 33.33% for surface soil and 34 to 36% with average of 35% for sub surface soil.

The topsoil and subsoil recorded a pH range of 4.16 to 5.88 and 4.09 to 5.42 respectively. The control stations values ranged from 4.18 to 5.01 for top oil and 4.34 to 4.73. The difference in mean values for the topsoil and subsoil was not significant ($p>0.05$) but the mean of the control station stations differs from the sampled stations significantly. The mean redox potential of the topsoil samples was 281.23mV, while the subsoil recorded 282.44mV. The mean values of the top soil and bottom soil were not significantly ($p>0.05$) different.

Total organic carbon contents of topsoil were 0.97±0.37% in the wet season and 0.75±0.37% in the dry season, while the subsoil recorded 0.97±0.36% in the wet season and 0.68±0.39%, in the dry season. Total organic carbon (TOC) contents of the soils within the study area ranged between 0.118 to 2.44% in topsoil and 0.079 to 2.44% in subsoil. The variation between the mean of the sample stations and that of the control stations showed no significant difference while the mean value of top soil and that of the sub soil did not significantly differ from one another ($p>0.05$). Total nitrogen concentrations in the topsoil and subsoil ranged from 0.03 - 0.16% and 0.03 - 0.15% respectively falling between low and medium soil fertility.

The nitrate concentrations in the soil ranged from 0.90 – 18.00 mg/kg (topsoil) and 0.95 – 19.00 mg/kg (subsoil), with mean values (3.80 mg/kg for topsoil and 4.26 mg/kg for subsoil) not significantly ($p>0.05$) different. The values from the control stations fell within the observed ranges obtained for the project area. Nitrite concentration ranged from 0.007 – 0.10 mg/kg (Mean = 0.04mg/kg) in topsoil and from 0.005 – 0.10 mg/kg (Mean = 0.04 mg/kg) in subsoil. The mean values showed no significant ($p>0.05$) difference. The control stations also showed values within the observed ranges.
Ammonium concentrations in topsoil and subsoil ranged from 0.54 - 11.00 mg/kg and 0.58 – 11.60 mg/kg respectively. The topsoil and subsoil mean values were not significantly ($p>0.05$) different. The control stations also recorded values within the ranges observed for the project area. The concentrations of total phosphate in topsoil ranged from 18.2 to 102mg/kg with average of 50.7mg/kg, while the subsoil recorded values between 17.4 and 139mg/kg with average of 54.83mg/kg. The difference between the mean concentrations at both soil depths was not significant ($p>0.05$). The mean values from control stations were, however, significantly different from the sampled stations. The concentrations of sulphate measured in the soil samples ranged from 40.80 – 248.00 mg/kg and 38.60 – 241.00 mg/kg in topsoil and subsoil respectively. The mean concentrations (128.76 mg/kg in topsoil and 144.01 mg/kg in subsoil) are not significantly ($p>0.05$) different.

Exchangeable cations concentrations (mg/kg) measured in the topsoil were Na+(156 to 181), K+(33.9 to 49.1), Mg2+(51.3 to 529) and Ca2+ (209 to 289), while the subsoil recorded Na+(150 to 181), K+(35.9-46.3), Mg2+(50.3 to 69.1) and Ca2+ (213 to 2341). The values recorded at the control station were within the ranges observed for the project area. The cation exchangeable capacity (CEC) values in the topsoil and subsoil ranged from 16.20 - 40.30 cmol/Kg and 21.60 - 37.70 cmol/Kg respectively. The values recorded in the control soil samples were within the ranges observed within the project area.

Total hydrocarbon concentrations, polynuclear aromatic hydrocarbons (PAHs) and BTEX in the soil samples were below instrument detection limits in both soil depths and in the control stations. The heavy metal burden as expressed by the levels of Ba, Cd, Cr, Cu, Fe, Hg, Ni, Pb, V, As, Al and Zn were generally low within allowable limit in soils.

The Total Heterotrophic Bacteria (THB) population in soil at Ubeta ranged from 0.15x105 to 6.25x105cfu/ml with average value of 1.67x105cfu/ml for surface and 0.10x105 to 9.50x105cfu/ml with average value of 1.50x105cfu/ml for subsurface soil.
Hydrocarbon Utilizing Bacteria (HUB) counts were in the range of 1.50x103 to 37.50x103cfu/ml with average value of 11.85x103cfu/ml for surface and <3.33 to 31.50x103cfu/ml with average value of 9.88x103cfu/ml for subsurface soil respectively.

Total Heterotrophic Fungi (THF) <3.33x104cfu/ml to 25.00x104cfu/ml (average 2.32x104cfu/ml) for surface and <3.33x104cfu/ml to 5.00x104cfu/ml (average 1.72x104cfu/ml) for subsurface soil respectively.
The Hydrocarbon Utilizing Fungi (HUF) enumerated from soil from the study area ranged from <3.33 to 35.00x102cfu/ml (average 10.25x102cfu/ml for surface soil and <3.33x104cfu/ml to 5.00x104cfu/ml (average 1.72x104cfu/ml) for subsurface soil respectively.
Feacal coliform had values ranging from <2.00MPN/100ml to >1800MPN/100ml with average value of 79.54MPN/100ml while Sulphur Reducing Bacteria had values ranging from <3.33x104cfu/ml to 5.50x104cfu/ml with average value of 1.21x104cfu/ml for surface soil and <2.00MPN/100ml to >1800MPN/100ml with average value of 97.29MPN/100ml while Sulphur Reducing Bacteria had values ranging from <3.33x104cfu/ml to 2.50x104cfu/ml with average value of 0.88x104cfu/ml for subsurface soil.. This shows the absence of hydrocarbon contamination

ES 4.4 Surface Water Quality

Surface water samples were collected from three (3) stations and three control stations during the sampling campaign. The samples were taken from seasonal swamps/ponds within the Study area.

The temperature ranged from 30.2 to 30.3 ^{0}C with an average of 30.23 ^{0}C, while the temperature values of the control obtained from the surface water 27.9 to 30.7 ^{0}C with average of 30.20 ^{0}C. Electrical conductivity ranged between 25 to 36 µS/cm with an average of 29 µS/cm while the control values from ranged from 18 to 86 µS/cm with average of 42 µS/cm. The average TDS value of the surface water samples ranged from 13 to 19 mg/1 with average value of 15mg/1. The total dissolved solids values in the surface water in the control ranged from 9 to 43 mg/1 with average of 21mg/1. The mean station values and the control station values did not significantly differ from one another (P>0.05). Total Dissolved Solids (TDS) is a measure of the amount of dissolved material in the water column. TDS is directly related to water hardness and waters with TDS levels <70 mg/l correspond to very soft water (Xylem Inc, 2011). The measured TDS values are normal for soft waters. Total suspended solid (TSS) ranged between 2 to 21 mg/1 with average of 8.33mg/1 the control ranged from 2mg/l to 5mg/l with average value of 3.67mg/l, while the turbidity ranged 5.5 to 18 NTU, with an average value of 11.5 NTU while the control values of the surface water ranged from 5 to 34 NTU, with average value of 23.33 NTU. The surface water pH ranged between 4.75 to 6.05 with an average concentration of 5.2 while the pH values of the control stations ranged from 5.92 to 6.3 with an average concentration of 6.05, with the salinity level ranging between 0.01 to 0.02 with a mean of 0.01 mg/L, while the control station ranged from 0.01 to 0.04 mg/L with an average of 0.02mg/L.

Nutrients comprising of nitrogen species, phosphate and sulphate levels in the surface water samples were measured. The sulphate concentration in the surface water ranged from 1.3 to 5.11mg/l with average of 3.3mg/l while the control station values ranged from 3.9 to 15.6mg/l with average of 8mg/l. The phosphate concentration in the surface water samples water ranged from 0.388 to 4.04 mg/l with an average value of 1.61mg/l, while control values ranged from 0.92 to 2.15mg/l with average of 1.54mg/l. The nitrate concentration in the surface water samples water ranged from 0.395 to 0.645mg/l with an average of 0.51mg/l, while control value ranged of 0.069 to 0.35mg/l with average of 0.23mg/l. Low to moderate concentrations of the exchangeable cations were recorded in the surface water samples with abundance in the order of Ca^{2+} > Mg^{2+} > K^{+}. The dissolved oxygen (DO) concentration in surface water body ranged between 3.10 mg/L and 5.30 mg/L with a mean of 3.93 mg/L, while the control recorded a range of 4.10 to 5.20 mg/L with a mean of 4.67 mg/L. Biochemical oxygen demand (BOD_5) load ranged from 3.68 to 15.5 mg/l with average value of 9.79mg/l, while the control value ranged from 4.56 to 15.2 mg/l (average 10.59mg/l). The Chemical Oxygen level in the surface water ranged from 4 to 51 mg/l with an average of 30mg/l. The COD had control value ranged from 5 to 45mg/l with average of 25 mg/l.

Hydrocarbons and organics determined in the surface water samples showed concentrations below instrument detection limits. Heavy metals analysed in the water samples recorded varying concentrations in the study stations and control in the order of Fe > Zn > Cu. Pb, Hg, As Cr, Ni, Cd, Co, Ba, Mn and Al showed concentrations below instrument detection limits.

Total heterotrophic bacteria (THB) counts in the surface water ranged from $0.10x10^4$cfu/ml to $2.25x10^4$cfu/ml (average $1.20x10^4$cfu/ml) while the control stations had average value of $3.45x10^4$cfu/ml. Meanwhile the Hydrocarbon Utilizing Bacteria population in surface water ranged from $4.50x10^2$cfu/ml to $12.50x10^2$cfu/ml (average $7.33x10^2$cfu/ml) while the control stations had average value of $2.33x10^2$cfu/ml. The results of Total Heterotrophic Fungi (THF) had values ranging from <1 to $5.00x10^2$cfu/ml (mean $5.00x10^2$cfu/ml) with the control station having an average value of $5.00x10^2$cfu/ml. The results of Hydrocarbon Utilizing Fungi (HUF) population and Sulphur Reducing Bacteria (SRB) showed no growth at <1cfu/ml and <1 SR/ml. Faecal Coliform also showed no growth at <2.00MPN/100ml in all the stations.

ES 4.5 Sediment Quality

Sediment samples taken from the same sampling points as water samples were also characterised. The particle size of the sediment samples showed sand, silt and clay contents of 82.0 – 89.5%, 9.00 – 16.6% and 1.40 – 2.20% respectively; and the control stations recorded values of 38.3 – 41.5%, 52.2 – 56.8% and 1.70 – 8.90% for sand, silt and clay respectively. The control stations are more than 1kilometre away from the sampling stations. The pH of sediment samples collected ranged from 4.75 to 6.05 with an average concentration of 4.8 while the pH values of the control ranged from 4.63 to 4.72 with average concentration of 4.68. The redox potential of sediment samples ranged from 235 to 314mV with an average value of 264.67mV while the control stations values ranged from 206 to 276mV (average 233.33mV).

Nitrate concentration in the sediment samples ranged from 0.457 to 0.957mg/kg with an average of 0.65mg/kg, with control value ranged of 0.092 to 0.455mg/kg with average of 0.25mg/kg. The mean station values and the control station values did not significantly differ from one another ($p>0.05$). Phosphate concentrations ranged from 5.95 to 9.57mg/kg with an average value of 7.32mg/kg, while control values ranged of 0.92 to 2.15mg/kg with average of 14.03mg/kg. There was no significant difference between the mean station values and the control station values ($p>0.05$). The Sulphate concentration of sediment samples collected had a range 31.3 to 54.7mg/kg with an average of 41.87mg/kg while control values ranged from 39.7 to 70.8mg/kg with average of 52.1mg/kg. Exchangeable cations concentrations recorded high values in the order calcium > sodium > magnesium > potassium in both the study stations and the control stations.

Oil and grease concentrations in the sediment sample ranged from from 30.3 to 45.5mg/kg with average of 37.9mg/kg with a control value ranged from 53 to 75.8mg/kg with average of 63.13mg/kg. The THC and TPH concentrations of sediment sampled were below the detectable limit of <0.10mg/kg and <0.01mg/kg in all the stations. Similarly, PAHs and BTEX concentration of sediments sampled were below equipment detection limit of <0.001mg/kg and <0.001mg/kg respectively.

Heavy metals levels in the sediment samples were in the order of: Fe > Zn > Cu in the study stations and the control; while the other metals were below the detectable limit of the equipment.
The heterotrophic bacteria count ranged from 2.90×10^5cfu/ml to 8.00×10^5cfu/ml (average 5.45×10^5cfu/ml. The Hydrocarbon Utilizing Bacteria (HUB) counts were in the range of 1.75×10^4cfu/ml to 2.60×10^4cfu/ml (average 2.18×10^4cfu/ml). The Total Heterotrophic Fungi (THF) counts were in the range of <1 to 1.50×10^4cfu/ml (average 1.50×10^4cfu/ml). The results for Sulphur Reducing Bacteria (SRB) and Faecal Coliform showed no growth at <1cfu/ml and (<2.00MPN/100ml) respectively.

ES 4.6 Vegetation Quality

Three vegetation types were observed in the study area, these are galloping freshwater swamp forest, secondary forest, and farmlands, while five (5) different types of vegetation growth forms namely, trees, shrub, herb, climbers/creeper and fern were identified within the study area. Among the flora species are *Manihot esculenta, Newbouldia laevis, Artocarpus artilis, Capsicum chinense, Psidium guajava, Ixora coccinea, Emilia praetermissa, Calopogonium mucunoides, Pueraria phaseoloides, Andropogon tectorum, Mangifera indica, Cocos nucifera, Abelmoschus esculentus, Syzygium samarangense, Annona muricata, Ananas comosus* and *Dioscorea rotundata***.** Oil palm tree (*Elaeis guineensis*) is of great economic importance as it is a source of edible oil. Among the economic plants were those used as wood for construction, medicine, food, cash crops, fruits, vegetables etc.

ES 4.7 Wildlife Study

The wildlife survey showed an uneven distribution of wildlife species within the study area. There was a presence of few larger mammals while the rodents, primates and reptiles were among the lower groups that dominates the study area. The other group that is also present in the area are the facultative species, mostly the carnivores that are associated with swamp forest edges. The bird populations in this study area are quite enormous with rich species abundance and diversity. They include the birds of prey, piscovores, insectivores, scavengers and colonizers. The wildlife survey identified a checklist of 110 species in the study area; 61 bird species representing 18 families, 41 mammal species representing 7 families, 8 reptiles species representing 7 families. Out of 110 species, two birds; African grey parrot (*Psittacus eitheus*) and palm nut vulture (*Gypohierax angolensis*): two mammals; maxwells duiker (*Cephalophus maxwelli*) and scalter monkey (*C. scalteri*) and one reptile; African dwarf crocodile (*Osteolaemus tetraspis*) are listed in the The World Conservation Union (IUCN) which is the World Largest umbrella organization for the conservation of nature and natural resources; near threatened, vulnerable, lower risk and data deficient.

ES 4.8 Plankton And Macro-Benthos

Four major classes of benthos were encountered in the study. The taxa group are Crustacea, Gastropoda, Arachnida, and Insecta. The Insecta was the dominant group with 12 species and a total of 167 organisms amounting to 74.9% of the total benthic organisms recorded during the study period. Gastropoda and Crustacea had 24 organisms each (10.8%), and Arachnida was least with 8 organisms (3.8%).

Five major classes of the zooplankton groups were recorded contributing a total number of 37 species of zooplankton. The Rotifera dominated the taxa groups with 15 species and a total number of 802 organisms amounting to 43.7% of the total zooplankton stock counted during the study. Other groups followed each other closely for example, Cladocera contributed a total of 370 organisms represented by 7 species amounting to 20.1%, followed by Rhizopoda 288 organisms (15.7%), Cilliata and Copepoda with 10.3% and 10.1% respectively.

The phytoplankton comprised of the Bacillariophyceae, Chlorophyceae, Cyanophyceae, and Euglenophyceae. Amongst the taxonomic groups, Chlorophyceae was highest in abundance with 342 organisms (32.6%) and the lowest Euglenophyceae (12.4%).

Fishing in the area is done as a regular activity on part-time or full time depending on the season. Fishing in the swamp and flood plains is carried out mainly from small permanent and temporary huts set up in the forest and farm bushes. Many different techniques are utilized including basic gears like gill nets, traps and trigger hooks. Most fish species encountered includes *H. fasciatus* (Cichlidae), *Tylochromis sp.* (Cichlidae), *Parachanna spp.* (Channidae), *X. nigri* (Notopteridae), *Papyrocranus afer* (Notopteridae), *Malapterurus electricus* (Malapteruridae), *Clarias* *sp.* (Clariidae), *Gymnarchus niloticus* (Gymnarchidae), *C. kingsleyae* (Anabantidae), *Protopterus sp.* (Protopteridae) and *Phractolaemus ansorgii* (Phractolaemidae).

ES 4.9 Socioeconomics

The socioeconomics and health impact survey was conducted in the eight host communities of Ubeta, Ubarama, Ubio, Ihuaje, Akabuka, Ogbogu, Obite and Anwunugbokor.The population studies was based on the 1991 census figures from which the 2021 population figures were projected. The projection was estimated using 2.5% growth rate as stated by World Bank. The population studies show that Akabuka has the highest population with 16,386 people while Ubio is the least with 4,302 persons.

The demography revealed that the working age (15-64yrs) were 88% while the remaining 12% were the elderly (65yrs and older). The focused group discussion reveled that adults constitute ¼ of the population while Youths/children make up the remaining ¾ of the population of communities in the proposed project area. The sex structure of the sampled respondents indicates a predominance of males (74%) over the females (26%). The major occupation of the people in the host communities indicates that business / Trading and farming are the major occupation engaged by the people. The household monthly income of people from the eight host communities showed that most of the respondents (80%) earn less than N50,000 per month while 16% earn between N50,000 and N200,000. The least percentage of household income were those that earn greater than N200,000 monthly and they constitute 4% of the respondents.

All the communities have at least one primary school that is accessible to the inhabitants. There are also secondary schools in the communities except Ubio, Ihuaje and Agwunugbokor. These facilities generally are present in most communities and are in various states of disrepair and functionality. Result reveals that most members of the communities use pit latrines which are usually less than 100 meters to their living houses. Also, open defecation in the bushes was common while few use the water closet toilet.

The power structure comprised the Paramount ruler (Eze Nwula), Council of Chiefs and the Elders, CDC Chairman, the Council of Elders, the Youth President, the Women leader. In hierarchy, the Council of Chiefs is higher than the CDC Chairman. Chiefs, Youth and Women organizations run a constitutional system that is binding on all in the community. The host communities of Ogbogu, Obite and Akabuka are in Ogba Kingdom. Ogba Kingdom had been influenced by social values, behaviours, laws, traditions and modern life, however, the people had maintained their identity and retained many of their traditions and customs. Ogba people were known for elaborate greetings, praise names and titles, which made them very prominent in any gathering.

The Christian Religion and African Tradition were present in the study area. About 75% of the population professes Christianity; this is evident by the presence of over 10 different church denominations in the area.
There were also some Muslims and traditional shrine worshippers in the communities but were in small numbers of less than 5%.

In general, only 25% of the respondents agreed that TotalEnergies E&P has been keeping with the MOU agreement with the community while 53%, in their own view, believed that the MOU agreement is not being kept by TotalEnergies E&P . The Other 22% of respondents do not know if it's being kept or not.

ES 4.10 Health Assessment

The availability of healthcare facilities in the communities from respondents showed patent medicine shops having 56% and followed closely by primary health care facilities (40%) with none at Anwunugbokor, while the hospitals were few (4%) and located in only Ogbogu and Obite. Our FGD and site visit showed that Ubarama health centre has long been non-functional and must have attributed to zero availability response by the respondents from the community.

The main sources of drinking water in the communities were borehole (community and private water schemes) and hand dug wells some of which has mono pump taps. Most of the communities had at least one functional borehole water scheme provided by TotalEnergies Exploration and Production Nigeria (TotalEnergies E&P).
The data presented on the prevalent diseases in the study area are (Fig 4.39) indicated that Malaria (24.4%) was the highest cause of mortality, followed by general sickness (15.1%), typhoid fever (11.6 %), diabetes (9.3%), Hypertension (9.3%), etc. Interestingly, poverty was ranked as the third highest common cause of mortality in the community with 11.6%. The others (18.7%) were asthma, gun shot, dysentery, tuberculosis, kidney failure, lack of medical care and accident.

ES 5.0 EVALUATION OF EXISTING AND ASSOCIATED IMPACTS

A methodical and rigorous impact assessment based on that developed by the World Bank and ISO 14001 Standards as well as the Federal Ministry of Environment guidelines as set out in the sectoral guidelines, and TEPNG's recommended methodology for impact evaluation as expressed in various documents including GS EP ENV 120 (Environmental Impact assessment of E&P activities), with an objective to ensure a comprehensive and systematic evaluation of all potential positive and negative effects associated with the project.

Direct potential negative impacts associated with the project include impacts to the environment, socioeconomic conditions, and health and safety of workers and members of the general public. The project is perceived to cause the following minimal negative impacts which include among others:

a) During pre-mobilization phase, land acquisition will lead to permanent loss of farmland and fishponds which will result to loss of livelihood;
b) During the pre-construction (site clearing), vegetation clearing will lead to loss of habitats for terrestrial fauna and important species, however, clearing will be limited to the ROW so as to limit the impact;
c) The back filling may affect the drainage pattern of the area if not properly done and may induce erosion if soil is not properly re-instated;
d) Potential increase in the rate of exposure to accidents as a result of increase in road traffic during mobilization of personnel and equipment to site over a period of time;
e) The potential for air quality impairment as a result of the construction activities of the Project is confined to exhaust emissions from vehicles and equipment;
f) Kidnap of personnel which is likely at every phase of the project because of the high rate of insecurity and kidnapping in Nigeria;
g) Waste will be generated during some of the project activities such as site clearing, trenching, drilling, pipeline and manifold construction and in the operational and decommissioning/abandonment phases;
h) Injury and fatality can result from occupational accidents during construction and the operation of the facility;
i) In the event of an accident workers may suffer injury which may result in lost time or even fatality;
j) Behavioural influences - Agitation for employment and supply contract by community;
k) Loss of gainful employment as a result of end in project cycle;
l) As a result of immigration, life style/habit changes involving crime, drug abuse, prostitution will be more pronounced in the communities.

The potential positive impacts include:
a) Increase gas utilization by TEPNG with resultant reduction in gas flared;
b) Improvement in the local economy of the host communities and the nation as a whole, in terms of tax revenue to the three tiers of Government;
c) Profit, employment opportunities, the opportunities for contract works and welfare improvements in the host community.

The overall impacts assessment revealed that Ubeta field development project beneficial impacts outweighed the adverse effects.

ES 6.0 MITIGATION MEASURES

Mitigation measures were provided for those impacts rated as moderate or major, while the identified negligible/minor impacts would be addressed by existing standard practices in TEPNG. The measures proffered were to reduce the severity of identified negative impacts and enhance the beneficial effects.
In a bid to mitigate the identified impacts, the following strategies among others were suggested. They include:

- Conduct a thorough assessment of land requirements.
- Pay adequate compensation for the loss of land.
- Continuous surface water and sediment quality monitoring.
- Pay adequate compensation for the loss of farmland and fishpond.
- Use existing route/path for site survey.
- Minimize bush clearing.
- Wildlife studies shall be carried out to the status of endangered/threatened species (species diversity and abundance) shall be carried out one year after major construction activities.
- Ensure that appropriate PPEs are provided and used.
- Anti- venom shall be provided on site.
- Awareness shall be created among site workers and nearby communities on the likelihood of exposure to poisonous wildlife and plants.
- Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities.
- Require local labour (both male and female, skilled and unskilled) to be employed as a priority to the extent practicable.
- Any form of agitation is looked into and addressed promptly.
- Develop and implement a security management plan for the project
- Work with the Government, communities and other relevant agencies to improve security in the project area.
- Ensure that security orientation and awareness is conducted for workforce.
- Ensure that staff adhere to instructions on daily journey management plan.
- Ensure government approved security personnel are used on transport vehicles when warranted and limit movements of personnel and equipment to daytime.
- Provide dedicated accommodation and logistics to all site personnel including local labour to prevent mixing with the larger community as part of Covid-19 measures throughout the construction phase of the project.
- Step-up health education and sensitisation activities prior commencing construction activities.
- Carry out HIV/AIDS education campaign for workers in line with the National Prevention Program.
- Enforce strict Access control within workers' camp sites.
- Awareness campaign and health education on dangers and problems of unwanted pregnancy and sexually transmissible diseases to members of communities and workers will be provided as part of tool box meeting on site.
- Ensure that workers respect the norms and values of the project communities.
- Ensure that drilling equipment is of high standard and in good condition prior to mobilization.
- Ensure that all emission releasing equipment shall be maintained regularly including gensets, cranes, welding machines, etc.

- Ambient air quality shall be monitored in line with FMENV/NUPRC requirement (NOx, COx, SOx, and SPM).
- Only skilled personnel and certified equipment are used.
- Use appropriate blowout prevention fluids.
- Use appropriate mud density.
- Use high quality chemicals and materials.
- Ensure emergency response procedures are in place.
- Job hazard assessment shall be conducted.
- Daily pep talks shall be conducted on identified hazards.
- A Blow out Preventer (BOP) will be used when drilling.
- Above mitigation measures are to ensure that there is no blow outs/accidents. However, in the event of blow out/accidents, emergency response in place is activated.
- Recover oil-based drilling mud for re-processing and re-use.
- Wells shall be drilled with Water Based Mud in top hole.
- Develop and implement waste management plans for all wastes generated in accordance with regulatory requirements and standard practice.
- All industrial wastes such as plastics, metals, rubber and wood shall be segregated on site and collected in designated containers. The containers will be transported to land base for disposal.
- Ensure the utilization of the existing ROWs to avoid habitat disturbances and losses of ecological species.
- Ensure minimum land clearing and clearing will be restricted to acquired area.
- Limit clearing activities to pipeline corridor only
- Carry out a biodiversity offset by reforesting of areas outside the ROW corridor.
- That all personnel are briefed with acceptable social behaviours and taboos of the host community.
- Ensure that security orientation and awareness is conducted for workforce.
- Ensure that staff adhere to security instructions.
- Ensure government approved security personnel are used during construction.
- Ensure provision of adequate firefighting equipment.
- Ensure that emergency response procedures are in place.
- Ensure a more frequent or rigorous pipeline inspections/testing.
- Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities.
- Require local labour (both male and female, skilled and unskilled) to be employed as a priority to the extent practicable.
- Any form of agitation is looked into and addressed promptly.
- Develop and implement a security management plan for the project
- Work with the Government, communities and other relevant agencies to improve security in the project area.

- Ensure that security orientation and awareness is conducted for workforce.
- Ensure that staff adhere to security and safety instructions.
- Ensure government approved security personnel are used.
- Provide a basecamp for accommodation and logistics to all site personnel. Use local labour to minimize additional labour demand from outside the communities.
- Provide a basecamp for accommodation and logistics to all site personnel. Use local labour to minimize additional labour demand from outside the communities.
- There will be low dependence on existing infrastructure as personnel will be camped on site.
- Public enlightenment about potential health risks (STDs).
- Use local labour as much as possible to have the youths gainfully employed.
- Facilitate skills acquisition and scholarship programmes.

ES 7.0 ENVIRONMENTAL MANAGEMENT PLAN

The essence of designing an Environmental Management Plan (EMP) is to monitor compliance with all the mitigation measures and commitments as discussed in the EIA. In addition, the plan checks the effectiveness of suggested mitigation measures, demonstrate that the project activities are carried out in accordance with the prescribed mitigation measures and existing compliance regulatory procedures, and provide early warning signals whenever an impact indicator approaches a critical level.

For the Ubeta Project, a comprehensive EMP have been developed to achieve the above objectives. The plan describes impacts, lists mitigation measures, catalogues monitoring indicators/parameters, frequency of monitoring and the party responsible for each action under the plan.

The EMP will remain a dynamic working tool and will be owned by the site management. The site manager, as the custodian of the document may exercise auditing roles to verify compliance by the operational units, contractors and vendors that carry out activities within the site. The EMP will be updated and revised periodically, throughout the life span of the project to incorporate improved technologies, modifications to environmental regulations, policies, guidelines, best available or affordable technologies and improved or more effective management systems.

ES 8.0 CONCLUSION

The EIA has shown that the Ubeta project will impact the environment positively and negatively. The identified adverse impacts were generally short-term and can be prevented, reduced, ameliorated, or controlled if the recommended mitigation measures are implemented. Furthermore, an Environmental Management Plan (EMP) has been developed to ensure that the identified potential impacts can be reduced to “as low as reasonably practical” (ALARP). The EMP should therefore form the basis for the actual project implementation and future monitoring of environmental components.

Chapter

1

INTRODUCTION

1.1 GENERAL

TotalEnergies EP Nigeria Limited (TEPNG), an affiliate of TotalEnergies S.A., has operated in the upstream sector of the Nigerian hydrocarbon industry for more than 55 years and has added over 3.6 billion barrels of oil equivalent to Nigeria's production to date. Incorporated in Nigeria in 1962, TEPNG has maintained strong and steadfast partnerships with the Nigerian Government, the Nigerian National Petroleum Corporation (NNPC) and several indigenous companies, in developing the country's hydrocarbon industry.

TotalEnergies operates and holds a 40% interest in the NNPC/TEPNG Joint Venture, producing oil and natural gas from several onshore and shallow water concessions. TotalEnergies is committed to working closely with its host communities and supporting many projects in the areas of health, education, environmental conservation, infrastructure and economic development, through its sustainable development and community relations programmes. TotalEnergies delivers world-class energy solutions adds economic value to the country and promotes best practices in safety and environmental protection, business ethics and corporate social responsibility.

As part of effort to compensate for gas production decline at some TEPNG fields and increase the overall gas production in OML 58, to meet growing demand by Nigeria Liquefied Natural Gas (NLNG) and for domestic use; TEPNG plans to develop the Ubeta field. Ubeta is a gas condensate field located 12 Km South West of Obite Gas Plant in OML 58, onshore Nigeria. Ubeta Field Development Project is captured in the Year 2006 OML 58 Upgrade Field Development Plan. In the past, one exploratory well was drilled in 1964, and three appraisal wells were drilled in 1972, 1979 and 1984, resulting in the discovery of (10) Reservoirs, five (5) of which are currently considered for initial development.

In line with TEPNG's commitment to environment friendly operations, continuous high environmental performance, compliance to local/international regulations and implementations of best practices; TEPNG is conducting an Environmental Impact Assessment (EIA) for Ubeta Field Development Project, using one season field survey data. The current EIA shall leverage on data from past Environmental Studies within the OML 58 Block to complement the One-season field data acquired during the Ubeta Field Development Project EIA. It is pertinent to state that several Environmental Studies have been conducted within OML 58 Block including, OML 58 Complimentary well drilling EIA (Year 2001), Obite Ubeta Rumuji (OUR) Pipeline EIA (Year 2014), OML 58 Upgrade Project EIA (Year 2014) and OML 58 Environmental Evaluation Study (Year 2018).

As part of TEPNG's commitment to environment friendly operations, continuous environmental performance, compliance to local/international regulations and implementations of best practices, TEPNG engaged the services of Delta Systematics Limited to carry out an Environmental Impact Assessment (EIA) of the proposed Ubeta Field Development Project. Regulatory oversight of the EIA was be carried out by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and the Federal Ministry of Environment (FMEnv).

Delta Systematics conducted a field sampling survey for the dry season from the 14th to the 30th of December 2021. The survey consisted of the Biophysical, socioeconomics and health components.

This document is a draft report for the Ubeta Field Development Project EIA

1.2 PURPOSE OF THE ENVIRONMENTAL IMPACT ASSESSMENT

The data generated from the survey would serve as background/scientific basis for monitoring environmental changes in the environment within Ubeta Field Development Project area. It would also serve as a basis for predicting and developing mitigation for the impacts of future activities within the area as well as support decision making in future project design, operation and management.

1.3 BENEFITS OF THE EIA

The benefits of the EIA include:

- Obtaining authorization; this is required by regulatory authorities before the commencement of any major development.
- Providing a forward planning tool; when environmental implications are taken into account with other design considerations at the conceptual design

stage. It allows for 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 Ubeta Field Development Project and identification of key issues that require special consideration for effective environmental management and controls.
- Involving all stakeholders through consultation to address common problems, impacts and mitigating measures that might be proposed.
- Informing management with a view to achieving long-term management objectives and plans associated with specific activities, in order to minimize associated financial and environmental risks.

1.4 OBJECTIVES OF THE EIA

The objectives of this study is to determine site specific environmental baseline data that will be used in addition to literature data to assess the impact of the Ubeta Field Development Project on the environment. Therefore, Delta Systematics Limited embarked on this study to:

- Determine environmental baseline conditions (i.e., physical, chemical, biological and Socio-economic and health status) at and around the Field Development Project area;
- Providing a reference point to evaluate future assessment of impacts; and to identify parameters within the ecosystem that may be sensitive to significant change.
- Identify and document any anticipated impact that may result from the field development, and in cases of detrimental effects, provide appropriate mitigation measures and remedial actions for identified impacts
- To develop an Environmental management plan for the implementation of the mitigation measures.

1.5 THE STUDY AREA

The project location cuts across three Local Government Areas in Rivers State namely Ogba/Egbema/Ndoni, Ahoada East and Ahoada West. It is approximately 70 km Northwest of Port Harcourt, 12km Southwest of Obite Gas Plant and 8km Southwest of Ogbogu Flow Station. Ubeta is a tectonically stable area situated in a low lying, relatively flat terrain within the equatorial rain forest belt. The topography of the area is flat and fall within the freshwater zone. in . The Ubeta area lies within a dry deltaic plain with abundant seasonal freshwater swamps. The area is characterized by farmland, low altitude secondary rainforest, and freshwater marshes. No permanent flowing water body (river, creek and streams)

is visible around the Ubeta Field Development Project propose location. However, the area is susceptible to flooding during the rainy season.
The major soil types are brown loams and sandy loams, sedimentary in nature. The vegetation type recognizable is the rainforest because it is located in both wetland and upland area of Rivers state. Detailed layout of proposed location and neighbouring communities is shown in Figure 1.
The location of Ubeta cluster and the associated infrastructure have been selected to minimize environmental impact and development costs.

1.6 SCOPE OF THE STUDY

The scope of work for the Ubeta field development project EIA includes the following:

1. A desktop review of available literature which include past environmental studies that have been carried out within OML 58 Block, and around the Ubeta Field.
2. Dry season field data gathering executed to obtain soil samples (0- 15cm, 15-30cm depths), Groundwater, Surface water and Sediment samples and Air quality sampling. Socioeconomic and Health data were also collected and analysed.
3. Performance of a review and evaluation of data acquired from literature and field samples, to ascertain lines of evidence that determine potential environmental impacts.
4. Development of recommendation for mitigation, monitoring and remedial measures for observed impacts.
5. Writing and issuance of an Environmental Impact Assessment Report for regulatory review and approval.

Fig 1.1: Map Showing Ubeta Field Development Project Location

1.7 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

Operations and all forms of development activities in the Nigerian oil industry sector are regulated by several specific laws, guidelines, and standards. These statutes together with applicable International Conventions and with Company health, safety and environment (HSE) Policy provide a basis for the Ubeta Field Development Project Environmental Impact Assessment.

1.7.1 International Agreements: Protocols and Conventions

Nigeria is signatory to several laws, treaties and regulations that govern the environment. Among these are:

- International Union for Conservation of Nature and Natural Resources (IUCN) Guidelines 1996
- United Nations Framework Convention on Climate Change (1992).
- Convention on Biological Diversity (Rio Summit) 1992
- World Bank Guidelines on Environmental Assessment, 1991
- Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention), 1990.
- Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal 1989.
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.
- Convention on International Trade in Endangered Species of Fauna and Flora (CITES) 1973.
- Guidelines of International Financing Institutions

1.7.1.1 International Union for Conservation of Nature and Natural Resources (IUCN) Guidelines 1996

The IUCN in conjunction with the Oil Industry International Exploration and production Forum presented a set of guidelines for oil and gas exploration and production in mangrove areas. These guidelines are aimed at conservation of mangroves and enhancing the protection of marine ecosystems during E & P activities. The document also discusses the policy and principles for environmental management in mangrove areas as well as EIA procedures, Environmental Audit and Monitoring.

1.7.1.2. United Nations Framework Convention on Climate Change (1992)

In order to achieve sustainable social and economic development, energy consumption for developing countries needs to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general. This also includes the application of new technologies on terms which make such an application economically and socially beneficial, determined to protect the climate system for present and future generations.

1.7.1.3. Convention on Biological Diversity (Rio Summit) 1992

The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

1.7.1.4. World Bank Guidelines on Environmental Assessment (1991)

The World Bank requires the execution of an EIA on a proposed industrial activity by a borrower as a pre-requisite for granting any financial assistance in form of loans. Details of World Bank's EIA procedures and guidelines are published in the Bank's EA Source Book Volumes I - III of 1991. Potential issues considered for EA in the upstream oil and gas industry include the following:

- Biological Diversity
- Coastal and Marine Resources Management
- Cultural Properties
- Hazardous and Toxic Materials and
- International waterways.

1.7.1.5. Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention), 1990

The convention sets aside areas of cultural and natural heritage for protection. The latter is defined as areas with outstanding universal value from the aesthetic, scientific and conservation points of view.

1.7.1.6. Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989

The convention focuses attention on the hazards of the generation and disposal of hazardous wastes. The convention defines the wastes to be regulated and control their trans-boundary movement to protect human and environmental health against their adverse effects.

1.7.1.7. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention,) 1979

The Bonn Convention concerns the promotion of measures for the conservation and management of migratory species.

1.7.1.8. Convention on International Trade in Endangered Species of Fauna and Flora (CITES), 1973

The fundamental principles of the Convention on International Trade in Endangered species of fauna and flora (CITES) is as follows: The Contracting States, Recognizing that wild fauna and flora in their many beautiful and varied forms are an irreplaceable part of the natural systems of the earth which must be protected for this and the generations to come; Conscious of the ever-growing value of wild fauna and flora from aesthetic, scientific, cultural, recreational and economic points of view; Recognizing that peoples and States are and should be the best protectors of their own wild fauna and flora; Recognizing, in addition, that international co-operation is essential for the protection of certain species of wild fauna and flora against over- exploitation through international trade.

1.7.1.9. Guidelines of International Financing Institutions

When a plan or program such as the proposed Ubeta field development project consisting of a set of projects in a particular area is considered for finance by the International Finance Corporation, a Cumulative Environmental Impact Assessment is required. The IFC Procedure for Environmental and Social Review of Projects (IFC, December 1998) states that environmental assessment should include consideration of: "Cumulative impacts of existing projects, the proposed project and anticipated future projects." To identify which other projects need to be considered alongside the project being assessed. The IFC Procedure states that:
"Assessment of cumulative impacts would take into account projects or potential developments that are realistically defined at the time the environmental assessment is undertaken, where such projects and developments could impact on the project area". The Cumulative Environmental Impact Assessment also takes into consideration the provisions of the following IFC and World Bank guidelines relating to the environment:

- IFC Technical Guidelines on Hazardous Material Management, December 2001;
- IFC Technical Guidelines on Occupational Health and Safety, June 2003;
- IFC Policy on Forestry (OP 4.36), November 1998;
- IFC Policy on Natural Habitat (OP 4.04), November 1998;
- IFC Policy on Environmental Assessment (OP 4.01), October 1998;
- World Bank Policy on Forests (OP 4.36), November 1998;
- International Finance Corporation (IFC), Environmental and Social Standards (Equator Principle) Revised Edition, 2006
- IFC Guidelines for Noise
- IFC Guidance Note G: Assessment and Management of Cumulative Impacts, June 2001
- The IFC Procedure and Social Review of Projects (December 1998)

1.7.1.10. IFC Guidance Note G Assessment and Management of Cumulative Impacts, June 2001

The guidance note provides guidance on how to incorporate cumulative effects analysis into the components of an environmental assessment. A comprehensive CEIA comprises the cumulative effects of the projects in a plan or program.

1.7.1.11. IFC Guidelines for Noise

To assess the potential impact of a new noise source on the nearest noise sensitive receptors, the following approach shall be employed:

- Noise criteria specify absolute maximum accepted facility noise levels either at the site boundary or at the nearest noise sensitive receptors. These criteria are expressed in LAeq. Some of these criteria are also based on a Best Available Techniques (BAT) approach.
- Noise criteria also use a comparison of relative noise levels at the nearest noise sensitive receptors using existing ambient noise levels LA90. Specific noise levels from the plant noise are assessed in terms of LAeq, with the difference between the two parameters giving the likelihood for complaints.

1.7.1.12. Equator Principles (EP)

It is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing.
Principle 2: Social and Environmental Assessment
For each project assessed as being either Category A or Category B, the borrower has conducted a Social and Environmental Assessment ("Assessment") process to address, as appropriate and to the Equator Principles Financial Institutions (EPFI) satisfaction, the relevant social and environmental impacts and risks of the proposed project (which may include, if relevant, the illustrative list of issues as found in Exhibit II of the EP). The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.
These Principles are intended to serve as a common baseline and framework for the implementation by each EPFI of its own internal social and environmental policies, procedures and standards elated to its project financing activities. EPFI will not provide loans to projects where the borrower will not or is unable to comply with her respective social and environmental policies and procedures that implement the Equator Principles.

1.7.2 Federal Regulations/Guidelines

There are legislations, guidelines and standards that govern the assessment of environmental impacts of development projects in the oil and gas industry in Nigeria. These regulations can be classified as follows:

- Environmental Impact Assessment Act CAP E12 LFN 2004.
- Environmental Guidelines and Standards for the Petroleum Industry in Nigeria, (EGASPIN), 2018 by the Department of Petroleum Resources (DPR)
- Department of Petroleum Resources (DPR) Mineral Oils Safety Regulations 1997
- S.I.8 National Environmental Protection (Effluent Limitation) Regulation 1991
- S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes Regulation), 1991.
- S.I.15 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations of 1991
- The Petroleum Act No. 51 of 1969
- The Petroleum Drilling and Production Regulations – 1969
- The Oil Pipeline Act and Oil and Gas Pipeline Regulation of 1995
- Endangered Species Control Act of 1985
- Land Use Act of 1978
- National Inland Waterways Authority (NIWA) Act 13 of 1997
- Factory Act, 1992
- Revised National Health Policy, 2004
- National Health Act, 2005
- National Guidelines and Standards for Environmental Protection 1991
- Nigerian Ports Authority Act No 38 of 1999
- Urban and Regional Planning Law, Decree 88 of 1992

1.7.2.1 National Policy on Environment (1989, revised 1999)

This document describes guidelines and strategies for achieving the policy goal of sustainable development by:

- Securing for all Nigerians a quality of environment adequate for their health and well-being;
- Conserving and using the natural resources for the benefit of present and future generations;
- Restoring, maintaining and enhancing the ecosystem and ecological processes essential for the preservation of biological diversity;
- Raising public awareness and promoting understanding of the essential linkages between the environment, resources and development; and

Collaboration with other countries, international organizations and agencies to achieve optimal use of trans-boundary co-operation in order to prevent environmental recourses.

1.7.2.2. Environmental Impact Assessment Act CAP E12 LFN, 2004

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

1.7.2.3. The Mineral Oil (Safety) Regulations, 1963

Sections 37 and 40 of the mineral oil (safety) regulations, 1963, require provision of personal protective equipment (PPE) and the safety measures for workers in drilling and production operation in accordance with international standards.

1.7.2.4. S.I.8 - National Effluent Limitation Regulation, 1991

The National Effluent Limitation Regulation, S.I.8 of 1991 (No. 42, Vol. 78, August, 1991), makes it mandatory for industries as waste generating facilities (including research institutes, clinics, hotels etc.) to install anti-pollution and pollution abatement equipment on site. The regulation is specific for each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for contravention are specified also in the regulation.

1.7.2.5. S.I.9 - Pollution Abatement in Industries Generating Wastes Regulation

The pollution abatement regulation, S.I.9 of 1991 (No. 42, Vol. 78, August, 1991) imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries; submission of lists and details of chemicals used by industries to FMEnv; requirement of permit by industries for the storage and transportation of harmful or toxic waste; the generator's liability; strategies for waste reduction; permissible limits of discharge into public drains; protection of workers and safety requirements; for environmental audit (or environmental impact assessment for new industries) and penalty for contravention.

1.7.2.6. S.I.15 – National Environmental Protection (Management of Solid and Hazardous Wastes) Regulation, 1991.

This provides that the objective of solid and hazardous waste management shall be to:

- Identify solid, toxic and extremely hazardous wastes dangerous to public health and environment,

- Provide for surveillance and monitoring of dangerous and extremely hazardous wastes and substances until they are detoxified and safely disposed,
- Provide guidelines necessary to establish a system of proper record keeping, sampling and labelling of dangerous and extremely hazardous wastes,
- Establish suitable and provide necessary requirements to facilitate the disposal of hazardous wastes;
- Research into possible re-use and recycling of hazardous wastes.

1.7.2.7. Endangered Species (Control of International Trade and Traffic) Act 11 of 1985

This Act prohibits hunting, capture and trade of some endangered species like crocodile, alligator, turtles, Parrot, etc. The Endangered (Control of International Trade and Traffic) Decree (No. 11 of 1985) has been enacted by the Federal Republic of Nigeria specifically to implement CITES. It is broader than CITES in that it also covers domestic taking of listed species. Two schedules are included: Schedule I (Endangered Species – Animals in relation to which International Trade is absolutely Prohibited), and Schedule 2 (Animals in Relation to which International Trade may only be conducted under License). The decree prohibits taking of Schedule 1 species and requires that taking of Schedule 2 species be in accordance with a license issued under the decree.

1.7.2.8. Oil Pipelines Ordinances (CAP) 145, 1956 and Oil Pipelines Act, 1965

The oil pipelines ordinance (CAP 145), 1956, as amended by the Oil Pipelines Act 1965, provides, under Section 4(2), for a permit to survey (PTS) a pipeline route to be issued to the applicant by the Minister of Petroleum Resources, for the purpose of transporting mineral oil, natural gas, or any product of oil or gas to any point of destination to which such a person requires such oil, gas or product, thereof, for any purpose connected with petroleum trade or operations.

1.7.2.9. The Oil and Gas Pipelines Regulations (1995), as published in the Federal Republic of Nigeria Official Gazette (No. 49 Gas Pipelines Regulations1995)

Federal Republic of Nigeria Official Gazette No. 26 of 2 October 1995, Vol. 82 [Government Notice No. 49], came into effect on 17 June 1995 and enlarges the scope and coverage of the pipeline Act of 1956. These regulations require that pipeline construction be performed in a manner minimizing disturbance to the provisions of API RP 1102 or other recognized equivalent international operating standards.

1.7.2.10. Procedure Guide for the Design and Construction of Oil and Gas Surface Production Facilities (2001)

These guidelines, issued by the DPR and pursuant to Regulations 36 and 39 of the Petroleum (Drilling and Production) Regulations (1969), outline permitting procedures for applications for approval of construction of all oil and gas surface production facilities in the Nigerian petroleum industry. The approval process for any project execution covers four sequential stages:

- Conceptual design
- Detailed design
- Pre-commissioning / oil and gas facility operating permit
- Decommissioning

1.7.2.11. Petroleum (Drilling and Production) Regulations (1969)

The Petroleum (Drilling and Production) Regulations (1969), empowers the holder of an OPL to do practically anything in the area covered by the license {Section 15 (1)}, but Section 15(2) holds such a holder responsible for all the actions of his agents and contractors.

1.7.2.12. Federal Environmental Protection Agency (Now FMEnv) Act No. 58, 1988

This Act, which was issued in 1988 and amended by Act No. 59 of 1992, provides the setting up of the Federal Environmental Protection Agency, as the apex organization for the overall protection of the Environment and Conservation of Natural Resources. The act also makes environmental impact assessment (EIA) mandatory for all new major projects. In compliance with its mandate, FEPA issued the procedure, guidelines and standards for the execution of EIA with emphasis on the significance associated with current and potential impacts of such projects. The procedure also indicates the steps to be followed (in the EIA process) from project conception to commissioning in order to ensure that the project is executed with adequate consideration for the environment.

1.7.2.13. FMEnv Sectoral and Procedural Guidelines for Oil and Gas (1995)

In compliance with its mandate, FEPA issued the EIA Procedural Guidelines and Sectoral Guidelines for Oil and Gas Projects in 1995. Contained in the Procedural Guidelines (pg. 8) are Category I projects (mandatory study activities) and listed under item 15, sub-item (a) on page 10) (Petroleum) is Oil and Gas Fields Development, making an EIA mandatory for the proposed project. The Procedural Guidelines also indicate the steps to be followed (in the EIA process) from project conception to commissioning in order to ensure that the project is executed with adequate consideration for the environment. Annex C contains the EIA writing format as required by FMEnv. The guidelines are intended to assist in the proper and detailed execution of EIA studies of projects in consonance with the EIA Act.

1.7.2.14. FEPA (Now FMEnv) National Guidelines on Waste Disposal through Underground Injection (1999)

These Guidelines and Standards on waste disposal through underground injection provide the 'modus operandi' for the most viable options for disposal of these wastes in a tropical environment as Nigeria.

1.7.2.15. FEPA (Now FMEnv) Nigeria's National Agenda 21 (1999)

Nigeria's National Agenda 21 was developed to:

- Integrate environment into development planning at all levels of government and the private sector;
- Intensify the transition to sustainable development;
- Address sectoral priorities, plans, policies and strategies for the major sectors of the economy and,
- Simultaneously foster regional and global partnerships.

1.7.2.16. Forestry Law CAP 51, 1994

The Forestry Act 1958 which was amended as the Forestry Law CAP 51, (1994) prohibits any act that may lead to the destruction of or cause injury to any forest produce, forest growth or forestry property in Nigeria. The law prescribes the administrative framework for the management, utilization and protection of forestry resources in Nigeria, which is applicable to the mangrove, and other forests of the Niger Delta.

1.7.2.17 National Oil Spill Detection and Response Agency (NOSDRA), 2006

The National Oil Spill Detection and Response Agency (NOSDRA) was established in 2006 as the lead Agency in ensuring timely, effective and appropriate response to oil spills, through clean up and remediation of all impacted sites to all best practical extent.

1.7.2.18 National Environmental Standards Regulatory and Enforcement Agency (NESREA), 2007.

The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established as a parastatal of the Federal Ministry of Environment. NESREA is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria.

1.7.2.19 The Nigerian Oil and Gas Industry Content Development Act 2010

All regulatory authorities, operators, contractors, subcontractors, alliance partners and other entities involved in any project, operation, activity or transaction in the Nigerian oil and gas industry shall consider Nigerian content as an important element of their overall project development and management philosophy for project execution. There shall be exclusive consideration to Nigerian indigenous service companies which demonstrate ownership of equipment, Nigerian personnel and capacity to execute such work to bid on land and swamp operating areas of the Nigerian oil and gas industry for contracts and services contained in the Schedule to this Act.

1.7.2.20Petroleum Industry Act, 2021, as published in the Federal Republic of Nigeria Official Gazette (Act No, 6 Petroleum Industry Act, 2021)

The Petroleum Industry Act was enacted to provide for the legal, governance, the regulatory, and fiscal framework for the Nigerian Petroleum Industry, the establishment, and development of host communities and other related matters in the upstream, midstream and downstream sectors of the petroleum industry.

The Act establishes dual regulators for the petroleum industry called the Nigerian Upstream Petroleum Regulatory Commission (the "Commission"), which is a body corporate with perpetual successions whose functions are limited to only the upstream petroleum activities as provided for in Section 4 of the Act, which provides that "the Commission is responsible for the technical and commercial regulation of the upstream petroleum operations". Amongst other functions of the Commission is that it is established to ensure compliance with all applicable laws and regulations governing upstream petroleum operations.

The other regulatory agency under Section 29 of the Act is the Nigerian Midstream and Downstream Petroleum Authority (the "Authority"). This regulatory authority is responsible for the technical and commercial regulation of the midstream and downstream petroleum operations in the petroleum industry as provided under Section 29(3) of the Act.

Furthermore, the Act also established the Nigerian National Petroleum Company Limited (NNPC Limited) under Section 53 of the Act. The NNPC Limited is established to be an agent of the Nigerian National Petroleum Corporation (NNPC) for the purpose of managing the winding down of assets, interest, and liabilities of the NNPC.

The Act also provides guideline for general administration of midstream and downstream petroleum operations, administration of midstream and downstream gas operations, host communities development, petroleum fiscal industry framework, introduction of hydrocarbon tax etc

1.7.2.21 The Nigerian Upstream Petroleum Regulatory Commission (NUPRC) Requirements for EIA

The Nigerian Upstream Petroleum Regulatory Commission (in the Federal Ministry of Petroleum Resources) is empowered to ensure that petroleum industry operators do not degrade the environment in the course of their operations. Thus, NUPRC is responsible for supervising operations in the oil industry and for enforcing remediation of impacted environments. Principal decrees and regulations that empower NUPRC to perform these functions include:

- Petroleum Act of 1969, Section 8(in)b (iii) which empowers the Minister of
- Petroleum Resources to make regulations for the conservation of petroleum resources, prevention of pollution of water courses and atmosphere;
- Petroleum (Drilling and Production) Regulations of 1969, Sections 25 and 36;
- Mineral Oil (Safety) Regulations of 1963, Part III, Section 7 and Part IV, Sections 44 and 45;
- Petroleum Regulation of 1967; the Oil in Navigable Waters Decree No.
- 34/Regulations1968;
- Oil Pipeline Ordinance Cap 145 of 1956 as amended by the Oil Pipeline Act, cap
- 338, Laws of the Federation of Nigeria, 1990;
- Petroleum Refining Regulation of 1974, Section 43;
- Associated Gas Re-injection Decree No.99, Section 1 (a) section 2(1), and Section3(1) of 1979;
- Associated Gas Re-injection (Continued Flaring of Gas) Regulations 1984; and Associated Gas Re-injection (Amendment) Decree No.7 of 1985, which amends section 3(2) of the Associated Gas Re-injection Act of 1979.
- NUPRC requires EIA for use as an environmental management and enforcement tool. The NUPRC Environmental Guidelines and Standards of 2018 stipulates in Part VIII (A), Sections 3, 4, 5 and 6, the details of EIA process for the oil industry in Nigeria.

1.7.3 Rivers State Ministry of Environment

The Ministry was created from the Rivers State Environmental Protection Agency (RSEPA). RSMENV was empowered by the decree that set up the repealed FEPA (Decree 58 of 1988, as amended by Decree 59 of 1992), which encourages State governments to set up their own Environmental Protection Agencies. Consequently, RSMEnv is charged with the protection of the environment of Rivers State and operates with Edict No. 2 of 1994.

In 2002, RSMEnv published the Interim Guidelines and Standards on Environmental Pollution Control and Management in Rivers State. The guidelines seek to:

- Regulate the generation, handling, storage, disposal and management of all wastes of whatever origin in Rivers State
- Regulate physical development in compliance with the principle of sustainable development
- Enhance and where possible, restore the quality of the environment and protect the biodiversity of the flora and fauna of Rivers State.

1.7.4 TEPNG Policies and Guidelines

TEPNG has HSE policies and commitments that guide its operations. These policies and commitments are of international standard and conform to the Total Group policies worldwide. Elements of these policies and operational philosophies have taken into consideration relevant Nigerian regulations, international laws, guidelines, conventions and treaties.

TEPNG shall in the course of executing this proposed project ensure that all relevant standards and conditions are complied with, and where double standards exist, TEPNG would as much as possible comply with the more stringent one.

1.7.4.1 Project Health, Safety & Environment (HSE)

The project shall be managed in accordance with all relevant sections of TEPNG's Health, Safety and Environment (HSE) Governing Policy.

The TEPNG's HSE policy at work imposes responsibilities on all levels of management, supervision and all employees, for which they will be held accountable. Implications of the TEPNG's HSE policy are:

- The provision of a safe place of work together, thereby establishing and maintaining high standards of safety in the workplace.
- The verification of the physical capacities of personnel and evaluating working conditions.
- The execution of its activities in a manner which demonstrates respect for the quality of the environment around its facilities through the adoption of appropriate procedures to minimize any adverse effects.
- The development and maintenance of a contingency system to cope with emergency situations.
- The promotion of HSE measures as an integral part of the duties of line management and thus shall accord the implementation of such measures the highest priority.
- The development and implementation of accident probability reducing measures.

- The selection and engagement of Contractors Whose HSE risk management systems are entirely compatible with that of TEPNG and whose commitment can be clearly and continuously demonstrated

1.8 REPORT STRUCTURE

The EIA report is presented in eight chapters.

Chapter one is an introduction stating the background information about the project and the legal/administrative framework for EIA in Nigeria and details of the Corporate HSE Policy of TEPNG.

Chapter two discusses the project justification and presents the need, benefits/ value and the envisaged sustainability of the project;

Chapter three contains a concise description of the proposed project activities including project scope of work, design philosophy, project management and operations philosophies, project emissions and associated rejects, and the project execution schedule.

Chapter four describes the existing physico-chemical status of the study/project area

as well as its baseline environmental conditions.

Chapter five contains the identified and predicted potential and associated environmental impacts of the proposed Ubeta Field Development project.

Chapter six proffers mitigation and enhancement measures and alternatives for the identified adverse and beneficial impacts.

Chapter seven describes the risk assessment and cost-effective environmental management plans that will be adopted during implementation of the proposed project. The Environmental Management Plan (EMP) is designed to ensure the effectiveness of the recommended mitigation measures. It presents a framework for providing guidance for developing suitable environmental management and monitoring practices.

Chapter eight concludes the EIA report while presenting the key findings of the study.

Chapter
2

PROJECT JUSTIFICATION

2.1 NEED FOR THE PROJECT

The Ubeta Field Development Project was conceived as part of effort to increase gas supply to satisfy the needs of Bonny Nigeria Liquefied Natural Gas (NLNG) plant and the domestic market. This is being undertaken in order to:

- Create additional opportunities for gas production in Nigeria for domestic consumption and export
- Enhance the efficiency of critical National Industries through the supply of more gas for power generation.
- increase the overall gas production in OML 58 and to meet growing demand by Nigeria Liquefied Natural Gas (NLNG),
- Increase the revenue base of Nigeria through increased sales of gas,
- Contribute to Nigeria's ability to sustain its growing energy needs
- Offer job opportunities in various categories to a number of Nigerian professionals' skilled and semi-skilled craftsmen.

2.2 BENEFITS OF THE PROJECT

The value and benefits of the proposed project to the economy of Nigeria and well being of Nigerians will be enormous. They include;

1. The purposeful utilisation of gas and foreign exchange earnings from its sale are positive signs of real development.
2. Income from employment of local labour will enhance the economic condition of the host communities.
3. Extension of electric power supply to the host communities, coupled with the community development activities associated with the project will boost the overall infrastructural status of the host communities.
4. The development projects will have multiplier effect on the quality of life in the host communities.

5. Supply of gas to the Federal Government Power Plants and thereby supporting the provision of a reliable power generation capacity for the Nigerian electricity grid.
6. Supporting the Nigerian economy by provision of gas to local industries.

2.3 ENVISAGED SUSTAINABILITY

Gas is non-renewable natural resources, so, sustainability in this context is within the limits of availability. Sustainability is anchored on sound economic, social and environmental health. It is based not only on compliance with regulatory and corporate standards and guidelines, but also largely on performance improvement. In recent times, environmental managers have discovered that sustainable development means that they have to take into account labour conditions, employee's health and safety, community relations and other soft social and cultural factors, as well as uncertain environmental factors in relation to ecosystems.

2.3.1 Economic Sustainability

Ubeta is a gas condensate field and significant volume of gas are contained within the field. This project is therefore expected to ensure continuous availability of gas supply to the Nigeria Liquified Natural Gas (NLNG) facility at Bonny and for domestic use. The project will therefore contribute substantially to the revenue accruing to Nigeria thereby boosting the economic development of the nation.

2.3.2 Technical Sustainability

The Ubeta Field Development project is technically sustainable because the proponent is an operator with several decades of experience in the oil and gas sector and has a pool of indigenous expertise in oil and gas technology with strict adherence to internationally and nationally acceptable engineering design and construction standards. Innovative technologies that are economically viable and having minimal environmental, social and health impacts shall be utilised in the execution of the proposed gas pipeline.

2.3.3 Environmental sustainability

The aim is to ensure that current use of the environment and its natural resources does not damage prospects for use by future generations. Therefore, the design for the proposed Ubeta Field Development project will incorporate features that will preserve its integrity so that the impact on the environment is minimal. This will be achieved through construction techniques suited to specific ecological requirements and guided by regulatory and engineering design standards. The incorporation of the findings and recommendations of this EIA at the appropriate stages of the project development and strict adherence to the mitigation measures entrenched in the environmental management plan (EMP) shall ensure environmental sustainability.

2.3.4 Social Sustainability

Ubeta Field Development project will attract a lot of improvements in the social wellbeing of the host and neighbouring communities. Local content policy of the government shall be enforced to ensure that some category of jobs including some sub-contracting services shall be outsourced to the host and neighbouring communities. This shall result in financial upliftment and reduction in youth unemployment and restiveness. The Memorandum of understanding (MOU) entered into by both parties will be respected and implemented to the betterment of both parties. This shall ensure the social sustainability of the proposed project.

2.4 PROJECT ALTERNATIVES

Established EIA processes including the requirements of Nigerian regulations call for an analysis of reasonable alternatives to various elements of the proposed project. The aim of the analysis of alternatives to the proposed activities is to identify the most environmentally sound, cost-effective, and practical means of accomplishing project goals and objectives. By explicitly incorporating environmental and social considerations into an early stage evaluation of the proposed project, the analysis of the alternatives is expected to assist in identifying the approach to meeting project objectives that offer the best combination of cost and impact. Project alternatives analysis in environmental assessment is designed to bring environmental and social considerations into project selection at the early stages of project planning, and the later stages of site selection, design and implementation.

For any project, there are a number of alternatives that can be considered. The project options took cognizance of environmental, safety, and operational considerations. These include the no-project option, delayed project and/ or the planned option. The various options considered for the Ubeta Field Development project are as follow:

The No Project option

The "No Project" option implies that Ubeta Field Development project will not be carried out. This option will eliminate associated and potential negative impacts within the areas of influence of the project. However, this option was rejected because it would mean persistent frequent shortfalls of gas supply to NLNG and for domestic use which will greatly impact the operations of the NLNG thereby slowing economic and industrial growth. It will also result in the loss of resources already invested in the project development as well as the loss of valuable baseline data of the project area.

Delayed Project option

By the "Delayed Project" option, the project would be postponed to a later date. Similar to the "No Project" option, associated and potential negative impacts within the area of influence of the project would be avoided; however, this will be temporary. It would have the advantage of allowing for further project planning and time to implement mitigation measures with longer lead times.

A "Delayed Project" option shall cause an anticipated increase in the cost of the project due to inflation and will adversely impact the operations of the NLNG thereby hampering economic and industrial growth. It is therefore unattractive to adopt the "Delayed Project" option.

Timely Project Option

This option has the advantage of optimizing the utilization of the gas and the mitigation of persistent frequent shortfalls of gas supply which will greatly impact the operations of the NLNG. This option was selected.

Options selection

The location of Ubeta cluster and the associated infrastructure have been selected to minimize environmental impact and development costs. The following key aspects have been considered;

Subsurface: Drilling of gas production wells from a single location/well pad, to various target reservoirs,

Elevation: Minimization of flood risks during rainy season.

Local communities: Minimization of adverse impacts and disturbances by ensuring adequate buffer distance with the communities.

Land Acquisition: Use of the existing OUR (Obite Ubeta Rumuji) Pipeline RoW to minimize land acquisition.

Chapter

3

PROJECT DESCRIPTION

3.1 PROJECT LOCATION

The proposed Project location cuts across three Local Government Areas in Rivers State namely Ogba/Egbema/Ndoni, Ahoada East and Ahoada West. It is approximately 70 km Northwest of Port Harcourt, 12km Southwest of Obite Gas Plant and 8km Southwest of Ogbogu Flow Station. Ubeta is situated in a low lying, relatively flat terrain within the equatorial rain forest with abundant seasonal freshwater swamps. The area is characterized by farmland, low altitude secondary rainforest, and freshwater marshes.

There are three significant dwellings in the vicinity of Ubeta field: Ubeta village (west of the Ubeta cluster), Ubio (east of Ubeta cluster) and Anwunugboko (south-west of Ubeta cluster).

The location of Ubeta cluster and the associated infrastructure have been selected to minimize environmental impact and development costs. The following key aspects have been considered.

- Subsurface: Drilling of gas production wells from a single location/well pad, to various target reservoirs,
- Elevation: Minimization of flood risks during rainy season.
- Local communities: Minimization of adverse impacts and disturbances by ensuring adequate buffer distance with the communities.
- Land Acquisition: Use of the existing OUR Pipeline RoW to minimize land acquisition.

Existing oil and gas infrastructure within the Project Location include, GTS1, GTS4 and O.U.R. pipelines, and Ubeta NLNG Node.

3.2 UBETA FIELD DEVELOPMENT PROJECT OVERVIEW

Ubeta Field Development Project entails Engineering design, Construction, Drilling and Commissioning of a Cluster of six (6) gas producing wells linked by 11.1 Km pipeline to the Obite Gas Plant/Obite Treatment Centre.

In summary the Ubeta cluster will consists of the following:

- Well cluster designed with 10 slots, of which 6 are dedicated to Ubeta gas development,
- 1 HP manifold,
- 1 test header and test separator for well testing and metering,
- 1 Pig Launcher for intelligent pigging (Pig receiver located at Obite TC),
- 1 technical building with electrical, instrumentation rooms and operation office and 1 security building for access control management,
- Chemicals Utilities (corrosion inhibitor & methanol injection package),
- 1 electrical cable for power supply and 1 fiber optics cable from Obite TC for data transmission & remote control / monitoring (telecom mast as radio back-up),
- UPS electricity is to be provided by battery packs,
- Potable water and sanitation water will be supplied by truck. Alternatively, a potable water borehole in-situ at Ubeta cluster can be built,
- Neither fixed firefighting system nor passive fire protection is required: mobile fire-fighting equipment is required at Ubeta cluster during periods of drilling, well intervention or any major hot works.
- 11.1 Km export gas pipeline between the Ubeta Cluster and the Obite Treatment facility, along the existing O.U.R. pipeline Right of Way between Obite and Ubeta.
- Construction and operation of the drilling camp within the cluster area which will accommodate approximately 100 workers, during the Field Development Project.
- Drilling of six wells using a single rig from the Ubeta Cluster; in a drilling campaign expected to last about 1.5 years from Quarter two of year 2026.
- Construction of an access road and various ancillary equipment (electric cable for power supply, storage area, water tanks, telecom mast and technical building).

These project activities shall be covered under the following headinds;

- Land Take
- Location Preparation, Land Clearing and Excavation
- Drilling Location Platform Preparation
- Drilling Camp Site Preparation

- Site Preparation for GHF Installation
- Drilling, Workover and Completion of Wells
- Pipelines
- Laying of Flow lines and Pipeline Networks
- ROW survey and bush clearing
- Trenching
- Stringing & Bending
- Bevelling, Welding and Non-destructive Weld Inspection
- Pipeline Coating
- Lowering and Backfilling
- Backfilling
- Cathodic Protection
- Cleaning, Gauging, Pressure testing and De-watering
- Concrete Works
- Commissioning and Handover

Site preparation works are expected to start by early 2023, while all construction activities are expected to be completed by end of 2026

3.3 PROCESS DESCRIPTION

3.3.1 Overall Description

A fully rated unmanned wellpad, the Ubeta PC facilities consist of:

- 6 production wellheads
- 6 flowlines NPS 8 from wellheads to production manifold.
- One MPFM per producing well flowline for testing.
- A production manifold which gathers the producing fluid prior being exported,
- A pig launcher for export pipeline pigging purpose,
- A mobile maintenance flare (for manual depressurization and maintenance activities)
- Two observations basins for collecting effluents on the open drain system,
- Chemical injection package (Corrosion inhibitor),
- Mobile chemical injection packages (Methanol),
- Nitrogen bottles for pig launcher inerting and methanol tank blanketing.

The concept is based on a well / production cluster where the development wells are drilled with minimum process facilities in order to produce at maximum capacity 10 MMSm3/d of gas (during HP mode). The Ubeta PC production will start in 2026 and the field will be developed as a plateau producer with 20 years field life. Ubeta Main will be a main contributor to OML58 gas export to NLNG. The production cluster is normally unmanned and thus is fully monitored and controlled from the Obite CCR. At Ubeta PC, the raw gas from each well is measured by a multiphase flowmeter, before being commingled at the production cluster manifold and then transported by one (1) 16″ multiphase CS pipeline to the Obite TC where the gas is fully processed and treated to commercial specifications before export (Fig 3.1).

In HP mode, UPC will send produced gas to OTC inlet manifold which operates at 90 bara. During MP and LP mode gas is sent to Ogbogu and thus these modes of operation are only considered at Ubeta PC for design verification and out of the scope of work of engineer for Obite TC node. During MP and LP operating pressure at OTC battery limit is considered as 40 bara and 20 bara, respectively

The pipeline from Ubeta will tie-in to Obite existing 20′′ inlet manifold, common to all other production fluids routed to Obite for treatment (i.e., pipelines from Ogbogu FS and Ogbogu Cluster). This 20′′ manifold gathers all inlet streams into Obite TC before dispatching it to the two (2) separate gas treatment trains (with dedicated inlet separators).

No gas will be routinely flared at Ubeta PC. There are no automatic emergency depressurization devices on Ubeta PC. Only manual depressurization devices are provided and will be connected to a small size maintenance flare package. No electrical generation is foreseen at UPC, and electrical power is supplied by a power cable from OTC along with optic fiber for communication between UPC and OTC.

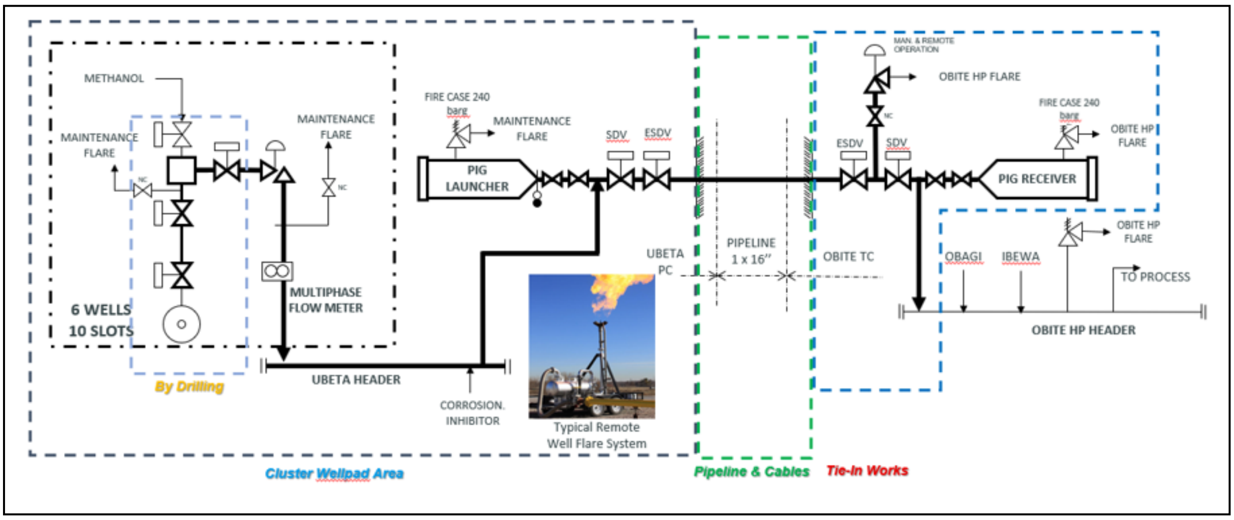


Fig 3.1 Ubeta Production Systems Overview

3.3.2 Production Wells and Flowlines

The Ubeta PC facilities consist of a fully rated and unmanned wellpad. Six (06) wells will be drilled on the UPC Wellpad. The six gas producing wells will start producing in HP mode from 2026. Each well is controlled by the Wellhead Control and Hydraulic Power Unit. The panel provides pressurized hydraulic fluid to all the well valve actuators (Table 3.1).

Table 3.1. UPC Production Well Actuated Valves

Service	Tag
Down hole safety valve	84-SCSSV-UB-1001/2001/3001/4001/5001/6001
Upper master valve	84-SSV-UB-1001/2001/3001/4001/5001/6001
Wing valve	84-SDV-UB-1001/2001/3001/4001/5001/6001
Choke valve	84-ROCV-UB-1001/2001/3001/4001/5001/6001

Flow from each well is controlled via the FCW (Full Control Well) providing the set point of the wells choke valves (84-ROCV-UB-1001/2001/3001/4001/5001/6001). FCW function shall be for production choke valves automatic controls during shutdown, restart sequences and degraded operating modes.

Each well flowline is 8' NPS and designed in duplex (PMC is H70) and equipped with high and low pressure/temperature alarms, and trips (for pipeline packing prevention) as well as a provision for acoustic sand detector. Each production flow line shall be designed for a maximum capacity of 2.5 $MMSm^3/d$ of gas.

One Multi Phase Flowmeter (MPFM) (84-UN-101/102/103/104/105/106) is installed on each flowline to enable the metering of production from each Ubeta wells and for well testing. MPFMs are vertically mounted, with the fluid flowing upwards. A bypass line with two isolation valves are provided for calibration purposes. A removable spool is also provided at the inlet of the MPFM for future installation of an in-line static mixer upstream of the sample connection.

Manual depressurization lines and drainage connections to mobile means are provided downstream each metering and at low points respectively. These lines allow for depressurization and drainage of the whole production flowline from the production choke valve up to and including the metering. Annulus A depressurisation means are also provided for each wellhead and connected to the flare header. Provision for depressurisation of Annulus B is provided via flexible connection. Design data of the Wellheads and MPFMs are presented in Tables 3.2 and 3.3

Table 3.2. Design Data – UPC Wellheads

Tag	**UB01IX//02X/03XI/04XI/05XII/06XII**
Description	Production Wellhead
WHSIP (barg)	240
WHFP (barg)	24 to 230
WHFT (°C)	32 to 77
Design Temperature (°C)	-28 / 92
Design Gas Flowrate (MMSm³/d)	2.5
Pressure Rating	API 5000

Table 3.3. Design Data – Multiphase Flowmeter

Tag	**84-UN-101/102/103/104/105/106**
Description	Multiphase Flowmeter
Design Pressure (barg)	FV/ 240
Max. Operating Pressure (barg)	23.9 to 122.2
Design Temperature (°C)	-28 / 92
Operating Temperature (°C)	7.7 to 76
Gas Design Capacity (MMSm³/d)	2.5

3.3.3 Production Manifold and Export

The fluid from the six production wells is routed to a Ubeta PC production manifold and sent to OTC via a 16” ND export pipeline. The production manifold is designed as a 16" ND on duplex. Provision flange connection are provided on the production manifold for future production of the four (04) spare wells connection. The production manifold is connected to the export pipeline via a barred tee on which a pig launcher is connected. Production from the 16” production manifold flows through the main line, the branch of the barred tee downstream of the launcher and then in the export pipeline.

The 16” Ubeta Pig Launcher (84-VP-001) is used for normal and/or intelligent pigging of the export pipeline. It is equipped with a “kicker” line for pig launching, an equalizing pressure line connected at both ends, drain connections for portable drainage means, vent, PSV and manual depressurization lines, and a utility connection for nitrogen purging. The launcher is sloped down towards the pipeline and a bypass pig technology shall be selected for Ubeta Main project due to limited available liquid surge volume at OTC facilities.

In normal operation, the 16” Pig Launcher (84-VP-001) is not in service. When pigging operations are finished, the pig launcher shall be depressurized, drained, purged and positively isolated. A specific procedure shall be developed for pigging operations to ensure there is no accumulation of hydrocarbon gas inside the pig launcher while not in operation.

Corrosion inhibitor is injected on the production manifold to protect from potential corrosion the carbon steel pipeline. A corrosion coupon and a corrosion probe are installed upstream the barred tee to record potential corrosion of the export pipeline.

A welded blind flange for future connection of Ubeta Deep is provided between 84-SDV-10001 and 84-ESDV-10001 at Ubeta pipeline departure.

Depressurization lines and drainage connections for portable drainage means are provided on the production manifold and on the pig launcher. A line allows depressurization of the whole production piping from the MPFMs up to the export pipeline 84-SDV-10001 and the drainage of the production manifold up to barred tee and another line allows manual depressurisation of the pig Launcher. Note that the depressurization of the export pipeline is not handled at UPC but via OTC. Design data of the ubeta pig launcher (84-VP-001) is presented in Table 3.4

Table 3.4. Design Data – Ubeta Pig Launcher

Tag	**84-VP-001**
Description	Ubeta Pig Launcher
Design Pressure (barg)	FV/ 240
Operating Pressure (barg)	23.7 to 121.8
Design Temperature (°C)	-23 / 92
Operating Temperature (°C)	12 to 73
Minor/Major Barrel Size	16'' / 20''
Material	CS + 3mm CA

3.3.4 Sand Production, Monitoring and Mitigation

There is tendency of sand production at a very early stage for the UBETA reservoirs. In the event that sand / solids production is anticipated, and downhole mitigation is in place, it is recommended to install acoustic emission detection implementation at each wellhead; in order to detect unacceptable levels of sand / solids production. Considering the deployment of such tools and operational practice (well choking), no solid erosion-corrosion risk is anticipated according to the Material selection and corrosion control philosophy.

Hence provision for installation of acoustic sand detector is provided at the well flowlines temporarily or permanently to monitor sand erosion on each of the six production flowlines.

3.3.5 Mobile Methanol Injection Package

Methanol shall be injected upstream wellhead choke valve at Ubeta PC to avoid the risk of hydrate formation during a cold start-up of the production wells. The injection is foreseen only on one well at a time and distribution header and lines are available for all wellheads although only the wells GP3DXI and GP5HXII require methanol injection.

Once production wells start up is performed, the methanol system is to be drained, inerted, isolated and disconnected since package is mobile and also used at Obite TC when methanol injection is required for pipeline depressurisation. Thus, no permanent storage of methanol nor permanent blanketing of the methanol tank is required at Ubeta wellpad or at Obite TC.

The mobile Methanol Injection Package (84-UB-821) comprises, the Methanol Tank (84-TA-821) and Methanol Injection Pumps (84-GX-821 A/B), however only one pump is installed in the skid and the spare pump is to be stored at the warehouse for change out when required.

The methanol Tank (84-TA-821) is filled from tote tank brought from OTC. The operator must connect the tote tank to the methanol tank filling line by a flexible hose. Each filling operation of methanol tank (84-TA-821) is to be continuously attended by the operator to avoid the overfilling of the methanol tank. Although Methanol Package (84-UB-821) details are to be confirmed by VENDOR, the following typical and minimum requirements are described hereunder.

An audible and local high-low level alarm (84-LAH/LAL-82003) will alert the operator that the methanol tank is high or low. The methanol tank is fitted with a low-low level trip that stops the methanol injection pumps and to avoid the pumps running dry.

A 2" connection line (2" NG 84 84 705 B01 via distribution header from the nitrogen package will supply nitrogen to the tank at 7 barg for blanketing purposes. An inlet with hose connection shall be provided on the tank and a pressure let down device 84-PCV-82007 shall be installed inside the package with a set point of 0.2 barg to let down the pressure from nitrogen distribution. For operations and monitoring, 84-PG-82005 shall also be available in the package. Note a pressure regulating valve is installed on the vent line (84-PCV-82006) in order to control pressure inside the tank to a maximum of 0.5 barg due to the injection of blanketing gas.

The Methanol Tank (84-TA-821) is open to atmosphere with flame arrester (84 FA-821) to prevent air ingress since methanol is a flammable product. Methanol tank is protected from control valve failure in the nitrogen feed and from fire by 82-PSV-82008. Two pumps (84-GX-821A/B, 2x100%) shall be designed. However, only one pump is connected to the bottom of the methanol tank and can distribute methanol to upstream of each production well choke valves 84-ROCV-UB-1001/2001/3001/4001/5001/6001. The spare pump shall be stored at the warehouse, this philosophy will allow to gain some weight loss for mobile methanol package.

The pumps are controlled-volume diaphragm type pumps with a remotely adjustable stroke from OTC CCR depending on injection requirements. Pump is driven by an electric motor. The pump suction piping is provided with an inlet calibration pot which is used by the operator to check the flow rate through the pump. Calibration pot shall be completely sealing to avoid any risk of methanol evaporation in the environment. The pump suction is also fitted with a Y-strainer to capture solids and other debris.

To reduce fluctuations in delivery rate in the discharge line from the reciprocating pump a pulsation damper is provided at the pump. The pump discharge line is protected by trip switches, 82-PSHH-82003 to trip the pump if High High-pressure conditions is reached and with 82-PSLL-82003 in case of low-low pressure trip for leakage protection. A high and low pressure alarm are also installed on the pump discharge line to alert the operator when high and low pressure are reached.

Pump discharge line ultimate overpressure protection, 82-PSV-82001 is added in the event of blocked outlet at the discharge of the injection pump and set at a pressure of 240barg (max WHSIP), relief methanol back to the storage tank 84-TA-821.

Methanol from the pump (84-GX-821A/B), flows through 1" discharge piping to UPC production wells via 1'' methanol distribution header. A flowmeter is installed downstream the 84-SDV-82001 in the common distribution to all wellheads. Design data of the Methanol system is presented in Tables 3.5 and 3.6

Table 3.5. Design Data – Methanol Tank

Tag	**84-TA-821**
Description	Methanol Storage Tank
Design Pressure (barg)	FV / 3.5
Operating Pressure (barg)	0.2
Design Temperature (°C)	13 / 50
Operating Temperature (°C)	18 / 35
Required Volume (m^3)	0.7

Table 3.6. Design Data – Methanol Injection Pump

Tag	**84-GX-821A /B**
Description	Methanol Injection Pump
Design Pressure (barg)	240
Maximum Operating Discharge pressure (barg)	230.1
Design Temperature (°C)	13 / 50
Operating Temperature (°C)	18 / 35
Rated Flowrate (L/h)	278

3.3.6 Chemical Injection - Corrosion Inhibitor

Corrosion inhibitor is a water-soluble chemical used to protect the carbon steel material against corrosion. Ubeta PC corrosion injection package, 84-UI-851, is made of one storage tank, 84-TA-851 (with 5.3 m3 of installed capacity), and two injection pumps, 84-GX-851A/B (2x100%). The storage tank is filled from intermediate bulk container (IBC) brought from OTC by means of an electrical pump. A high-and low-level alarm are installed on storage tank to alert the operator when the tank is full or low respectively. The storage tank is also fitted with an overflow line connection to the chemical drip pan and with a low-low level trip that stops the corrosion inhibitor injection pumps and to avoid the pumps running dry. The Corrosion Inhibitor Injection Pumps, 84-GX-851A/B are controlled-volume diaphragm type pumps with a remotely adjustable stroke from OTC CCR depending on injection requirements. Pump is driven by an electric motor. The pumps inject corrosion inhibitor into the Ubeta production header upstream the export pipeline barred tee.

The pumps take suction from the corrosion inhibitor suction header from Storage Tank (84-TA-851). The suction header is provided with an inlet calibration pot, which is used by the operator to check the flow rate through the pump. Each pump suction is also fitted with a Y-strainer to capture solids and other debris.

At the discharge of each pump, there is a discharge relief valve, pressure gauge, pressure switches high-high and low-low discharge non-return valve (NRV), pressure alarm (high/low), and system shutdown valve.

Each pump discharge line is protected by trip switches, 82-PSHH-85003 A/B to trip the pump and close the shutdown valve 82-SDV-85001 if High High-pressure conditions is reached and with 82-PSLL-85003 A/B in case of low-low pressure trip for leakage protection. A high- and low-pressure alarm are also installed on each pump discharge line to alert the operator when high and low pressure are reached. Pumps discharge line ultimate overpressure protection, 82-PSV-85001A/B are added in the event of blocked outlet at the discharge of the injection pump and set at a pressure of 240barg (max WHSIP), relieve Corrosion Inhibitor back to the storage tank 84-TA-851. Corrosion Inhibitor from the pumps (84-GX-851A/B), flows through 1” discharge piping to UPC 16’’ production header.

Design data of the chemical injection system are presented in Tables 3.7 and 3.8

Table 3.7. Design Data – Corrosion Storage Tanks

Tag	84-TA-851
Description	CI Storage Tank
Design Pressure (barg)	Atm + Full of liquid
Operating Pressure (barg)	ATM
Design Temperature (°C)	13 / 50
Operating Temperature (°C)	18 / 35
Required Volume (m^3)	5.4

Table 3.8. Design Data – Corrosion Injection Pumps

Tag	84-GX-851 A/B
Description	CI Injection Pump
Design Pressure (barg)	240
Maximum Operating Discharge Pressure (barg)	122
Design Temperature (°C)	13 / 50
Operating Temperature (°C)	18 / 35
Rated Flowrate (L/h)	10.7

3.3.7 Nitrogen System

Nitrogen is required for purging of the pig launcher after pigging operation and temporary blanketing of the methanol tank (intermittent users).

The nitrogen package, 84-UB-840 is made of:

- Two (2) bottle racks (2x100%).
- Each rack shall contain 15 bottles of 50L [HOLD 7].

Nitrogen from the bottle package is let-down via pressure control valve 84-PCV-84003 to decrease the pressure of the bottle (assumed as 200barg [HOLD 7]) to the operating pressure of the nitrogen network which is selected as 7 barg. When connected to the Methanol tank, additional control valve 84-PCV-82007 on nitrogen inlet line to the tank lets down the pressure further to 0.2 barg for tank blanketing. Nitrogen distribution network is rated at 150 pounds (design pressure is selected as 10 barg). Thus, 84-PSV-84004 with set pressure 10barg is provided in case of control valve failure or blocked outlet on the nitrogen distribution network. Design data of the Nitrogen system is presented in Table 3.9

Table 3.9. Design Data – Nitrogen Package

Tag	84-UB-840
Description	Nitrogen Package
Design Pressure (barg)	240 [HOLD 7]
Operating Pressure (barg)	200 [HOLD 7]
Design Temperature (°C)	13 / 50

Operating Temperature (°C)	18 / 35
Required Total Volume (Sm^3)	139.7
Quantity of Bottles (1)	15 [HOLD 7]

3.3.8 Hydraulic Power Unit System

Valve actuators for all actuated valves at UPC are hydraulic. Well valves (84 SCSSV, SSV, SDV UB 1001/2001/3001/4001/5001/6001), 84-ESDV-10001, 84-SDV-10001, 84-SDV-82001, 84-SDV-85001 and 84 ROCV UB 1001/2001/3001/4001/5001/6001 will be hydraulically actuated.

Hydraulic power unit, 84-UB-830 is a self-contained system that includes least pump motor, fluid reservoir, filters, accumulator system and pumps for each required level of pressure at which hydraulic fluid is required for different valves. It works to apply the hydraulic pressure needed to operate valves on UPC actuated wellhead valves.

Hydraulic Power Unit (HPU) provides pressurized oil to the hydraulic actuation system. The pump system charges the bladder accumulator automatically at a high pressure to utilize the ability of the actuators to store energy. A pressure reducing valve system provides the system with a constant stable system pressure. To ensure the oil cleanliness, filters are installed on the pump and return side. Filtration takes place whenever the pump is running. The HPU is provided with transmitters for oil tank level, temperature, and pressure.

The pumps are electrically driven high pressure gear pumps, one operational and one standby. Each pump is connected to a supervised pressure filter. HPU shall use electrical power as the primary source of energy to generate the hydraulic power source.

A pressure relief valve is installed to limit the output system pressure. Output pressure is monitored via a pressure transmitter. The accumulator pressure is monitored via a pressure transmitter and regulated by the Pump Control. A pressure relief valve limits the maximum accumulator pressure.

3.3.9 Maintenance Flare Package

Ubeta PC is a fully pressure rated well pad, hence, there is no requirement for automatic depressurization or any PSV for overpressure protection in normal operation. No conventional flare system shall be installed. However, a small size mobile maintenance flare package, 84-UB-291 will be available at Ubeta cluster for manual depressurization and maintenance operations.

Gas flaring is expected to be required for the following activities:

- Lines depressurization for maintenance purpose (manual depressurization) of flowlines, production header and pig launcher.
- Pigging operations (Pig Launcher PSV Fire case)

- Annular depressurization from the six production wells.

Maintenance Flare Package (84-UB-291) consists of:

  - Trailer,
  - Flare KO Drum (84-DS-291),
  - Flare stack with sonic tip (84-UB-292),
  - Ignition system with control panel (84-UB-293),
  - Flexible hose connection to the inlet of the mobile flare package KOD to the flare header,
  - Ultrasonic flowmeter (84-FE-29001) at the gas outlet of the flare KOD,
  - Flexible hose connection at the bottom of the KOD for mobile drainage means.

Flare ignition system 84-UB-293, will be triggered manually prior to any flaring operation. A small size KO drum, 84-DS-291 will be drained manually and disconnected after each operation. A flare sonic tip 84-UB-292 is provided as part of the package.

Permanent connection from the pig launcher PSV to the flare system will be provided, however when pigging operations are finished the pig is isolated and thus flare is not required to be online. Lines for manual depressurization will be provided with globe valves and connected to the Mobile Maintenance Flare. Design data of the Flare Package 84-UB-291 is presented in Table 3.10

Table 3.10. Flare System Design and Operating Conditions

Tag	**84-DS-291**
Description	Flare KO Drum
Design pressure (barg)	FV/ 15
Operating pressure (barg)	ATM to 8
Design temperature (°C)	-106oC (1) / 92
Operating temperature (°C)	-96 oC (1) / 77

3.3.10 Open Drain System

There will be no conventional open drain system due to minimal facilities at UPC. All permanently oil-contaminated drains collected on drip pans or bunded areas underneath pig trap, WHCP, HPU, wellhead area, chemicals packages or during maintenance operations, will be collected assisted by mobile pump to a temporary tank. OD2 liquids from paved areas on Ubeta wellpad are gathered via ditches and routed to two observation basins which will be emptied via vacuum trucks and transported to Obite TC for treatment. Sump pits are provided for cleaning of the ditches. Self-containment bunded areas are provided separately for the Pig Launcher (84-VP-001) and for the Utilities Shelter (to drain if required chemicals and utilities with drip pans).

Two observation basins with open drain concrete pits, will be provided for handling of accidentally oil-contaminated drains on the paved area located on wellheads (OD2). Observation Basin 1 (84-TA-911) located in the south-east collects effluents from wellheads paved area. Observation Basin 2 (84-TA-912) collects effluents from north and northwest paved drilling areas. Operators' intervention on site will be required to regularly pump out liquids and transport to Obite TC.

Oil free waters (OD3) are expected to naturally percolate through soil or to evacuate by gravity from inner concrete wall elevated area (Production Restricted Area) to the outside area by grids installed at the base of concrete wall.

Design data of the open drain system are presented in Table 3.11

Table 3.11. Design Data – Observation Basins and Bunded Areas

Tag	**84-TA-911/912**
Description	Observation Basin 1/2
Operating/Design Pressure (barg)	ATM / ATM
Design Temperature (°C)	13 / 50
Operating temperature (°C)	18 / 35

3.3.11 Closed Drain System

There will be no permanent closed drain drum and collection header system at Ubeta PC. Equipment drainage requirements will be fulfilled via portable means and are related to:

- Pigging operations
- Maintenance activities
- Flare package KO drum

All drainage operations will be done manually. A minimalistic drainage philosophy has been selected on Ubeta Production Cluster, capitalizing on Obite Treatment Center and proximity to treat Ubeta drained liquids. Permanent fixed Closed Drain drum and hard pipe network has not been deemed required to be installed on Ubeta Production Cluster. All drainage operations will be ensured through mobile/temporary containers either by using, mobile pumps and/or vacuum trucks and evacuated to Obite TC or designated liquid hydrocarbon handling sites for disposal. Specific operating procedures shall be developed and adequate drain points with valves, isolation and connection hoses will be considered in the design to allow for safe drainage operations into evacuation vessels.

3.3.12 Fresh Water System

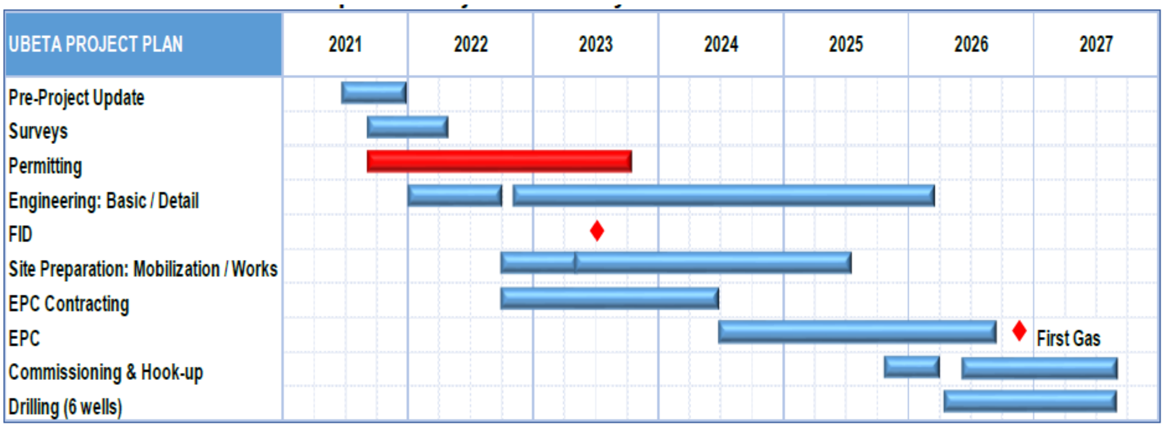
No water is required at UPC for Process operations. However, a fresh water system is provided for sanitary water distribution to technical and security buildings at

Ubeta PC. Fresh water will be supplied from a well (Bore hole) via submersible pump to fill the Fresh Water Overhead Tanks (84-TA-920 A/B) for storage and distribution by gravity to technical and security buildings.
Two septic tanks are provided for black water collection from security building (84-TA-921) and from technical building (84-TA-922).

3.4 PROJECT SCHEDULE

Ubeta Field Development Project is scheduled to commence in Year 2021. A summary of the Project schedule is provided in Table 3.12. However, it should be noted that the conduct of the Ubeta Field Development Project EIA is an activity under Permitting Stage of the Project Plan.

Table 3.12: Ubeta Field Development Project Summary Schedule



3.5 Wastes and Disposal Activities

Effective and responsible handling and disposal of wastes are key elements in environmental management system. Wastes are unwanted bye-products of a process. Waste management for the project shall be carried out in consultation and in line with the waste management guidelines as per appropriate directives of regulatory authorities.

3.5.1 Waste Management Approach

During this project, several steps would be taken to achieve the best results in relation to waste management. These steps are as follows:

- Inventories of waste: All wastes types and volumes generated from construction, operation, commissioning and abandonment phases of the project will be documented.
- Minimization: The minimization methods of reduce, reuse, recycle and recover will be adopted to identify appropriate waste management method so as to reduce liabilities and management costs.
- Treatment: Residue from minimization will be treated using best practicable.

- Disposal: Non-hazardous residue will be disposed to the environment by surface discharge or land farming

3.5.2 Waste Identification / Categorization

Wastes expected during the various phases include the following

- Excavated soil
- Drill cuttings
- Drill cuttings / excess or spent drilling mud and completion fluids
- Rig wash (Detergent) water.
- Vegetation wastes
- Pigging Trash
- Pipe coatings
- Drilling effluents.
- Used oils
- Wooden pallets
- Plastic wastes
- Contaminated soil
- Scrap metals
- Filters
- Welding torches and spent electrode
- Glass waste
- Food waste
- Sanitary waste
- Spent batteries
- Gaseous emission

The categories of waste and their characteristics are as indicated in Table 3.13. The physical, chemical as well as the toxicological properties of each waste type provide a guideline as to the appropriate waste management method to be utilized.

Table 3.13 Waste categories and characteristics

Waste type	Waste stream	Potential sources	Possible environmentally significant constituents
Emissions	Engine exhausts	Transportation, power generation, construction equipment and machinery	COx, SOx, Carbon monoxide and particulates
Industrial	Cleaning materials, insulation, batteries, coatings, scrap metals, plastics, paints and thinners, spent electrode, welding torches.	Construction, operations, Spills, maintenance and abandonment.	Hydrocarbons, acids, alkalis, heavy metals, PCBs, plastics.
Office	Paper, packaging materials, pins, IT wastes.	Office	
Hazardous	Drill Cuttings, Contaminated soils, Waste Fluids pigging wastes	Spills, commissioning, operations, maintenance and abandonment	Hydrocarbons, heavy metals, salts, chemicals, detergents
Domestic	Domestic sewage, food and kitchen wastes	Catering centres and camp sites	Solids, detergents, coliform bacteria

3.5.3 Waste Inventory and Segregation

At the point of wastes generation, the various waste streams shall be collected in separate colour-coded bins (Table 3.14). This is to enhance easy and proper management. Each waste stream will be quantified using properly calibrated scales, these records will be maintained by competent officers.

Table 3.14: Colour codes

Waste Stream	Colour codes
Domestic	Green
Industrial	Grey
Office	Black
Hazardous	Red

3.5.4 Wastes minimization Techniques

The waste minimization approach to be utilized in the cause of this project will involve: Reduce, Reuse, Recycle and Recover. This waste management approach for the wastes generated from this project are presented in Tables 3.15 and 3.16.

Table 3.15: Wastes minimization Techniques

Waste Type	Minimization option	Remark
Batteries	Reduce/Recycle	Used rechargeable batteries transferred to approved recycling facility
Contaminated Soil	Reduce/Recover	Transfer to approved waste management facility
Glass/plastic/metals	Reduce/Recycle	Transfer to approved recycling facility
Oil Contaminated filters	Reduce/Recycle	Transfer to approved recycling facility
Office wastes	Reduce/Recycle	Use double sided printing, transfer to approved recycling facility
Domestic Waste		Transfer to approved dumpsite for composting
Sewage		Transfer to Septic/Soak-away system
Wooden pallets	Reduce/reuse	Reuse on-site for community relation
Paint and thinners	Reduce/Reuse	Transfer to approved recycling facility
Vegetation waste	Reduce/Reuse	Transfer to approved dumpsite for composting
Gaseous emissions	Reduce	Ensure vehicle and equipment maintenance in good condition
Pigging trash (sludge)	Reduce	Incineration/Transfer to approved recycling facility
Drill cuttings	Reduce/Recycle	use to fill up waste pits, or use for construction or slurrify and transfer to an approved recycling facility
Waste fluids	Reduce/Recycle	Re-inject and treat at approved treatment facility

Table 3.16: Project phases and waste management

Project Phase	Waste Generated	Sources	Treatment Method
Construction	Metallic wastes,	Electrode stubs Pipe cutting Metal filings	Recycling
	Paper packaging materials, pins, plastic	Office wastes	Recycling, reuse
	Fabrics, food wastes, domestic sewage, packaging materials	Domestic Wastes	Biological Treatment Processes, recycling, reuse
	Wastes oils, filters	Welding machines Vehicles (Various)	Recovery, thermal treatment
	Paints, thinner, pipe coating	Pipeline finishing	Thermal treatment
Operations	Oil contaminated wastes, Pigging wastes, filters spent lubricant,	Maintenance gas receiving stations	Recovery, Thermal treatment
	Fabrics, food wastes, domestic sewage, packaging materials	Control points take off and receiving stations Valve Station	Biological Treatment Processes, recycling, reuse
Decommissioning and abandonment	Metallic waste, Pigging Waste, contaminated	Abandonment operations	Recycling, thermal treatment
	Paper packaging materials, pins, plastic	Office wastes	Recycling, reuse
	Fabrics, food wastes, domestic sewage, packaging materials	Domestic Waste	Biological Treatment Processes, recycling, reuse
	Wastes oils, filters	Welding machines Vehicles (Various)	Recovery, thermal treatment
	Paints, thinner, pipe coating	Pipeline finishing	Thermal treatment

3.6 Procedure for Handling / Transfer of Wastes

At the point of generation, wastes will be segregated using the colour coded bins. However, the excavated spoil / soil will be stockpiled in designated points in such a manner that it will not obstruct vehicular movement and construction operations.

The first line segregation will be accomplished with the waste bins. It should be noted however that any other class of waste that comes in contact with the hazardous wastes is classified as hazardous waste. All containments for the various waste streams must be leak proof, covered and when there are valves installed, such valves must be inspected to ensure there are no leakages. Other criteria include:

- Container safe levels (to avoid spillage).
- Reduction of rusts and corrosion.
- Adequate container identification.
- Appropriate sealing.
- Emergency response PPE and equipment.

The choice of location of the waste bins must be selected with the following criteria in mind:

- It should not be located in flood prone areas.
- It should not be near food or drinking water sources.
- It should be clearly identifiable.

3.6.1 Waste Handling

- At locations where provision is made for the segregation of waste for recycling the containers will be clearly and appropriately labelled
- All waste will be stored in a safe and secure manner prior to collection for recovery, recycling or disposal.
- All waste will be stored in a manner that prevents its escape.
- Wherever possible, access to hazardous waste containers will be restricted
- Redundant IT equipment shall be appropriately labeled and stored secured.
- All personnel involved in waste handling must be adequately kitted with relevant and appropriate PPE.
- Sewage are held in septic and soak-away tanks

3.6.2 Waste Transfer

- Wastes will be transported by certified transporters using pre-mobbed vehicles.
- The Crew, vehicle and equipment to be involved will be pre-mobbed and certified.
- The HSE Team shall ensure that all personnel are adequately kitted with appropriate PPEs.
- The HSE team ensure at site will adherence to company's Transport policy.

- Ensure that the skips are intact and properly sealed. In the cases of vessels fitted with valves, ensure that the valves are intact and will not leak.
- Ensure that the waste containment is properly secured on the vehicle
- Ensure that all traffic regulations are obeyed.

Chapter
4

DESCRIPTION OF THE ENVIRONMENT

4.1 INTRODUCTION

This chapter documents the environmental setting of the project area, as presently constituted. Acquisition of baseline data on a project environment is an important phase of any Environmental Assessment Impact process. Environmental baseline data provides information on the state of the existing environment prior to the project activities. It also provides information that will aid in the identification of impacts that would occur in any sensitive area for the development of appropriate mitigation and ameliorative measures including an Environmental Management Plan.

4.2 STUDY APPROACH

4.2.1 Desktop Studies

In this study, the environmental characteristics of the project area were established through extensive literature search of relevant studies, field sampling/measurements, laboratory analysis, stakeholders' consultation and data interpretation. In addition, the baseline data collected will serve as a veritable benchmark against which data to be collected during the Post Implementation Monitoring shall be compared, in order to establish the effectiveness (or otherwise) of mitigation measures put in place for the project.

Data from literature search were obtained from:

- Environmental Impact Assessment of Obite-Ubeta-Rumuji (O.U.R.) Pipeline Project (TEPNG, 2012);

4.2.2. Field Data Collection

A one-season (Dry season) field sampling exercise was conducted from 14th to the 30th of December 2021. A multi-disciplinary approach was adopted for the ecological characterization and data acquisition. The environmental components covered include climate/meteorology, air quality and noise, groundwater, surface water, sediments, hydrobiology, soil quality, vegetation, wildlife, socio-economics, health status assessment and waste management. NUPRC Guidelines and Standards

Part VIII D (2) and FMEnv Guidelines were strictly adhered to in the cause of field sampling and measurement.

4.2.3 Fieldwork Pre-Mobilization Activities

A number of preparatory activities were undertaken in order to ensure the success of the fieldwork. These activities are highlighted below:

Mission Planning

Mission Planning was conducted by using available maps of the study area from TEPNG and approved study sampling locations from the scoping exercise. Relevant literatures were reviewed, and work plan developed and presented to TEPNG for approval. The field program was designed to cover the area within the Ubeta field development project area.

Kickoff Meeting

A kickoff meeting was held on the 12th of November, 2021. During the meeting, discussions and agreements were reached on the sampling plans, procedures, sample storage and transportation to the laboratory. The adequacy of the field work equipment, sampling materials and Personnel Protective Equipment (PPE) and personnel competence and team composition were also verified and approved.

Job Risk Analysis (JRA)

Job Risk Analysis (JRA) for the project took place virtually on the 16th November, 2021. During the JRA, all possible hazards associated with the project were identified and closed out..

Toolbox Meeting

Toolbox talk was conducted every day prior to the commencement of sampling. During the toolbox meeting, attendance was recorded and safety issues and hazards relating to the field sampling were identified and closed out. (Appendix 2.1)

4.2.4 Materials and Methods of Survey

4.2.4.1 Sampling Design

The design and distributin of sampling stations for water, sediment, soil and air quality were conducted by TEPNG according to their desktop design of pre-determined sampling stations. The sampling design was to ensure that representative samples that will help obtain data required to describe the baseline status of the environment around the proposed Ubeta field development project. A total of 97 stations were sampled for soil and three control stations, 66 air quality stations and three control stations, 11 groundwater stations and 3 control stations (Figs 4.1a and 4.1b). Furhtermore, surface water, sediment and hydrobiology were sampled from three stations and three control stations. The vegetation study was conducted at the same location of the soil stations. The geographic coordinates of the sampling points are shown in Table 4.1.

Table 4.1: Coordinates of sampling stations at the proposed Ubeta FDP

	Station ID	Proposed		Achieved		Sample / Measurement Activity
		Easting	Northing	Easting	Northing	
1	UBE1	460892.92	129036.92	460894.603	129039.151	Soil, Air Quality
2	UBE2	460694.41	127968.88	460684.458	127972	Soil
3	UBE3	460319.09	127796.44	460316.076	127780.35	Soil, Air Quality
4	UBE4	459955.9	128566.57	459928.161	128569.281	Soil
5	UBE5	459217.71	129165.06	459217.71	129165.06	Soil
6	UBE6	459080	129445.55	459080	129445.55	Soil,
7	UBE7	458989.51	129344.35	458989.51	129344.35	Soil, Air Quality,
8	UBE8	459004.99	129797.68	459009.875	129790.668	Soil
9	UBE9	458871.37	129751.76	458927.626	129740.655	Soil,
10	UBE10	458504.93	129739.75	458504.93	129739.75	Soil, Air Quality
11	UBE11	460346.74	130077.87	460347.953	130076.427	Soil
12	UBE12	460190.46	130132.15	460196.541	130108.461	Soil,
13	UBE13	459824.45	130074.7	459741.842	130127.497	Soil,
14	UBE13A	-	-	458877.323	129708.702	Surface Water, Sediment, Plankton & Benthos
15	UBE14	459083.71	130098.06	459083.71	130098.06	Soil
16	UBE14A	-	-	459192.833	130012.02	Groundwater (Monitoring Well)
17	UBE14B	-	-	459244.259	130019.816	Surface Water, Sediment, Plankton & Benthos
18	UBE15	458910.46	127003.27	458869.452	127089.436	Soil,
19	UBE16	459244.33	129834.58	459244.494	129835.256	Soil
20	UBE16A	-	-	459249.115	129785.751	Groundwater (Monitoring Well)
21	UBE17	459344.34	129951.13	459344.319	129951.2	Soil
22	UBE17A	-	-	459193.258	130013.98	Groundwater (Monitoring Well)
23	UBE18	461091.83	130782.88	461094.057	130780.01	Soil, Air Quality
24	UBE19	461837.79	131449.8	461832.731	131431.875	Soil, Air Quality
25	UBE20	462443.02	131977.31	462467.024	131939.954	Soil, Air Quality
26	UBE21	461442.42	133031.65	461443.961	132994.97	Soil, Air Quality
27	UBE22	463193.78	132632.16	463252.354	132571.601	soil
28	UBE23	464284.17	133142.01	464294.665	133141.714	Soil, Air Quality
29	UBE24	465286.98	133836.61	465284.388	133837.571	Soil, Air Quality
30	UBE25	466406.67	136030.34	466405.277	136032.397	soil
31	UBE26	466418.57	136184.32	466419.324	136185.495	Soil, Air Quality
32	UBE27	466584.61	137622.16	466584.61	137622.16	Soil
33	UBE28	457392.88	127037.69	457382.858	126971.779	Soil, Air Quality
34	UBE29	457619.82	127389.46	457632.268	127372.774	Soil, Air Quality
35	UBE30	457517.7	128921.35	457578.585	128909.037	Soil, Air Quality

	Station ID	Proposed		Achieved		Sample / Measurement Activity
		Easting	Northing	Easting	Northing	
36	UBE31	458187.19	128796.53	458181.949	128734.695	Soil, Air Quality
37	UBE32	458402.79	129125.6	458402.37	129126.055	Soil
38	UBE33	459469.44	128773.83	459469.44	128773.83	Soil, Air Quality
39	UBE34	459685.04	128410.72	459685.04	128410.72	Soil, Air Quality
40	UBE35	459730.43	127639.1	459730.43	127639.1	Soil, Air Quality
41	UBE36	459571.56	126890.18	459571.56	126890.18	Soil, Air Quality
42	UBE37	459651	129182.34	459651	129182.34	Soil, Air Quality
43	UBE38	458743.21	129692.97	458744.424	129688.849	Soil
44	UBE39	459151.71	129931.26	459151.71	129931.26	Soil, Air Quality
45	UBE40	459367.31	130362.46	459367.31	130362.46	Soil, Air Quality
46	UBE41	459911.98	129829.14	459910.321	129784.116	Soil
47	UBE42	460161.63	130714.23	460161.63	130714.23	Soil, Air Quality
48	UBE43	461999.89	130839.05	461992.283	130884.305	Soil, Air Quality
49	UBE44	461999.89	130260.33	462002.678	130252.736	Soil, Air Quality
50	UBE45	462011.24	129681.62	462021.334	129674.232	Soil, Air Quality
51	UBE46	460694.95	130305.72	460693.579	130305.572	Soil, Air Quality
52	UBE47	460012.88	129660.61	460014.149	129618.235	Soil, Air Quality
53	UBE48	460104.23	129476.81	460106.665	129475.401	Soil
54	UBE49	460319.73	129169.91	460317.657	129171.575	Soil, Air Quality
55	UBE50	460312.19	129390.43	460306.106	129357.92	Soil, Air Quality
56	UBE51	460557.7	129519.84	460556.141	129523.072	Soil
57	UBE52	460637.93	128662.7	460650.48	128654.917	Soil, Air Quality
58	UBE53	460739.07	129911.11	460740.36	129910.699	Soil
59	UBE54	461267.84	129465.29	461276.06	129463.279	Soil, Air Quality
60	UBE55	461294.31	129891.12	461293.732	129891.504	Soil
61	UBE56	456248.75	128051.31	456272.81	127963.219	Soil
62	UBE57	459820.52	129343.88	459166.637	130378.355	Soil
63	UBE58	459938.99	129042.33	459938.99	129042.33	Soil
64	UBE59	460639	128988.49	460635.612	128986.223	Soil
65	UBE60	460132.84	129925.43	460131.158	129887.395	Soil, Air Quality
66	UBE61	460940.55	129623.89	460941.323	129631.615	Soil
67	UBE62	460430.44	129835.42	460430.897	129835.54	Soil, Air Quality
68	UBE63	460523.41	129264.79	460524.508	129261.206	Soil
69	UBE64	460357.53	129628.5	460354.315	129621.231	Soil
70	UBE65	460709.41	129361.12	460704.481	129355.451	Soil
71	UBE65A	-	-	460747.158	129267.979	Surface Water, Sediment, Plankton & Benthos
72	UBE66	460196.09	129775.88	460193.097	129777.301	Soil
73	UBE67	466464.92	136667.47	466470.528	136666.698	Soil
74	UBE68	460982.82	129285.75	460981.972	129288.343	Soil, Air Quality
75	UBE69	461201.81	129179.48	461210.202	129180.358	Soil, Air Quality
76	UBE70	461127.74	128876.76	461134.184	128870.487	Soil, Air Quality
77	UBE71	460821.8	128831.67	460820.899	128834.292	Soil, Air Quality
78	UBE72	461053.67	128632.01	461055.939	128632.998	Soil, Air Quality

	Station ID	Proposed		Achieved		Sample / Measurement Activity
		Easting	Northing	Easting	Northing	
79	UBE73	461397.53	129204.6	461401.887	129211.624	Soil, Air Quality
80	UBE74	461336.67	128799.78	461327.912	128800.445	Soil, Air Quality
81	UBE75	460807.5	128514.03	460804.663	128503.247	Soil, Air Quality
82	UBE76	461410.23	129713.66	461407.916	129682.087	Soil, Air Quality
83	UBE77	460959.37	130151.81	460960.699	130153.803	Soil, Air Quality
84	UBE78	461327.68	130208.96	461329.346	130207.623	Soil, Air Quality
85	UBE79	461086.38	130361.36	461078.117	130355.517	Soil, Air Quality
86	UBE80	461448.33	130462.96	461446.958	130464.316	Soil, Air Quality
87	UBE81	461594.38	129980.36	461596.391	130025.989	Soil, Air Quality
88	UBE82	461556.28	129523.16	461524.635	129535.865	Soil, Air Quality
89	UBE83	460972.07	129847.01	460976.886	129844.297	Soil, Air Quality
90	UBE84	461137.18	130024.81	461136.71	130026.547	Soil, Air Quality
91	UBE85	460692.67	129710.48	460691.223	129709.529	Soil, Air Quality
92	UBE86	460266.96	128844.5	460271.884	128847.443	Soil, Air Quality
93	UBE87	461156.23	129716.83	461171.259	129713.692	Soil, Air Quality
94	UBE88	460603.77	130085.13	460608.143	130128.565	Soil, Air Quality
95	UBE89	461130.83	130529.63	461128.646	130532.364	Soil, Air Quality
96	UBE90	461588.03	130174.03	461587.837	130177.443	Soil, Air Quality
97	UBE91	461270.53	128465.88	461262.829	128403.152	Soil, Air Quality
98	UBE92	460368.82	128592.88	460369.515	128593.836	Soil, Air Quality
99	UBE93	459967.45	128788.94	459981.819	128843.65	Soil, Air Quality
100	UBE94	460572.02	128383.33	460573.427	128381.927	Soil, Air Quality
101	UBE95	461035.58	128338.88	461035.274	128335.024	Soil, Air Quality
102	UBE96	460775.22	128205.53	460773.706	128214.646	Soil, Air Quality
103	UBE CTRL1	457053.25	135183.39	459198.212	135349.941	Soil, Air Quality
104	UBE CTRL2	456987.92	125515.1	457004.98	125478.588	Soil, Air Quality
105	UBE CTRL3	465479.21	127784.42	459373.013	125534.653	Soil, Air Quality
106	UBE CTRL1	-	-	462135.616	132329.199	Groundwater
107	UBE CTRL3	-	-	459370.553	125526.389	Surface Water, Sediment, Plankton & Benthos
108	UBE CTRL1	-	-	460212.442	122954.346	Surface Water, Sediment, Plankton & Benthos
109	UBE CTRL3	-	-	459865.956	122960.208	Groundwater
110	WWP UB1	-	-	459015.559	130062.494	Groundwater, Air Quality
111	WWP UB2	-	-	459031.238	129911.728	Groundwater, Air Quality
112	WWP UB3	-	-	458841.069	129816.318	Groundwater, Air Quality
113	WWP UB4	-	-	458757.277	129824.434	Groundwater, Air Quality
114	WWP UB5	-	-	458788.774	129633.585	Groundwater, Air Quality
115	WWP UB6	-	-	458852.754	129658.564	Groundwater, Air Quality
116	WWP UB7	-	-	458952.028	129674.281	Groundwater, Air Quality
117	WWP UB8	-	-	459212.28	130031.033	Groundwater, Air Quality
118	UBE CTRL2	-	-	457011.109	125888	Surface Water, Sediment, Plankton & Benthos
119	UBE CTRL2	-	-	457537.571	127030.944	Groundwater

(Source: TEPNG,2020)

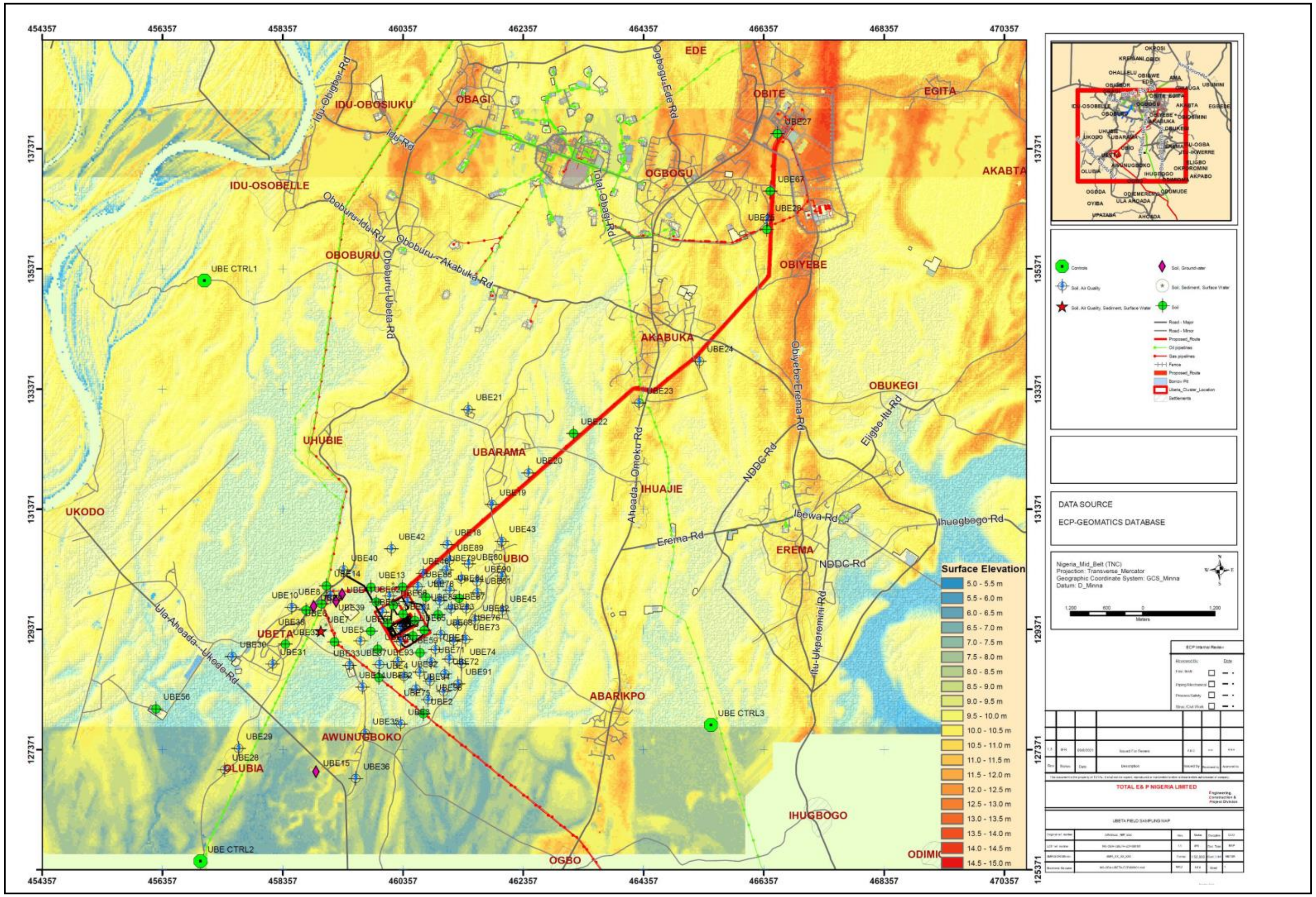


Fig. 4.1a: Map Showing the Distribution of Sampling Stations (Source: TEPNG, 2021)

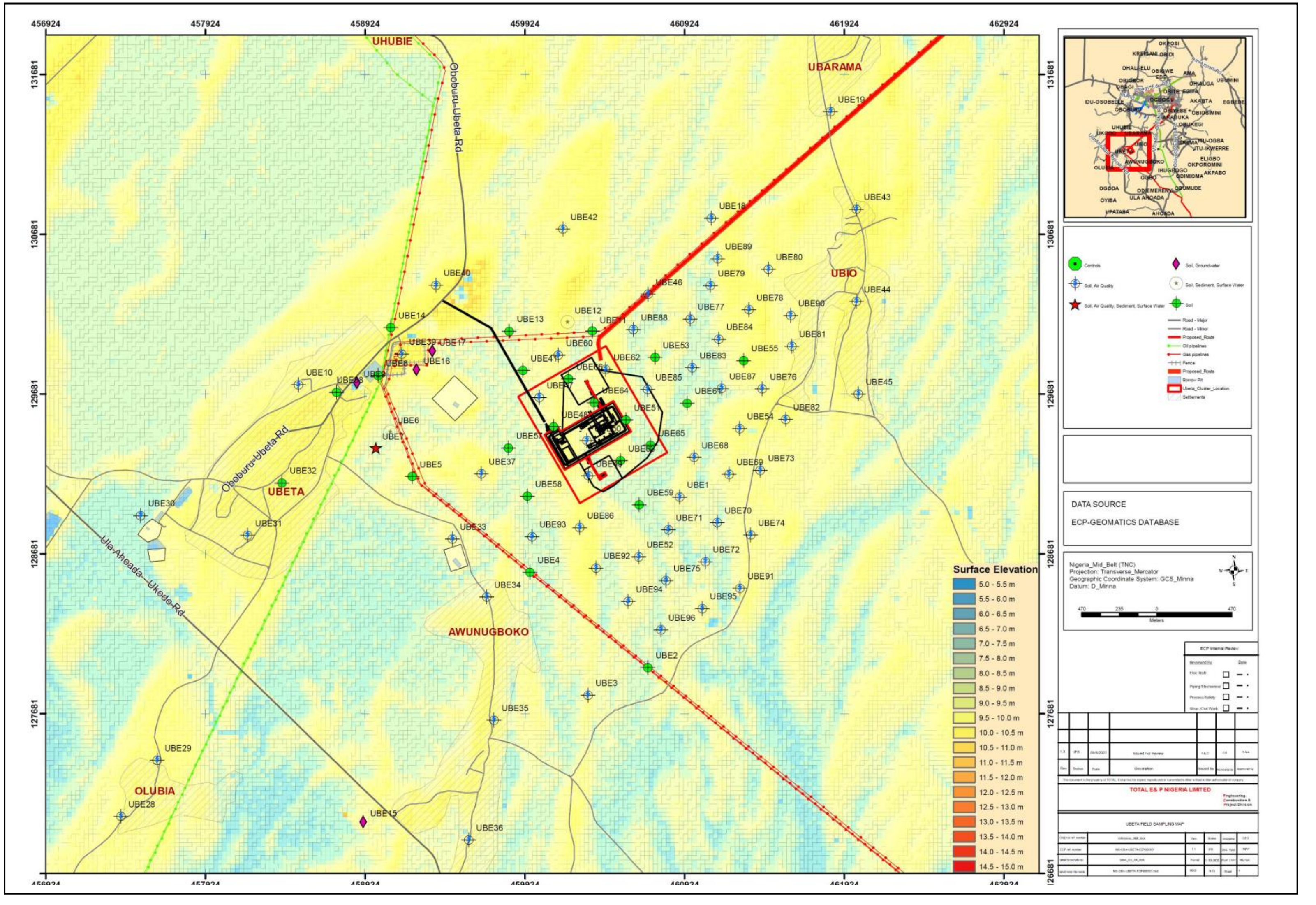


Fig. 4.1b: Map Showing the Distribution of Sampling Stations – Focus on Ubeta Cluster Area (Source: TEPNG, 2021)

4.2.5 Field Data Acquisition Methodology

4.2.5.1 Air Quality Measurement

Spot measurements for air quality and noise were undertaken in a total of 66 stations and three control stations. The parameters measured and the details of *in situ* equipment used are shown in Table 4.2. a photo of the field sampling exercise is shown in Plates 4.1a and 4.1b

Table 4.2: Air Quality and Noise Measurement Equipment

Parameters	Equipment Name	Equipment Manufacturer	Units
Carbon dioxide (CO_2)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	%Vol
Carbon monoxide (CO)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	ppm
Sulphur dioxide (SO_2)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	ppm
Nitrogen dioxide (NO_2)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	ppm
Hydrogen sulphide (H_2S)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	ppm
Methane (CH_4)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	%
Volatile Organic Compounds (VOC)	4 in 1 Multi Gas Detector	Henan Bosean Electronic CO.,Ltd	ppm
Particulate Matter ($PM_{2.5}$, PM_{10})	831 Aerosol Mass Monitor	Metone Instruments	µg/m3
Relative humidity/Temp	Accurite Weather Station	Accurite	% / ^{0}C
Wind speed/Direction/Temp	Accurite Weather Station	Accurite	m/s
Noise	Digital sound level meter	Extech Instrument	dBA

Plate 4.1a: Air Quality Sampling UBEAQ33 (Source: DSL, 2021)

Plate 4.1b: Air Quality Sampling at UBEAQ69(Source: DSL, 2021)

4.2.5.2 Soil

A total of 97 soil stations and three (3) control stations were sampled. At each station, composite soil sample were taken by mixing three individual soil cores/grabs samples taken within a specific area into one homogenous sample. Two (2) soil samples were collected from depths of 0-15cm and 15-30cm according to FMEnv/NUPRC protocol using a hand auger (Plate 4.2a to 4.2d). Samples were taken using appropriate sampling containers for the different analytical parameters as shown in Table 4.3. These containers were labeled, closed tightly and stored in an ice cooler.

Plate 4.2a: Soil Sampling UBESS-14

Plate 4.2b: Soil Sampling at UBESS-20

Plate 4.2c: Soil Sampling at UBESS17

Plate 4.2d: Soil Sampling UBESS30

Table 4.3: Sample Analytical Parameters and Collection Containers

COMPONENT	METHOD	NO OF SAMPLES	Analytical Parameters	Sample Containers
Soil	Hand Auger	101 Stations (202 Samples), 5 Duplicate Stations (10 Duplicate Samples)	pH, Water Content, Redox Potential, Na, K, Ca & Mg,	Cellophane bag
			TOC, TPH, PAH,	Foil Plate
			Heavy metals (Cu, Pb, Zn, Cd, Ba, Fe, Hg, Cr, Mn)	
			BTEX	Glass bottle
			Microbiology (THB, THF, HUB, HUF, Coliforms),	Sterile Vial
Sediment	Grab	6 Samples	pH, Water Content, Redox Potential, Na, K, Ca & Mg,	Ziplock bag
			TOC, TPH, PAH,	Foil Plate
			Heavy metals (Cu, Pb, Zn, Cd, Ba, Fe, Hg, Cr, Mn)	Foil Plate
			BTEX	Glass bottle
			Microbiology (THB, THF, HUB, HUF, Coliforms),	Sterile Vial
Ground water and Surface Water	Bailer/Direct Sampling	14 Groundwater Samples, 6 Surface Water Samples	Temp, pH, Colour, DO, Conductivity, TDS, Turbidity,	(Insitu Field Measurement)
			Alkalinity, Chlorides. BOD, COD, Nitrate, Sulphate,	1 litre plastic bottle
			THC Oil & Grease	1 litre glass bottle
			BOD	250ml Amber Bottle
			BTEX	100ml Amber Bottle
			Heavy metals (Cu, Pb, Zn, Cd, Ba, Fe, Hg, Cr, Mn)	120ml plastic bottle
			Microbiology (THB, THF, HUB, HUF, Coliforms)	50ml Sterile plastic bottle

4.2.5.3 Ground Water

Ground water samples were collected from three (3) monitoring wells, eight (8) community water wells and three (3) control stations and stored in appropriate containers (Table 4). The monitoring wells were purged for 15 minutes and allowed to settle before sampling. (Plates 4.3a and 4.3b). Samples for hydrocarbons were fixed with concentrated sulphuric acid (to pH of 2) and corked with aluminum foil before storage while samples for heavy metals were fixed with concentrated nitric acid (to pH of 2). All samples were stored in coolers with ice packs. *Insitu* measurements of temperature, pH, salinity, dissolved oxygen (DO), conductivity, total dissolved solids (TDS) and turbidity, were conducted using *in situ* equipment. (Plate 4.3c and 4.3e).

Plate 4.3a: Monitoring Well purging at UBEGW17

Plate 4.3b: Monitoring Well purging at UBEGW14

Plate 4.3c: Groundwater sampling at UBEGW1

Plate 4.3d: Groundwater sampling at UBEGW1 (Community water well)

Plate 4.3e: Groundwater depth measurement at

4.2.5.4 Surface Water

Surface water samples were collected from three (3) stations three (3) control stations and stored in appropriate containers (Table 4.3). The samples were taken from seasonal swamps/ponds and existing burrow pits/impoundments within the Study area. Samples for hydrocarbons were fixed with sulphuric acid and corked with aluminum foil before storage while samples for heavy metals were fixed with nitric acid. All samples were stored in coolers with ice packs. *Insitu* measurements of temperature, pH, salinity, dissolved oxygen (DO), conductivity, total dissolved solids (TDS) and turbidity, were conducted using *in situ* equipment. (Plate 4a and 4b).

Plate 4.4a: Surface Water sampling at UBESWCTRL3

Plate 4.4b: Surface water in situ measurement at UBESWCTRL1

4.2.5.5 Sediment

Sediment samples for the EIAwere collected from water bodies with an Eckman Grab. Three to five successful grab samples provided approximately 200g of sample. A portion of the top of the haul 1-2cm was preserved using polyethylene plastic bags for physical, chemical and other analyses (metals and grain size). Samples for hydrocarbon analyses (THC, BTEX PAH) were wrapped in aluminum foil paper and secured in an aluminum foil plate and stored in a cooler with ice at 4^{o}C` (Plates 4.5a and 4.5b)

The sediment portion for benthic community structure analyses was washed with the habitat water through a 0.5mm mesh size sieve. The sieved contents were preserved in 4% formalin and stained with rose bengal in labeled jars for further analysis in the laboratory.

Plate 4.5a: Sediments sampling at UBESWCTRL1

Plate 4.5b: Benthos washing at UBESWCTRL3

4.2.5.6 Plankton

Horizontal plankton hauls were made using 55µm mesh size standard plankton net (plates 6a and 6b. The plankton net was cast into the water and allowed to submerge for 5 min, before pulling it out and then transferring the content into a container. Each haul was concentrated into an attached bottle and transferred into a labelled 750ml plastic container with screw cap. Each sample was immediately fixed with 5% formalin and 1ml of Lugol's iodine solution, with each bottle secured in a box for transportation to the laboratory after proper labelling to reflect appropriate details.

Plate 6a: Retrieval of Plankton net during sampling at UBESWCTRL2

Plate 6b: Retrieval of Plankton net at UBESWCTRL1

4.2.5.7 Vegetation Study

Sampling Techniques

A random sampling technique was employed in the vegetation assessment of the study area. In each vegetation type observed in the study area, three sample plots of approximately 100 m^2 each were established, in which a random assessment of plant abundance, diversity, status and form/habit was conducted. Additionally, leave samples were collected for laboratory analysis of the presence of hydrocarbon and heavy metal pollutants.

Plant identification

Identification of plant species in the study area was done onsite by expert and local knowledge, aided by several field guide developed for the region (Nyanayo, 2006; Akobundu & Okazie, 1987). Unidentified plant species were photographed, and later taken to University of Port Harcourt Forestry Herbarium for dentification.

Abundance and Diversity

The abundance of plant species was assessed by counting and recording the occurrence of individual plant species observed per plot, and then the sum of the result for all the plot was calculated. The site diversity was calculated for each vegetation type observed using the Shannon Weiner diversity (Shannon & Weaver, 1949).

Vegetation status/Vigor

The vigor of some selected tree species was determined by measuring the total height and diameter at breast height of trees. The standard position for diameter measurements at standing trees is at breast height, defined at the height of 1.30m (Rodríguez-García *et al.*, 2014); while the total height of trees will be determined by directly estimating the observed height of vegetation.

Plant Life Forms

The plants observed and recorded were grouped into specific life forms such as Phanerophytes, Chamaephytes, Geophytes, Hemicrophytes, and Cryptophytes (Raunkiaer, 1934; Kershaw, 1973). These life forms were useful in categorizing the plant species based on their vulnerability. More so, plant behaviour in the form of trees, shrubs, herbs, grasses, climbers were also be documented.

Ethnobotanical and Conservation Value

Firstly, the ethnobotanical value of the vegetation was obtained through literature and by interacting with the locals of the study area, in other to obtain information on the utility of plant species locally. Secondly, the conservation status of each plant was obtained from the IUCN list of endangered species. This informed decision makers on the critical nature of the existing vegetation.

4.2.5.8 Wildlife Study
The ecological assessment of the proposed Ubeta field development project was carried out with the aim of assessing the environmental impact of the project on the wildlife within the project area and the adjoining areas as part of environment baseline monitoring plan

Materials and methods
Random sampling technique was used to assess the wildlife. Each sampling location covered an area of about 1.5km square. The pipeline (Right of way) and access roads were used for the wildlife observation and assessment.

The wildlife information in the report for mostly the mammals and reptiles came from interviews with experienced local hunters and trappers from the communities. During the interviews, field guide books and pictures were used for the species identification. Other methods used in this wildlife survey include; animal droppings, footprints, tracks, animals remains like skulls that were seen with the hunters.

For birds and arboreal species, direct observations were made with the aid of a pair of 10 x 42 Nikon binocular. Bird's observation and counting along pipe lines and access roads was the only method used in the study. The number of times a species was encountered during the trips along the access road was used as an index for its abundance.

For birds, observation and counting along access roads and power transmission route was the only method used in the study. The number of times a species was encounter during the trips along the roads was used as an index for its abundance.

4.2.6 Socioeconomics and Health Impact Assessment (SHIA)
This survey was undertaken to gather socioeconomics primary data on the general lifestyle and livelihood of the people within the proposed project area; document the possible socioeconomics and health impact of the proposed project and also understand the specific concerns and perceptions of the people with respect to the proposed Ubeta field development project

The survey was conducted in the eight host communities of Ubeta, Ubarama, Ubio, Ihuaje, Akabuka, Ogbogu, Obite and Anwunugbokor.

The study comprised of questionnaire administration, focused group discussions and semi-structured interviews with community stakeholders.

Questionnaire Design

Survey questionnaire was designed to elicit response from the respondents. The sample questionnaire for socioeconomics (Appendix 2.2) covered information related to personal data, community concerns, socio-cultural characteristics, economic characteristics, land Use, etc.

Sampling size/Administration of Questionnaire

The questionnaires were administered to both indigenes and residents of the communities with age range of 15years and above cutting across the various gender, occupational and socio-cultural groups in the community. Random samples from sample size were chosen for administration of questionnaires. Questionnaires were only given to persons who consented to answer them. Responses to questions contained on the questionnaires were further verified through direct observation or during discussions with other groups or individuals. The number and percentage sample of questionnaires distributed in each community is shown in Table 4.4.

Focused group discussions and semi-structured interview

The Focus Group Discussions were held with the selected groups using standard methods. Separate sessions were held with the elders, youths and women (Plate 1). Each session of the focus group discussion was conducted using a discussion guide. Additionally, semi-structured discussions and interviews were freely conducted with key informants and some leaders of the various communities.

Table 4.4: Questionnaires Sample Population

Community	`Local Government Area	Sample	Percentage (%)
Ubeta	Ahoada West	20	15.38
Ubarama	Ahoada West	15	11.54
Ubio	Ahoada West	18	13.85
Ihuaje	Ahoada East	19	14.61
Akabuka	Ogba/Egbema/Ndoni	15	11.54
Ogbogu	Ogba/Egbema/Ndoni	15	11.54
Obite	Ogba/Egbema/Ndoni	15	11.54
Anwunugbokor	Ahoada West	13	10.00
TOTAL		**130**	**100**

Field Activity

The field activities were conducted in company of TEPNG Community Liaison officers from 17th to 30th December 2022 (18days). Some general guidelines or rules were developed and followed by the survey team. The questionnaire administration and focused group discussions were held at a designated location in Ahoada (Plates 4.7a to 4.7z and Plates 4.8a to 4.8r) according to the agreed date and time schedule for the various communities and conducted in accordance with NCDC COVID-19 protocols. The interviewers ensured that the following guidelines were observed:

- explain clearly the purpose of the study;
- be patient, show respect for the community stakeholders;
- make phrasing simple and easily understandable to less literate community persons in particular;
- develop devices for questions with multiple choices and ranking;
- confirm answers with interviews by repeating both questions and answers.

The following QA/QC rules were observed during the survey:

- Team members communicated and exchanged ideas among each other all the time;
- Sub-group leaders checked questionnaires at the end of each day;
- If any problems arose, the sub-groups worked together in attempt to find solutions;
- At the end of each day, supervisors of each sub-team reviewed all the completed questionnaires to confirm that there were no omitted answers, that responses were consistent and logical, and that the coding of answers was correct.

4.2.7 Data Analysis and Management

All questionnaires returned were carefully coded and organized into usable form for easy computation. In doing this, data from various affirmative questions were reduced to simple and bivariate tables for ease of analysis. Data from the various sources, desk research, questionnaires and participatory analysis were critically reviewed, examined and triangulated to ensure reliability. Data analysis was done using simple statistical methods like percentages, rates and charts.

UBETA

Plate 4.7a: Questionnaire administration to women

Plate 4.7b: Questionnaire administration to

Plate 4.7c: Questionnaire administration to some Elders and Youths of Ubeta.

Plate 4.7d: SHIA consultant team supervising questionnaire administration to some members of

Plate 4.7f: Focused group discussion with Ubeta

Plate 4.7g: Focused group discussion with Ubeta Youths Exco representatives and some

UBARAMA

Plate 4.7h: Questionnaire administration to some Youths from Ubarama community

Plate 4.7i: Questionnaire administration to CDC Chairman & some elders from Ubarama

Plate 4.7j: Questionnaire administration to some stakeholders from Ubarama community

Plate 4.7k: Questionnaire administration to some Youth exco members from Ubarama community

Plate 4.7l: Questionnaire administration to Women

Plate 4.7m: Focused group discussion with Paramount Ruler (Eze Wula), CDC Chairman,

UBIO

Plate 4.7n: Questionnaire administration to

Plate 4.7o: Questionnaire administration to some members of Ubio community

Plate 4.7p: SHIA Team assisting a woman from Ubio

Plate 4.7q: Questionnaire administration and oral interview with the paramount ruler of Ubio

Plate 4.7r: Focused group discussion with Paramount Ruler, CDC rep. and some chiefs from

Plate 4.7s: Focused group discussion with Youth and Women representatives of Ubio community

IHUAJE

Plate 4.7t: Questionnaire administration to some women and Youths from Ihuaje

Plate 4.7u: SHIA Team supervising questionnaire administration to some members of Ihuaje

Plate 4.7v: Questionnaire administration to the Paramount ruler, an elder and lady from Ihuaje

Plate 4.7w: Questionnaire administration to some Youths from Ihuaje community

Plate 4.7x: Paramount Ruler of Ihuaje addressing community representatives on the SHIA and Questionnaire administration.

Plate 4.7y: Focused group discussion with Paramount Ruler, Youth and Women representatives of Ubio community

AKABUKA

Plate 4.7z: Akabuka Community CLO observing questionnaire administration to some members of his community

Plate 4.8a: Some Elders and Chiefs from Akabuka during questionnaire administration.

Plate 4.8b: Some Akabuka Youths being

Plate 4.8c: The SHIA rep. and Akabuka CLO doing due diligence during questionnaire administration

Plate 4.8d: Questionnaire administration to some Women and Youths from Akabuka community.

Plate 4.8e: Focused group discussion with Paramount Ruler (Ocha Ocha), Elders, CDC, Youth

OGBOGU

Plate 4.8f: Questionnaire administration to some Women, chiefs and elders of Ogbogu community

Plate 4.8g: Plate ##: Questionnaire administration to some youths of Ogbogu community.

Plate 4.8h: Focused group discussion with Paramount Ruler, Elders, Youth and Women reps. of Ogbogu

Plate 4.8h: The SHIA team member interview with the paramount ruler of Ogbogu community

OBITE

Plate 4.8i: Member of SHIA team enlightening some Obite community representatives on the proposed project before questionnaire administration.

Plate 4.8j: Some Obite community women and youth group discussion and questionnaire administration by SHIA team.

Plate 4.8k: Some Obite Youths being administered questionnaire during the SHIA

Plate 4.8l: The SHIA team rep. doing due diligence during questionnaire administration to Obite

Plate 4.8m: Questionnaire administration to some Elders and Youth from Obite community.

Plate 4.8n: Focused group discussion with Paramount Ruler (Eze-Ali II), Chiefs, Elders, CDC,

ANWUNUGBOKOR

Plate 4.8o: Member of SHIA team enlightening some Anwunugbokor community representatives on the proposed project before questionnaire administration

Plate 4.8p: Questionnaire administration to Anwunugbokor community reps. being supervised by SHIA team.

Plate 4.8q: Questionnaire administration to Anwunugbokor community reps. in progress

Plate 4.8r: Focused group discussion with CDC, Youth and Women representatives of

4.2.8 Chain of Custody

To maintain a record of sample collection, transfer between personnel, transportation and receipt at Technological Partners International Nigeria Ltd (TPI) Laboratory and Aegis One Consults Ltd laboratory; a chain-of-custody record was maintained from the time of sample collection until final deposition in the laboratories. The chain of custody form was endorsed by the TEPNG HSE department representative, Delta Systematics site supervisor and the dispatch personnel. The *in-situ* results sheet was endorsed by the TEPNG representative and the regulators (FMEnv and NUPRC).

4.2.9 Field Quality Assurance and Quality Control Measures

All aspects of the study were subjected to quality control procedures, as detailed in the QA/QC plan for the Ubeta FDP EIA. All Sampling and sample handling and transportation were subjected to strict quality control procedures. Chain of custody documentation was carried out and the planned number of samples collected for various environmental media documented.

All samples were maintained in accordance with the following protocols;

1. Sample bottles were labeled in the field with the location name, the sample station identification number, sample date, sample time and the parameters to be analyzed. Samples were stored in coolers immediately after collection until they were transported to the laboratory.
2. The vegetation samples collected for further identification and storage were put in a plant press and secured firmly to keep the plants intact.
3. Sample containers for movement to analytical laboratory were securely sealed with tight caps and adhesive tapes. Samples were placed in a transport container (coolers) and packed with absorbent material. Samples placed in the transport container (coolers) were packed in a manner that would prevent breakage. All sample containers were packed to maintain a temperature of 4°C.

4.2.9.1 Documentation Procedure

All activities carried out in the field were adequately reported using Field log Books, Chain of Custody forms, Project Update forms etc. and entered into computer database software (MS Excel).

4.2.9.2 Quality Assurance / Control Procedure

A detailed procedural guideline for sampling was prepared and used by all the consultants of the project team prior to the commencement of the fieldwork. This was to ensure data validity and reliability during sample collection, preservation, storage and transportation. All meters used for this study were calibrated with valid calibration certificates. An on-field check of calibration of meters was also carried out.

Standard methods and procedures were strictly adhered to in the course of this study. QA/QC procedures were implemented during sample collection, labeling, analyses and data verification. Chain of custody procedures including sample handling, transportation, logging and cross-checking in the laboratory were also implemented.

All analyses were carried out in NUPRC accredited laboratories. The methods of analyses used in this study were those specified in EGASPIN 2018 and other internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained. Details of the analytical procedures for all the parameters are presented in the section below.

The laboratory quality Assurance Procedure covers all aspects of the study, and includes sample collection, handling, laboratory analyses, data coding and manipulation, statistical analyses, presentation and communication of results.

4.3 LABORATORY ANALYSIS

The samples for chemistry and microbiology analysis were transported to Technology Partners International Nigeria Ltd (TPI) laboratory and Aegis One Consults Ltd laboratory respectively for analysis. Both laboratories are located in Port Harcourt. The laboratories are accredited by the NUPRC, FMENV and NOSDRA. All samples were logged into a laboratory log book. The chain of custody forms (***Appendix 2.3***) from the field was endorsed by the Laboratory supervisor and Delta Systematics representative at the point of handover of samples for analysis**.**

4.3.1 Laboratory Inspection / Regulatory Oversight

A laboratory inspection/witness of analysis was performed on the 4th of February, 2022 by representatives of Nigeria Upstream Petroleum Regulatory Commission (NUPRC), Federal Ministry of Environment and TEPNG at the analytical laboratories of Technology Partners International Nigeria Ltd and Aegis One Consults Ltd. (Plates 4.9a and 4.9b). The purpose of the inspection was to ascertain the adequacy of laboratory sample handling, preservation, equipment, analyses and QA/QC procedures and to witness analyses of some samples. The sample chain of custody was cross checked with the actual number of samples received by the laboratories. The laboratory inspection attendance sheet (Appendix 2.4) was endorsed by all the participants.

Plate 4.9a: Analysis Witnessing at TPI Laboratory

Plate 4.9b: Analysis Witnessing at Aegis One Consults Laboratory

4.3.2 Analytical Methods

The soil, water and sediment physico-chemistry analysis were conducted according to appropriate international standard methods (ASTM, USEPA, APHA, etc.) as shown in ***Table 4.5*** and described in this section.

Table 4.5: Test Methods for Laboratory Analyses

Parameters	**Units**	**Standard Test Method (ASTM, APHA)**	**Laboratory Analysis Equipment Name**
Temperature	°C	APHA 2550B	Electrometric/ Hanna meter
pH		APHA 4500-H^+B	Electrometric/ Hanna meter
DO	mg/l	Electrometric	Electrometric/ Hanna meter
Salinity	ppt	APHA 2520B	Electrometric/ Hanna meter
Alkalinity	mg/l	APHA 2320B	Titrimetric
BTEX	mg/l	USEPA 8260C	GC/FID
TPH	mg/l	USEPA 3550C/8015C	GC/FID
PAH	mg/l	USEPA 3550C/8015C	GC/FID
TDS	g/l	Electrometric	Electrometric/ Hanna meter
TSS	mg/l	APHA 2540D	HACH DR6000 UV-SPEC
Turbidity	NTU	APHA 2130B	Electrometric/ Hanna meter
THC	mg/l	ASTM D3921	Buck Infra-red spectrophotometer
BOD_5	mg/l	APHA 5210B	Incubation/Hanna meter
COD	mg/l	Reactor Digestion Method	COD Digester
NH_4^+	mg/l	HACH Method 8038	HACH DR6000 UV-SPEC
NO_3^-	mg/l	APHA 4500-NO_3^-.E	HACH DR6000 UV-SPEC
NO_2	mg/l	APHA 4500-NO_2^-.B	HACH DR6000 UV-SPEC
PO_4^{3-}	mg/l	APHA 4500-P.C	HACH DR6000 UV-SPEC
SO_4^{2-}	mg/l	APHA 4500-SO_4^{2-}E	HACH DR6000 UV-SPEC
SiO_2	mg/l	APHA 4500-SOi_2D	HACH DR6000 UV-SPEC
Na	mg/l	APHA 3111B/ASTM D3561	AAS
K	mg/l	APHA 3111B/ASTM D3561	AAS
Ca	mg/l	APHA 3111B/ASTM D3561	AAS
Mn	mg/l	APHA 3111B/ASTM D3561	AAS
Mg	mg/l	ASTMD1971/4691	AAS
Fe	mg/l	ASTMD1971/4691	AAS
Cd	mg/l	ASTMD1971/4691	AAS
Cr	mg/l	ASTMD1971/4691	AAS
Ni	mg/l	ASTMD1971/4691	AAS
V	mg/l	ASTMD1971/4691	AAS
Pb	mg/l	ASTMD1971/4691	AAS
Zn	mg/l	ASTMD1971/4691	AAS
Ba	mg/l	ASTMD1971/4691	AAS
Hg	mg/l	ASTMD1971/4691	AAS
THB	cfu/ml	ASTM 5465-93	Culturing (Pour plate)
THF	cfu/ml	ASTM 5465-93	Culturing (Pour plate)
HUB	cfu/ml	ASTM 5465-93	Culturing (Spread plate)
HUF	cfu/ml	ASTM 5465-93	Culturing (Spread plate)
Coliforms	MPN/100ml	APHA 9221C	Fermentation Tubes

4.3.2.1 Laboratory Analytical Methods and Procedures for water

Total Suspended Solids in water
TSS was determined by the APHA 2540 D method. The sample was thoroughly mixed to achieve homogeneity using a magnetic stirrer, and then filtered using whatman filter paper. The residue obtained was dried to a constant weight in an oven at temperature of 103 to 105^{o}C. The increase in weight over the empty dish represents the total suspended solid.

TSS (mg/l) = (A – B) 1000\ Sample Volume (ml)
where: A = weight of filter paper + residue (mg), and B = weight of filter paper (mg)

Biochemical Oxygen Demand (BOD_5)
The 5-day BOD test method (APHA 5210B) was used for BOD_5 determination. Samples for the BOD_5 test were diluted appropriately, seeded and incubated in the dark for 5 days at 20°C. The residual dissolved oxygen was determined electrometrically after the incubation period and the BOD_5 calculated afterwards.

Chemical Oxygen Demand (COD)
Reactor Digestion method was used for the analysis of Chemical Oxygen Demand (COD). The COD results are defined as the mg of O_2 consumed per litre of sample under conditions of this procedure. In this procedure, the samples were heated in a COD Digester for 2hrs with a strong oxidizing agent, Potassium dichromate. Oxidizable organic compounds react, reducing the dichromate ion ($Cr_2O_7^{2-}$) to green chromic ion (Cr^{3+}).

When the 0 – 150 mg/L colorimetric method is used, the amount of Cr^{6+} remaining is determined. When the 0 – 1500mg/L or the 0 – 15,000mg/L colorimetric method is used, the amount of Cr^{3+} produced is determined. The COD reagent also contains silver and mercury ions. Silver is a catalyst while mercury is used for complex chloride interferences.

Chloride
Salinity of the samples were determined as Chloride using ASTM D512 titrimetric Method. A measured quantity of the sample containing Dichromate indicator was titrated with Silver Nitrate to an end-point of faint yellow colour.

Phosphate in water
Phosphate in the water sample was determined with APHA 4500-PC test method; a colorimetric method based on the formation of a yellow complex under acidic condition in the presence of Vanadium. The intensity of the yellow colour is

proportional to Phosphate concentration. The sample was analysed at a wavelength of 470nm with UV-Spectrophotometer – DR2000.

Nitrate in water

Nitrate in the effluent samples was determined by Cadmium Reduction Method (APHA 4500-NO3-E) using UV-Spectrophotometer – DR2000 at a wavelength of 543nm.

Sulphate in water

Sulphate was determined using APHA 4500.SO_4^{2-}.E test method. Sulphate precipitates by displacing chloride in the presence of $BaCl_2$ and precipitated turbid solution was measured calorimetrically for sulphate concentration.

Exchangeable Cations in water

Exchangeable cations (Mg, Ca, K, and Na) were determined as described by APHA 18th edition 3111B and ASTM D3561. The concentrations were calculated thus:

Concentration (mg/l) = C x Y\X------

Where C = concentration of cation determined from calibration curve

Y = final volume, ml

X = volume of sample, ml

Total Hydrocarbon Content (THC) in water

ASTM D3921 test method is employed for the determination of Oil and Grease. 1000ml of sample is extracted serially thrice, each time with 30ml volume of tetrachloroethylene (solvent). The extract is diluted to 100ml and a portion is examined by infra-red spectroscopy to measure the amount of oil and grease.

For THC, a portion of the oil and grease extract is contacted with de-activated silica gel to remove polar substances thereby providing a solution of total hydrocarbon content. This resulting solution is then examined by infra-red spectroscopy. Calculation of final result is obtained by relating the absorbance of sample to the standard calibration curve plotted.

BTEX in Water

USEPA 5021A/8260C is employed for the analysis of BTEX in water samples. The sample collected is subjected to Headspace/GCMS calibrated with 6 components (analytes) BTEX standard manufactured by Acuu standard, USA. Concentration of BTEX is calculated using Agilent Chemstation software. The model of the Headspace Auto-sampler is Tekmar 7000 while that of the Agilent GC/MS is (6890N /5973).

Total Petroleum Hydrocarbon (TPH)

USEPA 3510C/8015C standard method is employed for TPH analysis of samples. The Gas Chromatograph (GC-FID) is calibrated using Hydrocarbon standards containing 35 components of n-alkanes from C8 – C40 manufactured by Acuu Standard, USA. The 1µL of elutes from the extracted water sample is injected into GC-FID for quantification of petroleum hydrocarbons. Agilent Chemstation software is then used for data processing of the analysed samples.

Heavy Metals in water

Heavy metals concentrations in the samples were determined using a Shimadzu Atomic Absorption Spectrophotometer (AAS-model 6650F). Analyses were carried out in line with ASTM 1971/4691. The acidified samples at pH ≤2 were aspirated directly into the AAS with the appropriate lamps installed. Heavy metal concentrations were quantified from calibration curves prepared using the individual metal standards.

4.3.2.2 Laboratory Analytical Methods and Procedures for Soil/Sediment

The following subsections present synoptic descriptions of the laboratory analytical methods and procedures employed for the various physical, chemical and biological parameters for Soil/Sediment samples.

Total Organic Carbon (TOC) in Soil/Sediment

The rapid wet oxidation method based on Walkey and Black procedure was used for the determination of total organic carbon (TOC).

TOC is calculated thus:

Organic Carbon (g/kg) = ((meq K2Cr2O7 - meq FeSo4) x (0.003 x 1000 x 1.3))\Weight of water free sample (g)

Total Organic Matter (g/kg) = Total organic carbon (g/kg) x 1.729

Where,

meq K2CrO7 = 1N x 10ml

meq FeSO4 = 0.5N x volume of titrant in ml

0.003 = mill equivalent weight of carbon

1.30 = Correlation factor

1000 = Conversion factor to kg.

Chloride in Soil/Sediment
APHA 4500- Cl. B was employed for the analysis of Chloride. Silver Chloride is precipitated quantitatively before red Silver Chromate is formed using Potassium Chromate as indicator.

Calculation:

Mg Cl-/l = ((A – B) × N × 35450)\Ml sample

Where A = ml titration of sample

B = ml titration for blank

C = Normality of $AgNO_3$

Nitrate in Soil/Sediment
APHA 4500 – No3-. E was used for determination of Nitrate. Here, nitrate is reduced quantitatively to nitrite in the presence of cadmium treated with copper sulphate and packed in a glass column. The No2 produced thus is determined by diazotizing with sulphamilamide and coupling with N –(1-naphthyl) – ethylenediamine dihydrochloride to form a highly coloured azo dye that is measured calorimetrically. Concentrations of nitrate are obtained directly from standard curve plotted using standard concentration.

Phosphate in Soil/Sediment
APHA 4500 – P. C was used to determine phosphate in the samples. In a dilute orthophosphate solution, ammonium molybdate reacts under acid conditions to form a heteropoly acid, molybdophosphoric acid. In the presence of vanadium, yellow vanadomolybdophosphoric acid is formed. The intensity of the yellow colour is proportional to phosphate concentration.

Phosphate concentrations are calculated as follows:

Mg P/l = (mg P (50ml final volume) × 1000)\Ml sample

Sulphate in Soil/Sediment
APHA 4500 – SO4 E was employed for the analysis of sulphate. Here, sulphate ion is precipitated in an acetic acid medium with barium chloride so as to form barium sulphate crystal of uniform sizes. Light absorbance of the $BaSO_4$ suspension was measured by a photometer and the SO42- concentration was determined by comparison of the reading with a standard curve.

Exchangeable Cations in Soil/Sediment

Exchangeable cations (Mg, Ca, K, and Na) were determined as described by APHA 18th edition APHA 3111B and ASTM D3561. The concentrations are calculated thus:

Concentration (mg/kg) = (A – B) C\D

Where A = concentration of metal in sample

B = concentration of metal found in blank

C = volume of extract, ml

D = weight of dry sample, g.

Redox Potential in Soil/Sediment

The ASTM D 1498 test method was used for determining redox potential using the

Orion Multimeter (model 1260).

Oil and Grease and Hydrocarbons in Soil/Sediment

ASTM D3921 is employed for the determination of the Oil and Grease. 5g of the thoroughly homogenized sediment sample is taken and mixed with about 5g of anhydrous sodium sulphate. 30ml of Tetrachloroethylene (solvent) is added to the homogenized mixture, stirred gently and sonicated for 20mins, and thereafter filtered through anhydrous sodium sulphate into an extraction bottle. The extraction process is repeated two more times on the same sample to obtain 90ml of extract. 10ml of solvent is used for rinsing and added to make up 100ml of extract. A portion of the extract is examined by infra-red spectroscopy to measure the amount of oil and grease.

THC is determined by contacting a portion of the oil and grease extract with deactivated silica gel to remove polar substances thereby providing a solution of total hydrocarbon content. This solution is then examined again by infra-red spectroscopy. Calculation of final result is obtained by relating the absorbance to the standard calibration curve plotted

Total Petroleum Hydrocarbon (TPH)

USEPA 3550C/8015C standard method is employed for TPH analysis of sediment samples. The Gas Chromatograph (GC-FID) is calibrated using Hydrocarbon standards containing 35 components of n-alkanes from C8 – C40 manufactured by Acuu Standard, USA. The 1μL of elutes from the extracted soil sample is injected into GC-FID for quantification of petroleum hydrocarbons. Agilent Chemstation software is then used for data processing of the analysed samples.

BTEX

USEPA 5021A/8260B is employed for the analysis of BTEX in sediment samples. The sample collected is subjected to Headspace/GCMS calibrated with 6 components (analytes) BTEX standard manufactured by Acuu standard, USA. Concentration of BTEX was calculated using Agilent Chemstation software. The model of the Headspace Auto-sampler is Tekmar 7000 while that of the Agilent GC/MS is (6890N /5973).

PAHs

The soil samples are extracted and analyzed using USEPA 3550C/8270D standard method for analysis of PAHs in sediment samples. The extract obtained was concentrated to 1ml prior to determinative analysis by GC/MS which is calibrated using 16 components PAHs standards manufactured by Acuu Standard, USA. Agilent Chemstation software is then used for data processing of the analysed samples.

Heavy Metals in Soil/Sediment

Heavy metals content of Soil/Sediment samples was determined using Shimadzu AA 6650F. Atomic Absorption Spectrophotometer. The sample digestion / preparation procedure followed is as described in ASTM D5198/D3974. The AAS measurement done following the procedures indicated below.

Cd, Zn, Fe, Ni, Cr, Pb, Cd Cu: APHA 20th edition 3111b

Ba: ASTM D3651

V: APHA 20th edition 3111 D

Metal concentration of Soil/Sediment sample (mg/kg) = (A -- B) x C/D

Where A = Concentration of metal in sample (mg/l) as determined by AAS

B = Concentration of the metal found in blank (mg/l)

C = Volume of extract (ml)

D = Weight of dry sample

Where A = Concentration of metal in sample (mg/l) as determined by AAS B = Concentration of the metal found in blank (mg/l)

C = Volume of extract (ml)

D = Weight of dry sample

Hg: APHA 3112b & ASTM D 3223.

Mercury (Hg) concentration is determined thus:

ųg/g = (A – B) C\D

Where A = concentration of mercury in sample, ųg/ml as determined by AAS (Instrument Reading)

B = concentration of mercury found in blank, ųg/ml (Procedural blank)

C = volume of extract (ml)

D = weight of dry sample (g)

Particle Size Distribution

The Hydrometer method was used and includes the following procedure:

- The Soil/Sedimentation tube was filled with water and agitated at least 30 times for 2 minutes.
- The suspension was left to Soil/Sediment according to determined time.
- The hydrometer was placed into the cylinder.
- The mixture was dispersed for 15 minutes with a dispersing paddle and the paddle washed with distilled water, allowing the wash water to run into the container with suspension.
- The suspension was poured into a PSD cylinder (Bouyoucos cylinder) and the jar rinsed with distilled water from the wash-bottle.
- The cylinder was filled with distilled water to the appropriate mark (1130ml for a 50 g sample) with the hydrometer inside.
- The hydrometer was removed and cylinder inverted a few times, then placed in the thermostat bath which is kept as near to 20oC as possible.
- Then contents of the cylinder were shaken to give a homogenous suspension after which the cylinder was returned to the water-bath and the time recorded.
- Sixty minutes after the cylinder has been placed in the bath, the hydrometer was inserted and reading taken.
- Then the hydrometer was removed and the cylinder shaken again as previously described.
- The cylinder was then placed on a table and the stop-watch started. Thereafter, in about 20 seconds, the hydrometer was insert and reading taken at 40 & 60 seconds

<u>*Calculations*</u>
The following table gives the maximum diameter of the particles which are accounted for by the hydrometer after different time intervals:

HydrometerReadings	diameterofparticles	Particle (mm)
18 seconds	0.075	
40 seconds	0.050	Silt & Clay
60 seconds	0.005	Clay

<u>Particle size (D was calculated accordingly):</u>

1. Pebble and Gravel

Gravel (or Pebble) (%) = G * 100 / weight of sample taken

Where G = weight retained on sieves > 2 mm

2. Sand

Weigh the portion of particles retained on each of the set from 2 – 75 µm sieve.

Percentage sand calculated as a cumulative sum of the individual percentages where

Sand (%) = Wr * 100 / (Wt)

Where;

Wr = weight of particles retained on each sieve

Wt = total weight of air (or oven) dried sample taken

3. Silt + Clay: (% silt = 100 – (% sand + % clay)

Calculate particle size (D) at different times from the relationship:

D (mm) = 0.315 * k * √(L/T)

where;

K = Soil/Sedimentation constant at a given temperature & particle density. If density is not known then value for k = 2.65 will be 0.01365 at 20oC; or 0.01286 at 25oC (mg/m3)

L = tabulated effective length for the hydrometer reading (mm)

T = Soil/Sedimentation time (min) for the particle

Cumulative percentage (P) was plotted against particle size diameter (D) and percentage interpolated from the curve.

Clay = < 0.002 mm

Silt = 0.002 - 0.02 mm

Fine Sand = 0.02 - 0.20 mm

Coarse Sand = 0.20 - 2.0 mm

Gravel = 2.0 - 64 mm

Cobble = 64 - 256 mm

4.3.3 Microbiology

4.3.3.1 Water Microbiology

Total heterotrophic bacteria and fungi in water

Total heterotrophic bacteria and fungi in the water samples were determined using APHA 9215B/9610B and ASTM D 5465-93 (Pour plate) test methods. Serial dilution of the water samples were carried out using sterile water. Aliquots of the 10-fold dilutions were plated on Nutrient agar and Sabouraud Dextrose agar for the enumeration of heterotrophic bacteria and fungi respectively. Bacterial plates were incubated at 35oC for 24-48 hours whereas fungal plates were incubated at the same temperature for 3-5 days.

Total microbial colonies were calculated as follows:

Water samples (cfu/ml) =(Colony Counted\Actual Vol of Samples Innoculated)xDilution Factor

Hydrocarbon Utilizing Bacteria in water

Bacteria in the water samples capable of utilizing hydrocarbons as their sole source of carbon and energy were determined using APHA 9215C/ASTM 5465-93 (Spread plate) test methods.

Serial dilution of the water samples were carried out using sterile water. Aliquots of the 10-fold dilutions were spread on minimal medium containing the appropriate mineral salts for bacterial growth. Crude oil-moistened filter papers placed on the lid of the inverted plates provided the carbon source for growth. The plates were incubated at 35oC for 7-10 days.

Total microbial colonies were calculated as follows:

Water samples (cfu/ml) = (Colony Counted\Actual Vol of Samples Innoculated) x Dilution Factor

4.3.3.2 Soil/Sediment Microbiology

Total Heterotrophic Bacteria and Fungi in sediment

Total heterotrophic bacteria and fungi in the sediment samples were determined using APHA9215B/9610B and ASTM D 5465-93 (Pour plate) test methods. Serial dilution of the samples was carried out using sterile water. Aliquots of the 10-fold dilutions were plated on Nutrient agar and Sabouraud Dextrose agar for the enumeration of heterotrophic bacteria and fungi respectively. Bacterial plates were incubated at 35oC for 24-48 hours whereas fungal plates were incubated at the same temperature for 3-5 days.

Total microbial colonies were calculated as follows:

Sediment sample (cfu/g) = (Colony Counted\Actual Vol of Samples Inoculated) X Dilution Factor

Hydrocarbon Utilizing Bacteria in sediment

Bacteria in the sediment capable of utilizing hydrocarbons as their sole source of carbon and energy were determined using APHA 9215C/ASTM 5465-93 (Spread plate) test methods. Serial dilution of the samples was carried out using sterile water. Aliquots of the 10 - fold dilutions were spread on minimal medium containing the appropriate mineral salts for bacterial and fungal growth. Crude oil-moistened filter papers placed on the lid of the inverted plates provided the carbon source for growth. The plates were incubated at 35oC for 7-10 days.

Total microbial colonies were calculated as follows:

Sediment sample (cfu/g) = (Colony Counted\Actual Vol of Samples Inoculated) X Dilution Factor

4.3.4 Plankton and Benthic Macrofauna Analysis

Plankton Analysis

Each sample was concentrated to 20ml. Five drops of each were thoroughly investigated under an MII Wild binocular microscope with calibrated eye piece. For each sample, five fields were investigated using the microtransect drop count method described by Lackey (1938). All organisms were identified using appropriate keys and illustrations described in Hendey (1964), Wickstead (1965), Wimpenny (1966), Olaniyan (1975) and Nwankwo (2004). All organisms were recorded as number of organisms per ml.

Benthic Macrofauna Analysis

In the laboratory, the preserved fauna samples collected from each station were washed through a 0.5mm sieve to remove the preservative and any remaining fine sediments. The samples were sorted under a x40 magnification binocular dissecting microscope. The macrofauna were identified to species level where possible, with the aid of relevant literature (e.g., Day, 1967; Edmunds, 1978; Gosner, 1971, Moor et al., 2003; IOWATER, 2005; Madsen, 1985; Umar et al., 2013, Onwuteaka and Uwagbae 2016 a&b) and subsequently counted. Juvenile macrobenthic animals which because of their size could not be identified to species level were recorded on higher taxonomic levels, usually the genus level. Where fragmented animals were found, only those fragments with heads and identifiable body parts were counted.

Statistical analysis involving Margalef's (d) Index and Shannon Wiener Diversity Index, were applied to evaluate species density and diversity.

Margalef's Index

Margalef (1957)'s (d) index was applied on the macrobenthos from the stations. Margalef's (d) was calculated as:

$$d = \frac{S - 1}{\text{Loge } N}$$

where d = diversity index

S = number of species

N = number of individuals

This is a diversity of species richness, which does not take into account dominance but is largely dependent on the species richness, i.e. the more species present in a sample, the greater the diversity.

Shannon Wiener Diversity Index

This index is sensitive to the number of species present and how evenly or unevenly the individuals are distributed in the sample. It is sensitive to both species and dominance diversity. It was calculated according to Shannon and Wiener (1963) as follows:

$H(s) = \sum Pi \, Loge \, Pi$

where s = total number of species

Pi= observed proportion of individuals that belongs to the ith species.

4.4 DATA ANALYSIS

All data generated in this study were subjected to statistical analysis to test for spatial variation and significant difference between data within proposed project area and past study results using Excel and JMP-SAS packages as applicable. The statistical calculations reported included descriptive statistics (range, mean, standard deviation and coefficient of variation) and a Student t-Test. One level of significance ($p < 0.05$) was considered in the results interpretation.

In addition, bar chart, pie chart and line graph were used in comparing results where appropriate. The analytical results were also compared with local and international standards where applicable and with data from previous study within the study area.

4.5 BASELINE ENVIRONMENTAL CONDITIONS

The detailed description of the environmental conditions of the study area as established during the field study and review of related literature is presented in this section.

4.5.1. Geology & Hydrogeology of the area

The geology of the Niger Delta has been described in various scientific papers (e.g, see Allen, 1965, K. J. Weber and E.M Doukuru (1975) papers, T. Reijers (1984), Akpokodje 1979, Akpokodje 1987, Arnajor and Ngerebara 1990, Etu – Efeotor and Akpokodje 1990). The Niger Delta covers an area of about 75000 km^2, Extending from the Calabar flank and the Abakaliki trough in Eastern Nigeria to the Benin flank in the west. The Niger Delta opens to the Atlantic ocean in the south and protrudes into the Gulf of Guinea as an extension from Benue trough and Anambra Basin, The Delta complex merges westwards across the Okitipupa high into the Dahomey Embayment. The Guinea Ridge and the Cameroon Mountains form the southeast margin. The formation of the Niger Delta began in early Palaeocene time and was as a result of the accumulation of fine grained sediments eroded and transported by the River Niger and its tributaries. The Niger Delta is composed of three sub-surface lithostratigraphic units including the following formations.

Benin formation

This formation, which is approximately 2100m thick, is the most prolific aquifer in the region and is comprised of over 90% massive, porous sands with localized day/shale interbeds, The quaternary deposits, which are 40 to 150m thick, generally consist of rapidly alternating sequences of sand and silt/clay, with the latter becoming increasingly more prominent seawards.

Agbada formation

This formation underlies the Benin formation, and was deposited under a transitional environment, with an almost equi-compositional make up of sands and shale. However, increasing clays may occur with depth.

Akata formation

This formation was deposited within the marine environment and underlies the Agbada formation. It consists of marine clays, silts and shale 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 an approximate thickness of 5882 m. These formations are overlain by various deposits of quaternary age as indicated in table below. Shown in Table 4.6 are the geologic units present in the Niger Delta.

Table 4.6: Geologic Unit of the Niger Delta (Allen, 1965)

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	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

4.5.2 Climate, Meteorology, Ambient Air Quality and Noise

4.5.2.1. Climate and Meteorology

The climatic and meteorological features such as rainfall, air temperature, relative humidity, wind direction/speed and sunshine of the area were obtained from literature. However, this was also complemented with information obtained from the field (Appendix 4.1).

The weather and climate of the study area, like the entire Niger Delta area, is closely tied to the general mesoscale trend in Nigeria. It follows that the weather regime experienced at any given location in Nigeria during the year is determined primarily by the geographical location in relation to the fluctuating position of the Inter-Tropical Convergence Zone (Ayoade, 1988). In this regard, the predominant weather regime in the study area is warm and humid.

The study area is within the humid tropical zone with defined dry (November – March) and Wet (April – October) seasons. The wet season is brought about by the South-West trade wind blowing across the Atlantic Ocean. This begins around April and stretches to October. September and October are the peak of flood in the area. The flood gradually recedes from November. The dry, dusty, and often cold North-East trade winds blowing across the Sahara Desert dominates the dry season and brings a short period of harmattan (Oguntoyinbo and Hayward, 1987). This starts around November and terminates in March.

4.5.2.2 Rainfall Pattern

The level of rainfall is a function of the hydrological factors, which in turn are driven by the circulation of the oceans and the atmospheric meteorology (Derek and Oguntoyinbo, 1987).

Rainfall in the project area is seasonal, variable, and heavy. This is typical of rainfall in the coastal area of Nigeria. Generally, south of latitude 05°N, rain occurs, on the average, every month of the year, but with varying duration. The area is characterized by high rainfall, which decreases from south to north. The mean total annual rainfall decreases from about 4,700 mm on the coast to about 1,700 mm in extreme north of the area. For example, in Rivers State, it is 4,698 mm at Bonny along the coast and 1,862 mm at Degema (Online Nigeria, 2003).

Rainfall is adequate for all year round crop production in the project area. According to Online Nigeria (2003), the mean annual rainfall as measured in Port Harcourt, the nearest major urban centre that has a weather station, shows that the wet season exhibits heavier rains with the highest occurring in September (367.1mm) and less intense in December to February (25.9-56.5mm) (Figure 4.2).

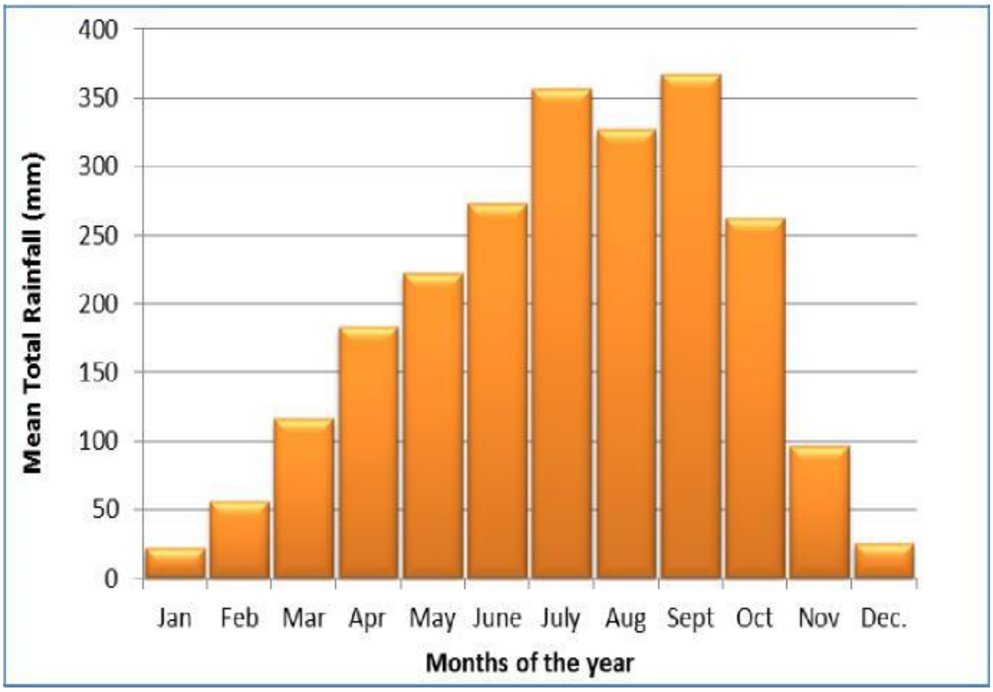


Figure 4.2 Variation in the monthly mean amount of rainfall in the project area (Source: Nigerian Institute of Meteorology (NIMET))

According to Online Nigeria (2003), the duration of the wet season is not less than 330 days, of which a great number is rainy days (days with 250 mm or more of rain). It is worthy to note that rainfall is adequate for all year-round crop production in the project area.

4.5.2.3 Temperature

The mean air temperature in the study area is fairly constant (SIDS BV, 1999). Mean maximum monthly temperatures in the study area range from 28°C to 33°C, while the mean minimum monthly temperatures are in the range of 17°C to 24°C (Figure 4.3).
According to Online Nigeria (2003), the mean annual temperature for the area is 26°C and the hottest months are February to May. Air temperature, like relative humidity and atmospheric pressure, is subject to rapid changes during the passage of thunderstorms (Gobo, 1998).
Relatively high atmospheric temperatures were measured in the study area during the fieldwork. At the sampling stations, atmospheric temperatures varied from 27.2 to 36.7°C with an average of 32.12°C while the control had values range from 30.2 to 34.6°C with mean of 31.9°C (Table 4.7). These ambient air temperature levels recorded were typical of coastal tropical environments (Ayoade, 2004). High atmospheric temperatures enhance the formation of photochemical oxidants such as tropospheric ozone and peroxylacetylnitrate (PAN). The spatial temperature variations recorded during the study may likely be accounted for by the transient cloud cover and time of day.

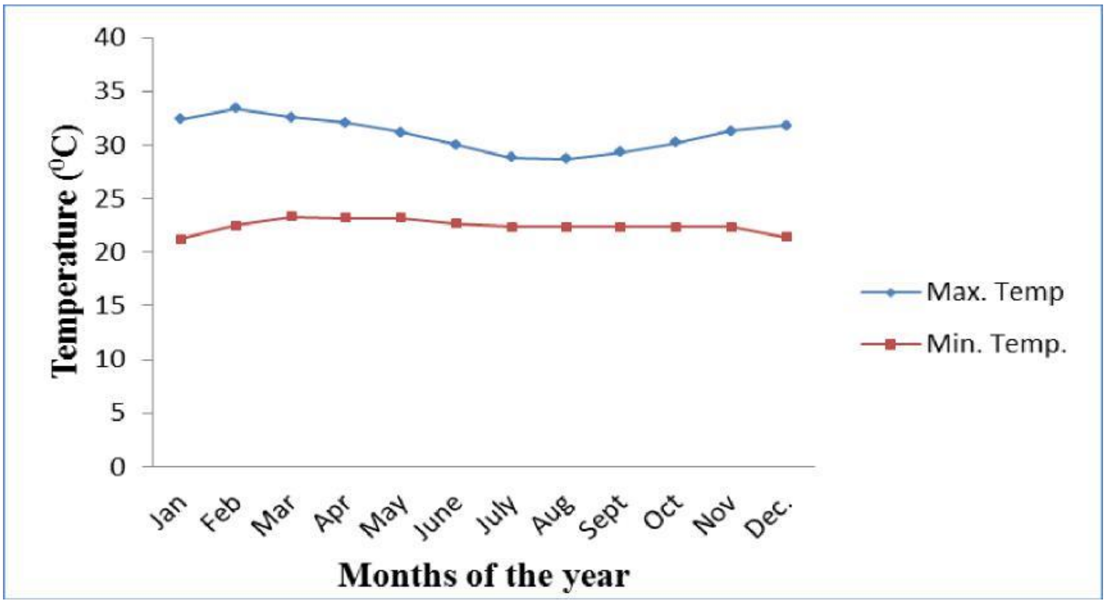


Figure 4.3: Monthly Mean Maximum and Minimum Temperature within the project area

(Source: Nigerian Institute of Meteorology (NIMET)

4.5.2.4 Relative Humidity

Relative humidity is high in the area throughout the year and decreases slightly in the dry season (Salawu, 1993). The available data indicates that relative humidity in the area is very high in the early hours and evening time. Afternoon in the study area are usually hot and humid (Ayoade, 1988). During the dry months (March-November), humidity can fall sharply to as low as 20-40% for a few days during the harmattan spell, leading to larger daily variations than in other months of the year (SIDS BV, 1999). At the sampling stations humidity ranged from 32 to 84.6% with a mean of 53.48%, while the control had a range of 30.2 to 34.6% with mean of 31.9%.

4.5.2.5. Wind Speed and Direction

Winds in the area are fairly consistent and sometimes very strong, especially during squalls associated with thunderstorms. It is these thunderstorms and the local 'tornadoes' accompanying them that are the dominant features of the weather in the area. They may occur throughout the year, even during the dry season, producing wind gusts of up to 100km/h (SIDS BV, 1999).

Furthermore, wind speeds were observed to be lower at nights compared to values recorded during day time hours. The highest wind speeds in the project area are recorded at the onset of the rainy season and this is usually in the month of March (Oguntoyinbo and Hayward, 1987).

Low wind velocities were observed during the sampling exercise with a range of 0.1 – 2.4 m/s at the sampling stations with a mean of 0.57 m/s. The control stations values ranged from 0.2 – 0.9 m/s with an average of 0.5 m/s (Table 4.7). The predominant wind direction during the study varied between South and Northwest. This observation agrees with the long-term wind distribution data retrieved and analyzed for Bonny (2004 - 2010) which shows that the wind blows generally from the south-westerly (SW) direction (Figure 4.4). Information on frequency distribution of wind speed and direction is important since it provides the basis for accurate estimation of the dispersion patterns of pollutants in the atmosphere.

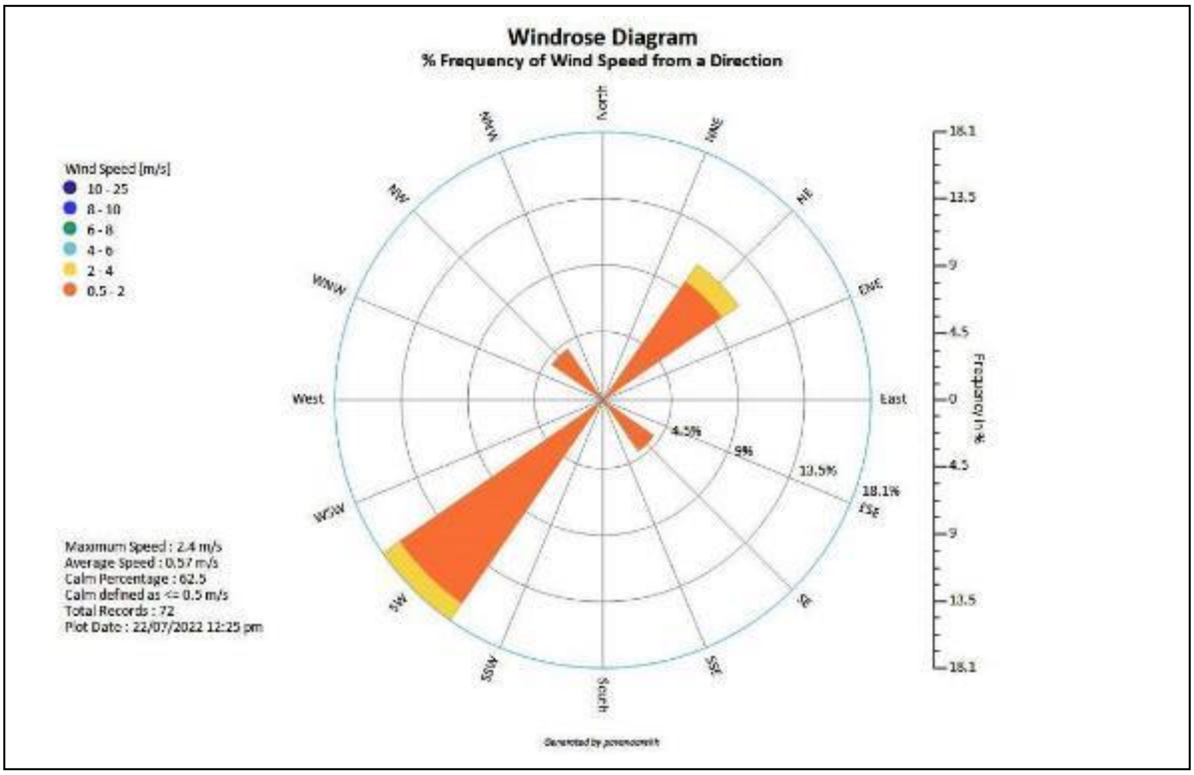


Figure 4.4: Typical Wind Rose for the study area (Source DSL Field Survey,2021)

4.5.2.6 Ambient Air Quality

Due to the dangers of excessive release of air pollutants into the atmosphere from anthropogenic activities, which ultimately affect man and his interests, attempts have been made to limit the volume of noxious gases and particulates that are discharged indiscriminately into the atmosphere. In present times, air quality is being judged against legally adopted standards.

In Nigeria, the regulatory agencies like the Nigerian Upstream Regulatory Commission (NUPRC) and the Federal Ministry of Environment (FMEnv) have adopted standards as the national interim standards for particulates and gaseous emissions in the nation's ambient air quality.

Air quality measurements for the Ubeta FDP were collected from sixty-six (66) stations situated around the project area and these were compared with data collected from control stations as well as their respective NUPRC /FMEnv limits. The details of the data collected from the field is attached as Appendix 4.1, while summary of the results obtained are presented in Table 4.7 which also shows the trend of the air quality parameters from the previous study.

The air quality parameters measured in the field include $PM_{2.5}$ and PM_{10} suspended particulate matter (SPM), carbon monoxide (CO), Volatile Organic Compounds (VOCs), methane (CH_4), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and Carbon dioxide (CO_2). As shown in Table 4.7, only $PM_{2.5}$, PM_{10} and SPM were detected The concentrations of Carbon monoxide (CO), methane (CH_4), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and Carbon dioxide (CO_2) in the atmosphere were too low to be captured by the handheld meter used for their measurement.

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds concentrations were below equipment detectable limit. was detected in this fieldwork at very low quantity at the sampling sites (Table 4.7). VOCs are low molecular weight organic fractions with boiling points low enough to make them readily volatile. At elevated levels, VOCs health effects include eye, nose and throat irritation, headaches, damage to liver, kidney and central nervous system (Jianfei *et al.*, 2018).

Sulphur dioxide (SO_2)

Sulphur dioxide is one of the killer constituents of classical smog. It is also an acid rain forming gas. In this study, atmospheric concentrations of SO_2 were below the equipment detection limit of 0.01 ppm and by implication, the FMEnv limit of 0.1 ppm. Naturally, SO_2 is emitted from volcanic eruption, while 80% of all SO_2 emissions from anthropogenic sources come from coal combustion (UNEP 1983).

Nitrogen dioxide (NO_2)

Nitrogen dioxide is the precursor gas for troposphere ozone formation which is a greenhouse gas. It also leads to stratospheric ozone depletion (ozone hole) (Manahan 2017). The main anthropogenic source of NO_2 in the atmosphere is vehicular exhaust (Air Quality Fact Sheet 2005), and as expected therefore, NO_2 was not detected (concentration less than 0.01ppm the detection limit of the sampler) at any of the sites (Table 4.7). It is significant to state that NO_2 has always been found in low concentrations at the neighouring environment (Table 4.7).

Methane (CH_4)

Methane is classified as a volatile organic compound. As a result of its global warming potentials, it was given a special consideration in this fieldwork. CH_4 was not detected at any of sampling and control sites in this study (Table 4.7).

Carbon Monoxide (CO)

In the environmental parlance, CO is regarded as a "silent killer" because it is colourless, odourless, tasteless, but highly toxic (Ukpebor *et al.,* 2010). Long – term (chronic) exposure to low levels of CO may produce heart disease and damage to the nervous system (Henry *et al.,* 2006). In this study, CO was not detected which indicates healthy environment for this parameter.

Respirable ($PM_{2.5}$) and Inhalable (PM_{10}) Particulate Fractions

The most widespread and challenging of the criteria air pollutants in Nigeria is airborne particles (Akeredolu 1989; Ukpebor *et al*., 2006). The health impacts of airborne particles in humans, depend on the particle size, concentration and composition (WHO 2003). Particle sizes of health concern are the $PM_{2.5}$ and PM_{10}. During the study, baseline $PM_{2.5}$ concentration was found to vary from 8.5 to 72.5 µg/m^3 with an average of 36.31 µg/m^3, while PM_{10} concentration varied from 43.8 to 477.8 µg/m^3 with an average value of 227.17 µg/m^3 (Table 4.7). The control stations recorded values ranging from 11.1-19.6 µg/m^3 with mean of 15.08 µg/m^3 for $PM_{2.5}$ while PM_{10} concentrations ranged from 41.6 to 129.2 µg/m^3 with mean of 86.03 µg/m^3. The $PM_{2.5}$ and PM_{10} concentrations recorded at the stations were below the FMEnv 250 µg/m^3 regulatory limit. At excessive levels, the health and environmental impacts of elevated $PM_{2.5}$ and PM_{10} can be grave (WHO 2002; Okokon *et al*., 2018). They include inflammatory reactions in the lungs, respiratory symptoms and adverse effects on the cardiovascular system.

4.5.2.7 Noise levels

Noise at the study area emanates from both natural and anthropogenic sources. Quite remarkably, the baseline noise data captured in this study area were within the international and national noise regulatory limits. The noise level varied from 29.4 dB(A) to 78.4 dB(A) at the sampling stations with a mean noise value of 51.96 dB(A). The control stations recorded a range of 34.6 – 70.4 dB(A) with an average of 53.76 dB(A). A compliance with the FMEnv occupational noise limit of 90 dB(A) was observed in this study. Independently, noise increases risk of annoyance, cardiovascular disorders, cognitive impairments and is a suspected risk factor for other mental health conditions such as anxiety and depression (WHO 2011; Basner et al., 2013).

Table 4.7: Summary and Trend analysis of measured Air pollutants and noise levels during the Ubeta FDP EIA study

Parameter	EIA for The Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	UBETA FDP EIA (2021)		NUPRC Limit	FMEnv Limit
	Sampling stations	Sampling Stations	Control Stations		
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)		
VOC (mg/m3)	NA	BDL	BDL	NA	160
SO_2 (ppm)	<6.5	BDL	BDL	NA	0.04 – 0.06
NO_2 (ppm)	27.27± 1.04 (25.7-28.8)	BDL	BDL	0.04	0.1
CH_4 (%)	NA	BDL	BDL	NA	NA
CO_2 (%vol)	NA	0.13±0.09 (0.03-0.4)	0.12±0.09 (0.04-0.23)	NA	NA
CO (ppm)	1.25± 0.27 (1-1.5)	BDL	BDL	10	10 – 20
H_2S	1.5±0 (1.5-1.5)	BDL	BDL	NA	8
SPM	690.43±127.79 (566.7-815.9)	272.61±147.79 (13.4-581.4)	122.6±68.86 (46.9-191.3)	150 - 230	250 – 600
$PM_{2.5}$ (µg/m³)	NA	36.31±16.8(8.5-72.5)	15.08±3.62(11.1-19.6)	NA	250
PM_{10} (µg/m³)	NA	227.17± 124.71 (43.8-477.8)	86.3±42.07(41.6-129.2)	NA	250
Noise (dba)	NA	51.96± 9.31(29.4-78.4)	53.7613.25 (34.6-70.4)	85	90
THC (mg/m3)	110.13±4.69(103.6-115.7)	BDL	BDL	NA	NA
Pb (mg/m3)	NA	BDL	BDL	0.5 – 1.0	NA
Cu (mg/m3)	NA	BDL	BDL	NA	NA
Cr (mg/m3)	NA	BDL	BDL	NA	NA
Zn (mg/m3)	NA	BDL	BDL	NA	NA
Ni (mg/m3)	NA	BDL	BDL	NA	NA
Cd (mg/m3)	NA	BDL	BDL	NA	NA
Mn (mg/m3)	NA	BDL	BDL	NA	NA
Fe (mg/m3)	NA	0.01± 0.01(0.003-0.04)	0.01±0(0.01-0.016)	NA	NA

NA: Not Available; 0.01 = detection limit for the sampler for SO_2, NO_2, VOC, CH_4, CO; BDL = Below Detection Limit (Source DSL Field Survey,2021)

4.6 GROUNDWATER QUALITY

The chemistry of groundwater varies depending on the nature of the subsoils and rocks that it passes through (Daly, 1994). Hydrologically, groundwater originates as infiltration from precipitation, rainfall, stream flows, lakes and reservoirs. The water seeps horizontally and vertically downwards into the soil through porous strata by gravity, until it reaches an impervious stratum, upon which it collects, forming groundwater (Hammer and Kenneth, 1981; Manning, 1996).

Groundwater is of major importance to civilization, because it is the largest reserve of drinkable water in regions where humans can live. During dry periods, it can also sustain the flow of surface water and even where the latter is readily available, groundwater is often preferable because it tends to be less contaminated by wastes and organisms (Aller *et al.,* 1985). Groundwater is usually considered pure as it undergoes a filtering and cleaning process through the subsoil cover and rock medium that surface waters do not have. This, however, does not guarantee its purity. Problems can arise either due to the natural conditions in the ground or pollution by human activities.

The results of the physicochemical characteristics obtained from ground water stations and control stations are presented in **Table 4.8** while comparison with previous study is presented in **Table 4.9**. These consist of the minimum, maximum, mean, standard deviation, means of past results and Regulatory limits. The details of physicochemical and biological results as well as the statistical analysis of the data are presented in **Appendix 4.1**

4.6.1 pH

pH is one of the most important water-quality parameters, which describes the acidity or alkalinity status of the water. It determines the solubility and mobility of most dissolved constituents in water and provides good indication of the types of mineral elements that has dissolved in water as it flows from recharge to discharge areas (Aiyesanmi *et al.,* 2005). Extremes of pH can affect the palatability of water but the corrosive effect on distribution systems is more of a serious problem (EPA, 2001). Corrosion effects may become significant below pH 6.5, and the frequency of incrustation and scaling problems may be increased above pH 8.5.

The pH values at Ubeta ranged from 4.94 to 5.49 (Average=5.23) while the control stations reported a range of pH values of 5.2 to 5.72 (Average=5.45. There was no significant difference between the mean station values and the control station results (P>0.05). The average value was within the pH guideline value for domestic water supply (FEPA, 1991; WHO, 2008),

Table 4.8: Physico-Chemical Characteristics of Groundwater

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	STD	Range	Mean
Ph pH	4.94 - 5.94	5.23	0.19	5.20 – 5.72	5.45
Temperature (0C)	27.10 – 29.10	27.72	0.63	27.20 – 28.20	27.57
Turbidity(NTU)	1.00 – 150.00	19.43	43.74	1.30-9.50	4.67
Electrical Conductivity(µS/cm)	34.00 – 129.00	72.09	29.31	16.00 -150.00	71.67
Alkalinity(mg/L)	12.00 – 32.00	19.45	1.62	10.00 – 24.00	14.67
T. Hardness (mg/L)	10.90 – 21.80	16.86	3.91	14.50 – 21.80	16.93
COD(mg/L)	7.00 – 46.00	26.01	12.48	9.00-48.00	25.33
BOD(mg/L)	5.74 – 14.90	11.37	2.51	7.78 – 15.10	11.56
DO(mg/L)	2.00 – 4.20	3.38	0.62	2.08 – 4.90	3.29
Salinity(ppt)	0.01 – 0.05	0.03	0.01	0.01 – 0.07	0.03
TSS(mg/L)	1.00 – 51.00	6.55	14.76	2.00 – 5.00	3.00
TDS(mg/L)	17.00 – 65.00	36.55	14.84	8.00 – 75.00	36.00
Redox Potential (mV)	329.00 – 364.00	347.00	10.05	331.00 – 346.00	340.33
TOC(mg/L)	14.90 – 20.80	18.91	2.39	17.80 – 23.80	19.80
Odour	N/A	N/A	N/A	Unobjection	N/A
Colour(PtCo)	2.00 – 110.00	19.36	30.44	2.00 – 16.00	11.00
Sulphate (mg/L)	1.11 – 17.60	3.25	4.77	1.13 – 2.30	1.88
Phosphate(mg/L)	0.07 – 7.11	1.00	2.05	0.17 – 2.15	0.85
Nitrate(mg/L)	1.57 – 5.57	3.22	1.25	0.28 – 0.52	0.39
Ammonium(mg/L)	0.96 – 3.41	1.92	0.77	0.17 – 0.31	0.24
Carbonate (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
Chloride (mg/L)	1.00 – 3.00	1.73	0.79	0.05 – 5.5	2.33
Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001
Sodium	5.37 – 6.53	5.83	0.39	5.28 – 6.11	5.67
Potassium	2.63 – 3.20	2.92	0.20	2.77 – 3.10	2.90
Magnesium	3.64 – 4.54	4.07	0.27	3.83 – 4.25	3.99
Calcium	7.30 – 10.40	8.61	1.08	7.34 – 7.57	7.46
Oil and Grease	<0.10	<0.10		<0.10	<0.10
THC	<0.10	<0.10	<0.10	<0.10	<0.10
TPH	<0.01	<0.01	<0.01	<0.01	<0.01
PAH	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001

NA = Not Applicable; NG = No guidelines; FMEnv/FEPA 1991; WHO, 2008;
Source: Field Data gathering (2019 & 2020)

Table 4.9: Comparison of Groundwater Data in Current Study with Previous Study Around the Project Area

Parameter	EIA for The Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	Current Study		FMEnv Limit	WHO
	Sampling stations	Sampling stations	Control Stations		
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)		
Ph	5.82± 0.83 (4.86 – 6.39)	5.23 ± 0.19 (4.94 - 5.94)	5.45± 0.26 (5.2-5.72)	6.5 – 8.5	6.5 – 8.5
Temperature (0C)	NA	27.72 ± 0.63 (27.10 – 29.10)	27.57± 0.55 (27.2-28.2)	NG	NG
Turbidity(NTU)	0.5 ± 0.13 (0.4 – 0.65)	19.43 ± 43.74 (1.00 – 150.00)	4.67± 4.29 (1.3-9.5)	5	5
Electrical Conductivity(µS/cm)	60 ± 60.83 (20 - 130)	72.09 ± 29.31 (34.00 – 129.00)	71.67± 69.82 (16-150)	1000	NG
Alkalinity(mg/L)	NA	19.45 ± 1.62 (12.00 – 32.00)	14.67± 8.08 (10-24)	NG	NG
T. Hardness (mg/L)	NA	16.86 ± 3.91 (10.90 – 21.80)	16.93± 4.21 (14.5-21.8)	NG	NG
COD(mg/L)	NA	26.01 ± 12.48 (7.00 – 46.00)	25.33± 20.26 (9-48)	NG	NG
BOD(mg/L)	NA	11.37 ± 2.51 (5.74 – 14.90)	11.56± 3.67 (7.78-15.1)	NG	NG
DO(mg/L)	NA	3.38 ± 0.62 (2.00 – 4.20)	3.29± 1.45 (2.08-4.9)	NG	NG
Salinity(ppt)	NA	0.03 ± 0.01 (0.01 – 0.05)	0.03± 0.03 (0.01-0.07)	NG	NG
TSS(mg/L)	8.9 ± 0.3 (8.6 – 9.2)	6.55 ± 14.76 (1.00 – 51.00)	3 ± 1.73 (2-5)	<10	NG
TDS(mg/L)	NA	36.55 ± 14.84 (17.00 – 65.00)	36 ± 34.83 (8-75)	500	<600
Redox Potential (mV)	NA	347.00 ± 10.05 (329.00 – 364.00)	340.33± 8.14 (331-346)	NG	NG
TOC(mg/L)	NA	18.91 ± 2.39 (14.90 – 20.80)	19.8± 3.46 (17.8-23.8)	NG	NG
Odour	NA	N/A ± N/A (N/A)	N/A ± N/A (N/A)	NG	NG
Colour(PtCo)	NA	19.36 ± 30.44 (2.00 – 110.00)	11 ± 7.81 (2-16)	NG	NG
Sulphate (mg/L)	<1.0	3.25 ± 4.77 (1.11 – 17.60)	1.88± 0.65 (1.13-2.3)	500	500
Phosphate(mg/L)	0.01 ± 0 (0.007 – 0.008)	1.00 ± 2.05 (0.07 – 7.11)	0.85± 1.13 (0.171-2.15)	NG	NG
Nitrate(mg/L)	0.5 ± 0.13 (0.4 – 0.65)	3.22 ± 1.25 (1.57 – 5.57)	0.39 ± 0.12 (0.28-0.519)	50	50
Ammonium(mg/L)	NA	1.92 ± 0.77	<0.24 ± 0.07	NG	NG

Parameter	EIA for The Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	Current Study		FMEnv Limit	WHO
	Sampling stations	Sampling stations	Control Stations		
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)		
		(0.96 – 3.41)	(0.172-0.319)		
Carbonate (mg/L)	NA	<0.50 ± <0.50 (<0.50)	<0.50 ± <0.50 (<0.50)	NG	NG
Chloride (mg/L)	5 ± 3.46 (3 – 9)	1.73 ± 0.79 (1.00 – 3.00)	2.33 ± 2.75 (0.5-5.5)	NG	NG
Cyanide (mg/L)	NA	<0.001 ± <0.001 (<0.001)	<0.001 ± <0.001 (<0.001)	NG	NG
Sodium	2.06 ± 1.02 (0.882 – 2.669)	5.83 ± 0.39 (5.37 – 6.53)	5.67± 0.42 (5.28-6.11)	NG	200
Potassium	0.89 ± 0.22 (0.648 – 1.043)	2.92 ± 0.20 (2.63 – 3.20)	2.9 ± 0.18 (2.77-3.1)	NG	NG
Magnesium	<0.001	4.07 ± 0.27 (3.64 – 4.54)	3.99 ± 0.23 (3.83-4.25)	NG	NG
Calcium	<0.001	8.61 ± 1.08 (7.30 – 10.40)	7.65± 0.35 (7.34-0.03)	NG	NG
Lead	<0.001	<0.009 ± <0.009 (<0.009)	<0.009 ± <0.009 (<0.009)	0.05	0.01
Iron	0.18 ± 0.14 (0.013 – 0.267)	0.01 ± N/A (<0.002 – 0.01)	0.01 ± NA (<0.002-0.01)	1	0.3
Copper	0 ± 0 (0.001 – 0.002)	<0.004 ± <0.004 (<0.004)	<0.004 ± <0.004 (<0.004)	NG	NG
Mercury	<0.001	<0.001 ± <0.001 (<0.001)	<0.001 ± <0.001 (<0.001)	0.001	0.001
Arsenic	NA	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	NG	NG
Chromium	<0.001	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	0.05	0.05
Nickel	<0.001	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	500	<600
Cadmium	<0.001	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	0.01	0.003
Cobalt	NA	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	NG	NG
Zinc	0.01 ± 0.01 (0.001 – 0.016)	2.78 ± 0.46 (2.19 – 3.86)	2.54± 0.10 (2.44-2.63)	5	3
Barium	<0.001	<0.003 ± <0.003 (<0.003)	<0.003 ± <0.003 (<0.003)	1000	0.7
Manganese	<0.001	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)	NG	NG
Aluminum	<0.002	<0.002 ± <0.002 (<0.002)	<0.002 ± <0.002 (<0.002)		
Oil and Grease	<0.20	<0.10 ± NA	<0.10 ± NA	NG	NG

Parameter	EIA for The Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	Current Study		FMEnv Limit	WHO
	Sampling stations	Sampling stations	Control Stations		
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)		
		(<0.10)	(<0.10)		
THC	NA	<0.10 ± <0.10 (<0.10)	<0.10 ± NA (<0.10)	NG	NG
TPH	NA	<0.01 ± <0.01 (<0.01)	<0.01 ± <0.01 (<0.01)	NG	NG
PAH	NA	<0.001 ± <0.001 (<0.001)	<0.01 ± <0.01 (<0.01)	NG	NG
BTEX	NA	<0.001 ± <0.001 (<0.001)	<0.01 ± <0.01 (<0.01)	NG	NG

SD = Standard Deviation; NA = Not Applicable; NG = No Guideline

Source: Field Data gathering (2021)

These values obtained from the present study are within the acceptable regulatory range values of 6.50 – 8.50 for domestic water supply (FEPA, 1991; WHO, 2008). This observed acidic nature is indicative of the general aquifer characteristics of the area. Niger Delta Basin Aquifers are typically characterized by low pH values (Edet et al., 2011).

4.6.2 Temperature

Temperature values obtained from the ground water samples at Ubeta varied from 27.1 to 29.1 ^{0}C with an average of 27.72^{0}C. The value obtained from the control station ranged from 27.2 to 28.2^{0}C with average of 27.57^{0}C. There was no significant difference between the mean station values and the control station results ($p>0.05$).

The values obtained are within normal ground water temperatures reported for Niger Delta Basin aquifers (Edet *et al.,* 2011). There is no guideline value for temperature, however, cool water is generally preferred to warm water for drinking. Also, temperature impacts on the availability of a number of inorganic constituents and chemical contaminants that may affect taste, as well as biochemical interactions that may take place in water (Aiyesanmi, 2006).

4.6.3 Turbidity

The type and concentration of suspended matter controls the turbidity and transparency of ground water. Suspended matter consists of silt, clay, fine particles, of organic and inorganic origin, soluble organic compounds and other microscopic organisms. Such particles vary in size from approximately 10nm in diameter to 0.1 mm in diameter. Turbidity results from the scattering and absorption of incident light by the particles, and transparency is the limit of visibility in the water. Both can vary seasonally according to biological activity in the ground water column (Howard, 1985).

The turbidity values of the ground water collected from Ubeta ranged from 1 to 150 NTU with average of 19.43 NTU. The result from the control station ranged from 1.3 to 9.5 NTU, with an average value of 4.67 NTU. However, the elevated turbidity value (150NTU) recorded in UBEGW17 (monitoring borehole) was as a result of the particles stirred up during the purging of the well which could not settle before the limited time allotted for sampling. However, there was no significant difference between the mean station values and the control station results ($P>0.05$).

The average values were greater than the 5.00 NTU guideline value for domestic water supply (FEPA, 1991; WHO, 2008).

4.6.4 Conductivity and Dissolved Solids

Conductivity is the ability of a solution to allow the electrical current flow through it. The conductivity of a solution is dependent on the number and type of ions in that solution. The conductivity in water is proportional to the concentration of dissolved solids, mostly inorganic salts. The higher the salinity of water the higher the conductivity value (Kiely, 1998).

Conductivity values in the ground water samples at Ubeta ranged from 34 to 129 µS/cm with an average of 72.09 µS/cm. The control stations had a conductivity value ranged of 16 to 150 µS/cm with an average of 71.67 µS/cm. Because conductivity does not directly indicate water quality, there are no health or water-use standard based on this parameter by World Health Organization (WHO). However, classification of potability based on electrical conductivity ascribes <325 µScm-1 for fresh and potable water, indicating that the groundwater is fresh. These very low conductivity levels also correspond to freshwater conditions are typical of groundwaters from the Niger Delta Basin aquifers (Edet et al., 2011).

Total Dissolved Solid (TDS) of water is the difference between the total solid (TS) and the suspended solid (SS) in the water. The values of total dissolved solids in the ground water ranged from. 17.00mg/l to 65.00mg/l at the sampling stations and ranged from 8.00 mg/l to 75.00 mg/l at the control stations.

Although, no health-based guideline value for TDS has been proposed, but an aesthetic objective of less than 600 mg/L has been established for drinking water (FEPA, 1991; WHO, 2008). All values are indicative of fresh water (<1000 mg/l) which are typical of Niger Delta Basin Aquifers (Edet et al., 2011).

4.6.5 Total Suspended Solids (TSS)

The values of total suspended solids in the ground water at Ubeta ranged from 1 to 51 mg/l with an average value of 6.55mg/l. The control ranged from 2 to 5 mg/l with average value of 3mgl/l. There was no significant difference between the mean station values and the control station results (P>0.05).

There is no health or cosmetic standard for suspended solids in water. However, suspended matter can contain toxins such as heavy metals and can harbour microorganisms, protecting them from disinfection (WHO, 2008).

4.6.6 Biochemical Oxygen Demand (BOD)

The Biochemical Oxygen Demand level after 5 days (BOD5), which is the level of oxygen consumed by biodegradable matters in the groundwater at Ubeta ranged from 5.74 to 14.9 mg/l with an average value of 11.37mg/l. while the control values ranged from 7.78 to 15.1 mg/l (average 11.56mg/l). However, there was no significant difference between the mean station values and the control station results (P>0.05). WHO standards of 1993 (Usharani et al., 2010) prescribed a limit of 10 mg/l for BOD in drinking water.

4.6.7 Chemical Oxygen Demand (COD)

The Chemical Oxygen Demand level in the ground water at Ubeta recorded 7 to 46 mg/l with an average of 26.9 mg/l in the sampled. The control ranged from 9 to 48 mg/l with average of 25.33 mg/l. (Fig 4.23). There was no significant difference between the mean station values and the control station values (P>0.05).

4.6.8 Hydrocarbons

The oil and grease concentrations in the ground water samples and at Ubeta were below equipment detection limit of <0.10mg/kg. The control recorded values below equipment detection limit of <0.10mg/kg. The THC concentration of the groundwater below equipment detectable limit of <0.10mg/kg. The control recorded values below equipment detection limit of <0.10mg/kg. The TPH, PAH and BTEX (Benzene, Toluene, Xylene and Ethylbenzene) were below equipment detection limit of <0.01mg/kg, <0.001mg/kg and <0.001mg/kg respectively. Control station recorded values below equipment detection limit of <0.01mg/kg <0.001mg/kg and <0.001mg/kg respectively. The undetectable values of TPH, PAH and BTEX is indicative of absence of petrogenic hydrocarbons in the total hydrocarbon component observed in groundwater.

4.6.9 Nutrients

Nutrients include the ionic forms (NO_3, SO_4^2, and PO_4^{3-}) and utilization forms of Nitrogen, Sulphur and Phosphorus respectively. Nitrate (NO_3-) is one of the most common identified groundwater contaminants. It is highly mobile and under wet conditions is easily leached out of the rooting zone, through soil and permeable subsoil. NO_3 is a good indication of contamination by fertilizer and waste organic matter. The consumption of nitrate rich water by children may give rise to a condition known as methemoglobinemia, also called bluebaby syndrome (Parvizishad, M, 2017, *et al*). Sulphate (SO_4^2) is also a good indicator of contamination by fertilizer and waste organic matter.

The sulphate concentration in the groundwater samples from Ubeta ranged from 1.11 to 17.6mg/l with an average of 3.25mg/l with control value ranged from 1.13 to 2.3mg/l with average of 1.88mg/l. There was no significant difference between the mean station values and the control station results (P>0.05).

The nitrate concentration in the groundwater samples water ranged from 1.57 to 5.57mg/l with an average of 3.22mg/l, with control value ranged of 0.28 to 0.519mg/l with average of 0.39mg/l.

The average values of nitrate and sulphate were also found to be below their respective guideline values of 50 mg/l and 250 mg/l respectively for domestic water supply (FEPA, 1991; WHO, 2008).

Phosphate (PO_4^{3-}) concentrations in water ranged from 1.00 mg/L in natural water to 300 mg/L in polluted water (DWAF, 1996). The phosphate concentration in the groundwater samples of the study area ranged from 0.066 to 7.11 mg/l with an average value of 1mg/l, while the control values ranged of 0.171 to 2.15mg/l with average of 0.85mg/l. There was no significant difference between the mean station values and the control station results (P>0.05).

4.6.10 Total Hardness

Hard water is water that has high mineral content, mainly of calcium and magnesium ions (Ca^{2+}, Mg^{2+}) and possibly other dissolved metals, bicarbonates and sulphates. Hard water is beneficial to health; it helps to build strong bones and teeth. In addition, it gives a pleasant taste. Conversely, very high levels can be a nuisance, resulting in soap wastage as it does not lather easily and causes scale formation in Kettles, pipes and boilers.

The magnesium concentration in the groundwater samples from Ubeta ranged from 3.64 to 4.54mg/l with average of 4.07mg/l, the control had value range of 3.83 to 4.25mg/l with average of 3.99mg/l. There was no significant difference between the mean station values and the control station values (P>0.05).

The calcium concentration in the ground water samples water ranged from 7.3 to 10.4mg/l with average of 8.61mg/l, control value ranged from 7.34 to 7.57mg/l with average of 7.46mg/l. There was no significant difference between the mean station values and the control station results (P>0.05). All values are typical of ground water samples from the Niger Delta Basin Aquifer which are generally reported to be soft (Edet et al., 2011).

4.6.11 Heavy Metal in Groundwater

Heavy metal refers to elements of atomic number 21 or higher, or metals with specific gravity greater than 5.0. Concerns about heavy metals in groundwater bother on toxicity, bioaccumulation and hazards to human health (GEMS 1992). Most of these elements including zinc, iron, copper and cobalt, at low concentrations are necessary for metabolic function for a large class of organisms. However, at high concentrations, all heavy metals are toxic. The heavy metals profile of groundwater around the study area is shown in Table 4.10 while the comparison with the previous study is shown in Table 4.11.

Iron

Iron concentration in the ground water samples at Ubeta ranged from 0.008 to 0.013mg/l with average of 0.01mg/l, while control ranged from 0.01 to 0.01mg/l with average of 0.01mg/l. The obtained values indicate iron concentration that are lower than the NUPRC values of 0.3 mg/l. There was no significant difference between the mean station values and the control station values (P>0.05).

Chromium and Cadmium

Chromium and Cadmium concentrations in the ground water samples at Ubeta were below the equipment detectable limit of 0.002 mg/l and 0.002 mg/l respectively in the sampling stations and control stations.

Vanadium and Mercury

Vanadium and Mercury concentrations in the ground water samples were below the equipment detection limit of <0.002 mg/l and 0.001 mg/l respectively in the stations and control staions.

Nickel and Lead

Nickel and Lead concentration in the ground water samples were below the equipment detection limit of <0.001 mg/l and <0.009 mg/l respectively in the sampling stations and control stations.

Zinc

The zinc concentration in ground water samples ranged from 2.19 to 3.86mg/l with average of 2.78mg/l, while the control value ranged from 2.44 to 2.63mg/l with average of 2.54mg/l. There was no significant difference between the mean station values and the control station values (p>0.05). The obtained values are below the WHO limit of 5.0 mg/l.

Table 4.10: Heavy Metal Levels of Groundwater

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	STD	Range	Mean
Lead	<0.009	<0.009	<0.009	<0.009	<0.009
Iron	<0.002 – 0.01	0.01	N/A	0.05 – 5.5	2.33
Copper	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.002	<0.002	<0.002	<0.002	<0.002
Nickel	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc	2.19 – 3.86	2.78	0.46	2.44 – 2.63	2.54
Barium	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese	<0.002	<0.002	<0.002	<0.002	<0.002
Oil and Grease	<0.10	<0.10		<0.10	<0.10
THC	<0.10	<0.10	<0.10	<0.10	<0.10
TPH	<0.01	<0.01	<0.01	<0.01	<0.01
PAH	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001

NA = Not Applicable; NG = No guidelines; FMEnv/FEPA 1991; WHO, 2008; NUPRC = EGASPIN 2018
Source: Field Data gathering (2021)

Table 4.11: Groundwater Heavy Metal Levels Trend

Parameter	EIA of the Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	Current Study		FMEnv Limit *FMEnv/FEPA 1991*	WHO *, 2008;*
	Sampling stations	Sampling stations	Control Stations		
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)		
Lead	<0.001	<0.009	<0.004	0.05	0.01
Iron	0.18 ± 0.14 (0.013 – 0.267)	0.01 ± N/A (<0.002 – 0.01)	<0.001	1	0.3
Copper	0 ± 0 (0.001 – 0.002)	<0.004	<0.002	NG	NG
Mercury	<0.001	<0.001	<0.002	0.001	0.001
Arsenic	NA	<0.002	<0.002	NG	NG
Chromium	<0.001	<0.002	<0.002	0.05	0.05
Nickel	<0.001	<0.002	<0.002	500	<600
Cadmium	<0.001	<0.002	2.54 ± 0.10 (2.44 – 2.63)	0.01	0.003
Cobalt	NA	<0.002	<0.003	NG	NG
Zinc	0.01 ± 0.01 (0.001 – 0.016)	2.78 ± 0.46 (2.19 – 3.86)	<0.002	5	3
Barium	<0.001	<0.003	<0.10	1000	0.7
Manganese	<0.001	<0.002	<0.10	NG	NG
Oil and Grease	<0.20	<0.10	<0.01	NG	NG
THC	NA	<0.10	<0.001	NG	NG
TPH	NA	<0.01	<0.001	NG	NG
PAH	NA	<0.001 (<0.001)	5.67 ± 0.42 (5.28 – 6.11)	NG	NG
BTEX	NA	<0.001	2.90 ± 0.1 (2.77 – 3.10)	NG	NG

NG = No Guideline *NA: Not Applicable*

Source: Field Data gathering (2021)

4.6.12 Microbial Population in Ground Water Ubeta

The microbial populations in ground water from the study area are shown in **Table 4.12**. Total Heterotrophic bacteria (THB) in groundwater ranged from <1 to 38.50x10^3cfu/ml (average 9.45x10^3cfu/ml) while the control stations had an average value of 2.50x10^3cfu/ml. Hydrocarbon Utilizing Bacteria population in groundwater ranged from <1 to 21.50x10^2cfu/ml (average 5.05x10^2cfu/ml) while the control stations had an average value of 1.30x10^2cfu/ml. The results of Total Heterotrophic Fungi (THF) had values ranging from <1 to 2.50x10^2cfu/ml (mean 2.50x10^2cfu/ml) with the control station having an average value of 1.50x10^2cfu/ml. Hydrocarbon Utilizing Fungi population ranged from <1 to 1.50x10^2cfu/ml (mean 1.50x10^2cfu/ml) with the control station having a mean value of 0.50x10^2cfu/ml. The results of the Faecal Coliform and Sulphur Reducing Bacteria (SRB) were <2.00MPN/100ml and <1cfu/ml respectively showing no growth.

Faecal coliform should be 0MPN/100ml in water intended to be used for domestic purposes. However, hydrocarbon utilizing bacteria occur in nature. Low counts of total heterotrophic fungi indicated low survival of fungi in the ground water.

Table 4.12: Microbial Population in Ground Water

SAMPLE ID	Parameters					
	THBX10^3 (cfu/ml)	HUBX10^2 (cfu/ml)	THFX10^2 (cfu/ml)	HUFX10^2 (cfu/ml)	F.COLIFORM MPN/100ml	SRB (SR/ml)
UBE GW 1	1	0.5	<1	<1	<2	<1
UBE GW 2	2.5	1	<1	<1	<2	<1
UBE GW 3	2	1	<1	<1	<2	<1
UBE GW 4	2.5	1	<1	<1	<2	<1
UBE GW 5	38.5	21.5	<1	<1	<2	<1
UBE GW 6	32	17.5	2.5	1.5	<2	<1
UBE GW 7	7.5	3	<1	<1	<2	<1
UBE GW 8	2.5	1.5	<1	<1	<2	<1
UBE GW 14	4.5	3	<1	<1	<2	<1
UBE GW 16	1.5	0.5	<1	<1	<2	<1
UBE GW 17	<1	<1	<1	<1	<2	<1
UBE CTRL 1	<1	<1	<1	<1	<2	<1
UBE CTL 2	1.5	0.5	1.5	0.5	<2	<1
UBE CTL 3	3.5	2	<1	<3.33	<2	<1

Source: Field Data gathering (2021)

4.7 SURFACE WATER PHYSICO-CHEMISTRY

Surface water and sediments samples were collected from three (3) stations and three control stations during the sampling campaign. The samples were taken from seasonal swamps/ponds and existing burrow pits/impoundments within the Study area. The details of the physico-chemical and biological characteristics of surface water samples are shown in **Table 4.13.** The details of physicochemical and biological results are presented in **Appendix 4.1.**

4.7.1 pH

The pH is an important variable in water quality assessment as it influences many biological and chemical processes within the surface water. It is controlled by the dissolved chemical compounds and biochemical processes in the waterbody. Daily variations in pH can be caused by photosynthesis and respiratory cycles of algae in eutrophic waters (Keily, 1998).

The pH values of the surface water at Ubeta ranged from 4.75 to 6.05 with an average concentration of 5.2 while the pH values of the control stations ranged from 5.92 to 6.3 with an average concentration of 6.05. There was no significant difference between the mean station values and the control station values (P>0.05).

According to Chapman (1996) the pH of most natural waters is between 6.0 and 8.5, although lower values can occur in dilute waters high in organic content, and higher values in eutrophic waters. Most waters from forested ecosystems in Nigeria show low pH values due to input of humic acids from decaying organic matter (Akpan, et al., 2002, Ajayi and Osibanjo, 1981). NUPRC/NNPC (1985) reported a range of 3.1 to 8.6 for the Niger Delta and associated waters of southern Nigeria. Present values are within the NUPRC/NNPC (1985) values and are therefore normal for the study area.

4.7.2 Temperature

The average temperature values obtained from the surface water samples from Ubeta FDP EIA ranged from 30.2 to 30.30C with an average of 30.230C, while the temperature values of the control obtained from the surface water 27.9 to 30.7 0^{C} with average of 30.200^{C}. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

Table 4.13: Summary of Surface Water quality

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	STD	Range	Mean
Ph pH	4.75 – 6.05	5.22	0.72	5.92 – 6.30	6.09
Temperature (oC)	24.40 – 33.80	29.43	4.74	27.90 – 30.7	29.53
Turbidity (NTU)	5.50 – 18.00	11.50	6.24	5.00 – 34.00	23.33
Electrical conductivity (µS/cm)	25.00 – 36.00	29.00	6.08	18.00 – 86.00	42.00
Alkalinity (mg/L)	18.00 – 22.00	20.67	2.31	12.00 – 20.00	16.00
T. Hardness (mg/L)	14.50 – 18.20	16.37	1.85	12.70 – 16.40	14.53
COD (mg/L)	4.00 – 51.00	30.00	23.90	4.56 – 15.20	25.00
BOD (mg/L)	3.68 – 15.50	9.79	5.92	4.56 – 15.20	10.59
DO (mg/L)	3.10 – 5.30	3.93	1.19	4.10 – 5.20	4.67
Salinity (ppt)	0.01 – 0.02	0.01	0.01	0.01 – 0.04	0.02
TSS (mg/L)	2.00 – 21.00	8.33	10.97	2.00 – 5.00	3.67
TDS (mg/L)	13.00 – 19.00	15.00	3.50	9.00 – 43.00	21.00
Redox Potential	348.00 – 361	353.33	6.81	321.00 – 353.00	336.67
TOC	17.80 – 29.70	23.77	5.95	14.90 – 23.80	19.83
Odour	Unobjectionabl e	-	-	-	-
Colour (PtCo)	23.00 – 58.00	34.67	20.21	24.00 – 61.00	37.33
Sulphate (mg/L)	1.30 – 5.11	3.30	1.91	3.90 – 15.60	8.00
Phosphate (mg/L)	0.39 – 4.04	1.61	2.11	0.92 – 2.15	1.54
Nitrate (mg/L)	0.40 – 0.65	0.51	0.13	0.07 – 0.35	0.23
Ammonium (mg/L)	0.24 – 0.40	0.31	0.08	0.04 – 0.21	0.14
Carbonate (mg/L)	<0.50	<0.50	-	<0.50	<0.50
Cloride (mg/L)	0.50 – 4.50	2.00	2.18	0.50 – 1.50	0.83
Sodium (mg/L)	5.23 – 6.38	5.67	0.62	5.14 – 5.31	5.22
Potassium (mg/L)	1.21 – 1.75	1.40	0.30	1.10 – 1.23	1.16
Magnesium (mg/L)	3.76 – 3.91	3.82	0.08	3.54 – 3.77	3.62
Calcium (mg/L)	15.70 – 20.40	17.40	2.61	15.6 – 19.60	17.20
Lead (mg/L)	<0.009	<0.009	-	<0.009	<0.009
Iron (mg/L)	0.02 – 0.07	0.05	0.03	0.01 – 0.05	0.04
Copper (mg/L)	<0.004 – 0.03	0.02	-	<0.004 – 0.02	0.01
Mercury (mg/L)	<0.001	<0.001	-	<0.001	<0.001
Arsenic (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Chromium (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Nickel (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Cadmium (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Cobalt (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Zinc (mg/L)	0.04 – 0.06	0.04	0.01	0.01 – 0.05	0.04
Barium (mg/L)	<0.03	<0.03	-	<0.03	<0.03
Manganese (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Aluminium (mg/L)	<0.002	<0.002	-	<0.002	<0.002
Oil and Grease	17.80 – 29.70	23.77	6.00	14.90 – 23.80	19.83

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	STD	Range	Mean
THC	<0.10	<0.10	-	<0.10	<0.10
TPH	<0.01	<0.01	-	<0.01	<0.01
PAH	<0.001	<0.001	-	<0.001	<0.001
BTEX	<0.001	<0.001	-	<0.001	<0.001

Source: Field Data gathering (2021))

4.7.3 Turbidity

The type and concentration of suspended matter controls the turbidity and transparency of water. Turbidity results from the scattering and absorption of incident light by the particles, and transparency is the limit of visibility in the water. Both can vary seasonally according to biological activity in the water column and surface runoff carrying soil particles. Turbidity is usually higher during the wet season than dry season (Howard, 1985).

The turbidity values of the surface water ranged from 5.5 to 18 NTU, with an average value of 11.5 NTU while the control values of the surface water ranged from 5 to 34 NTU, with average value of 23.33 NTU. The mean station values and the control station values did not significantly differ from one another ($P>0.05$).

The values are considered normal for surface waters. Chapman (1996) reports that normal values of turbidity can range from 1 to 1,000 NTU and levels can be increased by the presence of organic matter pollution, other effluents, or run-off with a high suspended matter content.

4.7.4 Conductivity

Conductivity values in the surface water samples ranged from 25 to 36 µS/cm with an average of 29 µS/cm while the control values from ranged from 18 to 86 µS/cm with average of 42 µS/cm. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

These results are within the known freshwater conductivity threshold of between 5 µS/cm to 1500 µS/cm which is indicative of the normal aquatic habitat. Chapman (1996) indicates that the conductivity of most freshwaters ranges from 10 to 1,000 µS/cm but may exceed 1,000 µS/cm, especially in polluted waters, or those receiving large quantities of land run-off.

4.7.5 Total Dissolved Solids (TDS)

The average TDS value of the surface water samples ranged from 13 to 19 mg/l with average value of 15mg/1. The total dissolved solids values in the surface water in the control ranged from 9 to 43 mg/1 with average of 21mg/1. The mean station values and the control station values did not significantly differ from one another ($P>0.05$). Total Dissolved Solids (TDS) is a measure of the amount of dissolved material in the water column. TDS is directly related to water hardness and waters with TDS levels <70 mg/l correspond to very soft water (Xylem Inc, 2011). The measured TDS values are normal for soft waters.

4.7.6 Total Suspended Solids (TSS)
The TSS values of surface water ranged from 2 to 21 mg/1 with average of 8.33mg/1 the control ranged from 2mg/l to 5mg/l with average value of 3.67mg/l. The variation between the mean of the sample stations and that of the control stations showed no significant difference

The levels are normal for Niger Delta area. NUPRC/NNPC (1985) reported a range of 1.2 to 397 mg/l for TSS in waters of southern Nigeria. According to USEPA (1973) TSS values up to 80 mg/l has no significant negative impacts on fisheries resources.

4.7.7 Biochemical Oxygen Demand (BOD)
The Biochemical Oxygen Demand level in the surface water ranged from 3.68 to 15.5 mg/l with average value of 9.79mg/l with a control value ranged from 4.56 to 15.2 mg/l (average 10.59mg/l). There was no significant difference between the mean station values and the control station values (P>0.05.

According to Raveendran, B. & Gokulnath, D. (2023). When BOD is low, the dissolved oxygen present in the water body is high. This indicates that the water is less polluted by organic matter. High BOD levels are caused by high consumption of dissolved oxygen by microorganisms. It indicates that the water is highly polluted with organic matter

4.7.8 Chemical Oxygen Demand (COD)
The Chemical Oxygen level in the surface water ranged from 4 to 51 mg/l with an average of 30mg/l. The COD had control value ranged from 5 to 45mg/l with average of 25 mg/l. The mean station values and the control station values did not significantly differ from one another (P>0.05).

4.7.9 Oil and Grease and Total Hydrocarbon Content (THC)
The oil and grease concentration in the surface water samples ranged from 17.8-29.7mg/l with mean of 23.7mg/kg with a control value ranged from 14.9-23.8mg/kg with mean of 19.83mg/l. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

The total hydrocarbon content concentration in the surface water were below the detectable limit of <0.10mg/l in the station.

4.7.10 Total Petroleum Hydrocarbon (TPH), PAHs and BTEX
The TPH, PAHs and BTEX (Benzene, Toluene, Xylene and Ethylbenzene) parameter measured in the surface water samples at Ubeta were below detectable limit in the sample stations and control stations.

4.7.11 Macro Nutrients

Sulphate, Phosphate, Nitrate and Nitrite

The sulphate concentration in the surface water ranged from 1.3 to 5.11mg/l with average of 3.3mg/l while the control station values ranged from 3.9 to 15.6mg/l with average of 8mg/l. There was no significant difference between the mean of the sample station values and the control station values ($P>0.05$).

The levels are normal for unpolluted waters. Sulphate concentrations in natural freshwaters are usually between 2 and 80 mg/l, although they may exceed 1,000 mg/l near industrial discharges (Chapman, 1996).

The phosphate concentration in the surface water samples water ranged from 0.388 to 4.04 mg/l with an average value of 1.61mg/l, while control values ranged from 0.92 to 2.15mg/l with average of 1.54mg/l. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

The nitrate concentration in the surface water samples water ranged from 0.395 to 0.645mg/l with an average of 0.51mg/l, while control value ranged of 0.069 to 0.35mg/l with average of 0.23mg/l. There was no significant difference between the mean station values and the control station values ($P>0.05$).

4.7.12 Total Hardness

Hard water is water that has high mineral content, mainly of calcium and magnesium ions (Ca^{2+}, Mg^{2+}) and possibly other dissolved metals, bicarbonates and sulphates. Hard water is beneficial to health; it helps to build strong bones and teeth. In addition, it gives a pleasant taste. Conversely, very high levels can be a nuisance, resulting in soap wastage as it does not lather easily and causes scale formation in Kettles, pipes and boilers.

The calcium concentration in the surface water samples ranged from 15.7 to 20.4mg/l with average of 17.4mg/l, control value ranged from 15.6 to 19.6mg/l with average of 17.2mg/l. The potassium concentration in the surface water samples ranged from 1.21 to 1.75mg/l with average of 1.4mg/l, control value for potassium ranged from 1.1 to 1.23mg/l with average of 1.16mg/l. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

The magnesium concentration in the surface water samples ranged from 3.76 to 3.91mg/l with average of 3.82mg/l, the control had value ranged of 3.54 to 3.77mg/l with average of 3.62mg/l. There was no significant difference between the mean station values and the control station values ($P>0.05$).

4.7.13 Heavy Metals

Iron

Iron concentration in the surface water samples ranged from 0.015 to 0.072mg/l with average of 0.05mg/l, while control station ranged from 0.012 to 0.052mg/l with average of 0.04mg/l. The mean station values and the control station values did not significantly differ from one another ($P>0.05$).

Chromium and Cadmium

Chromium and Cadmium were below the equipment detectable limit of <0.002 mg/l and <0.002 mg/l in the station including control station respectively.

Vanadium Mercury and Nickel

Vanadium Mercury and Nickel concentrations in the surface water samples were below the equipment detection limit of <0.002mg/l, 0.001mg/l and <0.002mg/l respectively in the sample stations.

Copper

Copper concentration in the surface water samples ranged from 0.011 to 0.03mg/l with average of 0.02mg/l, while the control value ranged from 0.009 to 0.017 mg/l with average of 0.01mg/l. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

Lead

Lead concentration in all the surface water samples were below the equipment detection limit of <0.009mg/l in the station

Zinc

The zinc concentrations of surface water samples ranged from 0.035 to 0.056mg/l with an average of 0.04mg/l, while the control value ranged from 0.011 to 0.053mg/l with average of 0.04mg/l The mean station values and the control station values did not significantly differ from one another ($P>0.05$).

4.7.14 Microbial Population in Surface water

The microbial populations in surface water from the study area are shown in **Table 4.14**. The Total Heterotrophic bacteria (THB) in surface water ranged from $0.10x10^4$cfu/ml to $2.25x10^4$cfu/ml (average $1.20x10^4$cfu/ml) while the control stations had average value of $3.45x10^4$cfu/ml.

Hydrocarbon Utilizing Bacteria population in surface water ranged from $4.50x10^2$cfu/ml to $12.50x10^2$cfu/ml (average $7.33x10^2$cfu/ml) while the control stations had average value of $2.33x10^2$cfu/ml.

The results of Total Heterotrophic Fungi (THF) had values ranging from <1 to 5.00×10^2cfu/ml (mean 5.00×10^2cfu/ml) with the control station having an average value of 5.00×10^2cfu/ml. The results of Hydrocarbon Utilizing Fungi (HUF) population and Sulphur Reducing Bacteria (SRB) showed no growth at <1cfu/ml and <1 SR/ml. Feacal Coliform also showed no growth at <2.00MPN/100ml in all the stations.

Table 4.14: Microbial Population in Surface Water

Station ID	**Parameters**					
	THBX10^4 (cfu/ml)	**HUBX10^2 (cfu/ml)**	**THFX10^2 (cfu/ml)**	**HUF (cfu/ml)**	**FECAL COLI MPN/100ml**	**SRB SR/ml**
UBE SW 13	2.25	12.5	5	<1	<2	<1
UBE SW 14	1.25	4.5	<1	<1	<2	<1
UBE SW 65	0.1	5	<1	<1	<2	<1
UBE CTRL 1	3.2	2	<1	<1	<2	<1
UBE CTRL 2	3.7	2.65	5	<1	<2	<1
UBE CTRL 3	<1	<3.33	<1	<1	<2	<1

Source: Field Data gathering (2021)

4.8 SEDIMENT PHYSICO-CHEMISTRY

The summary of the physico-chemical characteristics of sediment samples collected from Imo River tributary at Owaza in the wet season are presented in **Table 4.15.** The details of physicochemical and biological results are presented in **Appendix 4.1**

4.8.1 pH

The pH of sediment samples collected ranged from 4.75 to 6.05 with an average concentration of 4.8 while the pH values of the control ranged from 4.63 to 4.72 with average concentration of 4.68. There was a significant difference between the mean station values and the control station values (P<0.05). Acidic sediments are commonly reported in the Niger Delta (Ansa and Francis, 2007).

4.8.2 Temperature

The temperature values obtained from the sediment samples were between 24.4 to 33.8 0C with average of 29.430C, while the temperature values of the control obtained from the surface water 27.9 to 30.7 0C with average of 29.530C.

4.8.3 Redox Potential (mV)

The redox potential of sediment samples ranged from 235 to 314mV with an average value of 264.67mV while the control stations values ranged from 206 to 276mV (average 233.33mV). Submerged sediments display a range of redox potentials from +700 mV, which indicates highly oxidized sediment, to -300 mV, which indicates highly reduced sediment (DeLaune *et al*., 1976). The present results indicate highly reduced sediments.

4.8.4 Particle size and Texture class

Particle size analysis of the sediment showed a constitution of sand fractions which ranged from 82 to 89.5% with average of 86.57%, with control values of 38.3 to 41.5% with average of 39.63%. silt, 9 to 16.6% with average 11.73%, with control values of 52.2 to 56.8% with average of 53.93% and clay 1.4 to 2.2% with average of 1.7%, with control values of 4.63 to 4.72%, with average values of 6.48%.

4.8.5 Total Organic Content

The Total Organic Content (TOC) concentration in the sediment samples ranged from 0.118 to 1.34% with average of 0.75%. The control station had 0.826 to 1.26% with mean of 0.98%.

Table 4.15: Summary of Sediment Quality

Parameter	PROJECT AREA			CONTROL		NUPRC Limit
	Range	Mean	STD	Range	Mean	
Colour	Light Brown – Dark Brown			Light Brown – Yellowish Brown		
Sand (%)	82.00 – 89.50	86.57	4.01	38.30 – 41.50	39.63	
Silt (%)	9.00 – 16.6	11.73	4.23	52.20 – 56.8	53.93	NG
Clay (%)	1.40 – 2.20	1.70	0.44	1.70 – 8.90	6.43	NG
Ph	4.41 – 5.26	4.80	0.43	4.63 – 4.72	4.68	NG
Temperature (oC)	30.20 – 30.3	30.23	0.06	29.70 – 30.70	30.2	NG
Redox Potential (mV)	235.00 – 314.00	264.67	43.01	206 - 276	233.33	NG
TOC (%)	0.12 – 1.34	0.75.00	0.61	0.83 – 1.26	0.98	NG
Carbonate (mg/Kg)	<0.50	<0.50	-	<0.50	<0.50	NG
Sulphate(mg/kg)	31.30 – 54.70	41.87	11.86	39.70 – 70.80	52.10	NG
Phosphate(mg/kg)	5.95 – 9.57	7.32	1.96	6.28 – 26.80	14.03	NG
Nitrate (mg/kg)	0.46 – 0.96	0.65	0.27	0.09 – 0.45	0.25	NG
Chloride (mg/kg)	140.00 – 150.00	146.67	5.77	140.00 – 145.00	143.33	NG
Sodium (mg/kg)	38.20 – 47.00	43.83	4.89	39.00 – 43.10	41.47	NG
Potassium (mg/kg)	11.80 – 17.90	15.70	3.39	17.10 – 17.40	17.25	NG
Magnesium (mg/kg)	29.80 – 33.40	31.77	1.82	29.50 – 30.70	30.23	NG
Calcium (mg/kg)	78.50 – 88.90	84.37	5.33	76.80 – 86.10	82.37	NG
Cadmium (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	0.8
Zinc (mg/kg)	0.59 – 0.85	0.68	0.13	0.59 – 0.84	0.70	140
Iron (mg/kg)	0.67 – 0.88	0.79	0.11	0.67 – 0.87	0.79	NG
Cobalt (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	NG
Copper (mg/kg)	0.47 – 0.61	0.54	0.07	0.47 – 0.61	0.54	36
Chromium (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	100
Vanadium (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	NG
Nickel (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	35
Lead (mg/kg)	<0.009	<0.009	-	<0.009	<0.009	85
Manganese (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	NG
Barium (mg/kg)	<0.03	<0.03	-	<0.03	<0.03	200
Arsenic (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	29
Mercury (mg/kg)	<0.001	<0.001	-	<0.001	<0.001	0.3
Silver (mg/kg)	<0.002	<0.002	-	<0.002	<0.002	NG
Oil and Grease (mg/kg)	30.30 – 45.50	37.90	7.60	53.00 -75.80	63.13	NG
THC (mg/kg)	<0.10	<0.10	-	<0.10	<0.10	50
TPH (mg/kg)	<0.10	<0.10	-	<0.10	<0.10	NG
PAH (mg/kg)	<0.01	<0.01	-	<0.01	<0.01	1
MAH (mg/kg)	<0.001	<0.001	-	<0.001	<0.001	NG
BTEX (mg/kg)	<0.001	<0.001	-	<0.001	<0.001	NG

SD – Standard Deviation; NG – No Guideline (Source DSL Field Survey,2021)

4.8.6 Petroleum Hydrocarbons

The oil and grease concentration of sediments samples ranged from 30.3 to 45.5mg/kg with average of 37.9mg/kg with a control value ranged from 53 to 75.8mg/kg with average of 63.13mg/kg. The THC and TPH concentrations of sediment sampled were below the detectable limit of <0.10mg/kg and <0.01mg/kg in all the stations.

Similarly, PAHs and BTEX concentration of sediments sampled were below equipment detection limit of <0.001mg/kg and <0.001mg/kg respectively.

In general, the values for all the stations for oil and grease, were lower than the NUPRC target value of 50 mg/kg.

4.8.7 Micro Nutrients

Phosphates and Nitrates

The Phosphate concentration of sediment samples collected had a range of 5.95 to 9.57mg/kg with an average value of 7.32mg/kg, while control values ranged of 0.92 to 2.15mg/kg with average of 14.03mg/kg. There was no significant difference between the mean station values and the control station values (P>0.05).

The Sulphate concentration of sediment samples collected had a range 31.3 to 54.7mg/kg with an average of 41.87mg/kg while control values ranged from 39.7 to 70.8mg/kg with average of 52.1mg/kg. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

The nitrate concentration of sediment samples collected had a range of 0.457 to 0.957mg/kg with an average of 0.65mg/kg, with control value ranged of 0.092 to 0.455mg/kg with average of 0.25mg/kg. The mean station values and the control station values did not significantly differ from one another (P>0.05).

Ammonium

The ammonium concentration of sediment samples collected had a range of 0.243 to 0.395mg/kg with average of 0.31mg/l, while the control ranged from 0.043 to 0.21mg/l with average of 0.14mg/kg. The low concentration of ammonia in the sediment is consistent with acidic nature of the pH which was between 4 and 6. It provides a lower release risk of ammonia toxicity between sediment-water interface.

4.8.8 Exchangeable Cation

Sodium, Potassium, Calcium and Magnesium

The sodium concentration of sediment samples collected had a range of 38.2 to 47mg/kg with average of 43.83mg/kg, while the control ranged from 39 to 43.1mg/kg with average of 41.47mg/kg. There was no significant difference between the mean station values and the control station values (P>0.05).

The potassium concentration of sediment samples collected had a range of 11.8 to 17.9mg/kg with an average of 15.7mg/kg. Control stations values for potassium ranged from 17.1 to 17.4mg/kg with average of 17.25mg/kg. The mean station values and the control station values did not significantly differ from one another (P>0.05).

The calcium concentration of sediment samples collected had ranged from 78.5 to 88.9mg/kg with an average of 84.37mg/kg, control value ranged from 76.8 to 86.1mg/kg with average of 82.37mg/kg. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

The magnesium concentration of sediment samples collected had ranged from 29.8 to 33.4mg/kg with an average of 31.77mg/kg, the control had value ranged of 29.5 to 30.7mg/kg with average of 30.23mg/kg. There was no significant difference between the mean station values and the control station values (P>0.05).

4.8.9 Heavy Metals

The heavy metals concentrations of sediment samples collected from Ubeta FDP area were all below detectable limits (barium <0.03mg/kg, chromium<0.002mg/kg, cadmium<0.002mg/kg, mercury<0.001mg/kg, vanadium<0.002mg/kg, nickel<0.002mg/kg and lead<0.009mg/kg) except for iron, copper and zinc.

Iron

The total iron concentrations in sediment samples from the study ranged of 0.673 to 0.875mg/kg with an average of 0.79mg/kg, while control ranged from 0.612 to 0.629mg/kg with average of 0.62mg/kg. The mean station values and the control station values did not significantly differ from one another (P>0.05).

Copper

Copper concentrations in sediment samples ranged 0.468 to 0.61mg/kg with average of 0.54mg/kg, while the control value ranged from 0.515 to 0.538mg/kg with average of 0.53mg/kg. The variation between the mean of the sample stations and that of the control stations showed no significant difference.

Zinc

Zinc concentrations in sediment samples at Ubeta ranged from 0.589 to 0.848mg/l with average of 0.7mg/l, while the control value ranged from 0.553 to 0.643mg/l with average of 0.59mg/l. There was a significant difference between the mean station values and the control station values (P<0.05).

All the heavy metal concentrations were well below their corresponding NUPRC target limits which shows an evidence of no.

4.8.10 Microbial Population in Sediments

The microbial populations in sediments from the study area are shown in **Table 4.16.** The Heterotrophic Bacteria (THB) population in sediment from the study area ranged from 2.90x10^5cfu/ml to 8.00x10^5cfu/ml (average 5.45x10^5cfu/ml).

The Hydrocarbon Utilizing Bacteria (HUB) counts were in the range of 1.75x10^4cfu/ml to 2.60x10^4cfu/ml (average 2.18x10^4cfu/ml).

The Total Heterotrophic Fungi (THF) counts were in the range of <1 to 1.50x10^4cfu/ml (average 1.50x10^4cfu/ml).

The results for Sulphur Reducing Bacteria (SRB) and Feacal Coliform showed no growth at <1cfu/ml and (<2.00MPN/100ml) respectively.

Table 4.16: Microbial Population in Sediments

SAMPLE ID	**Parameter**					
	THBX10^5 (cfu/g)	**HUBX10^4 (cfu/g)**	**THFX10^4 (cfu/g)**	**HUFX10^2 (cfu/g)**	**Feacal Coliform (MPN/100g)**	**SRB (SR/g)**
UBES 13	8	2.6	<1	<1	<2	<1
UBES 65	2.9	1.75	1.5	5	<2	<1
UBE SW 65	3.1	1.9	1.43	<1	<2	<1
UBE CTRL 1	3.2	2	1.31	<1	<2	<1
UBE CTRL 2	3.7	2.15	1.16	<1	<2	<1
UBE CTRL 3	4.13	2.31	1.21	<1	<2	<1

Source: Field Data gathering (2021)

4.9. SOIL STUDIES

This subsection discusses the physico-chemical, heavy metals and microbiological characteristics of soils within the project area and the control stations.

4.9.1 Soil Physico-chemical Characteristics

The summary of results of physico-chemical characteristics of the topsoil (0 – 15 cm) and subsoil (15 – 30 cm) for the study area and control are presented in **Tables 4.17a** and **4.17b**, respectively while comparison with previous study is presented in **Table 4.18**. Detailed analytical and Paired–Samples T-test results are presented in **Appendices 4.3 to 4.8**.

Colour

The colour of soil indictes much about how the soil is formed and what it is made of. The colour may range from white through brown, to black as a result of an increasing content of humus, which is finely divided, partially decomposed organic matter. Red and yellow colours are the results of small quantities of iron compounds, while the yellow may indicate the presence of limonite. The colour of the soil samples taken at both depths within the project area of influence ranged from light brown to dark brown, while the control stations showed light brown to yellowish brown.

Moisture Content

The soil moisture content correspondingly referred to as water content is an indicator of the quantity of water existing in soil. The values ranged 8.34 to 16.3% with average of 13.65% for surface soil and 11.7 to 17.8% with average of 14.98%, for sub surface soil. The control stations had a value ranged from 12.5 to 13.4% with average of 12.93% for surface soil and 13 to 15.1% with average of 13.73% for sub surface soil.

Soil moisture is a crucial variable in governing the exchange of water and warmth energy among the land surface and the atmosphere through plant transpiration and soil evaporation. In plant situation, the uptake of nutrients through the roots is intermediated by soil water. Consequently, water and soil are the elementary requirements for the life and growth of plants. Soil water also influences soil microbial processes and biological soil remediation, in addition to soil permeability for estimation of the success of *in situ* remediation.

Table 4.17a: Summary of soil physico-chemical characteristics within the project area and control (Topsoil: 0 – 15 cm)

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	SD	Range	Mean
Colour	Light Brown – Dark Brown			Light Brown – Yellowish Brown	
pH	4.16 – 5.88	4.87	0.28	4.18 – 5.01	4.59
Conductivity (µS/cm)	411.00 – 556.00	505.22	26.95	507 – 525	515. 33
Temperature (oC)	26.30 – 29.30	28.26	0.64	12.5 – 13.40	12.93
CEC (cmol/Kg)	0.28 – 40.30	20.71	13.04	29.50 – 36.40	32.47
TOC (%)	0.12 – 2.44	0.88	0.43	0.71 – 1.06	0.89
TOM (%)	0.20 – 4.21	1.53	0.74	1.22 – 1.83	1.54
Moisture Content (%)	8.34 – 16.30	13.65	1.15	12.50 – 13.40	12.93
Redox Potential (mV)	232.00 – 321.00	281.23	18.14	250.00 – 293.00	276.00
T. Nitrogen	0.03 – 0.16	0.08	0.03	0.07 – 0.10	0.09
Porosity (%)	32.00 – 47.00	37.60	4.81	32.00 – 35.00	33.33
Bulk density (g/cm3)	1.02 – 1.36	1.26	0.12	1.29 – 1.35	1.35
Permeability (mL/s)	0.22 – 0.68	0.50	0.15	0.54 – 0.58	0.56
Sand (%)	38.10 – 91.30	74.89	19.66	86.80 – 89.30	88.13
Silt (%)	5.60 – 59.20	21.41	17.82	9.10 – 10.10	9.43
Clay (%)	1.30 – 10.60	3.69	2.53	1.60 – 3.10	2.43
Ammonium (mg/kg)	0.54 – 11.00	2.15	1.50	0.46 – 3.57	1.55
Phosphate (mg/kg)	18.20 – 102.00	50.70	22.79	43.10 – 298.00	155.37
Sulphate (mg/kg)	40.80 – 248.00	128.76	44.53	65.20 – 102.00	80.07
Nitrate (mg/kg)	0.90 – 18.00	3.58	2.42	0.75 – 5.82	2.54
Nitrite (mg/kg)	0.01 – 0.10	0.04	0.02	0.01 – 0.05	0.02
Carbonate (mg/kg)	<0.50	<0.50	-	<0.50	<0.50
Sodium (mg/kg)	156.00 – 190.00	170.7	7.73	170.00 – 176.00	173.00
Potassium (mg/kg)	33.90 – 49.10	41.79	3.03	38.50 – 47.10	42.03
Magnesium (mg/kg)	51.30 – 529.00	65. 24	47.74	54.10 – 56.00	55.27
Calcium (mg/kg)	209.00 – 289.00	256.87	18.91	230.00 - 266.00	247.00
Oil & Grease (mg/kg)	<0.10 – 37.90	24.56	-	30.30 – 45.50	37.90
THC (mg/kg)	<0.10	<0.10	-	<0.10	<0.10
TPH (mg/kg)	<0.01	<0.01	-	<0.01	<0.01
PAHs (mg/kg)	<0.001	<0.001	-	<0.001	<0.001
BTEX (mg/kg)	<0.001	<0.001	-	<0.001	<0.001

SD – Standard Deviation; (Source DSL Field Survey,2021)

Table 4.17b: Summary of soil physico-chemical characteristics within the project area and control (Subsoil: 15 – 30 cm)

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	SD	Range	Mean
Colour	Light Brown – Dark Brown			Light Brown – Yellowish Brown	
pH	4.09 – 5.42	4.84	0.23	4.34 – 4.73	4.51
Conductivity (µS/cm)	422.00 – 556.00	500.86	22.49	480.00 – 514.00	492.33
Temperature (oC)	26.60 – 29.40	28.24	0.65	26.60 – 29.20	27.77
CEC (cmol/Kg)	21.60 – 37.70	28.64	13.04	29.90 – 34.50	32.43
TOC (%)	0.08 – 2.44	0.78	0.45	0.59 – 0.94	0.77
TOM (%)	0.14 – 4.21	1.35	0.77	1.02 – 1.63	1.34
Moisture Content (%)	11.70 – 17.80	14.98	1.32	13.00 – 15.10	13.73
Redox Potential (mV)	234.00 – 334.00	282.44	18.88	288.00 – 310.00	299.33
T. Nitrogen	0.03 – 0.15	0.08	0.03	0.07 – 0.08	0.08
Porosity (%)	32.00 – 48.00	37.93	4.50	34.00 – 36.00	35.00
Bulk density (g/cm3)	1.01 – 1.36	1.23	0.10	1.23 – 1.30	1.30
Permeability (mL/s)	0.23 – 0.68	0.51	0.14	0.55 – 0.60	0.58
Sand (%)	37.00 – 90.10	75.33	19.35	87.00 – 88.90	87.70
Silt (%)	6.30 – 61.10	21.04	17.49	9.20 – 10.10	9.50
Clay (%)	1.30 – 10.70	3.63	2.54	1.90 – 3.80	2.80
Ammonium (mg/kg)	0.58 – 11.60	2.56	1.60	0.58 – 5.03	2.18
Phosphate (mg/kg)	17.40 – 139.00	54.83	24.91	38.70 – 321.00	159.57
Sulphate (mg/kg)	38.60 – 241.00	144.01	48.01	84.30 – 106.00	94.77
Nitrate (mg/kg)	0.95 – 19.00	4.26	2.54	0.95 – 8.20	3.56
Nitrite (mg/kg)	0.01 – 0.10	0.04	0.02	0.004 – 0.05	0.02
Carbonate (mg/kg)	<0.50	<0.50	-	<0.50	<0.50
Sodium (mg/kg)	150.00 – 181.00	168.34	6.20	166.00 – 172.00	169.67
Potassium (mg/kg)	35.00 – 46.30	41.40	2.41	38.20 – 44.50	40.93
Magnesium (mg/kg)	50.30 – 69.10	59.28	4.06	53.60 – 55.30	54.47
Calcium (mg/kg)	213.00 – 283.00	256.64	17.41	231.00 – 262.00	247.33
Oil & Grease (mg/kg)	<0.10 – 30.30	12.79	-	15.20 – 22.70	17.70
THC (mg/kg)	<0.10	<0.10	-	<0.10	<0.10
TPH (mg/kg)	<0.01	<0.01	-	<0.01	<0.01
PAHs (mg/kg)	<0.001	<0.001	-	<0.001	<0.001
BTEX (mg/kg)	<0.001	<0.001	-	<0.001	<0.001

SD – Standard Deviation; (Source DSL Field Survey,2021)

Table 4.18: Comparison of data in current study with previous study around the project area

Parameter	Current Study		EIA of Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	
	Topsoil	Subsoil	Topsoil	Subsoil
pH	4.16 – 5.88	4.09 – 5.42	3.76 – 4.73	3.83 – 4.84
Conductivity (µS/cm)	411.00 – 556.00	422.00 – 556.00	NA	NA
Temperature (oC)	26.30 – 29.30	26.60 – 29.40	NA	NA
CEC (cmol/Kg)	0.28 – 40.30	21.60 – 37.70	NA	NA
TOC (%)	0.12 – 2.44	0.08 – 2.44	0.29 – 2.10	0.21 – 0.93
TOM (%)	0.20 – 4.21	0.14 – 4.21	NA	NA
Moisture Content (%)	8.34 – 16.30	11.70 – 17.80	NA	NA
Redox Potential (mV)	232.00 – 321.00	234.00 – 334.00	NA	NA
T. Nitrogen	0.03 – 0.16	0.03 – 0.15	0.01 – 0.13	0.01 – 0.04
Porosity (%)	32.00 – 47.00	32.00 – 48.00	NA	NA
Bulk density (g/cm3)	1.02 – 1.36	1.01 – 1.36	NA	NA
Permeability (mL/s)	0.22 – 0.68	0.23 – 0.68	NA	NA
Sand (%)	38.10 – 91.30	37.00 – 90.10	55.20 – 81.20	47.20 – 72.20
Silt (%)	5.60 – 59.20	6.30 – 61.10	7.00 – 13.00	6.00 – 17.00
Clay (%)	1.30 – 10.60	1.30 – 10.70	8.60 – 31.80	17.80 – 35.80
Ammonium (mg/kg)	0.54 – 11.00	0.58 – 11.60	0.02 – 0.13	0.01 – 0.06
Phosphate (mg/kg)	18.20 – 102.00	17.40 – 139.00	NA	NA
Sulphate (mg/kg)	40.80 – 248.00	38.60 – 241.00	NA	NA
Nitrate (mg/kg)	0.90 – 18.00	0.95 – 19.00	NA	NA
Nitrite (mg/kg)	0.01 – 0.10	0.01 – 0.10	NA	NA
Carbonate (mg/kg)	<0.50	<0.50	NA	NA
Sodium (mg/kg)	156.00 – 190.00	150.00 – 181.00	0.02 – 0.11	0.05 – 0.10
Potassium (mg/kg)	33.90 – 49.10	35.00 – 46.30	0.03 – 0.11	0.03 – 0.21
Magnesium (mg/kg)	51.30 – 529.00	50.30 – 69.10	0.33 – 1.19	0.33 – 1.61
Calcium (mg/kg)	209.00 – 289.00	213.00 – 283.00	0.001 – 0.10	0.003 – 0.07
Lead (mg/kg)	0.58 – 1.41	0.07 – 1.28	2.80 – 3.60	2.86 – 4.40
Iron (mg/kg)	2.31 – 10.90	2.70 – 10.70	2130.00 –2256.00	2030.00 –2345.00
Copper (mg/kg)	1.24 – 5.13	1.21 – 4.78	4.20 – 5.20	5.25 – 6.20
Mercury (mg/kg)	<0.001	<0.001	<0.01	<0.01
Arsenic (mg/kg)	<0.002 – 0.02	<0.002 – 0.01	NA	NA
Chromium (mg/kg)	<0.002 – 0.24	<0.002 – 0.02	8.45 – 11.00	9.20 – 12.59
Nickel (mg/kg)	1.00 – 1.46	0.89 – 1.39	5.46 – 6.80	6.45 – 6.96
Cadmium (mg/kg)	<0.002 – 0.02	<0.002 – 0.02	<0.10	<0.10
Zinc (mg/kg)	2.19 – 3.56	2.22 – 3.44	4.96 – 8.20	5.02 – 10.20
Barium (mg/kg)	<0.03	<0.03	64.00 – 93.50	73.00 – 102.00
Vanadium (mg/kg)	<0.002 – 0.03	<0.002 – 0.03	5.20 – 5.99	5.80 – 6.30
Aluminium (mg/kg)	<0.002	<0.002 – 0.004	16.20 – 19.25	17.45 – 20.60
Oil & Grease (mg/kg)	<0.10 – 37.90	<0.10 – 30.30	NA	NA
THC (mg/kg)	<0.10	<0.10	109.30 – 230.10	66.20 – 113.98

Parameter	Current Study		EIA of Obite-Ubeta-Rumuji (O.U.R.) Gas Pipeline Project (2012)	
	Topsoil	Subsoil	Topsoil	Subsoil
TPH (mg/kg)	<0.01	<0.01	NA	NA
PAHs (mg/kg)	<0.001	<0.001	8.20 – 13.60	8.20 – 10.50
BTEX (mg/kg)	<0.001	<0.001	NA	NA

NG = No Guideline; NA = Not Applicable (Source DSL Field Survey,2021)

Soil Texture

The results of soil texture analysis at Ubeta FDP area showed a constitution of sand fractions which ranged from 38.1 to 91.3% with average of 74.89%. The silt content had values ranging from 5.6 to 59.2% with average 21.41% while clay content ranged from 1.3 to 10.6% with average of 3.69%. At the control stations, sand content ranged from 86.8 to 89.3% with average of 88.13%; silt, 9.1 to 10.1% with average of 9.43% and clay 1.6-3.1%, with average values of 2.43% for the surface soil. For sub soil, sand fractions ranged from 37.2 to 90.1% with average of 75.33%; silt 6.3 to 61.1% with average value of 21.04% while clay ranged from 1.3 to 10.7% with average 3.63%. At the control stations for the sub soil, sand fractions ranged from 87 to 88.9% with average of 87.7%, silt 9.2 to 10.1%, with average value 9.5% and clay 1.9-3.8% with average value of 2.8%.

The texture of a soil determines the water absorption/infiltration rate, the water holding capacity and the rate of migration of pollutants down the soil strata. The texture also determines the amount of soil aeration, ease of tilling, and soil fertility (Udoh 1986). Soil having low clay and high sand content is porous and will permit easy percolation of nutrients and pollutants to the groundwater table, causing depletion of soil nutrients at the topsoil and subsoil levels and make the groundwater vulnerable to pollution

Other parameters that determine the structure of soil and dynamics of pollutants in soil include bulk density and porosity. The bulk density in particular gives a rough estimation of the aeration and permeability of a soil. The lower the bulk density, the higher is the permeability. Bulk density varies with structural conditions of the soil, therefore, it is related to packing and often used as a measure for soil structure. The results obtained in the study revealed porosity ranging from 32 to 47 %with average of 37.61% for surface soil and 32 to 48% with average of 37.93%, for sub surface soil. The control stations had a value ranged from 32 to 35% with average of 33.33% for surface soil and 34 to 36% with average of 35% for sub surface soil.

Bulk density ranged from 1.02 to 1.36 g/cm3 with average of 1.25 g/cm3 for surface soil and 1.01 to 1.36 g/cm3 with average of 1.22 g/cm3, for sub surface soil. The control stations had a value ranged from 1.35 to 1.35 g/cm3 with average of 1.35 g/cm3 for surface soil and 1.3 to 1.3g/cm3 with average of 1.3g/cm3 for sub surface soil. Also, their mean values in the two soil strata were different significantly ($p<0.05$) but the variation between the mean of the sample stations and that of the control stations showed no significant difference.

Soil pH

The soil reaction (pH) for both soil depths in the study area fell within the acidic value of 4.16 to 5.88 for topsoil and 4.09 to 5.42. The control stations values ranged from4.18 to 5.01 for top oil and 4.34 to 4.73. The difference in mean values for the topsoil and subsoil was not significant ($p>0.05$) but the mean of the control station stations differs from the sampled stations significantly.

Soil pH, which expresses the acidity or basicity of soil solution, often determines the soil capability and suitability to support plants growth. This is because the value of the free H^+ concentration in a soil influences the availability of nutrient elements and biochemical reactions in the soil (Bohn *et al*., 1984). Soil reaction is thus important for nutrients availability for plants uptake as well as the dynamics of pollutants in soil. The observed pH values of the soil in this study were lower than the minimum value requirement for plant optimum growth (Table 4.19) (FAO, 1990).

Table 4.19: Classification of Soil Macro and Micro Nutrients

Soil Characteristics	Low	Medium	High
pH	<6	6 – 7	>7
Exchangeable K^+ (cmol/kg)	<0.15	0.15 – 0.4	>0.4
Organic Matter (%)	1.5	1.5 – 3	>3
Total Nitrogen (%)	0.08	0.08 – 0.15	>0.15
Total Phosphorus (mg/kg)	7	7 – 20	>20
Fe (mg/kg)	23	90	360

Source: FAO (1990)

Redox Potential

Redox Potential refers to the oxidation reduction potential (ORP) of a system. The ORP values measured in the topsoil ranged from 232 to 321mV (Mean = 281.23mV), while it ranged from 234 to 334mV (Mean = 282.44mV) in the subsoil. The mean values of the top soil and bottom soil were not significantly ($p>0.05$) different. Values obtained in topsoil from the control stations (250 to 293mV) were within the range obtained for the project area, while similar ORP values (288 to 310mV) were recorded in the subsoil.

The redox potential of soil is a measure of electrochemical potential or electron availability that are essential to all inorganic and organic chemical reactions in soil. Redox potential measurements allow for rapid characterization of the degree of reduction and for predicting stability of various compounds that regulate nutrients and metal availability in soil. Processes which reduce oxygen levels and decrease redox potentials are driven by microbial consumption of oxygen. Thus, the conditions necessary for lowering redox potentials include, a source of decomposable organic materials (energy source), a population of microbes capable of utilizing this energy source for metabolism, and a restriction on the re-supply of oxygen. Redox potential is also diagnostic for determining whether an area is functioning as wetland or non-wetland. Due to frequent hydrologic fluctuations, wetland soils and sediments can have ORP values ranging from 700 mV (under drainage conditions) to −300 mV (under prolonged flooding conditions).

Total Organic Carbon /Organic Matter

Total organic carbon (TOC) contents of the soils within the study area ranged between 0.118 to 2.44% in topsoil and 0.079 to 2.44% in subsoil. The variation between the mean of the sample stations and that of the control stations showed no significant difference while the mean value of top soil and that of the sub soil did not significantly differ from one another (P>0.05). However, values obtained from the control stations fell within the ranges observed for the topsoil and subsoil respectively within the project area.

Nitrogen Species

Nitrogen is one of the macro nutrients in soils that have very significant effect on plants growth. Its deficiency in plants is often observed by the yellowing of leaves and stunting of the plants. nitrate (NO_3^-), nitrite (NO_2^-) and ammonium (NH_4^+) are available forms of nitrogen in soils. Total nitrogen concentrations in the topsoil and subsoil ranged from 0.03 - 0.16% and 0.03 - 0.15% respectively falling between low and medium soil fertility rating according to FAO (1990) classification of soil macro and micro nutrients (**Table 4.10)**. The with mean values of topsoil and subsoil showed significant (p<0.05) difference. The control stations, however, showed values within the ranges observed for the project area. Nitrogen is one of the macronutrients in soils that have very significant role on plants growth. Its deficiency in plants is often observed by the yellowing of leaves and stunting of the plants. Soil nitrogen of more than 0.15% is considered optimal for most crops (Sobulo and Osiname, 1986).

The nitrate concentrations in the soil ranged from 0.90 – 18.00 mg/kg (topsoil) and 0.95 – 19.00 mg/kg (subsoil), with mean values (3.80 mg/kg for topsoil and 4.26 mg/kg for subsoil) not significantly (p>0.05) different. The values from the control stations fell within the observed ranges obtained for the project area.

Nitrite concentration ranged from 0.007 – 0.10 mg/kg (Mean = 0.04mg/kg) in topsoil and from 0.005 – 0.10 mg/kg (Mean = 0.04 mg/kg) in subsoil. The mean values showed no significant (p>0.05) difference. The control stations also showed values within the observed ranges.

Ammonium

Ammonium concentrations in topsoil and subsoil ranged from 0.54 - 11.00 mg/kg and 0.58 – 11.60 mg/kg respectively. The topsoil and subsoil mean values were not significantly ($p>0.05$) different. The control stations also recorded values within the ranges observed for the project area.

Phosphate

Phosphorus is an essential macro element in soil because of the relatively large quantity required by plants. Plant growth is limited by phosphorus more than by any other plant nutrient element. The concentrations of total phosphate in topsoil ranged from 18.2 to 102mg/kg with average of 50.7mg/kg, while the subsoil recorded values between 17.4 and 139mg/kg with average of 54.83mg/kg. The difference between the mean concentrations at both soil depths was not significant ($p>0.05$). The mean values from control stations were, however, significantly different from the sampled stations. The measured phosphorus levels in the soil were within low to high macro nutrient rating (FAO, 1990).

Sulphate

Sulphate behaves like nitrate in the soil. In the plant nitrogen and sulphur are both essential building blocks for proteins. Sulphur deficiency will severely reduce the efficient use of nitrogen and limit protein synthesis. Sulphur can only be taken up by plants from the soil solution as sulphate. The concentrations of sulphate measured in the soil samples ranged from 40.80 – 248.00 mg/kg and 38.60 – 241.00 mg/kg in topsoil and subsoil respectively. The mean concentrations (128.76 mg/kg in topsoil and 144.01 mg/kg in subsoil) are not significantly ($p>0.05$) different. Sulphate concentration up to 0.30% (3,000 mg/kg) is considered as safe limit for soil (Mitchell and Dermatas, 1992).

Exchangeable Cations,

Exchangeable cations in soil include sodium (Na^+), potassium (K^+), calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions, which are loosely attached to the active surfaces of clay particles or organic matter in the soil. Several soil properties such as acidity, nutrient availability and leachability depend on the relative proportions of the exchangeable cations present.

Exchangeable cations concentrations (mg/kg) measured in the topsoil were Na^+(156 to 181), K^+(33.9 to 49.1), Mg^{2+}(51.3 to 529) and Ca^{2+} (209 to 289), while the subsoil recorded Na^+(150 to 181), K^+(35.9-46.3), Mg^{2+}(50.3 to 69.1) and Ca^{2+} (213 to 2341). The values recorded at the control station were within the ranges observed for the project area. The difference between mean concentrations of the cations in topsoil and subsoil was not significant ($p>0.05$).

Cation Exchange Capacity

The exchangeable cations and the exchangeable acidity (Al^{3+} and H^{+}) constitute the cation exchange capacity (CEC). The cation exchangeable capacity (CEC) values in the topsoil and subsoil ranged from 16.20 - 40.30 cmol/Kg and 21.60 - 37.70 cmol/Kg respectively. The values recorded in the control soil samples were within the ranges observed within the project area. It was also observed that the difference in the mean values for both topsoil and subsoil was not significant ($p>0.05$).

4.9.2 Oil and Grease and Hydrocarbons

Low oil and grease concentrations (7.58-37.9mg/kg with average of 24.56mg/kg and 7.58 to 30.3mg/kg with average of 12.79mg/kg in topsoil and subsoil respectively) were recorded in the soil samples. The control stations recorded values within the ranges observed for the project area. The difference between the mean concentrations in topsoil and subsoil was significant ($p<0.05$). The recorded values for oil and grease is similar across all the sampling stations including the controls. All the values recorded are below the target and intervention limits according to the regulatory guideline.

Total hydrocarbon concentrations, polynuclear aromatic hydrocarbons (PAHs) and BTEX in the soil samples were below instrument detection limits in both soil depths and in the control stations.

4.9.3 Heavy Metals

The statistical summary of results of heavy metals (Al, As, Ba, Cd, Cr, Cu, Fe, Ni, Pb, V and Zn) analysed in the soil samples are presented in **Tables 4.20.** All metals gave varying concentrations with the exception of barium (Ba), arsenic (As), mercury (Hg) and vanadium (V) that showed concentration below the instrument detection limit. Spatial variation across the sampling stations and for both soil depths was very low.

Iron (Fe) recorded concentrations ranging from 2.31 to 10.9mg/kg with average of 6.6mg/kg in topsoil and 2.7 to 10.7mg/kg with average of 6.52mg/kg in subsoil. There was no significant difference in the subsoil mean concentration and that of topsoil. The observed level of Fe in the current study is consistent with most studies carried out on Nigerian soils in which high concentrations of Fe have been reported (Ojanuga *et al.*, 1996; Aiyesanmi, 2005). The observed Fe concentrations in soils of the project area fall between low and medium soil macro nutrient rating (**Table 4.10**) (FAO, 1990).

Table 4.20: Heavy metal concentration (mg/kg) in soil samples

Parameter	PROJECT AREA			CONTROL	
	Range	Mean	SD	Range	Mean
TOPSOIL					
Lead (mg/kg)	0.58 – 1.41	0.87	0.20	0.53 – 0.61	0.56
Iron (mg/kg)	2.31 – 10.90	6.65	1.45	5.29 – 6.01	5.65
Copper (mg/kg)	1.24 – 5.13	3.30	0.79	2.00 – 3.01	2.51
Mercury (mg/kg)	<0.001	<0.001	-	<0.001	<0.001
Arsenic (mg/kg)	<0.002 – 0.02	0.01	-	<0.002	<0.002
Chromium (mg/kg)	<0.002 – 0.24	0.04	-	<0.002 – 0.02	0.02
Nickel (mg/kg)	1.00 – 1.46	1.27	0.11	1.11 – 1.27	1.17
Cadmium (mg/kg)	<0.002 – 0.02	0.01	-	<0.002	<0.002
Zinc (mg/kg)	2.19 – 3.56	2.89	0.26	3.29 – 3.41	3.63
Barium (mg/kg)	<0.03	<0.03	-	<0.03	<0.03
Vanadium (mg/kg)	<0.002 – 0.03	0.04	-	<0.002	<0.002
Aluminium (mg/kg)	<0.002	<0.002	-	<0.002	<0.002
SUBSOIL					
Lead (mg/kg)	0.07 – 1.28	0.79	0.17	0.51 – 0.60	0.54
Iron (mg/kg)	2.70 – 10.70	6.53	1.35	5.22 – 5.84	5.52
Copper (mg/kg)	1.21 – 4.78	3.19	0.70	2.06 – 2.16	2.11
Mercury (mg/kg)	<0.001	<0.001	-	<0.001	<0.001
Arsenic (mg/kg)	<0.002 – 0.01	0.00	-	<0.002	<0.002
Chromium (mg/kg)	<0.002 – 0.02	0.01	-	<0.002	<0.002
Nickel (mg/kg)	0.89 – 1.39	1.16	0.13	0.95 – 1.00	1.02
Cadmium (mg/kg)	<0.002 – 0.02	0.01	-	<0.002	<0.002
Zinc (mg/kg)	2.22 – 3.44	2.79	0.26	3.21 – 3.54	3.41
Barium (mg/kg)	<0.03	<0.03	-	<0.03	<0.03
Vanadium (mg/kg)	<0.002 – 0.03	0.02	-	<0.002	<0.002
Aluminium (mg/kg)	<0.002 – 0.004	0.00	-	<0.002	<0.002

All the heavy metals determined in this study recorded mean concentrations far lower than their allowable limits (AL) in soils of most countries of the world and the NUPRC Target values for Nigerian soils (**Table 4.21**) (Kabata-Pendias, 1995; Aiyesanmi and Idowu, 2012; NUPRC, 2018).

The cadmium concentrations ranged from 0.002-0.022mg/kg with average of 0.01mg/kg for surface soil and 0.002 to 0.022mg/kg with average of 0.01mg/kg for sub-surface soil. The control were below detectable limits for both surface soil and sub-surface soil respectively.

The total chromium concentration recorded ranged of 0.012 to 0.246mg/kg with average of 0.04mg/kg for surface soil and 0.004 to 0.022mg/kg with average of 0.01mg/kg for sub-surface soil. The control recorded a value ranged of 0.018 to

0.021mg/kg with average of 0.02mg/kg for surface soil, but were below detectable limits for sub-surface. The mean concentrations at both depth did not show any significant difference. The results were below the NUPRC target value of 100 mg/kg.

The nickel concentrations had a range of values of 1 to 1.46mg/kg with average of 1.27mg/kg for surface soil and 0.886-913mg/kg with average of 15.36mg/kg for sub-surface soil. The control recorded a value ranged of 1.11 to 1.27mg/kg with average of 1.17mg/kg for surface soil and 0.946 to 1.1mg/kg with average of 1.02mg/kg for sub-surface soil. The results were below the NUPRC target value of 35 mg/kg and were not significantly difference at both depths.

Lead concentrations recorded a range of values of 0.578 to 1.41 mg/kg with an average of 0.87mg/kg for surface soil while the values for sub surface soil ranged from 0.071 to 1.28mg/kg (average 0.79mg/kg). The control stations recorded a value ranged of 0.525 to 0.611mg/kg with average of 0.56mg/kg and 0.511 to 0.601mg/kg with average of 0.54mg/kg for surface and subsurface soil respectively. There was a significant difference ($P<0.005$) between the means at both depths and the results were below the NUPRC target value of 85mg/kg.

The copper concentrations ranged from 1.24 to 212mg/kg with average of 5.49mg/kg for surface soil and from 1.21 to 315mg/kg with average of 9.43mg/kg for the sub surface. The control station recorded a value ranged of 2 to 3.01mg/kg with average of were 2.51mg/kg (surface) and 2.06 to 2.16mg/kg with average of 2.11mg/kg (sub-surface). The results were below the NUPRC target value of 36 mg/kg and were not significantly different at both depths.

The zinc concentrations recorded a ranged of 2.19 to 272mg/kg with average of 5.66mg/kg for surface soil and 2.22 to 270mg/kg with average of 5.55mg/kg for sub-surface soil. The control recorded a value ranged of 3.29 to 3.41mg/kg with average of 3.36mg/kg for surface soil and 3.21 to 3.54mg/kg with average of 3.41mg/kg for sub-surface soil. The results were below the NUPRC target value of 140 mg/kg.

Table 4.21: Allowable limits (MAL) (mg/kg) for heavy metals in soil

Heavy Metals	Austria	Canada	Poland	Japan	G. Britain	Germany	Nigeria*
As	-	-	-	-	-	-	29
Ba	-	-	-	-	-	-	200
Cd	5	8	3	-	3	2	0.8
Cr	100	75	100	-	50	200	100
Cu	100	100	100	125	100	50	36
Hg	-	-	-	-	-	-	0.30
Ni	100	100	100	100	50	100	35
Pb	100	200	100	400	100	500	85
Zn	300	400	300	250	300	300	140

*NUPRC Target Value for heavy metals in soil/sediment
Source: Kabata-Pendias, 1995; Aiyesanmi and Idowu, 2012; NUPRC, 2018

4.9.4 Soil Microbiology

The summary of results of the microbes enumerated in the soil samples in this study are presented in **Table 4.22,** while the detailed results are presented in the Appendix 4.1.

The Total Heterotrophic Bacteria (THB) population in soil at Ubeta ranged from 0.15x105 to 6.25x105cfu/ml with average value of 1.67x105cfu/ml for surface and 0.10x105 to 9.50x105cfu/ml with average value of 1.50x105cfu/ml for subsurface soil.

Hydrocarbon Utilizing Bacteria (HUB) counts were in the range of 1.50x103 to 37.50x103cfu/ml with average value of 11.85x103cfu/ml for surface and <3.33 to 31.50x103cfu/ml with average value of 9.88x103cfu/ml for subsurface soil respectively.

Total Heterotrophic Fungi (THF) <3.33x104cfu/ml to 25.00x104cfu/ml (average 2.32x104cfu/ml) for surface and <3.33x104cfu/ml to 5.00x104cfu/ml (average 1.72x104cfu/ml) for subsurface soil respectively.

The Hydrocarbon Utilizing Fungi (HUF) enumerated from soil from the study area ranged from <3.33 to 35.00x102cfu/ml (average 10.25x102cfu/ml for surface soil and <3.33x104cfu/ml to 5.00x104cfu/ml (average 1.72x104cfu/ml) for subsurface soil respectively.

Feacal coliform had values ranging from <2.00MPN/100ml to >1800MPN/100ml with average value of 79.54MPN/100ml while Sulphur Reducing Bacteria had values ranging from <3.33x104cfu/ml to 5.50x104cfu/ml with average value of 1.21x104cfu/ml for surface soil and <2.00MPN/100ml to >1800MPN/100ml with average value of 97.29MPN/100ml while Sulphur Reducing Bacteria had values ranging from <3.33x104cfu/ml to 2.50x104cfu/ml with average value of 0.88x104cfu/ml for subsurface soil. Higher microbial load recorded in topsoil is attributable to the presence of more decomposable materials like plant litters in the topsoil for microbial growth than in subsoil.

Table 4.22: Summary of microbial population in soils within the project area and control station

Parameter	PROJECT AREA				CONTROL	
	Range	Mean	STD	CV (%)	Range	Mean
TOPSOIL						
THB (cfu/g) $x10^5$	0.15- 6.25	1.67	1.15	0.69	0.15- 0.4	0.29
HUB (cfu/g) $x10^3$	1.5- 37.5	11.85	8.13	0.69	0.5- 1.5	1.0
THF (cfu/g)$x10^4$	<1 - 25.00	2.32	4.18	1.81	<1	-
HUF (cfu/g) $x10^2$	<1 - 35.00	10.25	7.16	0.7	<1	-
SRB (cfu/g)	<1 – 5.5	1.21	1.26	1.05	<1	-
Faecal Coliform (MPN/100ml	<2.00 - >1800	79.55	252.47	3.18	<2.00	-
SUBSOIL						
THB (cfu/g) $x10^4$	0.1 – 9.5	1.51	1.34	0.89	0.1 – 0.25	0.15
HUB (cfu/g) $x10^3$	<1 – 31.5	9.88	7.03	0.72	0.5 – 1.5	0.84
THF (cfu/g)$x10^4$	<1 - 5.00	1.72	1.57	0.92	<1	-
HUF (cfu/g) $x10^2$	<1 – 25.0	8.94	7.13	0.8	<1	-
SRB (cfu/g)	<1 – 2.5	0.88	0.75	0.86	<1	-
Faecal Coliform (MPN/100ml	<2.00 - >1800	97.29	263.51	2.71	<2	-

(Source DSL Field Survey,2021)

4.10 PLANKTON AND BENTHIC STUDIES

The results of the plankton and benthic communities from the water bodies within the proposed project location are presented in Table 4.23 to Table 4.25. The summary of percentage abundance is presented in Fig 4.5. to Fig 4.7.

4.10.1 Benthos

Four major classes of benthos were encountered in the study. The taxa group are Crustacea, Gastropoda, Arachnida, and Insecta. The Insecta was the dominant group with 12 species and a total of 167 organisms amounting to 74.9% of the total benthic organisms recorded during the study period. Gastropoda and Crustacea had 24 organisms each (10.8%), and Arachnida was least with 8 organisms (3.8%) as shown in Fig 4.5. A total of 223 organisms were counted in the study (Table 4.23). The total number of organisms and the lack of families such as Oligochaetes, Ephemeroptera, Plecoptera and Trichoptera as well as their proportion to Chironomidae indicated that groups sensitive to environmental conditions occurred at low abundance which indicate a poor benthic community. The results show that the structure of invertebrate communities inhabiting these floodplain ponds reflects physico-chemical conditions of water. They can contribute to an understanding of the environmental conditions and be a valuable source of monitoring data, indispensable to the management and protection of these important aquatic ecosystems in the life cycle of the project.

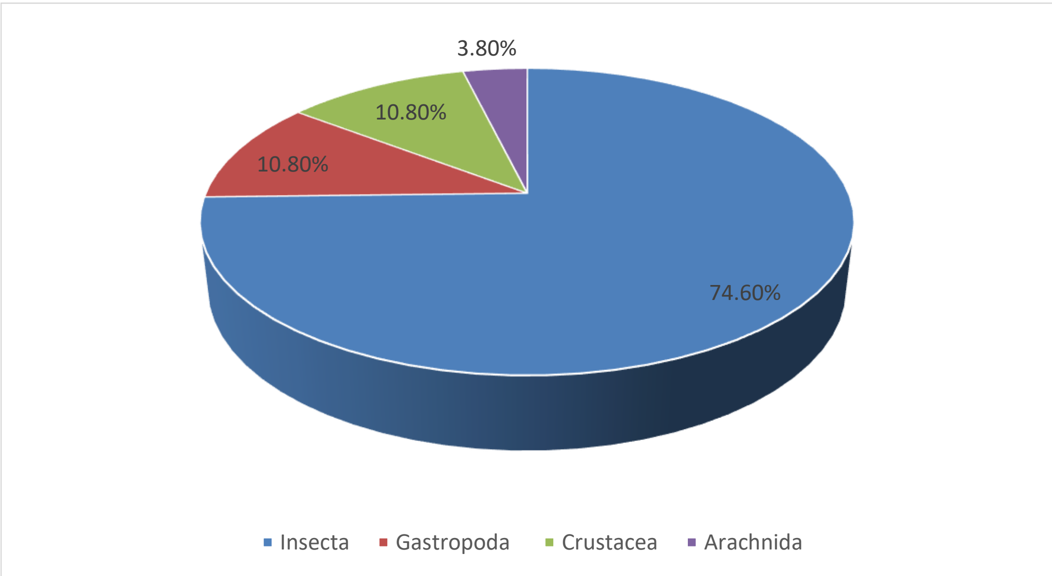


Fig 4.5 Percentage abundance of Benthos groups

4.10.2 Zooplankton

Five major classes of the zooplankton groups were recorded contributing a total number of 37 species of zooplankton. The Rotifera dominated the taxa groups with 15 species and a total number of 802 organisms amounting to 43.7% of the total zooplankton stock counted during the study. Other groups followed each other closely for example, Cladocera contributed a total of 370 organisms represented by 7 species amounting to 20.1%, followed by Rhizopoda 288 organisms (15.7%), Cilliata and Copepoda with 10.3% and 10.1% respectively (Fig 4.6). The highest density of zooplankton was recorded in station UBSW-13 (20.8%) while the lowest abundance was obtained in station UBSW-control C-1(12.8%). (Table 4.24). There were no significant differences observed in stations UBSW-14 (13.7%), UBSW 63 (14.7%), UBSW-C-2 (14.4%) and UBSW-C-3 (14.1%). Meanwhile, a total of 1,835 zooplankton organisms was recovered during the study period. The results indicate a moderately rich zooplankton community that has representative groups that are typical of freshwater such as Rotifers, Cladocera, Protozoa and Copepoda. They are homoiosmotic and thus any changes in water quality from operational processes will have an effect on the metabolism of these fauna and thus provide measurable indicators of change.

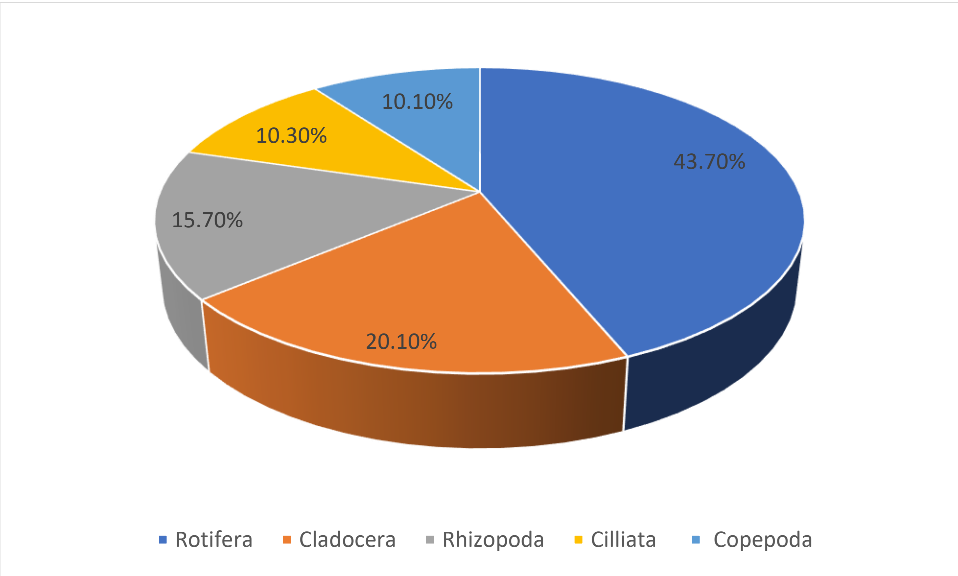


Fig 4.6 Percentage abundance of Zooplankton groups

4.10.3 Phytoplankton

The phytoplankton comprised of the Bacillariophyceae, Chlorophyceae, Cyanophyceae, and Euglenophyceae. Amongst the taxonomic groups, Chlorophyceae was highest in abundance with 342 organisms (32.6%) and the lowest Euglenophyceae (12.4%) (Fig 4.7). The results are presented in Table 4.25. A total of 1,189 phytoplankton cells were recorded in the study. The range of abundance and distribution along the stations studied was between 11.7% and 23.6%. No much difference was observed. The Phytoplankton encountered in the study area appeared to be normal inhabitants of natural lakes, ponds, streams and artificial impoundments in the tropics and subtropics (Nwankwo, 1998; Aneni and Hassan, 2003; Olaleye and Adedeji, 2005). The presence of Bacillariophytes is evidence of an important component of the photosynthetic organisms that are important components of photosynthetic organisms that form the basis in the aquatic food chain. The absence of dinoflagellates is important to note as the environment is monitored for any changes from operations.

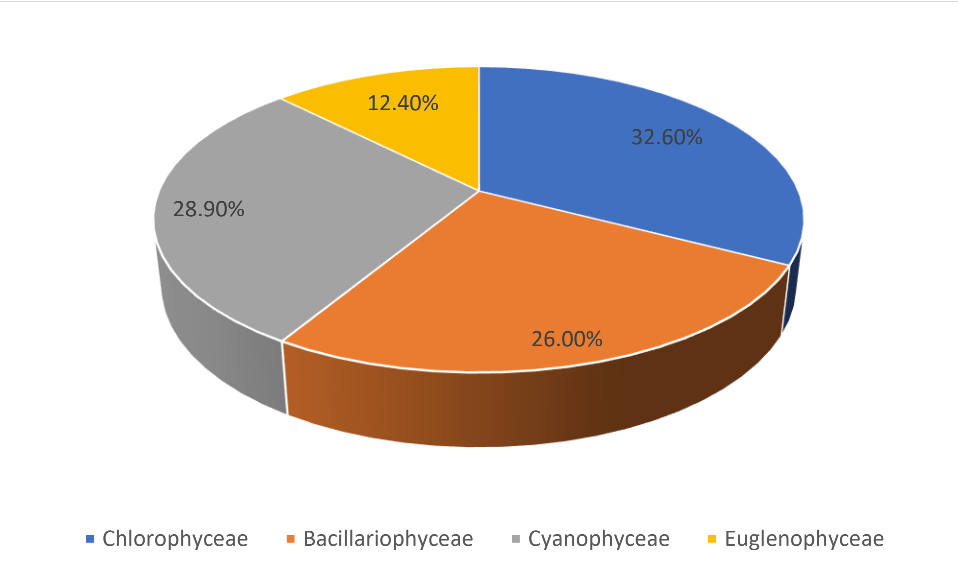


Fig 4.7 Percentage abundance of Phytoplankton groups

4.10.4 Fisheries

The fisheries study area was within the Ubeta proposed oil well sites (fresh water swamp). An extensive and complex swamp and rainforest influenced by the Orashi River System of Niger Delta, the swamp forest is jointly owned and controlled by several communities in the area as follows: Ubeta, Anwunugbokor, Ubio, Ula-ubie, Odiokwu-ete.

The fisheries is controlled by ponds that are in the swampforest floor which is galloping with varied depth of between 1–1.5 metres high is dominated by Raphia palm with a mixture of oil palm, shrubs and climbers. The area is heavily fished both dry and wet season is flood plains. Dry season fishing is intensely done by bailing of swamp ponds.

Our visit to the area in addition to physical interview with fishers revealed that the area is a good nursery site for various species of fish. Fishing in the area is done as a regular activity on part-time or full time depending on the season. Fishing in the swamp and flood plains is carried out mainly from small permanent and temporary huts set up in the forest and farm bushes. Many different techniques are utilized including basic gears like gill nets, traps and trigger hooks.

From interviews and literature fishing is intensive as the water level falls in the early day season Fishes living in the drying swamp are caught by traps and fish fences placed across the swamp channels. Most other fish species encountered in these ponds, such as H. fasciatus (Cichlidae), Tylochromis sp. (Cichlidae), Parachanna spp. (Channidae), X. nigri (Notopteridae), Papyrocranus afer (Notopteridae), Malapterurus electricus (Malapteruridae), Clarias sp. (Clariidae), Gymnarchus niloticus (Gymnarchidae), C. kingsleyae (Anabantidae), Protopterus sp. (Protopteridae) and Phractolaemus ansorgii (Phractolaemidae), (Ezekiel 2002, Amadi et al. 2019)

Table 4.23: Benthos

TAXONOMIE GROUP	Sampling Stations						
	UBSW 13	UBSW 14	UBSW 65	UBSWCTRL 1	UBSWCTRL2	UBSWCTRL 3	TOTAL
CRUSTACEA							
Palaemonidae							
Desmocharis trispinosa	4	6	10	1	-	3	
Total	4	6	10	1	-	3	**24**
GASTROPODA							
Ampularidae							
Pila ovata	-	3	9	2	1	1	
Lanistes libyanus	-	-	2	6			
Total	**0**	**3**	**11**	**8**	**1**	**1**	**24**
ARACHNIDA							
Arrenuridae							
Argynecta aquatic	-	2	1	5			**8**
Total	**2**	**1**	**5**				
INSECTA							
Chironomidae							
Chironomus sp	8				6	3	
AESHNAIDAE							
Aeshna cyanea	8	2			5	8	
Choanagridae							
Choanagrion puella	6				7	2	
COXIDAE							
Notonecta sp	3			1		1	
DYTISTIDAE							
Dytiscus marginalis		5	3	8	1	3	
Loccophilus variegates	2	12	9	6	1	1	
GYRINIDAE							
Gyrinus natator					1		
HYDROPHILIDAE							
Hydrous piceus	2	6	10	3			
NEPIDAE							
Nepa cynerea	2	8	6	3			
Leptoflabia sp						2	
Ranatra linearis		3		8	2		
Total	**31**	**36**	**28**	**29**	**23**	**20**	**167**
Total No. of Individuals	**35**	**41**	**50**	**42**	**24**	**32**	**223**
Abundance	**15.7**	**18.4**	**22.4**	**18.8**	**10.8**	**14.3**	

Table 4.24: Zooplankton

		Sampling Stations						
	TAXONOMIC GROUP	UBSW 13	UBSW 14	UBSW 65	UBSWCTRL 1	UBSWCTRL 2	UBSWCTRL 3	TOTAL
	CLADOCERA							
1	*Alona monoclartha*	12	3	8	2	11	6	
2	*Bosmina longirostris*	18	16	12	9			
3	*Bosmina fatalis*	10	1	9	4	18	10	
4	*Daphnia corinata*	14	4	12	18	9	16	
5	*Microthrix rosea*	9	2	5	10	6	8	
6	*Moina dubia*	11	6	7	21	7	5	
7	*Cerodaphia dubia*	12	3	14	18	3	1	
	Total	**86**	**35**	**67**	**82**	**54**	**46**	**370 20.2%**
	COPEPODA							
1	*Calamus finmarchus*	16	8	11	6	4	2	
2	*Centropages typicus*	14	10	8	11	2	6	
3	*Paracydops affinis*	19	6	14	5	9		
4	*Pseudocalanus elongatus*	10	3	7	3	4	8	
	Total	**59**	**27**	**40**	**25**	**19**	**16**	**186 10.1%**
	ROTIFERA							
1	*Asplanchina priodonta*	14	9	3	1	13	5	
3	*Brachionus angularis*	16	4	19	4	3	9	
4	*Collothaea campanulata*	3	1	8	6	1	1	
5	*Cururella uncinata*	1	4		3	2		
6	*Euchlanis dilatata*	8		4	1	1	6	
7	*Kellioptera longispina*	1	3	10	6	4	2	
8	*Keratera quadriata*	11	19	4	2	8	7	
9	*Keratera stipidata*	16		26	11	28	18	
10	*Keratera codilearis*	12	7	13	4	16	11	
11	*Lucane luna*	19	21	14	9	22	20	
12	*Lucane petrica*	12	18	6	3	16	14	
13	*Monostyla bulba*	3	2	1	5	2	8	
14	*Monostyla lunaris*	4	6	1	12	9	4	
15	*Platyieas militaris*	9	4	2	7	1	10	
	Total	**149**	**110**	**117**	**76**	**134**	**116**	**802 (43.7%)**
	CILLIATA							
1	*Voticella ctrina*	18	6	12	10	9	13	
2	*Epistyles sp*	5	14	12	8	3	6	
3	*Phascalodon voticella*	2	1	18	4	6	8	
4	*Opercularia sp*	7	3	12	6	1	5	
	Total	**32**	**24**	**54**	**28**	**19**	**32**	**189 10.3%**
	RHIZOPODA							
1	*Arcella vulgaris*	18	6	14	3	11	6	
2	*Arcella dentata*	5	2	18	5	8	12	
3	*Difflugia amphora*	8	3	16	2	6	6	

		Sampling Stations						
	TAXONOMIC GROUP	**UBSW 13**	**UBSW 14**	**UBSW 65**	**UBSWCTRL 1**	**UBSWCTRL 2**	**UBSWCTRL 3**	**TOTAL**
4	*Difflugia corona*	1	8	12	8	1	4	
5	*Diffugia unceolata*	6	3	11	10	8	12	
6	*Diffugia rusbestus*	3	1	14	3	1	9	
7	*Pseulinella chromatophira*	1	9	7	1	4	2	
	Total	**42**	**32**	**92**	**32**	**39**	**51**	**288 (15.7%)**
	Total No. of ind. abundance	**381 20.1%**	**238 13.0%**	**370 14.7%**	**234 12.8%**	**265 14.4%**	**261 14.2%**	**1,835**

Table 4.25: Phytoplankton

		Sampling Stations						
	TAXONOMIC GROUP	**UBSW 13**	**UBSW 14**	**UBSW 65**	**UBSW CTRL 1**	**UBSWCTRL 2**	**UBSWCTRL 3**	**TOTAL**
	BACILLARIOPHYCEAE							
1	*Amphora sp*	6	10	3	1	1	8	
2	*Actinella punctata*	11	4	1	6	9	1	
3	*Anomoensis seriands*	8		14	2	2	7	
4	*Nelosira numonuloides*	2	2	1			4	
5	*Eunotia gilbbosa*	1	6	10	2	1	7	
6	*E. Lunaris*	1	6	1	1	4	6	
7	*E. Monodon*	11			4	1	6	
8	*Fragilaria construens*	6	10	2	8		1	
9	*Fragularia rhomboids*	1	4		5	2	19	
10	*Gyrosipgma scalproides*	7		10	2	4	2	
11	*Nwicula pasilla*	2	6		7	1	23	
12	*Navicula lanceolata*	1	2	8	4	1	8	
13	*Nitzschie palae*	1		4		2	1	
14	*Nitzschia occicularis*			4	8	14	4	
15	*Prinularia inflate*	8	2		1	6	11	
16	*Synedra acus*	5	6	3	4	1	8	
17	*Synedra ulna*	3	10	1	12	3	4	
	Total	**79**	**72**	**68**	**66**	**58**	**81**	**273**
	CHLOROPHYCEAE							
1	*Closterium acerosum*	8	2	13	18	5	2	
2	*C. Closteriodes*	3	1	22	10	9	4	
3	*C. lunulo*	1	4	3	1	18	1	
4	*Pleurotaenium sp*	2	6	11	13	22	6	
5	*Spirogyra communis*	25	17	2	8	10	35	
6	*Scenedesmus quadricauda*	9	11	6	2	3	4	
7	*Ulothrix tenuissima*	6	3	1	1	4	8	
	TOTAL	**54**	**44**	**58**	**53**	**73**	**60**	**342**
	CYANOPHYCEAE							
1	*Anabaena flos-aqua*	10	6	1	1	21	23	
2	*Oscillatoria bornettia*	18	8		2	5	11	
3	*Gleocapsa rupestris*	3	14	3	1	10	16	
4	*Gleocapsa turgida*	1	2		2	5	11	
5	*Gomphosphaeris sp*	6	4	1	1	7	3	
6	*Lyngbya aeruginneo*	14	21	1		9	18	
7	*Phormidium molle*	5	3			4	9	
	Total	**57**	**58**	**6**	**10**	**65**	**97**	**303**
	EUGLENOPHYCEAE							
1	*Euglena oblonga*	2	4		2	8	11	
2	*E. Tripleris*	1	9	1	4	3	6	
3	*E. Acus*	6	12	6	1	7	4	
4	*Phascus ostreatus*	1	7		3	10	21	
	Total	**10**	**32**	**7**	**10**	**28**	**43**	**130**
	Total No. of organisms	**200**	**206**	**139**	**139**	**224**	**281**	**1,189**
	Abundance	**16.8%**	**17.3%**	**11.7%**	**11.7%**	**18.8%**	**23.6%**	

4.11 VEGETATION STUDY

a. Site Description

The study area is composed of three major types of vegetation as follows: a) Galloping Freshwater Swamp Forest, b) Secondary Forest and c) Farm Land. The galloping freshwater swamp forest (Plate 4.10a) is characterized by an undulating soil terrain, a high density of plant species, which creates a 70 to 100% forest cover with lots of intertwining lianas (Plate 4.10b), thus making navigation very difficult. At the peak of the rainy season, the nearby water body overflows its bank and find its way into the forest, which makes the forest nearly in accessible, and when the water recedes, it creates patches of ponds in the forest, leaving the soil remains moisty all year round (Plate 4.10c).

Plate 4.10a: Galloping Freshwater swamp forest in UBETA

Plate 4.10b: Lianas in the Galloping Freshwater swamp forest

Plate 4.10c: A pond inside the Galloping Freshwater swamp forest in UBETA

The secondary forest in the study area refers to the part that has been transformed from its primary state by tree felling and deforestation, thus leaving patches of trees and abundance of shrubs, herbs and grasses (Plate 4.10d). More so, the secondary forest region also has a flood plain zone that is affected by the upwelling of the nearby water body during the wet season (Plate 4.10e). The current state of the secondary forest revealed that it is between the first to second stage of succession.

Plate 4.10d: Secondary Forest in UBETA

Plate 4.10e: Flood plain zone of the secondary forest dominated by *Clappertonia ficifolia*

The farm land vegetation of the study area refers to the part that the primary vegetation has been cleared and converted to a land for growing staple crops (Plate 4.10f). This area is an elevated portion that is not affected by the annual flood.

Plate 4.10f: Mixed crop Farm land in UBETA

b. Plant Composition and Structure

Table 4.26 presents findings on the plant species in the study area. Generally, a total of 84 plant species belonging to 43 families were identified in the area. The relative abundance of the plants species in the area ranged from 5 to 842 individuals with an average of 52, the height ranged from 6 to 45 metres with an average of 18 meters, the diameter at breast height ranged from 9 to 115 centimeters with an average of 22 centimeters and a crown width of 3 to 17 feet with an average of 10 feet. The most abundant plant family in this area was Fabaceae, which contributed eight plant species to the total plant population in the area; while the most abundant plant habit was the tree, then followed by the herb, shrub, climber, fern and the least was the grass. Furthermore, the result of the plant diversity and evenness in the study area produced a high diversity index of 3.65 and a moderate species evenness value of 0.43. The study also documented the life forms of plant species in the study area. These life forms are arranged in a natural series in which the main criterion is the height of perennating buds, which normally reflect adaptation to climate (Raunkiaer, 1934; Kershaw, 1973). The vegetation of the study area is dominated by Phanerophytes which constitute over 48% of the life form. These are species with perennating buds or shoot apices borne on aerial shoots and are usually between 2 and 30 meters in height. The chamaephytes, with perennating buds or shoot apices borne very close to the ground, make up about 29% of the flora diversity.

The geophytes with perennating buds below ground level or submerged in water and possessing rhizomes, bulbs or tubers from which arise the buds to produce the next season's aerial shoots e.g. grasses and sedges, constitute about 6%. Hemicrytophytes, which have perennating buds at ground level, all above ground parts dying back at the onset of unfavourable conditions, constitute about 7%. Therophyte constitute 7% of the life forms; Epiphytes constitute 4% of the life form. In the event of stress in this environment, the various life forms that are most vulnerable in the following order: Geophytes > Hemicryptophytes > Chamaephytes > -Phanerophytes > Epiphytes.

On a specific note, the galloping freshwater swamp forest was composed of 27 plant species in 21 families. The most abundant plant families were Apocynaceae, Aracaceae, Araceae, Clusiaceae, Fabaceae and Moraceae with each contributing two plant species. The indicator plant species of this vegetation type include *Cleistopholis patens, Alstonia boonei, Callichilia barteri, Raphia hookeri, Calamus derratus, Anthocleista vogelii, Melastomastum capitatum, Mitragyna ciliate, Musanga cecropioides, Pandanus candelabrum, Symphonia globulifera, Treculia africana* and *Platycerium stagelephantotis.*

The secondary forest was composed of 30 plant species in 19 families. The most abundant family was Fabaceae which accounted for five plant species, while the trees were the most abundant plant form. Some indicator plant species of this vegetation type include *Chromolaena odorata, Mimosa pudica, Elaeis guineensis*, *Colocasia esculenta, Ageratum conyzoides, Tridax procumbens, Harungana madagascariensis, Euphorbia hirta, Prosopis africana, Indigofera hirsute, Leptochloa caerulescens Alchornea cordifolia* and *Aspillia africana.*
Fourty seven plant species belonging to 31 families were counted in the farmland vegetation. The most abundant family in the farmland was Fabaceae which accounted for five individual plant species, while trees were the most abundant plant form. The farmland consisted of mixed crop farm and homestead garden in the form of Agri-silvicultural system (Plate 4.10g). Agrisilviculture is a land use system that involves the integration of trees and other large woody perennials into farming systems through the conservation of existing trees, their active planting and tending operations (Uleh & Usman, 2020). Some indicator species in this area include *Manihot esculenta*, *Newbouldia laevis, Artocarpus artilis, Capsicum chinense*, *Psidium guajava, Ixora coccinea, Emilia praetermissa, Calopogonium mucunoides, Pueraria phaseoloides,*

Andropogon tectorum, Mangifera indica, Cocos nucifera, Abelmoschus esculentus, Syzygium samarangense, Annona muricata, Ananas comosus and *Dioscorea rotundata.*

Plate 4.10g: Homestead form of Agrisilviculture in UBETA

Table 4.26: Tree Species abundance in the study area

Specie	Family	Plant species distribution			Habit	Form	Height (m)	DBH (cm)
		Farm land	Secondary forest	Freshwater Swamp forest				
Cleistopholis patens	Annonaceae	0%	20%	80%	T	Ph	13	16
Alstonia boonei	Apocynaceae	0%	0%	100%	T	Ph	16	11
Callichilia barteri	Apocynaceae	0%	0%	100%	S	Ph	NA	NA
Elaeis guineensis	Aracaceae	33%	65%	2%	T	Ph	28	23
Raphia hookeri	Aracaceae	0%	0%	100%	T	Ph	17	16
Calamus derratus	Araceae	0%	0%	100%	T	Ph	NA	NA
Cyrstosperma senegalensis	Araceae	0%	0%	100%	H	Ge	NA	NA
Aspillia africana	Asteraceae	21%	79%	0%	H	Th	NA	NA
Chromolaena odorata	Asteraceae	35%	65%	0%	H	Ch	NA	NA
Newbouldia laevis	Bignoniaceae	100%	0%	0%	T	Ph	13	9
Dacryodes edulis	Burseraceae	100%	0%	0%	T	Ph	17	21
Costus afer	Costaceae	75%	9%	16%	H	Ge	NA	NA
Alchornea cordifolia	Euphorbiaceae	26%	66%	7%	S	Ph	NA	NA
Hevea brasiliensis	Euphorbiaceae	78%	22%	0%	T	Ph	10	12
Mimosa pudica	Fabaceae	55%	45%	0%	H	Ph	NA	NA
Pterocarpus santalinoides	Fabaceae	0%	42%	58%	T	Ph	19	36
Anthocleista vogelii	Gentianaceae	0%	26%	74%	T	Ph	14	9
Ceiba pentandra	Malvaceae	0%	86%	14%	T	Ph	18	14
Marantochloa purpurea	Marantaceae	0%	45%	55%	H	Ge	NA	NA
Melastomastum capitatum	Melastomataceae	0%	0%	100%	H	Th	NA	NA
Artocarpus altilis	Moraceae	100%	0%	0%	T	Ph	33	32
Musa parasidiaca	Musaceae	100%	0%	0%	S	He	NA	NA
Psidium guajava	Myrtaceae	100%	0%	0%	S	Ph	NA	NA
Nephrolepis biserrata	Nephrolepidaceae	0%	53%	47%	F	Ge	NA	NA
Leptochloa caerulescens	Poaceae	0%	100%	0%	H	Th	NA	NA

Specie	Family	Plant species distribution			Habit	Form	Height (m)	DBH (cm)
		Farm land	Secondary forest	Freshwater Swamp forest				
Pennisetum purpureum	Poaceae	100%	0%	0%	H	Ch	NA	NA
Mitragyna ciliata	Rubiaceae	0%	0%	100%	T	Ph	24	41
Citrus sinensis	Rutaceae	100%	0%	0%	S	Ph	NA	NA
Smilax kraussiana	Smilacaceae	23%	36%	41%	H	Ge	NA	NA
Musanga cecropioides	Urticaceae	0%	0%	100%	T	Ph	11	16
Manihut esculenta	Euphorbiaceae	66%	34%	0%	S	Ph	NA	NA
Urtica dioica	Urticaceae	100%	0%	0%	H	He	NA	NA
Acalypha fimbriata	Euphorbiaceae	100%	0%	0%	H	Ch	NA	NA
Calopogonium mucunoides	Fabaceae	64%	36%	0%	C	Ch	NA	NA
Pueraria phaseoloides	Fabaceae	100%	0%	0%	C	Ch	NA	NA
Andropogon tectorum	Poaceae	100%	0%	0%	G	He	NA	NA
Mangifera indica	Anacardiaceae	100%	0%	0%	T	Ph	16	19
Cocos nucifera	Arecaceae	100%	0%	0%	T	Ph	16	14
kyllinga erecta	Cyperaceae	100%	0%	0%	G	He	NA	NA
Ipomoea asarifolia	Convolvulaceae	69%	31%	0%	C	Ch	NA	NA
Diplazium sammatii	Athyriaceae	35%	40%	25%	F	Ep	NA	NA
Abrus precatorius	Fabaceae	0%	0%	100%	H	Ch	NA	NA
Pandanus candelabrum	Pandanaceae	0%	0%	100%	T	Ph	NA	NA
Gnetum africanum	Gnetaceae	89%	0%	11%	C	Ch	NA	NA
Symphonia globulifera	Clusiaceae	0%	33%	67%	T	Ph	16	16
Indigofera hirsuta	Fabaceae	0%	100%	0%	S	Th	NA	NA
Cnestis ferruginea	Connaraceae	12%	54%	34%	S	Ph	NA	NA
Treculia africana	Moraceae	0%	20%	80%	T	Ph	17	14
Emilia sonchifolia	Asteraceae	33%	67%	0%	H	Ch	NA	NA
Platycerium stagelephantotis	Polypodiaceae	0%	0%	100%	F	Ep	NA	NA
Dioscorea rotundata	Dioscoreaceae	69%	31%	0%	C	Ch	NA	NA

Specie	Family	Plant species distribution			Habit	Form	Height (m)	DBH (cm)
		Farm land	Secondary forest	Freshwater Swamp forest				
Abelmoschus esculentus	Malvaceae	100%	0%	0%	H	Ch	NA	NA
Capsicum chinense	Solanaceae	100%	0%	0%	H	Ch	NA	NA
Eclipta alba	Asteraceae	100%	0%	0%	H	Ch	NA	NA
Ixora coccinea	Rubiaceae	100%	0%	0%	S	Th	NA	NA
Emilia praetermissa	Asteraceae	100%	0%	0%	H	Ch	NA	NA
Clappertonia ficifolia	Tiliaceae	36%	64%	0%	S	Th	NA	NA
Persea americana	Lauraceae	100%	0%	0%	T	Ph	9	18
Euphorbia hirta	Euphorbiaceae	0%	100%	0%	H	Ch	NA	NA
Prosopis africana	Fabaceae	0%	100%	0%	T	Ph	38	115
Aframomum melegueta	Zingiberaceae	100%	0%	0%	H	Ch	NA	NA
Dennettia tripetala	Annonaceae	100%	0%	0%	T	Ph	18	23
Saccharum officinarum	Poaceae	100%	0%	0%	G	He	NA	NA
Telfairia occidentalis	Cucurbitaceae	100%	0%	0%	C	Ch	NA	NA
Bambusa vulgaris	Poaceae	0%	0%	100%	T	Ph	NA	NA
Cola acuminata	Malvaceae	100%	0%	0%	T	Ph	26	15
Theobroma cacao	Malvaceae	100%	0%	0%	S	Ph	6	9
Polyalthia longifolia	Annonaceae	100%	0%	0%	T	Ph	12	16
Chrysophyllum albidum	Sapotaceae	100%	0%	0%	T	Ph	23	15
Annona muricata	Annonaceae	100%	0%	0%	S	Ph	NA	NA
Syzygium samarangense	Myrtaceae	100%	0%	0%	T	Ph	17	12
Garcinia kola	Clusiaceae	67%	0%	33%	T	Ph	21	16
Ageratum conyzoides	Asteraceae	0%	100%	0%	H	Ch	NA	NA
Caladium bicolor	Araceae	0%	0%	100%	H	Ch	NA	NA
Eichhornia crassipes	Pontederiaceae	0%	0%	100%	H	Ch	NA	NA
Pentaclethra macrophylla	Fabaceae	100%	0%	0%	T	Ph	13	14
Tridax procumbens	Asteraceae	0%	100%	0%	H	Ch	NA	NA

Specie	Family	Plant species distribution			Habit	Form	Height (m)	DBH (cm)
		Farm land	Secondary forest	Freshwater Swamp forest				
Harungana madagascariensis	Hypericaceae	0%	100%	0%	T	Ph	9	12
Colocasia esculenta	Araceae	0%	100%	0%	H	Ch	NA	NA
Musa serpentina	Musaceae	100%	0%	0%	S	He	NA	NA
Ananas comosus	Bromeliaceae	100%	0%	0%	H	Ch	NA	NA
Luffa cylindrica	Cucurbitaceae	0%	0%	100%	C	Ch	NA	NA
Nymphaea lotus	Nymphaeaceae	0%	0%	100%	F	Ep	NA	NA
Milicia excelsa	Moraceae	0%	0%	100%	T	Ph	45	56

DBH – Diameter at breast height, Ph – Phanerophyte; Ge – Geophyte; Ch – Chamaephyte; Th – Therophyte; He – Hemicryptophyte; Ep – Epiphyte; H – Herb, G – Grass, T- Tree, H – Herb, F – Fern, m – metres, cm – centimeters, NA – Not applicable

Table 4.27 shows the list of non-wood economic plants observed in the area. The benefits derived from these plants include provision of food substances, condiments, vegetables, herbs, fibre and other raw materials for production finished goods.

Table 4.27: Economic Plant species in Ubeta

S/N	Botanical Name	Uses
1.	*Ceiba pentandra*	Wool production, diuretic, aphrodisiac
2.	*Costus afer*	Local medicine for treating measles, cough, chest pain, stomach pain
3.	*Elaeis guineensis*	Palm oil production, local medicine for detoxification
4.	*Gnetum africana*	Leafy vegetable and traditional medicine for treating nausea
5.	*Gongronema latifolium*	Leafy vegetable, and as anesthesia in traditional medicine
6.	*Musa paradisiaca*	Food
7.	*Musa sapientum*	Food
8.	*Nephrolepis biserrata*	Traditional medicine against cough and bleeding
9.	*Neuboldia laevis*	Traditional medicine to aid parturition
10.	*Nympheae odorata*	Traditional medicine as antiseptic, astringent and demulcent
11.	*Psidium guajava*	Food, Traditional medicine for analgesic
12.	*Pterocarpus santalinoides*	Leafy vegetable
13.	*Raphia hookeri*	Fibre, palm wine production, traditional medicine for enhancing libido
14.	*Dacryodes edulis*	Edible fruit
15.	*Hevea brasiliensis*	Rubber latex production
16.	*Marantochloa purpurea*	Organic food wrapper
17.	*Citrus sinensis*	Edible fruit
18.	*Manihut esculenta*	Edible fruit and tuber
19.	*Smilax kraussianaChromolaena odorata*	Food condiment
20.	*Dioscorea rotundata*	Edible tuber
21.	*Abelmoschus esculentus*	Food spice
22.	*Capsicum chinense*	Food spice
23.	*Persea americana*	Edible fruit
24.	*Telfairia occidentalis*	Food spice,
25.	*Cola acuminata*	Edible fruit for medicinal benefit
26.	*Theobroma cacao*	Edible fruit and seeds for beverage production
27.	*Annona muricata*	Edible fruit
28.	*Syzygium samarangense*	Edible fruit
29.	*Garcinia kola*	Edible fruit for medicinal benefit
30.	*Pentaclethra macrophylla*	Food condiment

Phenological Regime of plants

The survey also took into cognizance the phenological regime of the plant species in the study area. Plants such as *Pterocarpus santalinoides, Cnestis ferruginea, Syzygium samarangense, Chrysophyllum albidum and Capsicum chinense* were all observed to be either in their flowering or fruiting stage (Plates 4.10h to 4.10j). This further suggests that the environmental conditions are favourable for the plant species.

Plate 4.10h: *Pterocarpus santalinoides* flowering

Plate 4.10i: *Cnestis ferruginea* fruiting

Plate 4.10j: *Syzygium samarangense* fruiting

Anthropogenic activities in the Study Area

The result of the survey also showed evidence of anthropogenic activities in the study area as revealed by the farmland and the secondary vegetation type. More so, there were evidence of tree felling for timber and for fuel wood (Plate 4.10k). This practice, although a threat to the sustainability of the natural vegetation, provides energy for the residents of the area and the merchantable timber which are sold for monetary returns.

Plate 4.10k Evidence of tree felling and logging in UBETA

4.12 WILDLIFE

Literature review was carried out to synthesize documented information on characteristic wildlife of the study area. The wildlife survey showed an uneven distribution of wildlife species within the study area. There was a presence of few larger mammals while the rodents, primates and reptiles were among the lower groups that dominates the study area. The other group that is also present in the area are the facultative species, mostly the carnivores that are associated with swamp forest edges.

The bird populations in this study area are quite enormous with rich species abundance and diversity. They include the birds of prey, piscovores, insectivores, scavengers and colonizers.

The birds of the study area are typically of those found in areas of swamp forest throughout the south of Nigeria.

The birds that are characteristic of swamp forest such as Hartlaub's Duck, 2 species of hornbill, 2 species of turraco, various bulbuls, flycatchers malimbes were all to be found. The presence of few numbers of Grey parrots is a sign that reasonable extensive patches of relatively undisturbed swamp forest remains as these very soon disappear once the forest begins to be cleared.

In cleared areas, seed and insect enters are seen, as evidenced by the presence of Red breasted and Barn swallows, yellow wagtails, plain-backed pipits orange checked waxbills and pin-tailed whydahs and the presence of these species gives clear indication of habitat change.

In areas of open swamp forest and grassland, Lilytrotters and several species of cisticola are found. Small numbers of herons and egrets were seen along the more permanent water course while white faced whistling Ducks were found in quieter back-waters. There were lots of Guinea fowl nestle seen on the floor of forest.

The wildlife survey identified a checklist of 110 species in the study area; 61 bird species representing 18 families, 41 mammal species representing 7 families, 8 reptiles species representing 7 families. Out of 110 species, two birds; African grey parrot (*Psittacus eitheus*) and palm nut vulture (*Gypohierax angolensis*): two mammals; maxwells duiker (*Cephalophus maxwelli*) and scalter monkey (*C. scalteri*) and one reptile; African dwarf crocodile (*Osteolaemus tetraspis*) are listed in the The World Conservation Union (IUCN) which is the World Largest umbrella Organization for the conservation of nature and natural resources; near threatened, vulnerable, lower risk and data deficient.

And in addition to the IUCN list, one bird, two mammals and two reptiles are listed either on schedule 1 (endangered) or schedule 2 (vulnerable) or the Nigerian endangered species act (1985).

None of the listed wildlife species is endemic to Nigeria. All the animals identified in this survey especially those listed in IUCN red list and Nigerian decree 11 of 1985 are either directly or indirectly at risk and proper care must be taken to minimize those risks during clearing stage. The wildlife species reported in the study area and their status are presented in Table 4.28 – Table 4.30. The pictorial evidence of the wildlife seen during the study is shown in Plates 4.11a – 4.11f

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Plate 4.11a: Giant Rat in capture at Ubeta

Plate 4.11b: Droppings of a Bush Bug

Plate 4.11c: Green backed Heron from Ubio swamp forest

Plate 4.11d: Eggs of a Guinea Fowl

Plate 4.11e: Guinea Fowl Feather

Plate 4.11f: Cattle Egret seen along Ubio/Ubarama

Table 4.28: List of Bird Species in the Study Area

S/N	FAMILY	SPECIES	STATUS	NIGERIAN DECREE (1985)	IUCN	NUMBER SIGHTED
1.	Railidea	*Sarathrura pulchra*	C			11
2.	Railidae	*Amauronis plavirostris*	C			12
3.	Jacanidae	*Actophitornis africana*	C			7
4.	Columbidae	*Streptopelia Semitorquata*				11
5.	Columbidae	*Streptopelia Semitorquata*				8
6.	Columbidae	*Turtur tympanistria*	C			12
7.	Columbidae	*Turtur afer*	C			18
8.	Columbidae	*Treron calva*	C			9
9.	Alcedinidae	*Halcyon senegalensis*	C			11
10.	Alcedinidae	*Halcyon malimbica*	R			3
11.	Alcedinidae	*Alcedo cristata*	C			8
12.	Alcedinidae	*Megaceryle maxima*	C			7
13.	Sylviidae	*Cisticola anonymus*	C			11
14.	Sylviidae	*Hylia prosina*	R			6
15.	Sturnidae	*Lamprotornis spendidus*	R			13
16.	Estrildidae	*Estrilda melapoda*	C			9
17.	Estrildidae	*Lonchura bicoler*	C			11
18.	Estrildidae	*Lonchura fringilloides*	C			8
19.	Estrildidae	*Nigrita canicapilla*	C			13
20.	Estrildidae	*Pyrenestes ostrinus*	C			10
21.	Corvidae	*Corvus albus*	C			18
22.	Accipitridae	*Necrosyrtes monachus*	C			8
23.	Accipitridae	*Gypohierax angolensis*	R		IU CN	4
24.	Accipitridae	*Kaupifalco monogrammicus*	C			11
25.	Accipitridae	*Buteo auguralis*	R			3
26.	Ploceidae	*Ploceus aurantius*	C			10
27.	Ploceidae	*Ploceus nigertimus*	C			Colony
28.	Ploceidae	*Ploceus cucullatus*	C			Colony
29.	Ploceidae	*Ploceus melanocephalus*	C			Colony
30.	Anatidae	*Dendrocygna viduata*	C			8
31.	Cuculidae	*Centropus senegalensis*	C			13
32.	Cuculidae	*Chrysococcya caprius*	C			11
33.	Cuculidae	*Ceuthmochates aereus*	C			7
34.	Psittacudae	*Psitacus erithacus*	C	Nig. Decree	IU CN	8
35.	Coraciidae	*Eurystomus glaucurus*	C			10
36.	Capitonidae	*Pogoniulus sedopaceus*	C			11
37.	Bucerotidae	*Tockus fasciatus*	C			8
38.	Bucerotidae	*Bycanistes fistulator*	C			12
39.	Ardeidae	*Egretta garzetta*	C			18
40.	Ardeidae	*Butorides striatus*	C			7
41.	Ardeidae	*Ardea purpurea*	C			11

S/N	FAMILY	SPECIES	STATUS	NIGERIAN DECREE (1985)	IUCN	NUMBER SIGHTED
42.	Ardeidae	*Egretta alba*	R			4
43.	Ardeidae	*Ardeola ralloides*	C			11
44.	Ardeidae	*Bubulcus ibis*	C			14
45.	Scopidae	*Scopus umbretta*	R			11
46.	Nectariniidae	*Chalcomitra fuliginosa*	C			8
47.	Nectariniidae	*Cyanomitra cyanolaema*	C			9
48.	Nectariniidae	*Cinnyris chloropygius*	R			5
49.	Nectariniidae	*Cynomitra obscura*	C			10
50.	Pycnonotidae	*Pycaonotus barbatus*	S			7
51.	Pycnonotidae	*Andropadus virens*	S			6
52.	Hirundinidae	*Hirrundo rustica*	C			13
53.	Hirundinidae	*Hirrundo semirufa*	C			11
54.	Hirundinidae	*Hirrundo aethiopica*	C			16
55.	Blackkite	*Milvus migrans*	C			21
56.	Duck	*Ptronetta harlaubii*	R			3
57.	Hawk	*Polyboroides typus*	C			11
58.	Lilys Trotter	*Actoplulornis Africana*	C			6 7
59.	Sand Piper	*Actitis hypoleucos*	C			8
60.	Sparroro	*Passer griseus*	R			4
61.	Numididae	*Galloanserae sp.*	C			Call
	TOTAL	NUMBER OF BIRDSS SIGHTED	=			345

Table 4.29: List of Mammal Species in the Study Area

S/N	FAMILY	SPECIES	STATUS	METHOD OFRMATION INFORMATION	NIGERIAN DECREE (1985)	IUCN
1.	Soricidae	*Crocidura Nigeria (bates)*	**C**	INT		
2.	Soricidae	*Crocidura crossei*	R	INT		
3.	Pteropodidae	*Epomops franqueti ,,*	C	INT		
4.	Nycteridae	*Nycteri arge ,,*	S	INT		
5.	Vespertilinoidae	*Pipisterellus annulus ,,*	S	INT		
6.	Molossidae	*Tadarida numila ,,*	R	INT		
7.	Lorisidae	*Perodictus potto (primates)*	R	INT		
8.	Lorisidae	*Artocebus calabarensis ,,*	S	INT		
9.	Galagidae	*Galago alleni ,,*	S	INT		
10.	Galagoidae	*Galagoides demidovii ,,*	R	INT		
11.	Cercopithecidae	*Cercopithecus mona ,,*	C	CALL		
12.	Cercopithecidae	*Cercopithecus nictians ,,*	S	INT		
13.	Cercopithecidae	*Cercopithecus sclateri ,,*	S	INT	Decree	IU

S/N	FAMILY	SPECIES	STATUS	METHOD OFRMATION INFORMATION	NIGERIAN DECREE (1985)	IUCN
					1985	CN
14.	Cercopithecidae	*Cercocebus torquatus ,,*	R	INT		
15.	Cercopithecidae	*Colobus verus ,,*	R	INT		
16.	Manidae	*Manis tetractyla (Pholidota)*	R	INT		
17.	Manidae	*Tricuspis rafineque ,,*	S	INT		
18.	Anomaluridae	*Anomalurus beecrofii (rodents)*	C	INT		
19.	Anomaluridae	*Anomalurus derbianus ,,*	C	INT		
20.	Sciuridae	*Funisciurus anerythrus ,,*	C	INT		
21.	Sciuridae	*Protoxerus stranger ,,*	C	Si		
22.	Sciuridae	*Xerus erythropus ,,*	C	Call		
23.	Cricetidae	*Cricetomys gambianus ,,*	C	Si		
24.	Cricetidae	*Mus minutoides ,,*	R	INT		
25.	Muridae	*Ratus ratus ,,*	C	INT		
26.	Muridae	*Mus musculus ,,*	C	INT		
27.	Muridae	*Lemniscomys striatus ,,*	C	INT		
28.	Muridae	*Atherurus africanus ,,*	C	INT		
29.	Hystricidae	*Thryonomys swinderianus ,,*	C	INT		
30.	Mustelidae	*Aonyx capensis (otter)*	S	INT		
31.	Viverridae	*Viverra civetta (senegalensis)*	R	INT		
32.	Viverridae	*Genetta poensis ,,*	C	INT		
33.	Viverridae	*Nandinia binatata ,,*	R	INT		
34.	Viverridae	*Atilax pelidunosus*	C	INT		
35.	Viverridae	*Crossarchus obscures*	R	INT		
36.	Procaviidae	*Dentrohyrax dorsalic*	R	INT		
37.	Suidae	*Potamochoerus porcus*	S	INT		
38.	Tragulidae	*Hyemoschus aquaticus*	R	INT		
39.	Bovidae	*Tragelaphus scriptus*	C	INT		
40.	Bovidae	*Tragelaphus spekei*	R	INT		
41.	Bovidae	*Cephalophus spekei*	C	Decree 1985	IUCN	

Table 4.30: List of Reptile Species in the Study Area

S/N	FAMILY	SPECIES	STATUS	METHOD OFRMATION INFORMATION	NIGERIAN DECREE (1985)	IUCN
1.	Crocodylidae	Crocodiles niloticus	R	INT		
2.	Crocodylidae	Osleolaemus tetraspis	C	INT		
3.	Varanidae	Varanus nilioticus	C			
4.	Aganidae	Agama agama	C	SI		
5.	Scincidae	Mohlus fernandi	C	SI	Niger Decree	
6.	Pythonidae	Phython sebae	C	INT		
7.	Viperidae	Echis carinatus	C	SI		
8.	Elapidae	Naja nigri colis	R	INT		

Key

IUCN	International union for conservation of nature.
Nt	Near threaten
Vu	Vulnerable
LR/NT	Lower Risk/Near Threatened
L/R/CD	Lower Risk/Conservation Defendant
DD	Data Deficient
E	Endangered
Si	Sighted

C	**Common**	An animal with high probability of encountered by over visitor to the area.
Nu	**Not uncommon:**	An animal that will be seen by anybody who makes conscious efforts to search for it in the area.
U	**Uncommon**	Animal that requires a significance search effort to sight on the area.
S	**Scare**	Animal encounter in frequently in the area.
R	**Rare**	An animal that is known or previously recovered or known to local residents in the area

4.13 SOCIOECONOMICS SURVEY

4.13.1. Population Studies

The population studies was based on the 1991 census figures from which the 2021 population figures were projected. The projection was estimated using 2.5% growth rate as stated by World Bank (World Bank, 2019). The population studies show that Akabuka has the highest population with 16,386 people while Ubio is the least with 4,302 persons. (Fig 4.8)

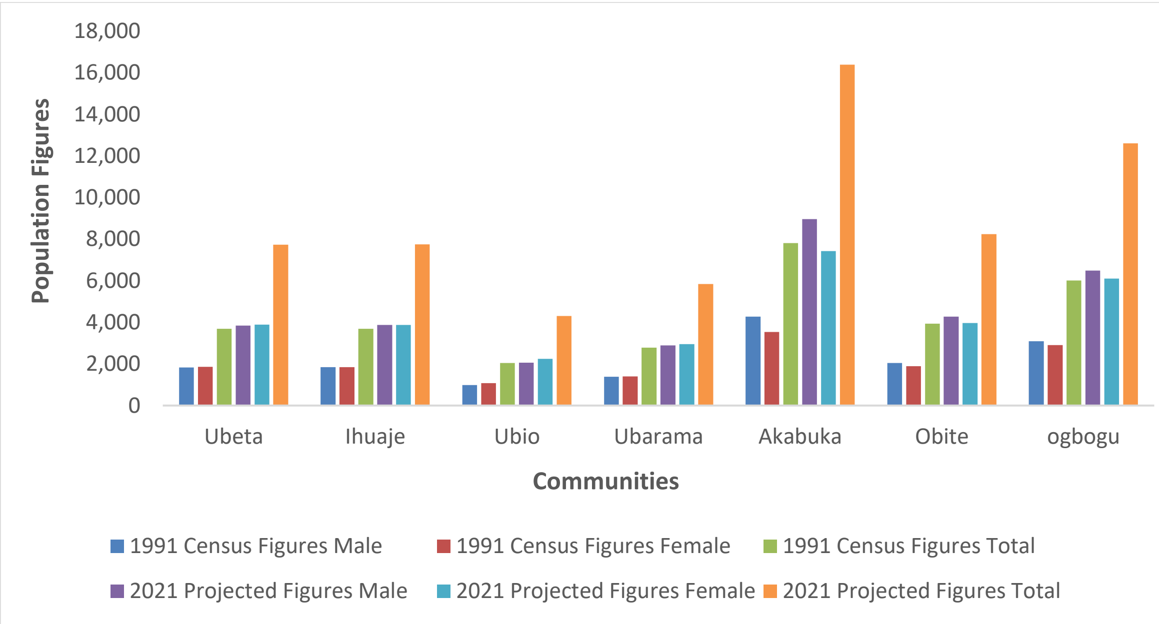


Fig 4.8: Population Distribution

4.13.2 Population Structure of the Study Area

The age-sex distributions of the sampled population of the study area are presented in Fig 4.9. The working age (15-64yrs) were 88% while the remaining 12% were the elderly (65yrs and older). The Children/young adolescents (<15yrs) were not sampled for obvious reasons of not being able to provide the required information. The focused group discussion reveled that adults constitute ¼ of the population while Youths/children make up the remaining ¾ of the population of communities in the proposed project area.

The sex structure of the sampled respondents indicates a predominance of males (74%) over the females (26%). However, the focused group discussion with the various group suggests that the females constitute about ¾ of the population while the males about 1/4.

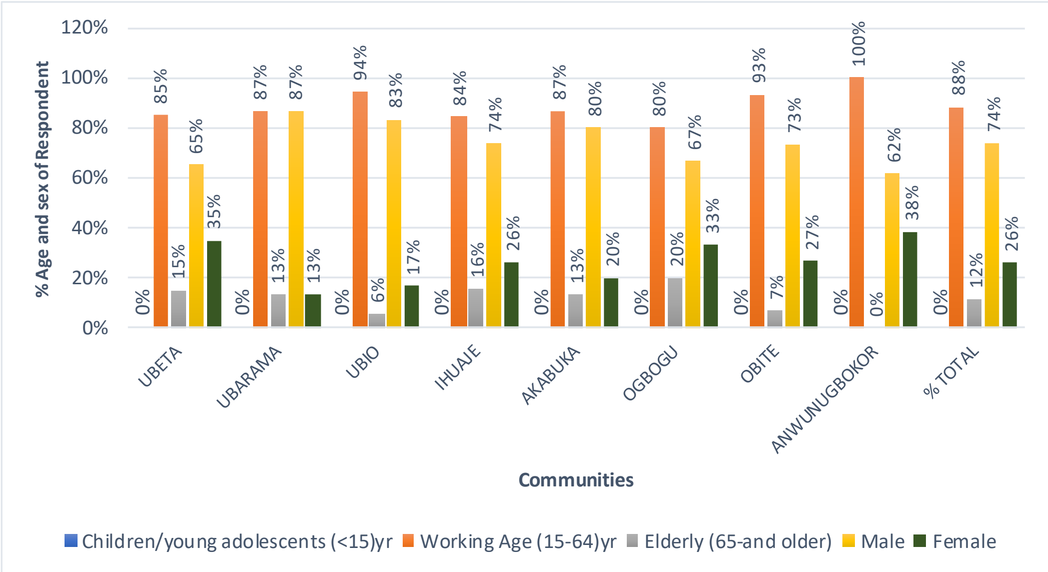


Fig. 4.9: Age and Sex Structure of Sampled Population

4.13.3 Household Information of Respondents

The respondents were mostly landlords and constitute 97% of the sampled population while the remaining 3% were tenants as shown in Fig. 4.10. The position of respondents in their household shows that 66% were the head of the household, wives 21% and dependents 13% (Fig. 4.11). The marital status of the respondents shows 17% of singles, 81.5% of married persons and 1.5% of widow/widower (Fig. 4.12).

Fig. 4.10: Tenancy Status of Respondents

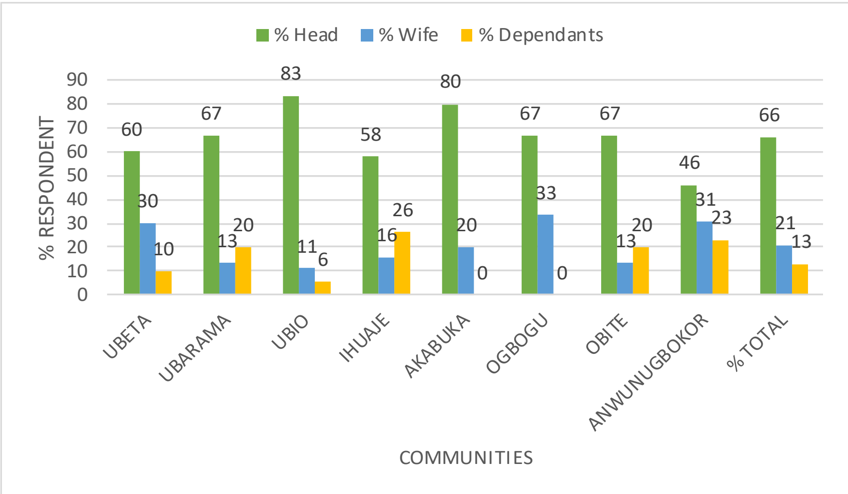
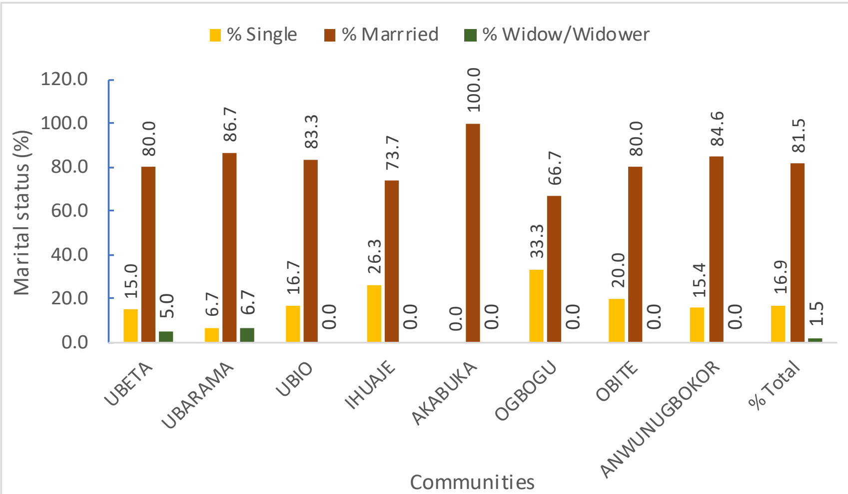


Fig. 4.11: Positions of Respondents in the Household



4.13.4 Educational Status of Respondents

Fig 4.13 below shows that about 8% of the respondent's population was made up of people with primary school education background, while 52% have secondary school education and about 38% have tertiary education background. Majority of our respondents totaling about 56% had post-secondary education. This indicated that the respondents were reasonably knowledgeable about events around them and were therefore expected to have an educated opinion on the issues related to the socioeconomics aspect of the proposed project.

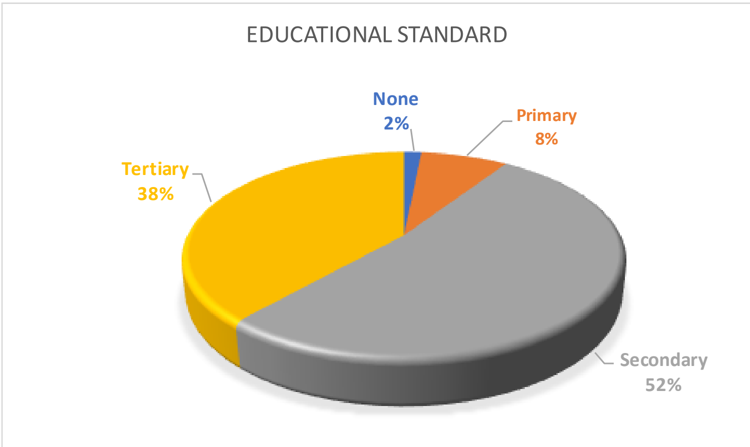


Fig. 4.13: Educational Status of Respondents

2.2 Ethnicity and how long Respondents have lived in the Community

The response from respondents (Table 4.31) showed that about 65% are of the Ekpeye ethnic group and primarily from Ubeta, Ubarama, Ubio, Ihuaje and Anwunugboko communities. The other 35% are of the Ogba ethnic extraction and are from Ogbogu, Obite and Akabuka. Majority (75%) of the respondents have been living in the community for more than 20yeras and are well placed to provide necessary socioeconomics information of the communities as required for the proposed project area.

Table 4.31: Ethnicity and Years of Habitation

	Ethnicity			No. of years living in the Area			
COMMUNITY	Ekpeye	Ogba		<5yrs	5-10yrs	11-20yrs	>20yrs
UBETA	20				1	3	16
UBARAMA	15				2	4	9
UBIO	18				3	3	12
IHUAJE	19				3	3	13

	Ethnicity			No. of years living in the Area			
AKABUKA		15			1	2	12
OGBOGU		15				5	10
OBITE		15				1	14
ANWUNUGBOKOR	13					2	11
TOTAL	85	45		0	10	23	97
% TOTAL	65	35		0	8	18	75

4.13.5 Local Economy

4.13.5.1 Major Occupation of the Respondents:

The occupational classification of the survey population in the host communities indicates that business / Trading and farming are the major occupation engaged by the people interviewed (Fig. 4.14).

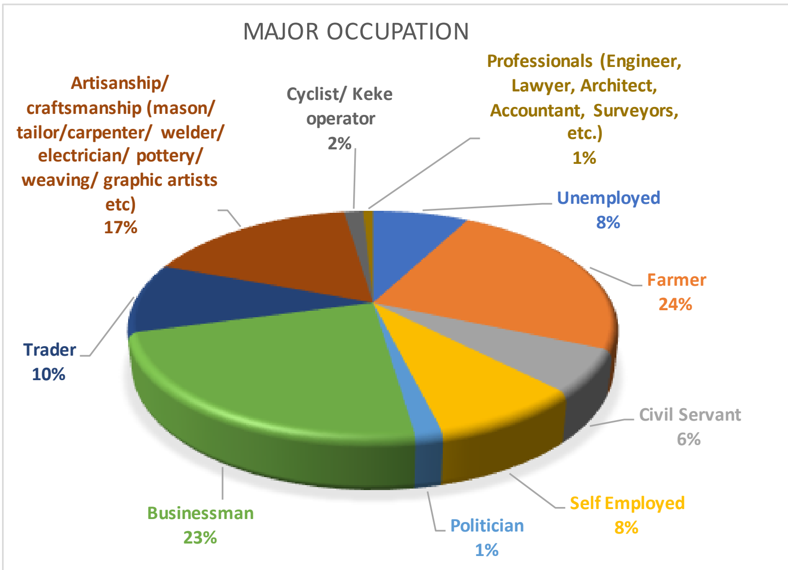


Fig. 4.14: Major Livelihood of the People as Indicated by Respondents

Within the eight stakeholder communities, about 35 per cent of the male and female population are engaged in business/Trading. The other major occupations vary between genders in different communities although from the focused group discussions hired labour, mechanic repairs, motorcyclist/'keke' operators are exclusively males. In all the communities, farming rank as the next important occupation with 24% of the respondents. This is closely followed by artisanship/ craftsmanship with 17%. The unemployed and self-employed constituted 8% each in the study population. The civil servants, politicians, Cyclist/ 'Keke' operator and professionals occurred also in lower percentages of between 1 to 6 percent.

Farming in Ubeta

Ubeta community is blessed with vast land. It has land to the centre of some Ubie communities that surrounds it namely Owube, Anunugboko, Ula-ubie, Ihuechi and even to the bank of Orashi river and hence Ubeta has enough land to put up with agriculture - an assertion made by some of the respondents. The Ubeta indigenes love farming, fishery and other forms of agriculture and thus they never lacked food as a community except until recently with the flood outbreak (Plates 4.12a to 4.12f). Ubeta indigenes are unique in their farming methods as during the period of November till May their women are hardly found at home till night time as they farm all day. For a while Ubeta was solely depended on agriculture as their means of livelihood and due to their historic and naïve nature so many projects planned for the community were driven away. Projects like the airport project and general hospital project at Jonkrama, as they thought, was only a means of introducing unknowns into the community.

According to some respondents interviewed, while farming still remains a major source of livelihood to the people, advent of the white men and the discovery of oil and gas in the community brought problems like:

- Restriction of farming areas in all four divisions of Ubeta;
- Pipelines crisscrossing all over the community;
- Plants like cassava and cocoyam were not doing well;
- Oil contamination of fishing ponds;
- The indigenes were not getting wealthier although their oil was being exploited, even the rich were getting poorer;
- Air pollution leading to sickness;
- Water pollution leading to loss of aquatic life;

According to those interviewed, with little or no benefits whatsoever to the community, Ubeta being a very peaceful community still maintained the peaceful co-existence between the white men evolution and Ubeta people.

Plate 4.12A: Cassava Farm at Ihuaje

Plate 4.12B: Farming activity at Ubarama

Plate 4.12c: Palm Oil Mill at Ubarama

Plate 4.12d: Farmer at Ubeta transporting

Plate 4.12e: Cassava farm showing mounds for new plant at Ubio

Plate 4.12f: Fetching of firewood at Ubeta

4.13.6 Household Income of the Respondents:

The Fig. 4.15 shows the household monthly income of respondents from the eight host communities. Most of the respondents (80%) earn less than N50,000 per month while 16% earn between N50,000 and N200,000. The least percentage of household income were those that earn greater than N200,000 monthly and they constitute 4% of the respondents. The respondents also emphasized that their earnings dropped significantly since the Post COVID-19 period which they all agreed were a general economic issue throughout Nigeria and the world at large.

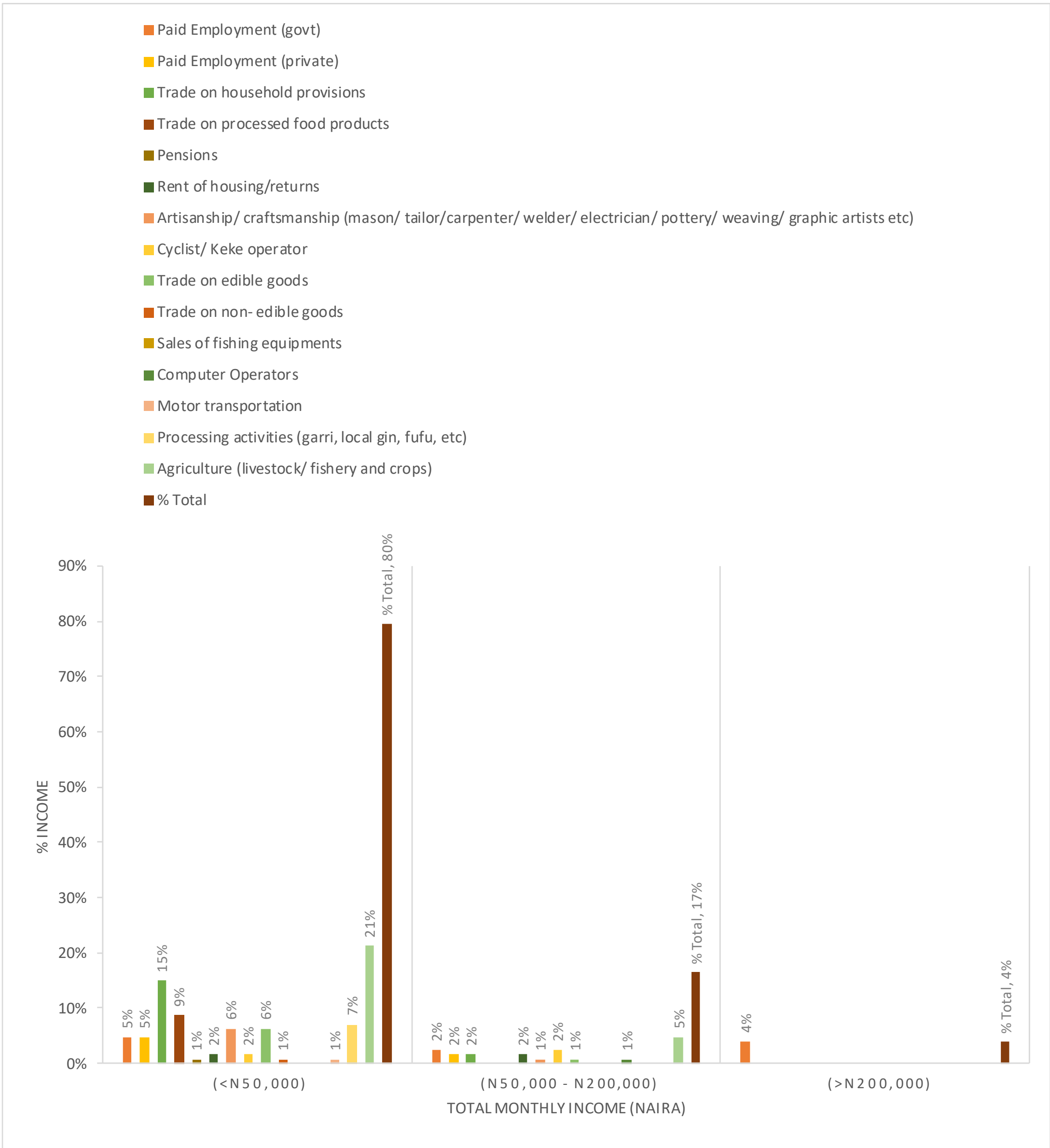


Fig. 4.15: Summary of Household Monthly Income of Respondents

Information from respondents (67%) and focused group discussion indicates that about three quarter (¾) of the community members are poor. The major reason for poverty was attributed to unemployment / lack of job according to 83% of the respondents (Fig 4.16).

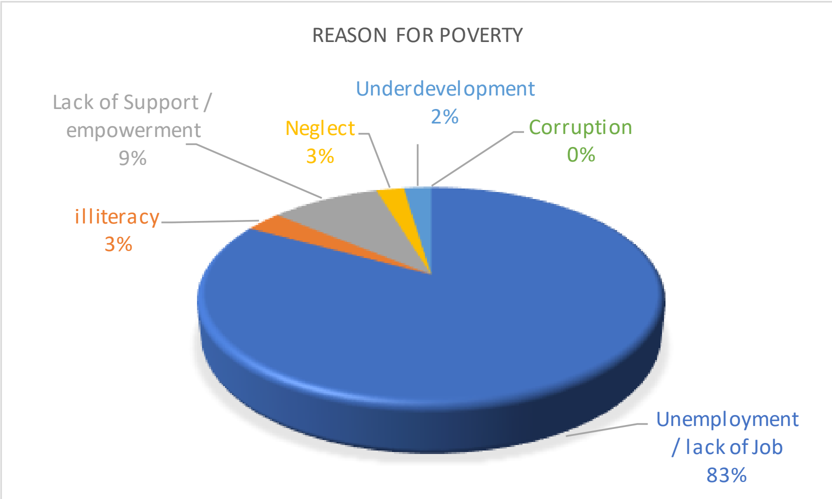


Fig. 4.16: Respondents Reasons for the Poverty level in the Community

4.13.7 Socio-Cultural Organizations

<u>History of Ubeta Community</u>

The historical account provided by Elder Elegbor Zoputam and collaborated by some other community members showed that UBETA is derived from the customary word Ubienta, meaning Ubie's younger brother. That was the highest respect an Ekpeye man can give to his son as at then, particularly his first son. Akalaka was the grandfather of Ubeta who hailed from Benin but settled down at ULA-UBIE and had four sons which today make up six sons namely; Ubie(the first son), Akoh(the second son), Upata(the third son), Igbuduya(the fourth son) and also the present day Ahoada - the administrative headquarter of Ekpeye land, and Ogbogu. UBIE who was the first son settled with his father Akalaka at Ula-Ubie as tradition demanded that the first sons do not settle far from their fathers particularly considering the aging of their fathers. Ubeta as the first son of UBIE kingdom is also the first son of the present Ekpeye kingdom. The very first place Ubie preferred to settle was supposed to be Odereke along Orashi river but based on tradition he was prohibited from staying far from his father so he had to settle at ULA-UBIE the ancestral home of Ekpeye land. Ubeta was blessed with three children namely; Imidieke, Imibo, Imowu. Ubeta historically was made up of eight families namely; Idewulu, Emaji, Agolo, Umuzhi, Ishikoloko, Uchie, Odogwu, and

Umakpan that have spanned to fifty (50) autonomous families today in Ubeta. Ubeta is further divided into four divisions namely; Odiogulu (Ubeta one), Ebagwa (Ubeta two), Odiokpu (Ubeta three), Odiowo (Ubeta four).

4.13.8 Traditional Governance

The power structure comprised the Paramount ruler (Eze Nwula), Council of Chiefs and the Elders, CDC Chairman, the Council of Elders, the Youth President, the Women leader. In hierarchy, the Council of Chiefs is higher than the CDC Chairman.

Chiefs, Youth and Women organizations run a constitutional system that is binding on all in the community.

The CDC is headed by an elected Chairman whose responsibilities include: care of all community matters and day to day activities; reporting to traditional council of chiefs at the end of the day; promoting and executing self-help projects; organizing vigilante groups to protect the community; and creating political awareness.

The Women's role is recognized in traditional governance and the various communities have an elected women's leader who functioned with her executives Her responsibility included regulation of women affairs in the community; handling of market and farm issues; participate in marriage and burial ceremonies, and community festivals.

The youth leader and his executives carry out self-help projects; organize vigilante services and sanitation exercises; assist in festivals, marriages and burial ceremonies; and create political awareness in the community.

The two most important groups in the community are the Age grade and the youth according to 36% and 26% of the respondents respectively as shown in Fig 4.17.

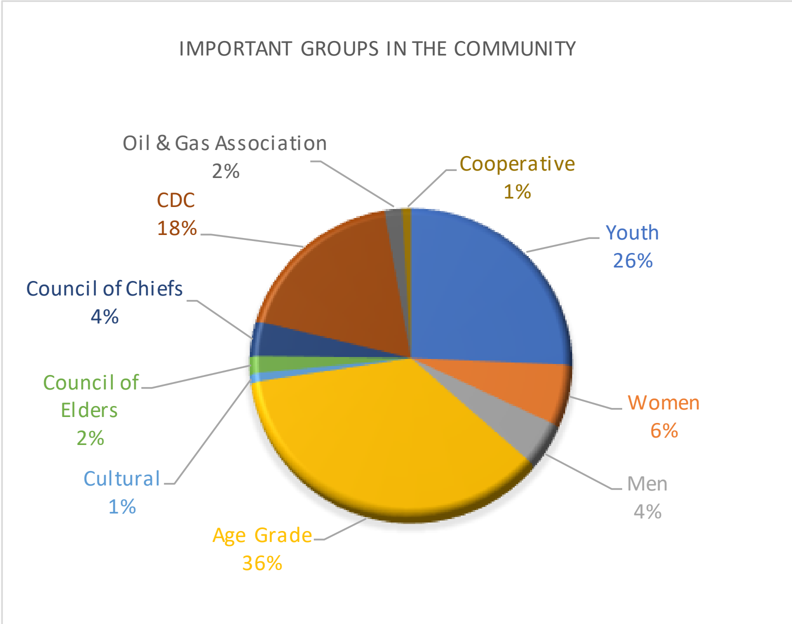


Fig. 4.17: The Important Groups in the Community by respondents

Ubeta community like other communities in Ekpeye and Ogba kingdom have laws with measures taken to instill discipline on offenders. Like in historic times even before the advent of the white men a thief was made to dance naked round the community regardless of their gender. Also, individuals caught in the act of witchcraft in severe cases that have caused death, were compelled to hang themselves. In modern years, Payment of Fine/Penalty, Sanctioning, Punishment and simple caution are measures used to ensure compliance to cultural norms.

4.13.9 Culture and Tradition of Ekpeye kingdom:

The host communities in Ekpeye kingdom namely Ubio, Ubarama, Ubeta, Ihuaje and Anwunugbokor generally have rich tradition and cultural heritage

Ubeta for instance, witnessed culture and traditions from his father Ubie which he maintained till date. Periodically there are some cultural displays and traditions at Ubeta known in Ekpeye palance or dialect as Omunala (meaning tradition or culture) which by common adaptation have acquired a force of law according to Elder Elegbor Zoputam.

Some of the cultural displays in Ubeta are:

Okukpolimini: This event happens at around April. In this period the girls are dressed and the fishes they've caught from their ponds are dried, tied with ropes and hung on their necks.

Wrestling: At around May/June comes the wrestling competition where age grades will be brought to the playgrounds on a drum beaten by a particular group, to showcase their talents. The wrestlers struggle to fall the drums to win.

At a point wrestling became a very important factor in Ubeta as good wrestlers got so much opportunities, honour and recognitions and some marriage.

Ogu ekpeye Festival: This is celebrated just shortly after the wrestling contest and in September of every year. All the kingdoms of Ekpeye land assemble at Odlereke and fix dates for Ogu Ekpeye, Aliace, Ezino, Equino, Ekino, Udino festivals. And at the very night (eve) of the first daughters festival day will be accompanied by fire carry night, where all the communities and the sub-regions of the communities namely; Odiogwulu goes first, beat their drum, meet up with Ebagwa and they move together and meet up with Odiokpu and they move again and meet up with Odiowo and then they all eventually carry the fire and fresh palm fruits to ula-ubie road to chase away evil spirits that may tend to disrupt the festival. Then the icing on the cake is the masquerade festival that closes the festival proper. Then all the masquerades will be celebrated starting from the younger ones (dancers) but the last masquerade will be celebrated in a shrine owned by the entire community known as Odube and the masquerade will be dedicated by its name Owudube and this ends the festival.

Okolosu: This festival only happens when the elders' sense there is danger in the community capable of causing epidemic particularly children sickness. Okolosu will be worn and danced to drive away evil forces

Udumini: This festival comes at the end of every year particularly mostly from twenty-fifth (25) December, and it's at the moment the swamp gets dry or is almost dried. The native basket is brought to the playground and every elderly man in the community will be compelled to swear before a particular shrine and before the community to manifest their faith. Any elder that swears while their hands are not clean is likely to face death that year.

Ubeta also has so many other cultural displays like Ogbukele, Awureja, Amujelunwo

But today in Ekpeye, Ubeta is about the only community that is consistent with their cultural displays and celebrates all the culture and traditions known to his father Ubie. This among many other reasons is why Ubeta (who was a wrestler) was given the headquarters of UBIE clan up till date.

Owu Festival:
At Anwunugbokor community, there is also the Owu Festival and women are forbidden to go to Farm during the festival.

The other communities of Ubarama, Ubio, Ihuaje and Anwunugboko in Ekpeye kingdom also holds in high esteem the Ogu Ekpeye / New Yam Festival, Masqurade and Wrestling festival.

Cultural Sites of Importance in all the communities are the playground. Also of importance in Anwunugboko community is the Utho-Owu.

4.13.9.1 Culture and Tradition of Ogba Kingdom:
The host communities of Ogbogu, Obite and Akabuka are in Ogba Kingdom. Although Ogba Kingdom had been influenced by social values, behaviours, laws, traditions and modern life, the people had maintained their identity and retained many of their traditions and customs. Ogba people were known for elaborate greetings, praise names and titles, which made them very prominent in any gathering.

Ogba land is also known for cultural celebrations, which are staged to show gratitude to God for fertility, cleansing and protection, and to mark the end of the planting or harvesting season.

The most prominent among the cultural celebrations of the people is the Nchaka festival. Other cultural festivals celebrated by the communities of Ogba land are Igba-Ogwe, Ebiam, Egwi-Iji Onube and Egwu-Ohali.

Nchaka is celebrated between November and December. It is performed for five days, beginning with traditional rituals performed by the female folk of the communities, called Nchaka-ki-inyenwa, and the one performed by their male counterparts, known as 'Nchaka-ki-ikenwa.

Several activities are lined up for the five days, such as singing, dancing and merrymaking, which involves eating foods throughout the festival period.

The festival is heralded by its proclamation at the famous Ahiakwo, the main market in Omoku, the headquarters of the kingdom by the Ogba Council of Traditional Rulers, on the directive of the king and custodian of the customs and tradition of the people.

Egwu Obah (Egu Ogba) Festival:
This is celebrated in August of every year and mostly by communities of Ogbogu, Akabuta and Obite.

4.13.10 Religious Belief systems

The Christian Religion and African Tradition were present in the study area. About 75% of the population professes Christianity; this is evident by the presence of over 10 different church denominations in the area.

There were also some Muslims and traditional shrine worshippers in the communities but were in small numbers of less than 5%.

4.13.11 Land ownership and administration

In UBETA and the other host communities in Ekpeye kingdom, no land is owned communally and as written in the laws of the land of Ekpeye, lands are owned individually and not communally such that any land owned by a family is inherited by their children (particularly male) of that family. The terms are also made very clear to visitors and land disputes are settled in the ancestral halls of the said family and not the community. Therefore, bringing Eze Nwula (the paramount ruler today) the CDC chairman, the youth president, the women leader and all other institutions is for the better administration of these terms to avert trouble and not to take away the customary title vested on the land owners.

The pattern of land acquisition and tenure in Ogba Kingdom are similar among the communities in the study area. In Obite community, land ownership is by inheritance and on family basis while in Ogbogu, land is communally owned according to the various family compounds.

4.13.12 Land use pattern

Land is relatively in abundance in these communities though most of the land is been increasingly now acquired for oil related activities. Farming is the major occupation of the people. Land is mostly used for farming, oil exploration and infrastructural development. There is also a concentration of commercial activities in Obite, Ogbogu and Akabuka due to its semi-urban nature and oil exploration activities (TEPNG 2016).

4.13.13 Social Conflicts

The respondents and FGD indicated that there has been relative peace in the communities as reported by 41% of the respondents. Most of the conflicts that have been experienced in the community was due to leadership/chieftaincy tussle, embezzlement of public funds and abandonment of projects as shown in Fig 4.18.

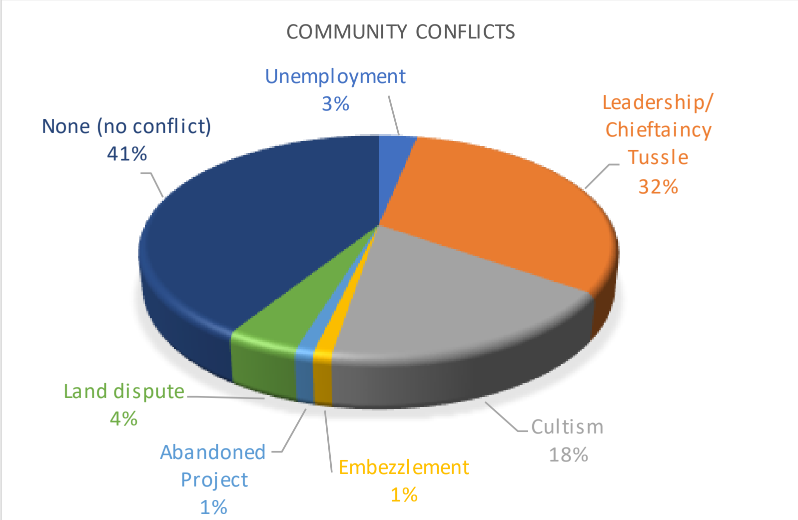


Fig. 4.18: Reasons for recent Conflict in the Communities

4.13.14 Crime and Safety

Theft and crime in the communities are relatively low. There are strong traditional regulations and penalties on assault and stealing. The Youth and CDC in most of the communities are particularly effective at effecting judicial decisions on offenders. There is also presence of organised vigilante groups in most of the communities especially Akabuka, Obite and Ogbogu.

4.13.15 Infrastructural Facilities

The availability and state of educational, health, water supply, electricity, religious and waste management infrastructural facilities in the host communities were documented from focused group discussions, interviews and verified through direct field observations. These facilities generally are present in most communities and are in various states of disrepair and functionality as summarized in Table 4.32. The subsequent sub sections present the availability status of these facilities from respondents in the various communities.

Table 4.32: Infrastructural Facilities in the Host Communities

SN	NAME OF COMMUNITY	SCHOOLS	WATER	MARKET	HEALTH CENTER	ELECTRICITY	CHURCH	SHRINES	REMARKS
1a	Ubeta 1	Functional Government secondary school	Presence of borehole and hand dug well water	Functional market square		The community barely enjoy stable electricity supply	The community have churches	Shrines present	• The secondary school have a borehole structure that is not functional as students drink water from the hand dug well behind the school, • they dispose their refuse by burning.
1b	Ubeta 2	State primary school that needs improvement.	There is a functional borehole in the community and hand dug well water.			The community barely enjoy stable electricity supply	They have churches	Shrines present	These communities have both block and mud houses and also farmlands
1c	Ubeta 3		Presence of a functional community borehole and a mono pump tap			The community barely enjoy stable electricity supply	There are churches.	Shrines present	
1d	Ubeta 4				• Have the Felix Agbani health center Which is in a poor functional state. • Also have a community health center which is not functional	The community barely enjoy stable electricity supply	There are churches in this community		• Felix Agbani health centre only handles immunization which is only on Wednesdays. • The community health center has been taken over by bushes.

S N	NAME OF COMMUNITY	SCHOOLS	WATER	MARKET	HEALTH CENTER	ELECTRICITY	CHURCH	SHRINES	REMARKS
2	Ubarama	Community secondary school and state primary school	There is borehole and hand dug well water	Have market square.	Ubarama health centre which was built by an NGO and Salvation Army church is not functional.	They barely enjoy stable electricity supply	They have churches	Shrines present	• Due to the crisis that ended in 2019/2020 the equipment which was provided by Total E&P to the health centre was stolen. • There are farmlands, block and mud houses.
3	Ubio	• They have functional state primary school that needs renovation and expansion. • No secondary school.	They community borehole is not functional but private boreholes are functional. They have hand dug well water.	They have market sheds	Ubio health centre is not functional due to lack of equipment and health officers and needs renovation and improvement.	They barely enjoy electricity supply	They have churches	They have shrines	Have farmlands, block and mud houses.
4	Ihuaje	They have functional state primary school which needs renovation	They have borehole, mono tap pump and hand dug well water	They have markets stalls	They have a very functional model primary healthcare centre with 10 staff, 23 casual staff and a doctor.	They have relatively stable electricity supply	There are churches	Shrine present	• They need some medical equipment, essential drugs and generator at the model primary health centre. • Community has farmlands, block and mud houses. • they dispose their waste by burning

S N	NAME OF COMMUNITY	SCHOOLS	WATER	MARKET	HEALTH CENTER	ELECTRICITY	CHURCH	SHRINES	REMARKS
5	Akabuka	Have Government secondary school and community primary school	They have borehole, mono pump tap and hand dug well water.	They have market stores stalls and shades.	Has Community health centre which is functional. Has 10 beds, 1 doctor and 11 nurses	They enjoy very stable electricity supply from TOTAL E&P gas turbine.	They have churches	Shrines present	• They have fertile farmlands, block and mud houses. • They dispose their waste by burning.
6	Obite	Functional Government comprehensive secondary school and model primary school. A wing of the secondary school building is used for the primary school.	Have borehole and hand dug well water.	Have market square with stalls and stores.	Obite model health centre is functional with 10 beds a doctor and 16 nurses	They enjoy very stable power supply from TOTAL E&P gas turbine.	They have churches.	They have shrines.	• Obite is known for greenish vegetation and farmland. • Have great farmers and traders. • They have block and mud houses. • They dump their waste at dump sites.
7	Ogbogu	They have a functional community primary and community secondary school.	They have borehole and hand dug well water.	They have a market square with stalls and stores	The Ogbogu community health Centre is functional. with 10 beds 1 doctor and 8 nurses. They need generator.	They have relatively stable power supply from TOTAL E&P gas turbine.	They have churches	They have shrines.	• The community has farmlands, great farmers, business men/women in addition to traders. • Have farm lands. • Presence of block and mud house. • They dump there refuse at dump sites
8	Anwunugbokor	Community primary school is functional	They have borehole and hand	They have a market square	They don't have a health centre	Have poor power supply	Have churches	They have shrines	They have farmlands, block and mud houses.

S N	NAME OF COMMUNITY	SCHOOLS	WATER	MARKET	HEALTH CENTER	ELECTRICITY	CHURCH	SHRINES	REMARKS
		but it is in a bad infrastructural state. No secondary school	dug well water	with stalls and sheds					They dispose their refuse by burning

4.13.16 Portable water

The main sources of drinking water in the communities were borehole (community and private water schemes) and hand dug wells some of which has mono pump taps Plates 4.12g to 4.12l). Most of the communities had at least one functional borehole water scheme provided by Total Exploration and Production Nigeria (TOTAL E&P). Fig 4.19 shows the availability of Portable water in the host communities from respondents.

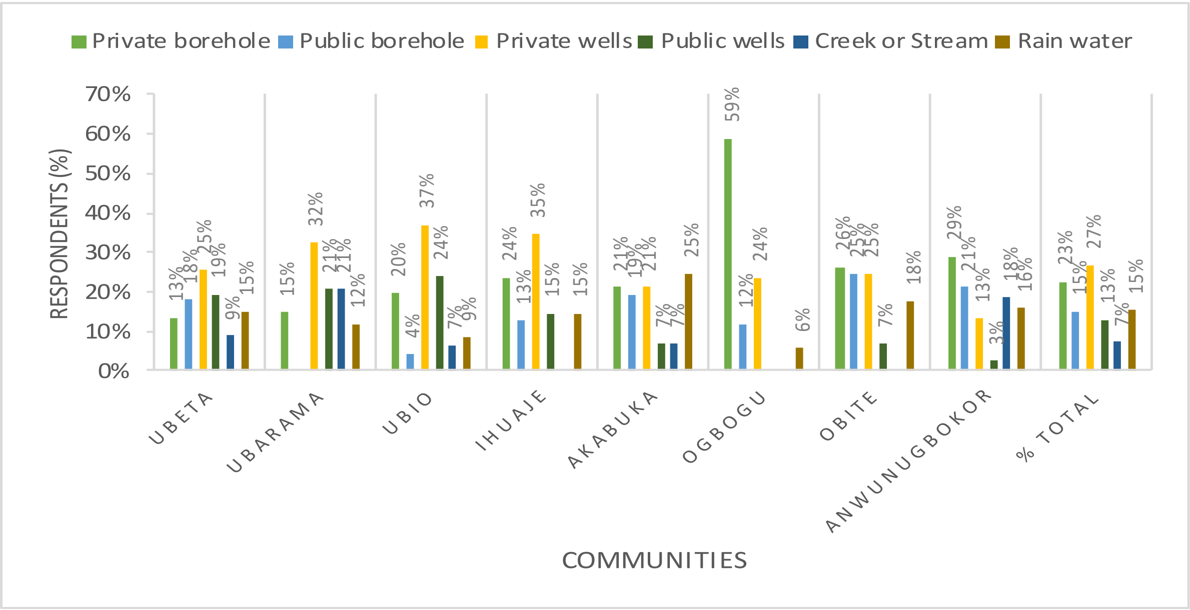


Fig. 4.19: Availability of Water Supply in the Community

Plate 4.12g: Typical hand dug well at Ubarama

Plate 4.12h: Community Water Scheme at

Plate 4.13i: Borehole with Monopump at Ihuaje

Plate 4.12j: Community Borehole at Ubio (not

Plate 4.12k: Ubeta Community Borehole

Plate 4.12l: Borehole at Obite

4.13.17 Sanitation facilities

Responses from most of the participants at FGDs revealed that most members of the communities use pit latrines which are usually less than 100 meters to their living houses. Also, open defecation in the bushes was common while few use the water closet toilet.

4.13.18 Health Facilities

The availability of healthcare facilities in the communities from respondents showed patent medicine shops having 56% and followed closely by primary health care facilities (40%) with none at Anwunugbokor, while the hospitals were few (4%) and located in only Ogbogu and Obite (Fig 4.20). Our FGD and site visit showed that Ubarama health centre has long been non-functional and must have attributed to zero availability response by the respondents from the community.

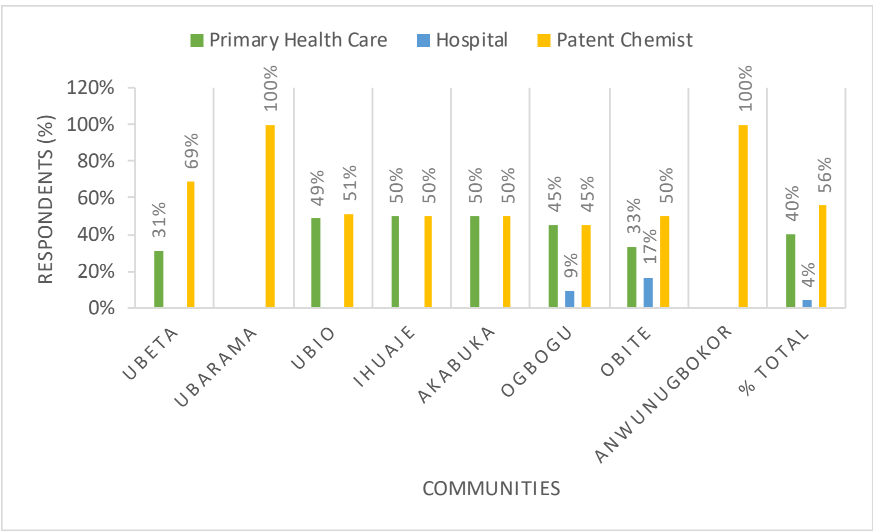


Fig. 4.20: Availability of Health Facilities in the Community

4.13.19 Solid Waste Management

The wastes generated in the communities were mainly garbage and other domestic wastes; and were often dumped openly and burnt close to residential houses. In Obite and Ogbogu additionally, the community members make use of designated dump sites for solid waste disposal (Plates 4.12m and 4.12n).

Plate 4.12m: Dump site at Akabuka Secondary School

Plate 4.12n: Dump site behind Obite Market

4.13.20 Housing

Most houses in the communities were built with cement blocks and 'zinc' roofing sheets, with few mud and thatch houses scattered in the communities (Plate 4.12o to 4.12t). Houses were not often built too close to each other. Most of the rooms had adequate ventilation and were not usually overcrowded. The houses are not adequate in size for greater number of the households according to 64% of the respondents (Fig. 4.21) and confirmed from field observation. Also 73% of the respondents indicated that between a quarter (1/4) and a half (1/2) of the households in the communities have modern facilities/conveniences (e.g. television, fan, motorcycle etc.).

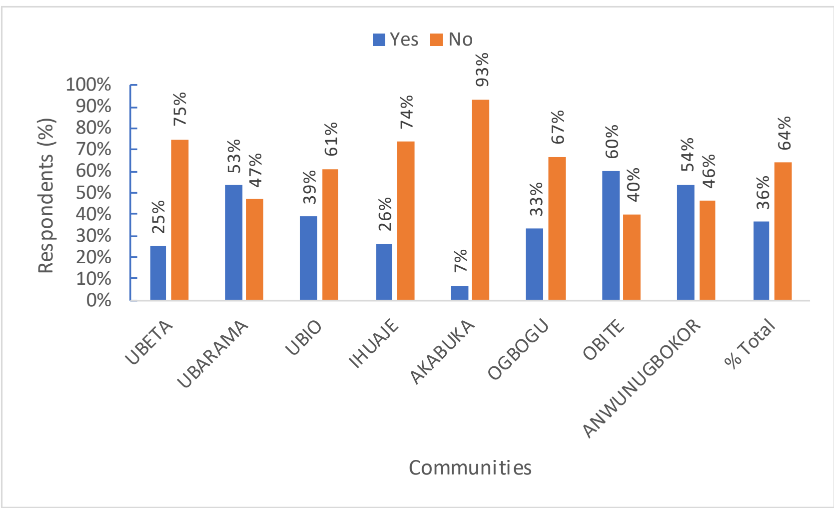


Fig. 4.21: Adequacy of Living Accommodation

Plate 4.12o: Typical compound at Ubarama with Mud house

Plate 4.12p: Typical Compound at Ubeta with mud house

Plate 4.12q: Block house at Ubeta Beside the Government Secondary school

Plate 4.12r: Typical compound at Ihuaje with block house

Plate 4.12s: A residential building and compound at Akabuka

Plate 4.12t: Residential House with block work at Obite

4.13.21 Electricity Supply

The respondents from Ubeta, Ubarama, Ubio, Ihuaje and Anwunugbokor (41%) indicated that they get their electricity supply from the national grid via PHEDC but do not enjoy it as a result of the epileptic nature. Most (about 31%) of the respondents from these communities use private generators on daily basis (Table 4.22). The other communities of Akabuka, Ogbogu and Obite are not on the national grid but have relatively stable and steady power supply from TOTAL E&P gas turbine. Few (about 3%) of the respondents make use of solar power to augment their power needs.

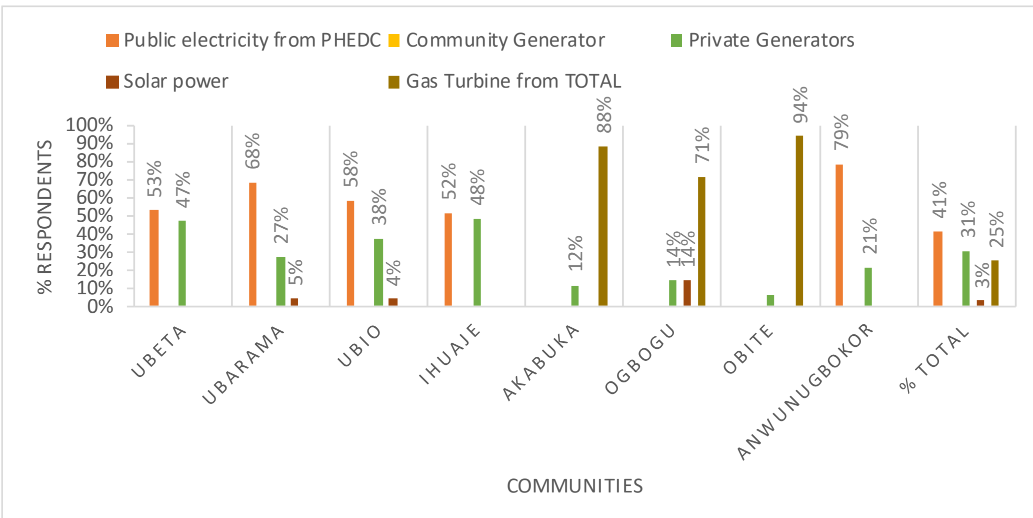


Fig. 4.22: Electricity Supply in the Communities

4.13.22 Schools

All the communities have at least one primary school that is accessible to the inhabitants. There are also secondary schools in the communities except Ubio, Ihuaje and Agwunugbokor (Fig 4.23). However, from focused group discussions / interviews and field observations, these schools are in different states of functionality and infrastructural decay as shown in summary Table 4.32 and Plates 4.13a to 4.13l. There are no tertiary institutions in the area as the closest institutions are in Omoku (ONELGA L.G.A) and Port Harcourt in Rivers State.

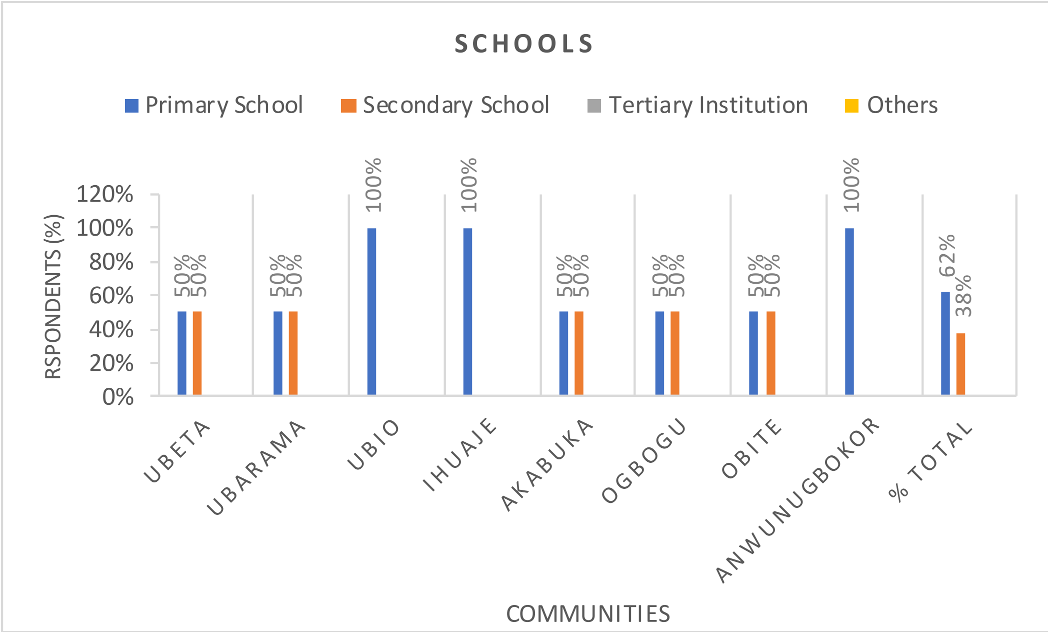


Fig. 4.23: Availability of Schools in the communities

Plate 4.13a: Ubeta 1; Government Secondary school

Plate 4.13b: Ubeta 2; Com. Primary school

Plate 4.13c: Agwunugbokor; Community Primary

Plate 4.13d: Akabuka; Government Secondary school

Plate 4.13e: Ubarama; Community Secondary School

Plate 4.13f: Ubrama; Community Primary School

Plate 4.13g: Obite; Comprehensive Government

Plate 4.13h:Obite; Community Primary School

Plate 4.13i: Ogbogu; Community Primary School

Plate 4.13j: Ogbogu; Community Primary School

Plate 4.13k: Ubio; State Primary School

Plate 4.13l: Ihuaje; Universal Primary School

4.13.23 Markets

The markets are mostly in the local village square with no permanent stalls according to 43% of the respondents, while others are the open stall market system (32%) and the permanent lockup stalls (26%) as shown in Fig. 4.24 and Plates 4.13m to 4.13x.

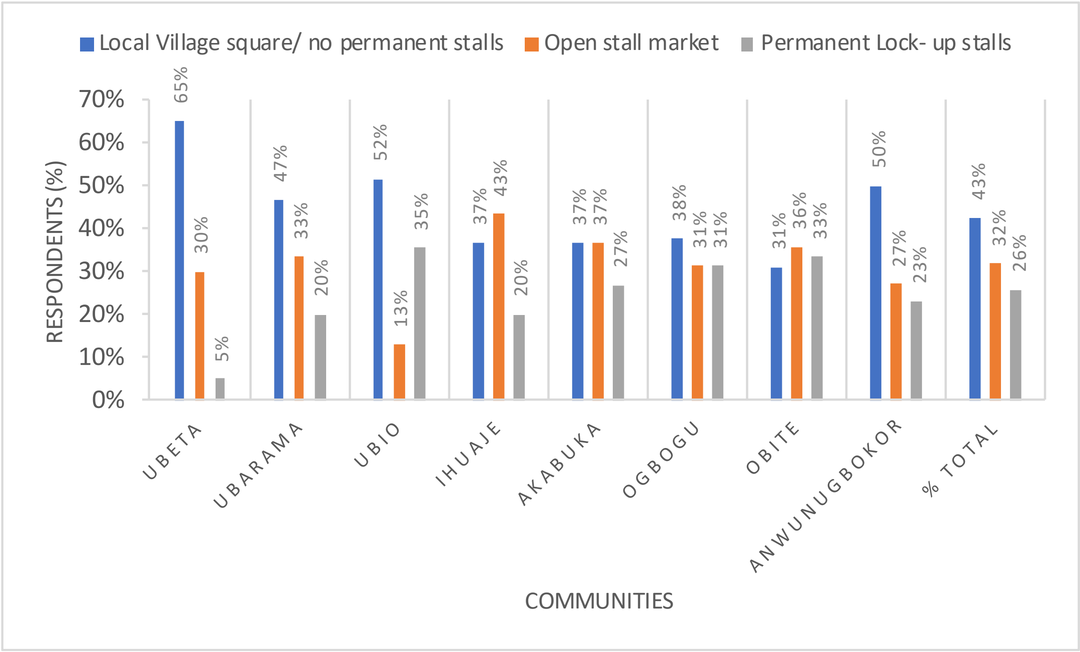


Fig. 4.24: Availability of markets in the communities

Plate 4.13o: Ogbogu market (front view)

Plate 4.13p: Ihuaje market

Plate 4.13q: Ubarama market square

Plate 4.13r: Ogbogu market stalls

Plate 4.13s: Market shops at Akabuka

Plate 4.13t: Ihuaje market stores

Plate 4.13u: Obite market (back view)

Plate 4.13v: Anwunugbokor market

Plate 4.13w: Akabuka model market

Plate 4.13x: Akabuka mini market

4.13.24 Transportation

The major means of transportation in the study area motorcycles and bicycles which constitute 62% of the respondents. Buses and cars are also used for transportation in the area by about 22% of the respondents while about 12% use tricycles popularly known as keke. (Fig 4.25)

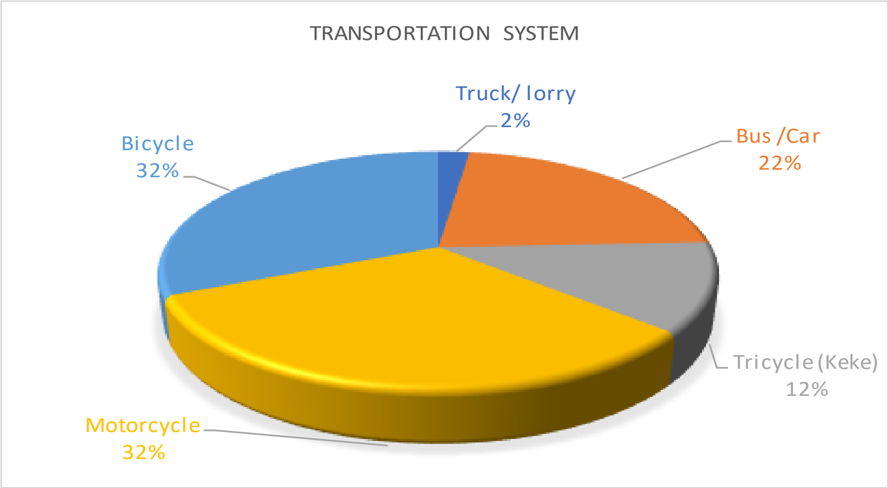


Fig. 4.25: Availability of Transportation in the communities

4.13.25 Other Available Facilities

The respondents and feedbacks from the focused group discussions showed that all the communities in the proposed project area have their town halls. The police stations/police post and civic centers are present in Ubeta, Ubio and Obite as shown in Fig 4.26.

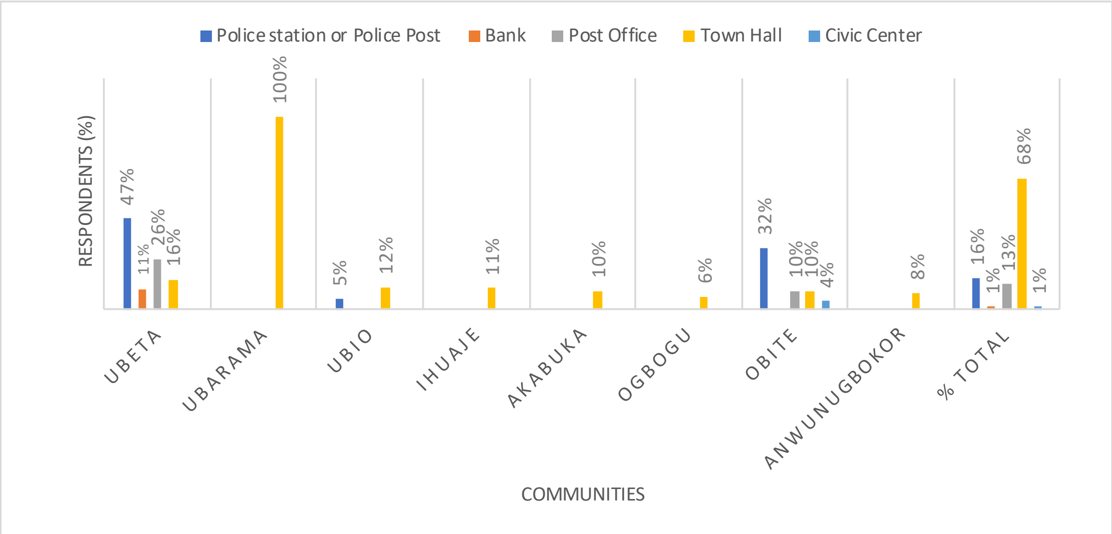


Fig. 4.26: Availability of Other Facilities in the communities

4.13.26 Community Perceptions of TOTAL Operations in their Area

<u>Closeness of human habitation to TOTAL E&P -related installations/ Facilities in the communities</u>

The community stakeholders during the focused group discussion and respondents from the in-depth interview expressed concern over the closeness of the oil and gas facilities to their living accommodation and farms (Plates 4.14a to 4.14f). A greater percentage (about 72%) of the respondents were of the view that the closest of these installations are less than 500m from their living houses or farms. Some (about 12%) indicated 500 – 1000m proximity to these TOTAL E&P facilities as shown in Fig 4.27

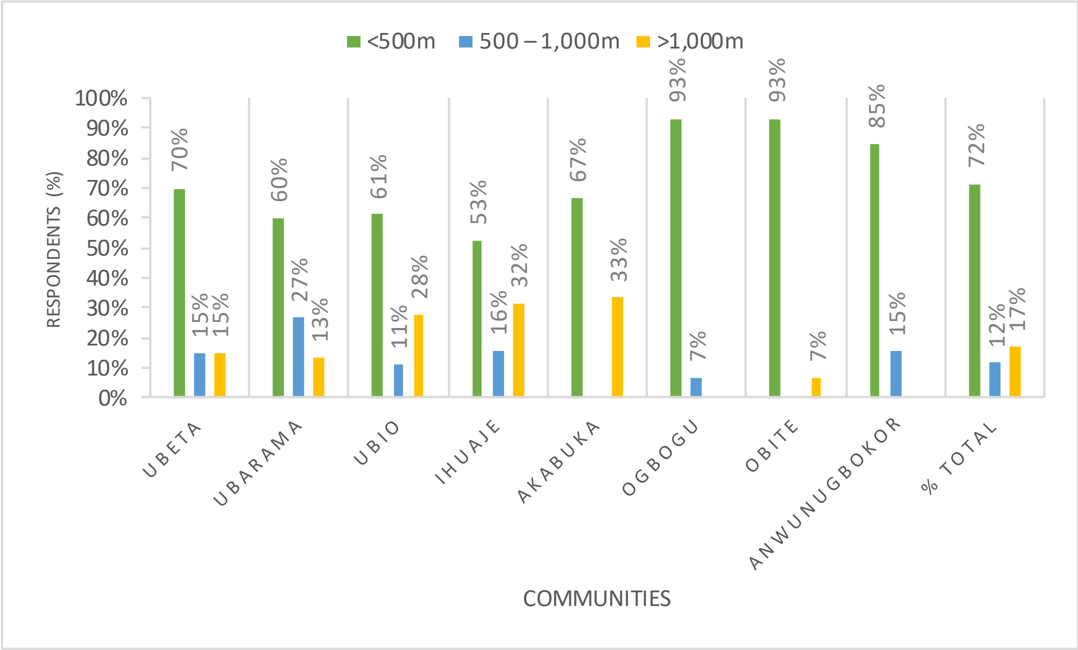


Fig. 4.27: Community Perception on their Proximity to TOTAL Installations / Facilities

Plate 4.14a: Building about 20metres from the gas

Plate 4.14b: Cassava Farms around the Pipeline

Plate 4.14c: Housing close to Pipeline ROW at Akabuka

Plate 4.14d: Commercial Wielding and Fabrication Activity close to Pipeline ROW at Akabuka

Plate 4.14e: Cassava Farms around the Pipeline ROW at LNG node (in front of TOTAL node)

Plate 4.14f: Cassava farms and Palm Fruits around Pipeline ROW at Ubarama

Respondents' Perception on implementation of MOU by TOTAL E&P

In general, only 25% of the respondents agreed that TOTAL has been keeping with the MOU agreement with the community while 53%, in their own view, believed that the MOU agreement is not being kept by TOTAL. The Other 22% of respondents do not know if it's being kept or not (Fig 4.28).

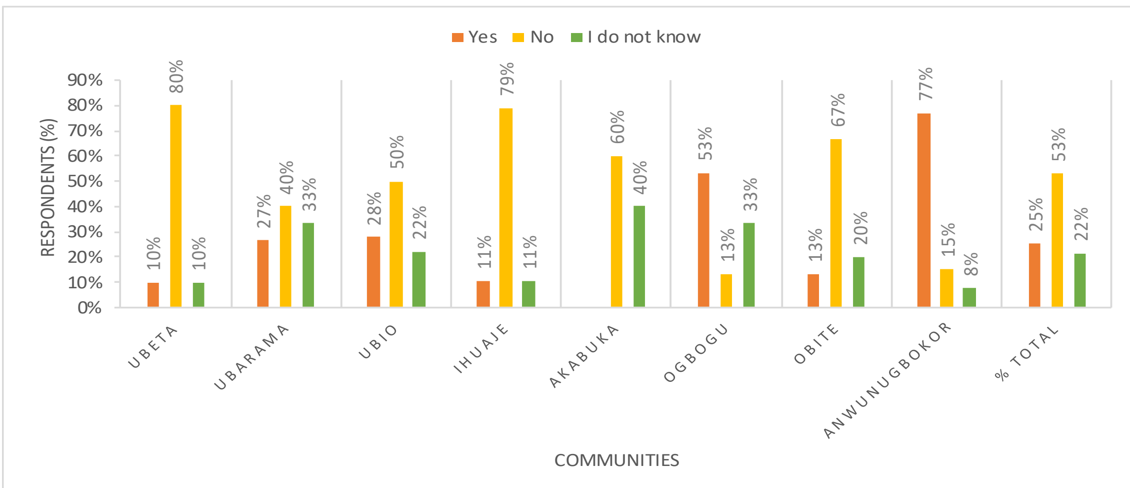


Fig. 4.28: Community Perception on Implementation of MOU by TOTAL E & P

4.13.27 Perceptions and Expectations of Communities on the Proposed Total Ubeta Field Development Project

One critical aspect of the survey was to obtain the views and expectations of communities on the proposed Ubeta Field development project.

Awareness of the Proposed Ubeta Field Development Project

The study showed a high level of awareness (85%) by respondents of the proposed project by community stakeholders (Fig. 4.29). Most of them confirmed that information on the project was communicated to them directly or indirectly by their representatives at the stakeholder's engagement / sensitization meeting for the proposed project EIA that was conducted by TOTAL on the 16th of December 2022. The respondents also confirmed that the information from the workshop was also cascaded down to other community members through their chiefs/CDC.

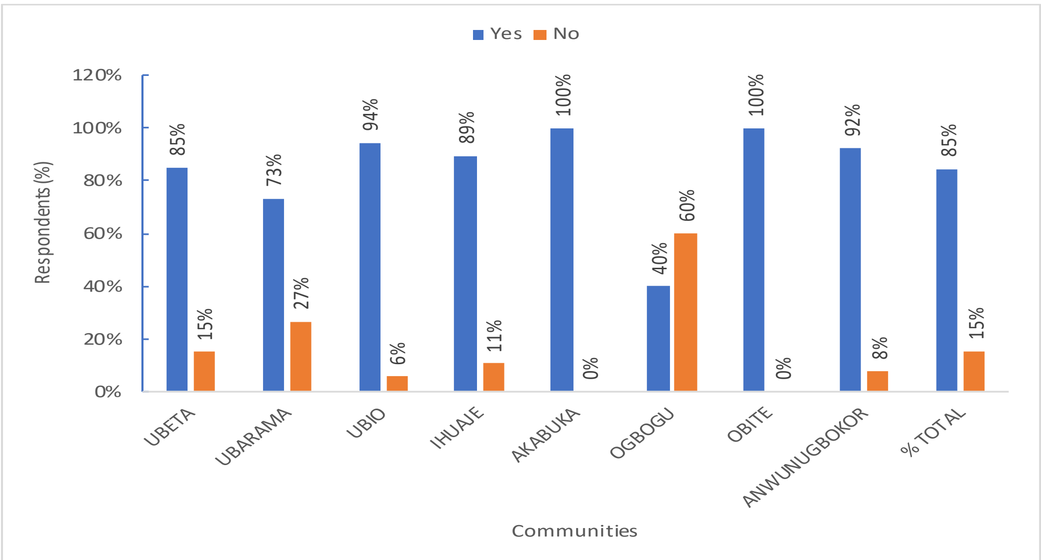


Fig. 4.29: Community awareness of the proposed TOTAL Ubeta Field Development

Possible Positive Impacts of the Project

As expressed in the focused group discussions, the respondents of the in-depth structured interview also confirmed their expectations of employment and general development of their communities as the key benefits from the proposed project. Also, is the provision of Infrastructures (Electricity, water, etc.) amongst other benefits as shown in Fig. 4.30.

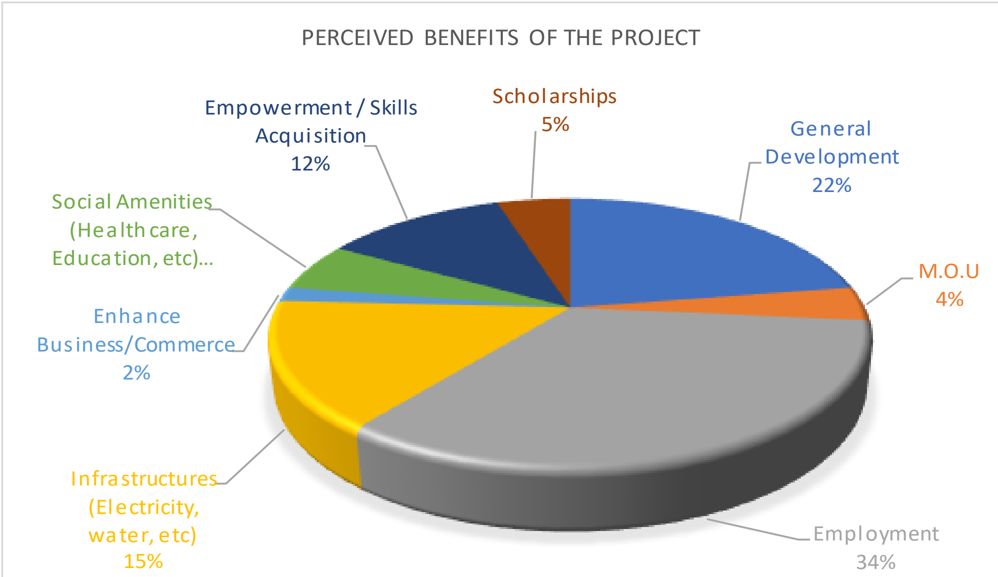


Fig. 4.30: Beneficial Aspects of the Project

Possible Negative impacts

The respondents when asked if they know of any negative socio-economic impact on their communities that could occur as a result of the project, their response identified the following in the proportions shown in Fig. 4.31.

- Environmental Hazard (pollution, degradation, etc.)
- Loss of Farmland/agriculture
- Conflict
- Neglect & Exploitation
- Health Issues

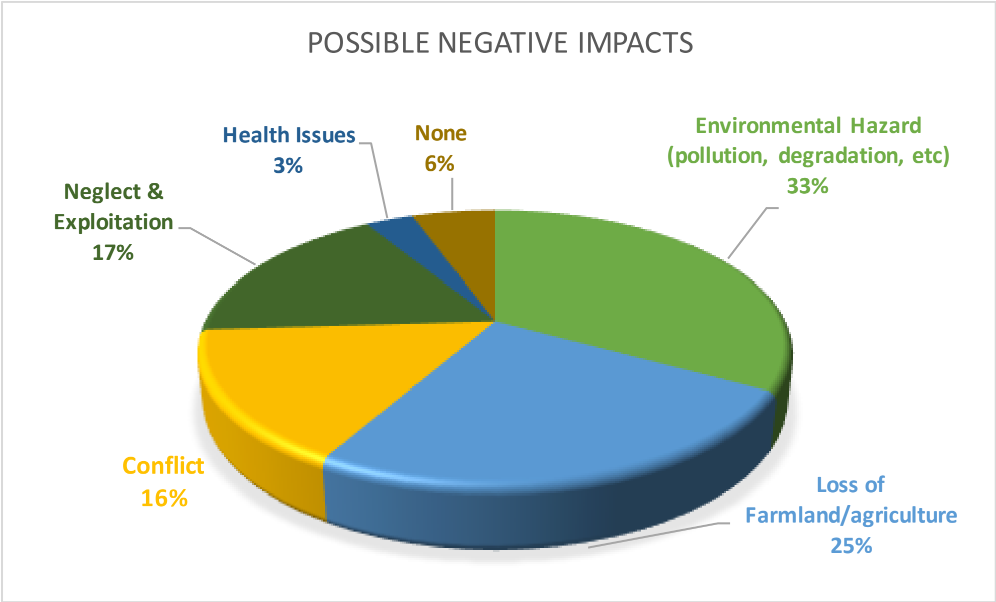


Fig. 4.31: Possible Negative Impacts of the Project

Respondents Personal expectations of the project

Fig 4.32 shows the expectations of the respondents from the different stakeholder communities. Employment, Loan Facility/Empowerment/ Scholarship and general development of the communities happens to be top on the expectation list of the respondents with an aggregate of 65%. This was followed by water supply (11%) especially at Ihuaje, Ogbogu and Anwunugbokor. Others down the list are Skill acquisition, Security, MOU, Electricity, Healthcare, Cordial relationship and Basic amenities with aggregate of 25%

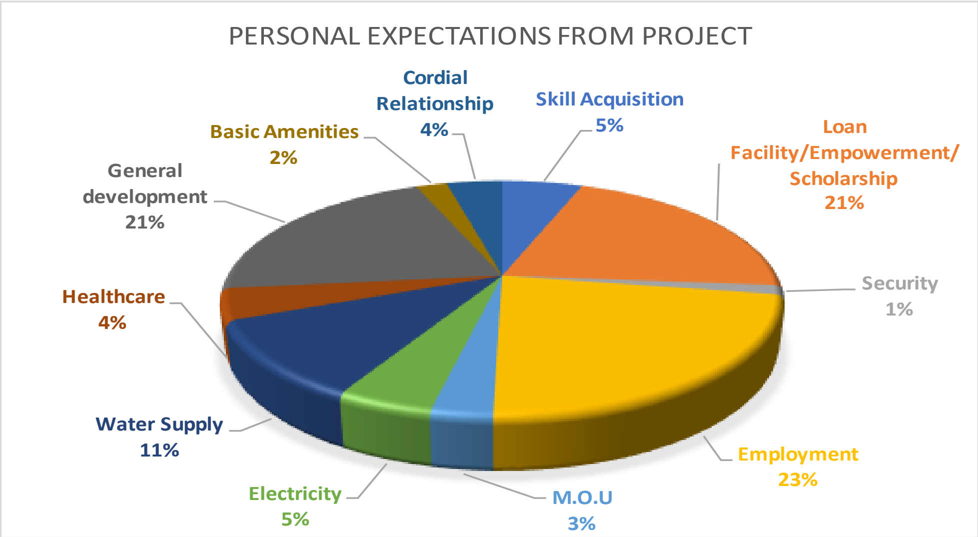


Fig. 4.32: Respondents Personal Expectations from the Project

Perception about Acceptance of the Project in the Communities.

Most of the respondents (83%) including community leaders and other stakeholders expressed their readiness to welcome the project. The willingness to welcome the project cannot be unrelated to the perceived benefits associated with the project as reference is usually made to the employment it will create during the period of construction and operations as well as the general economic benefit and perceived community developmental advantages accruable from the project. However, a 1.5% of the respondents showed displeasure for having the project. Their disapproval was basically due to their perceived experience of environmental degradation, neglect and unfulfilled MOU's with TOTAL in their operations in the area. The remaining 15% of the respondents have mixed fillings and were uncertain about accepting or not accepting the project (Fig. 4.33).

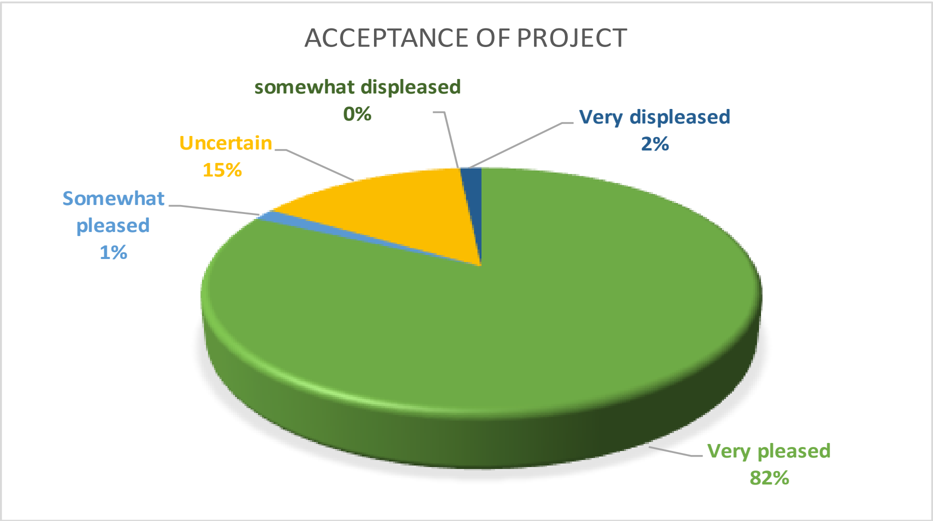


Fig. 4.33: Acceptance of the Proposed Project by Respondents

4.14 HEALTH IMPACT ASSESSMENT (HIA)

The purpose of the Health Impact Assessment survey was to conduct a baseline health survey, evaluate current health statistics (disease prevalence, disease trends, morbidity / mortality pattern and rates, immunization status etc.) and disease prevalence of the host communities of the proposed Ubeta Field Development.

The survey was conducted in the eight host communities of Ubeta, Ubarama, Ubio, Ihuaje, Akabuka, Ogbogu, Obite and Anwunugbokor.

Mortality

There was a total of 58 cases of mortality comprising 30 males (52%) and 28 females (48%) reported from the sampled households for the year 2017 to 2021 (Fig. 4.34). The Frequency of mortality amongst the affected households was mostly one person in 5yrs and constitute 52% while 31% involved between 2 to 3 persons (Fig 4.34). More deaths were recorded by respondents between 2017 and 2020 (Fig 4.35). The working-class age (15 – 64yrs) constituted about 64% of the mortality rate while the elderly and children/young adolescents were 19% and 17% respectively (Fig 4.36).

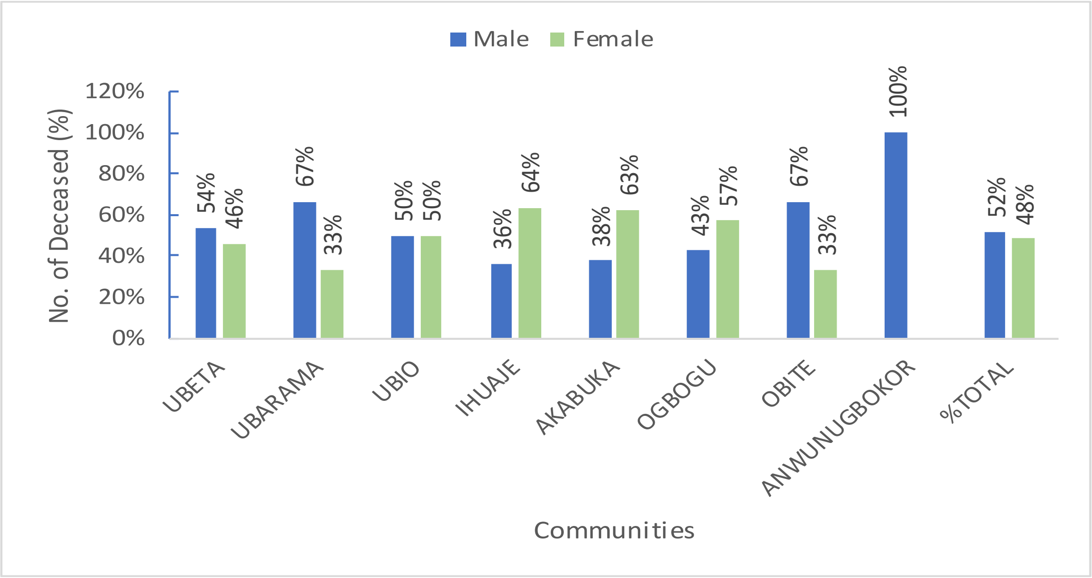
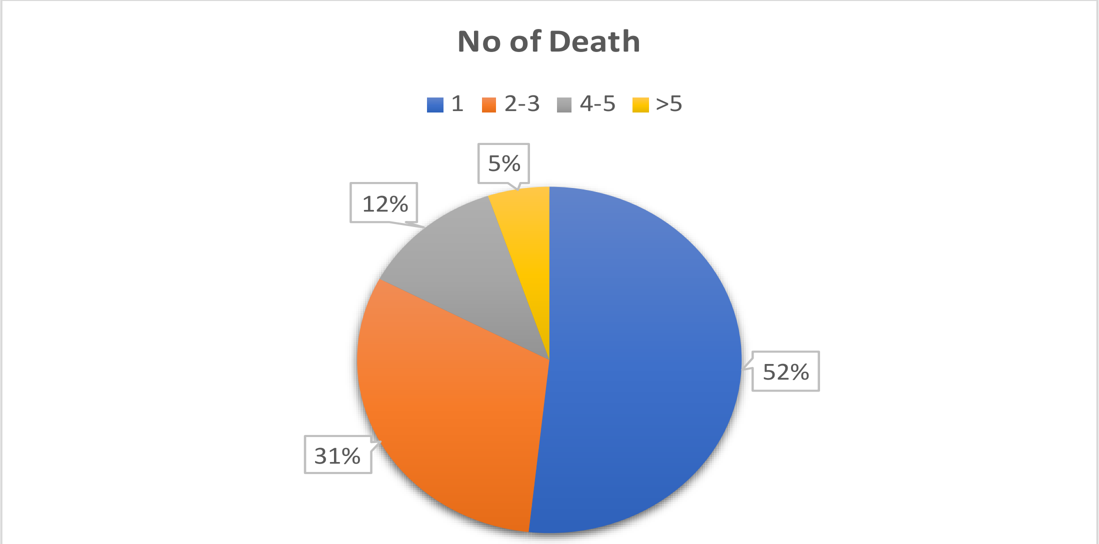


Fig 4.34: Mortality rate for sampled households by sex between year 2017 to 2021



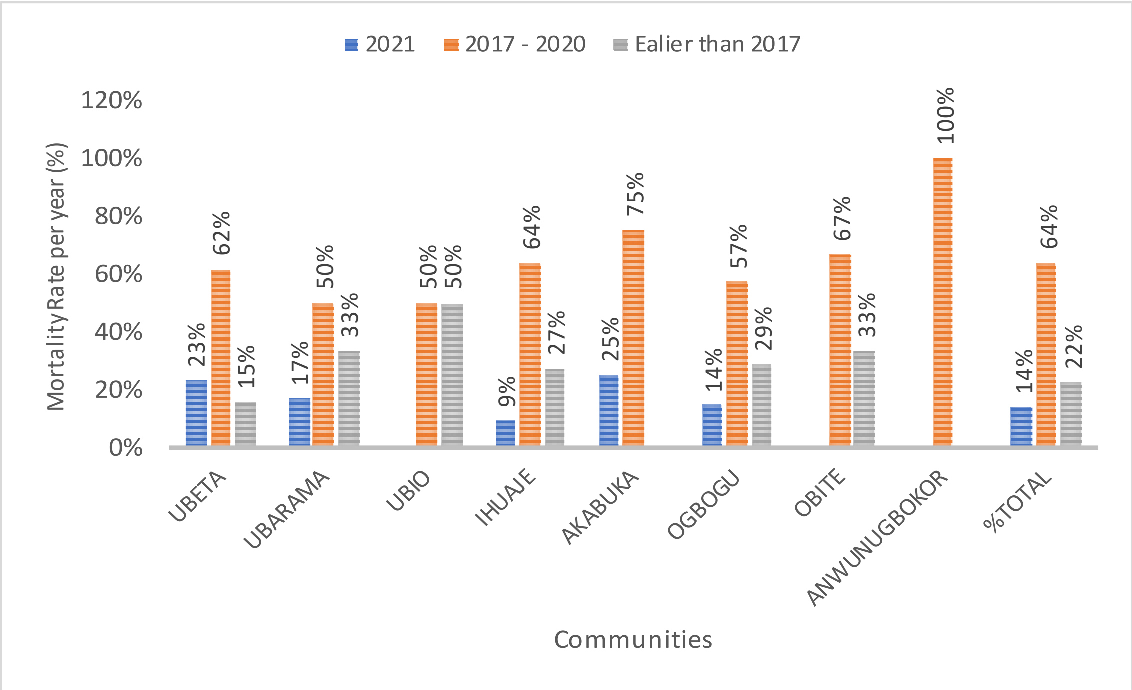


Fig 4.36: Mortality rate by year in sampled households in the community

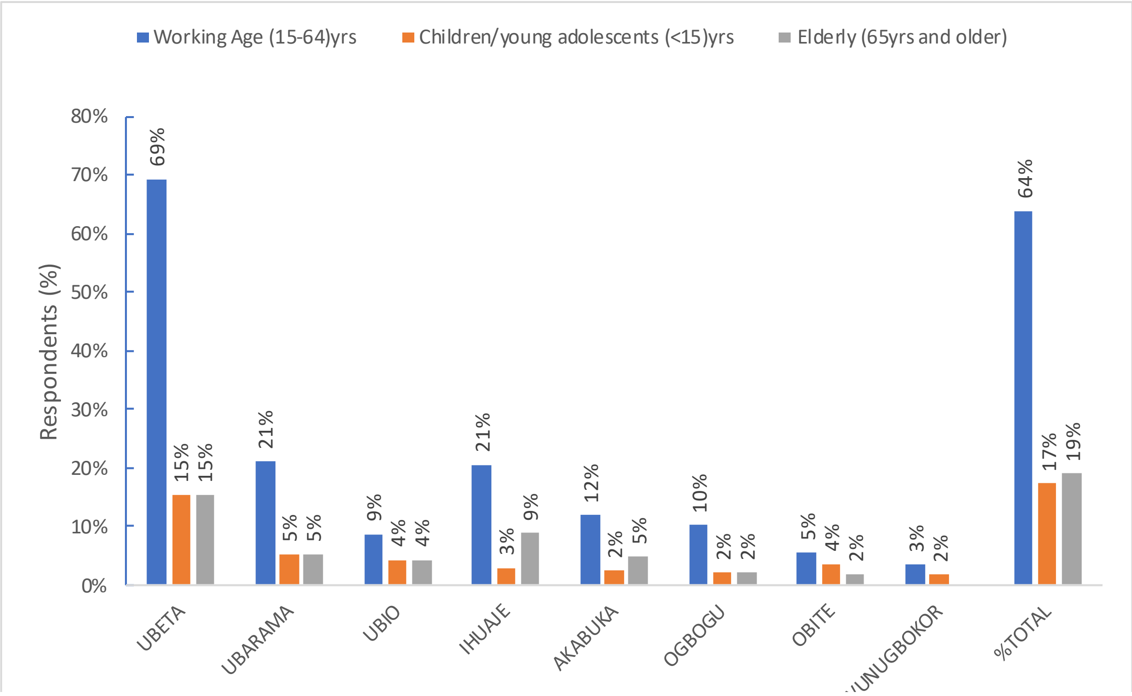


Figure 4.38 presents the probable causes of mortality reported by households during the study; while Fig. 4.38 presents the common causes of mortality in the community from structured questionnaires, focused group discussions and interviews. On the probable cause of death, 48% of the respondents attributed it to general sickness while the other 52% was spread across other sources as shown of which only 7% was attributed to natural death as a result of old age.

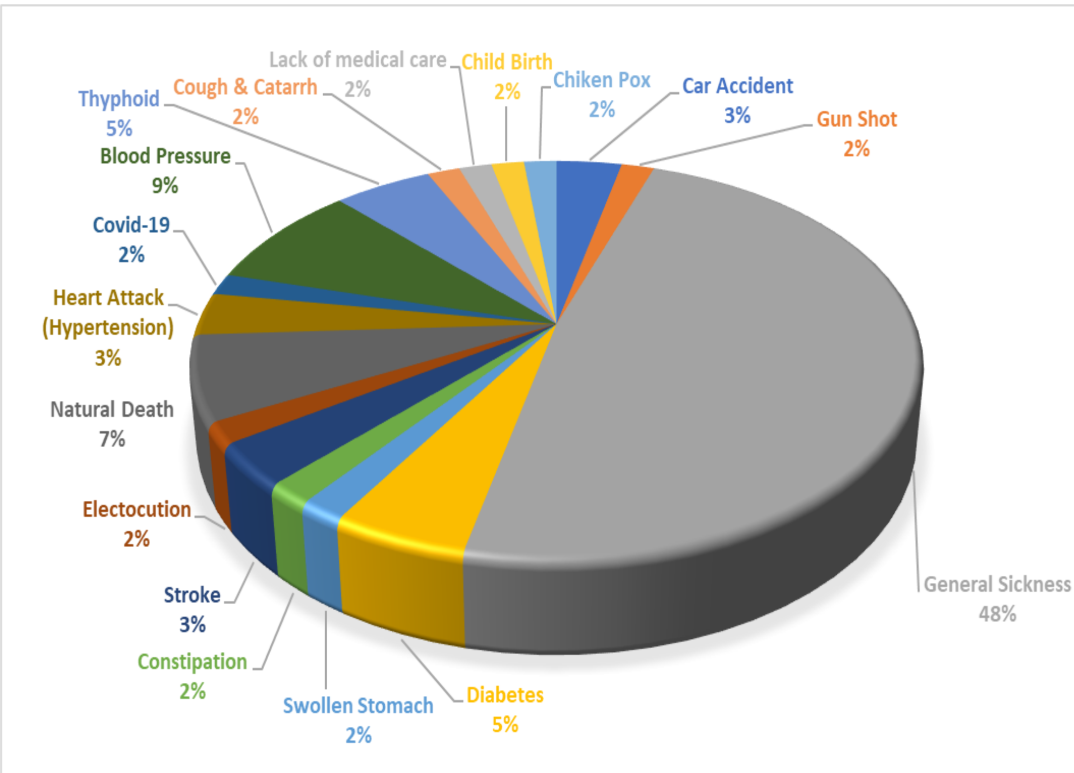


Fig. 4.38: Probable cause of Mortality in the households

The data presented on common cause of death in the community (Fig 4.39) indicated that Malaria (24.4%) was the highest cause of mortality, followed by general sickness (15.1%), typhoid fever (11.6 %), diabetes (9.3%), Hypertension (9.3%), etc. Interestingly, poverty was ranked as the third highest common cause of mortality in the community with 11.6%. The others (18.7%) were asthma, gun shot, dysentery, tuberculosis, kidney failure, lack of medical care and accident.

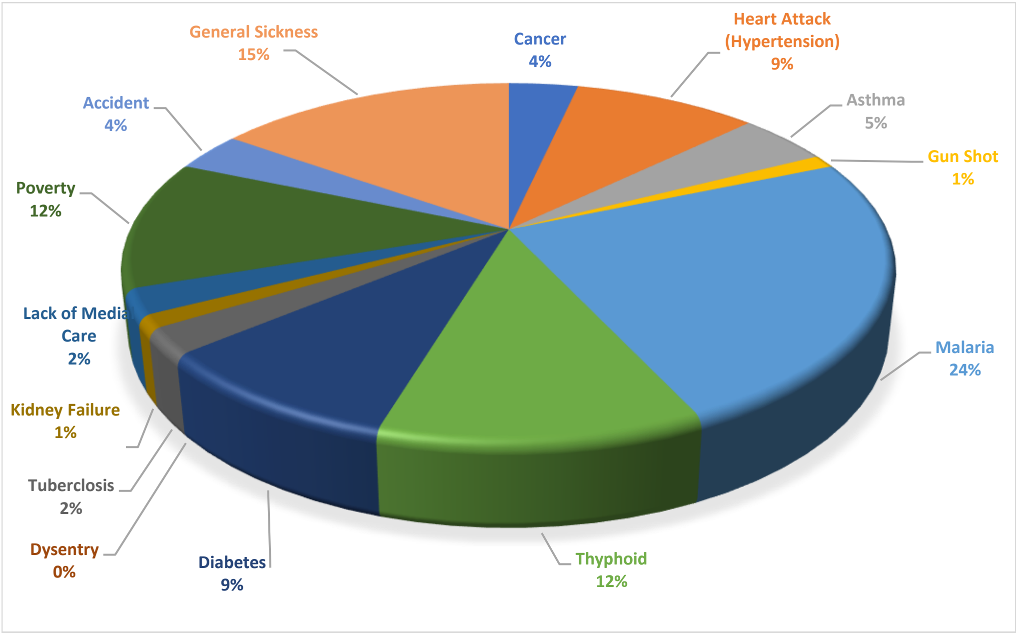


Fig. 4.39: Common Causes of Mortality in the Community

Morbidity

The most common cause of disease amongst households is mosquitoes from stagnant water bodies / grown bushes as reported by 52% of respondents (Fig. 4.40). This is followed by Environmental Pollution (28%), Poor and untreated Drinking Water (15%), Poor Nutrition / Feeding Habits (4%) and Poor Sanitary / Hygiene Condition (1%). None of the respondents subscribed to lack of good exercise as a common cause of morbidity.

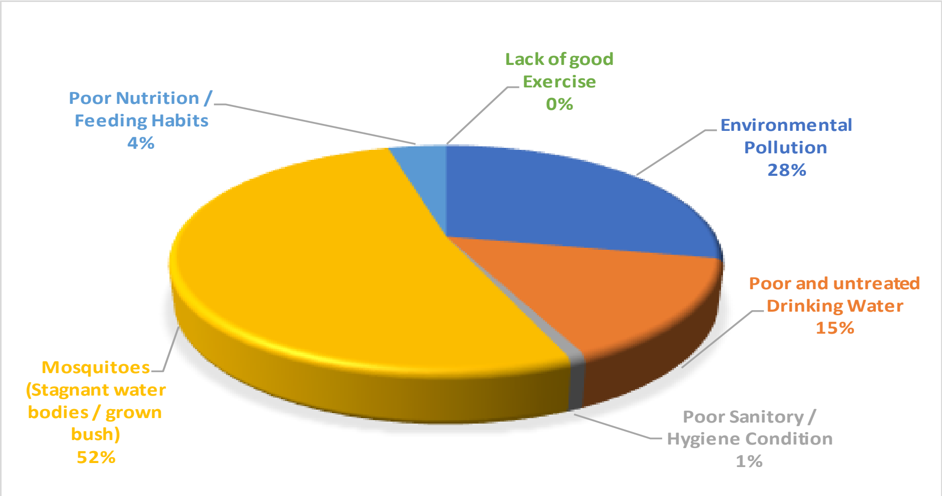


Fig. 4.40: Common Cause of Morbidity in the Households

The frequency of visits by household members for treatment at health facilities since past one year showed that a cumulative of about 70% of the households have visited between two to twelve times in the year 2020. Those that visited once and more than twelve times were 18% and 10% respectively. The other 1.5% of the households have not visited the health facilities at all for treatment (Figs 4.41 and 4.42).

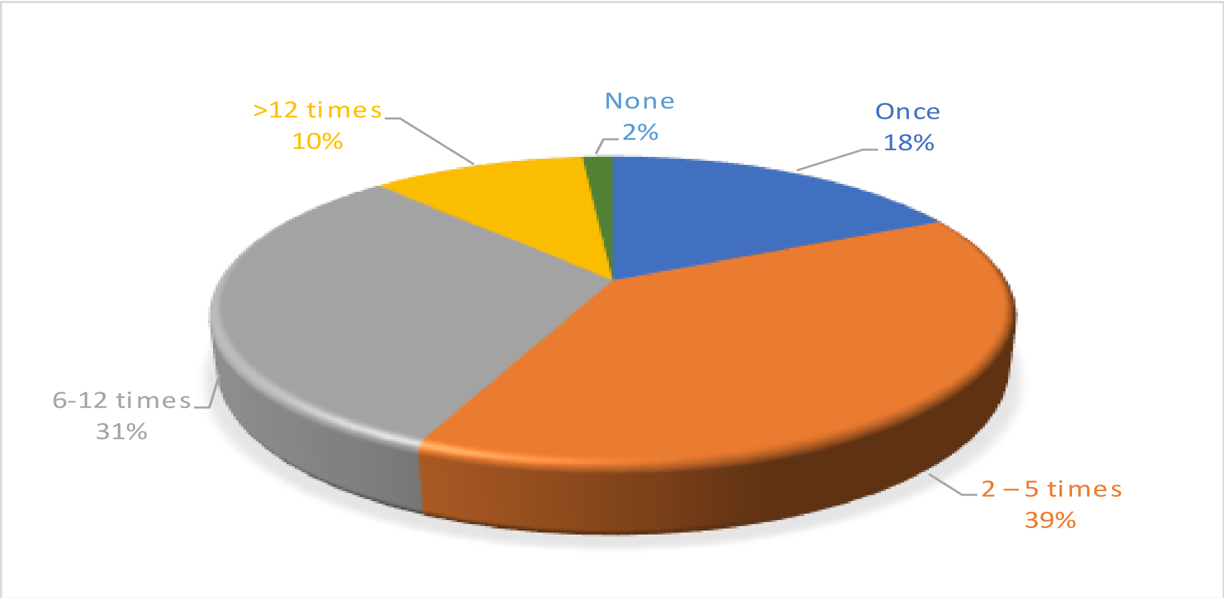
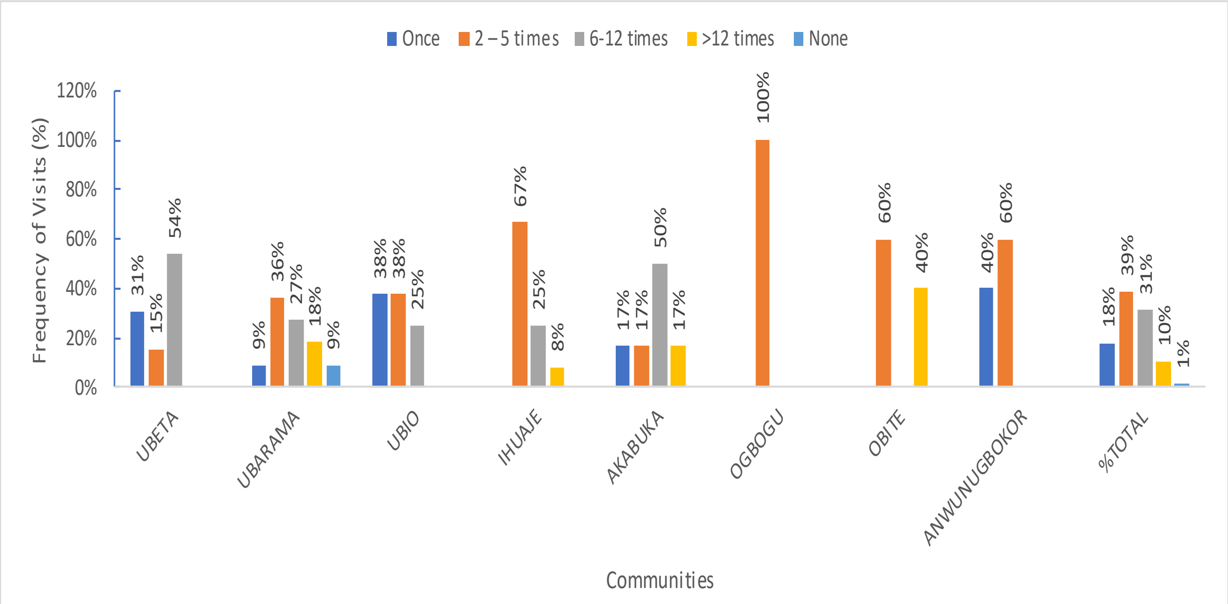


Fig. 4.41: Frequency of visits by household members for treatment at health facilities



The ailment (health condition) that necessitated visit to the health facilities were mostly malaria, general illness and typhoid which constitute about 76% of the respondents (Fig. 4.43). The other 24% were due to diabetes, blood pressure, eye sight issues, severe headache, asthma, fever, cough / catarrh, ulcer, skin disease and general routine checkup (Fig 4.44).

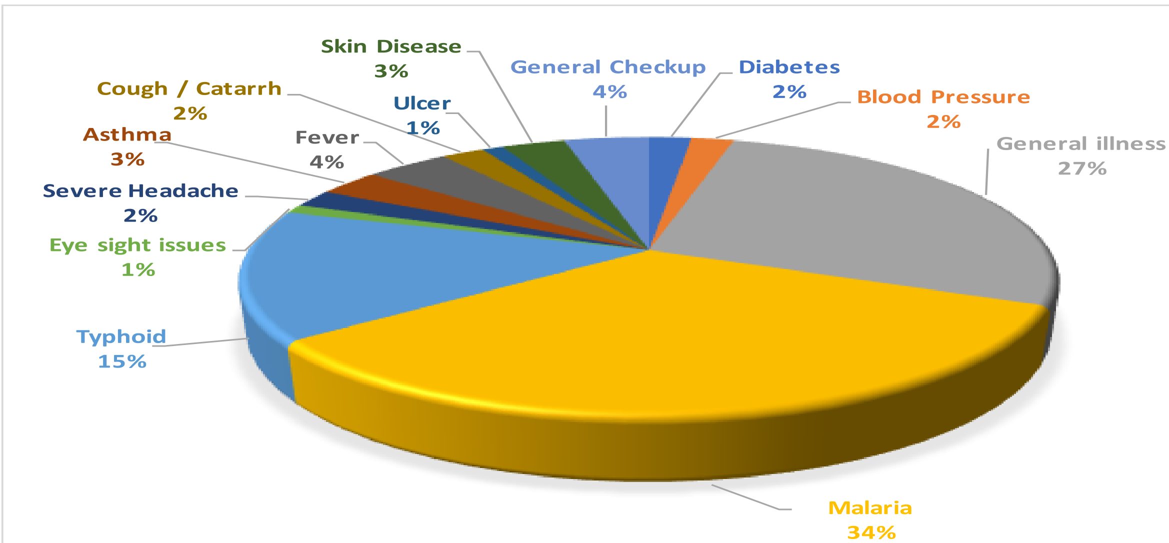
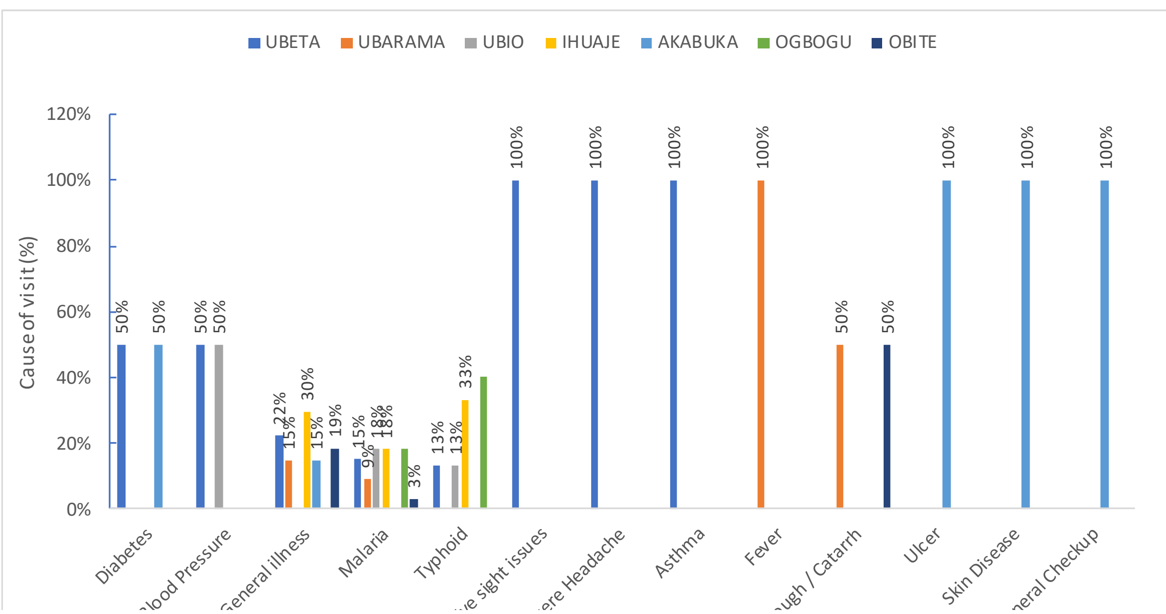


Fig. 4.43: Health Conditions - visits by household members for treatment at health facilities



The frequency of admission cases in the health facility by respondents for the year 2020 was mostly once to twelve times in the year with aggregate of about 70% while greater than 12 times was about 5%. The remaining 25% of the respondents weren't involved in any ailment that led to admission into any of the health facilities as shown in Fig 4.45. The surgical cases amongst the respondents was once to five (1-5) times in the year for about 90% of the sampled population and the remaining 10% had none (Fig 4.46).

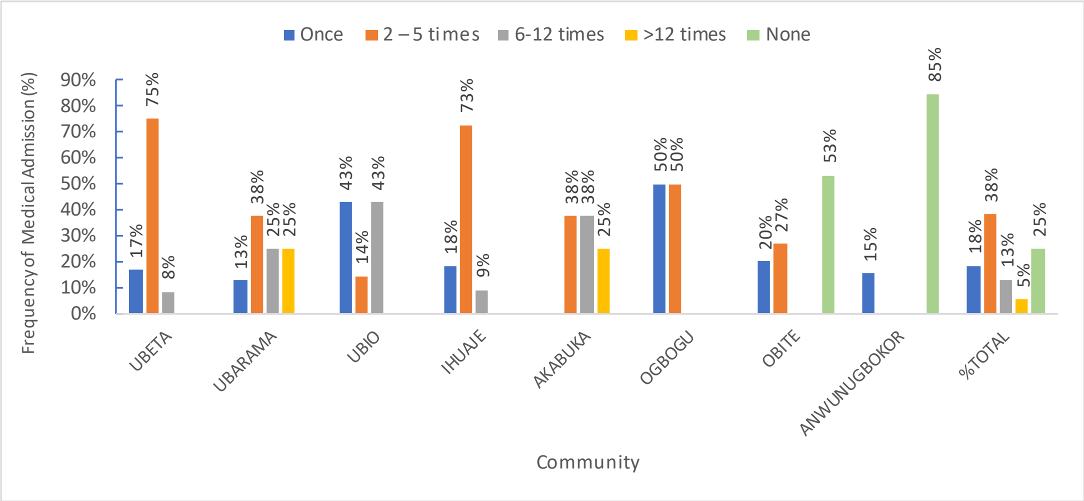
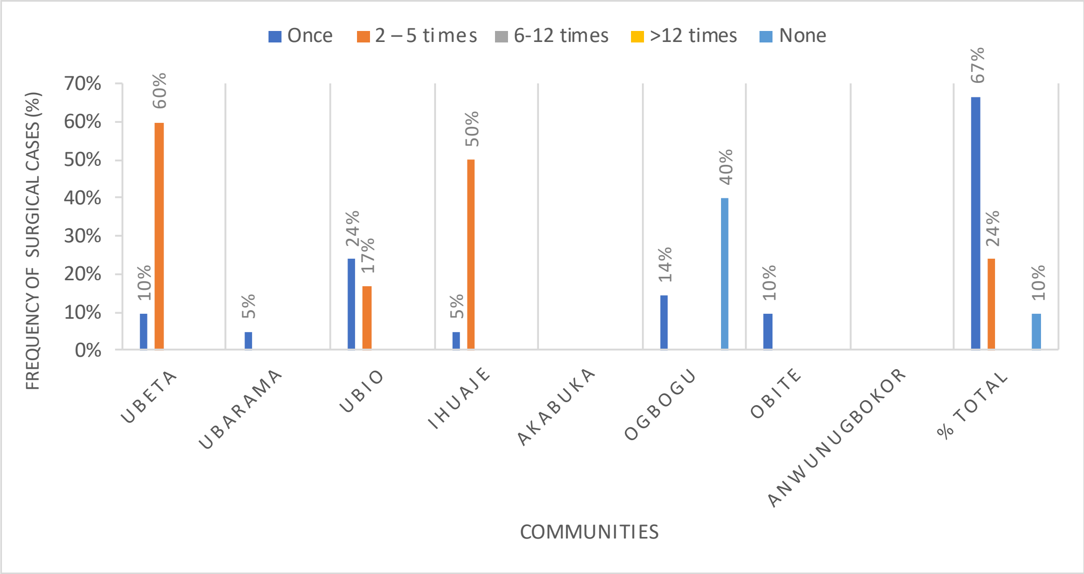


Fig. 4.45: Frequency of Medical Admission cases amongst household members in the past one year



Preferred health treatment pattern by 73% of households was the orthodox medical treatment. The others followed in the order native treatment (12%) > patent medicine stores (9%) > spiritual healing (4%) > drug hawkers (2%) as shown in Fig 4.47. It is interesting to note that in-spite of the presence of the health centers in most of the communities the traditional medicine and spiritual healing homes, still enjoy a reasonably high patronage, as gathered from the survey.

For baby delivery, Fig. 4.48 shows that 82% of the respondents preferred nurse/midwives as against 12% that subscribed to use of native (traditional) child birth attendants. The Traditional Birth Attendants (TBAs) interviewed expressed ignorance of standard practices in child delivery but admitted to referring complicated cases encountered to the health centers or private hospitals in the area.

The Chronic diseases experienced in households of the sampled population indicated higher occurrence of malaria (15%), Hypertension (13%), diabetes (11%), Cough (10%), typhoid (10%) than the others as shown in Fig. 4.49.

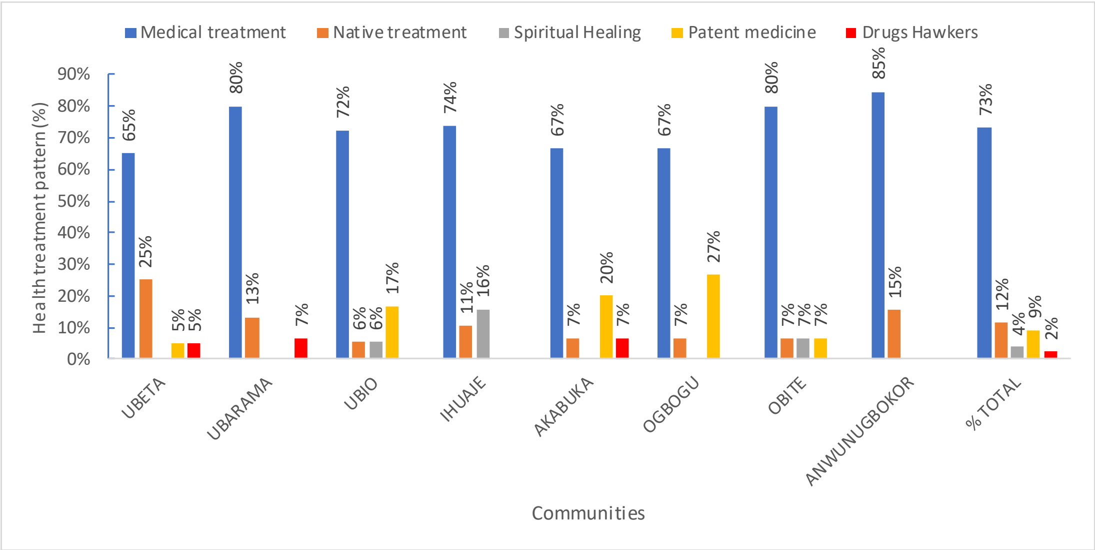
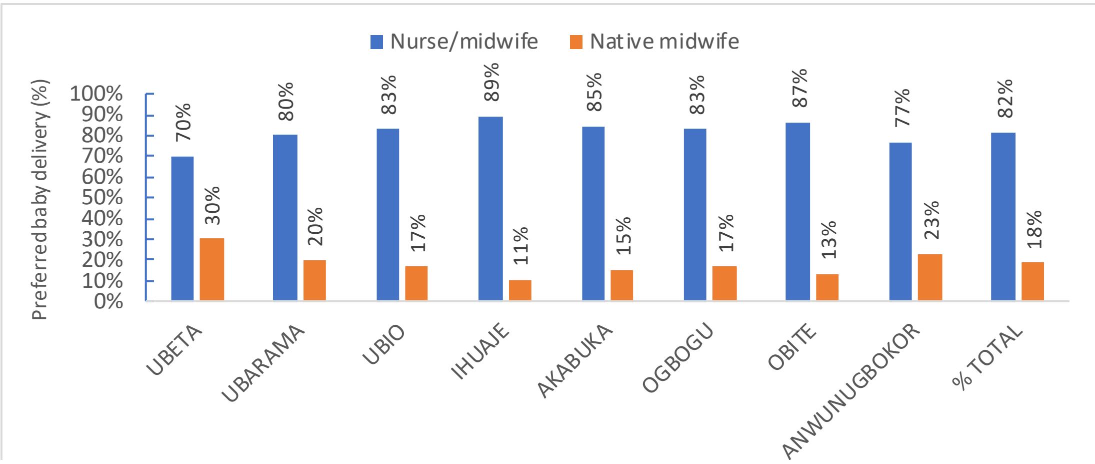


Fig 4.47. Preferred health treatment pattern



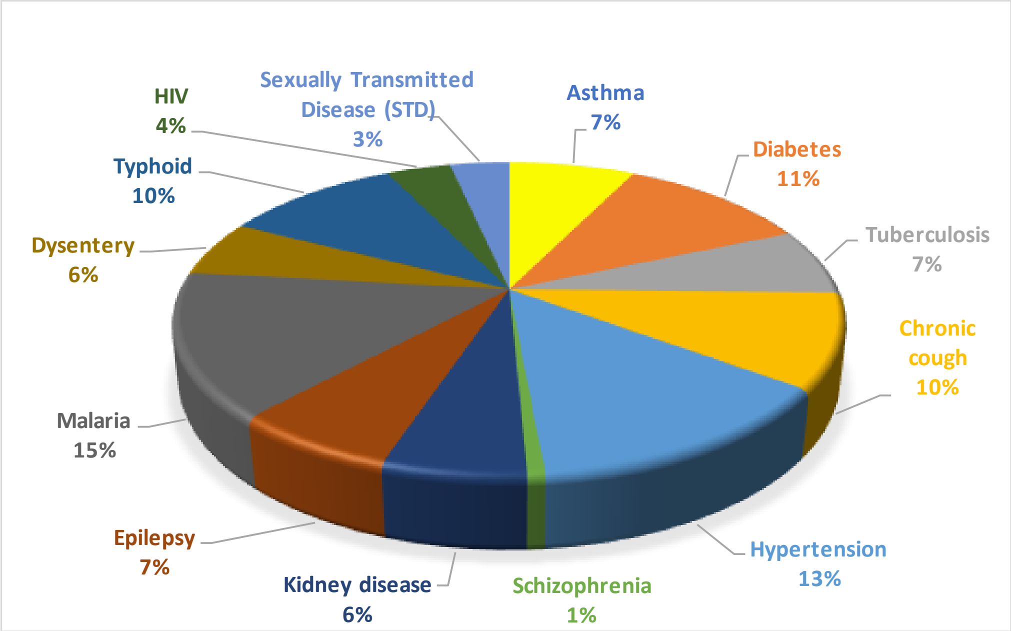


Fig 4.49: Chronic diseases experienced in the households

Vaccination Against Children Disease and COVID-19

Fig. 4.50 shows a relatively moderate compliance level of 65% for vaccination against basic children disease amongst the households as presented by the respondents.

For COVID-19, about half (52%) of the respondents admitted having received COVID 19 vaccine (Fig. 4.51).

Incidence of COVID-19 in the Community

The respondents when asked if they are aware or know of anyone that suffered from COVID-19 infection, 76% confirmed having incidence of COVID-19 in their household /community while 18% were not aware whether an incidence has occurred or not (Fig. 4.52).

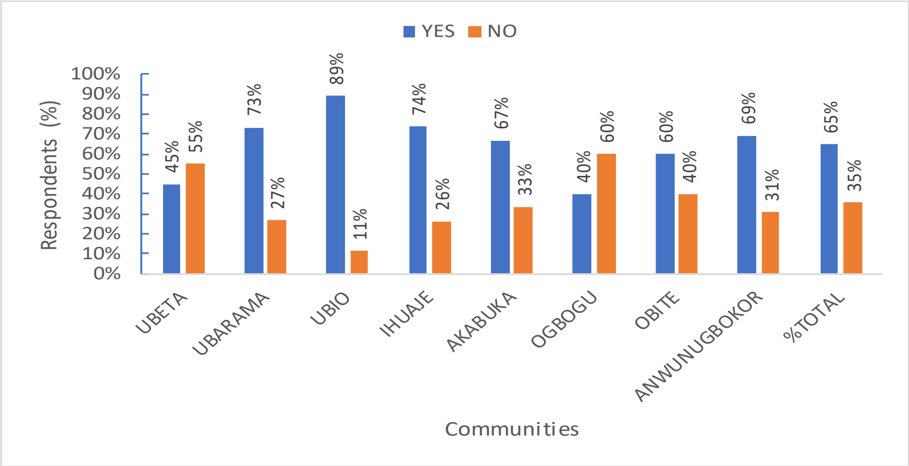


Fig. 4.50: Vaccination against basic children diseases

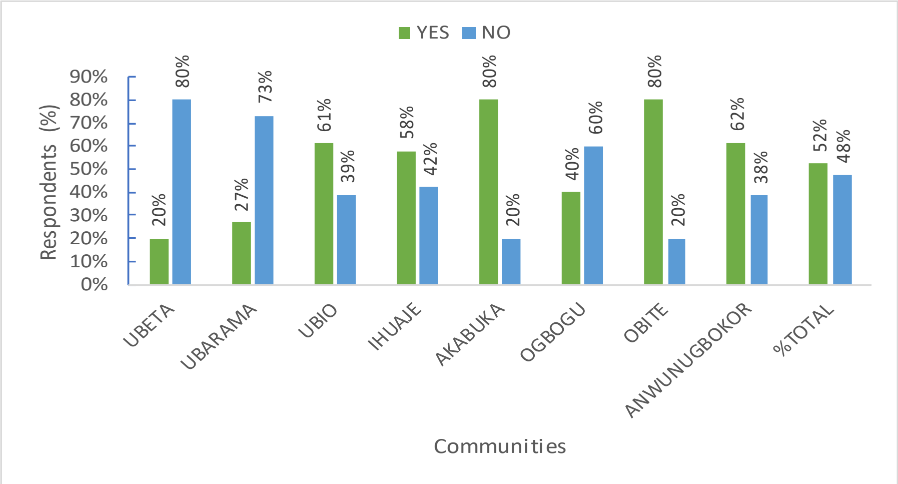
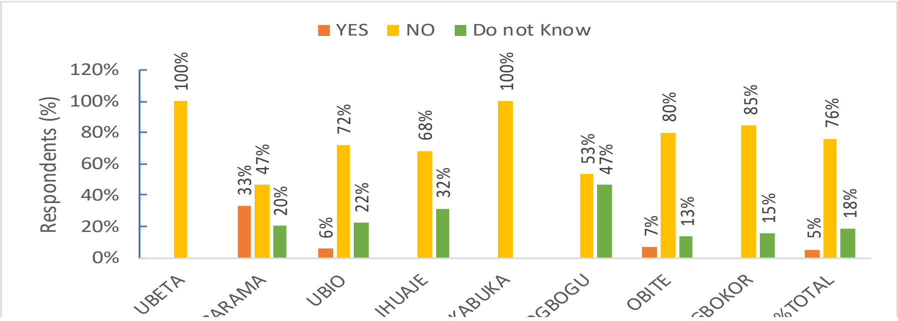


Fig 4.51: Vaccination against COVID-19 by members of household



Health Facilities and Accessibility

Ubeta

Ubeta4 community has the Felix Agbani health center which is in a poor functional state and handles only immunization on Wednesdays. There is also a community health center that was built during the regime of Governor Rotimi Amaechi which is not functional and overgrown by bushes. The Ubeta 1, 2 and 3 community members visit the health Centre at Ubeta4 for their immunization.

Ubarama and Ubio

The health centre in Ubarama and Ubio were not functional. Ubarama health centre was built by an NGO and Salvation Army. Moreover, due to the crisis in the community that ended in 2019/2020 the equipment which was provided by Total E&P to the Ubeta health centre was stolen. The Ubio health centre is not functional due to lack of equipment and health officers; it also needs renovation.

Ihuaje, Akabuka, Obite and Ogbogu

These communities have a health centres which are functional with equipment and trained medical personnel.

The Ihuaje model primary healthcare centre has 10 nurses / healthcare / technicians' staff, 23 casual staff and a doctor. According to our key informant at the centre, they need some medical equipment, essential drugs and electricity generator to enhance service delivery.

The Akabuka health centre has presently 10 beds, 1 doctor and 11 nurses. There are also two private hospitals in Akabuka namely Binasco Clinic and Grace Memorial Services which are functional.

The Obite model health centre has 10 beds, a doctor and 16 nurses. There is also a functional private hospital - Estaville Life Hospital.

The Ogbogu community health centre has 10 beds, a doctor and eight nurses. Our key informant at the centre identified that they need an electricity generator urgently. Ogbogu community also have two private clinics namely Prize Medicals and Cosmo Clinic.

Anwunugbokor

Anwunugbokor community does not have a health centre. The inhabitants go to neighboring communities like Ubeta for immunization; and for other medical issues to other communities where they can get medical attention in the area.

Pharmacies / Patent Medicine shops

Local pharmacies and patent medicine shops were one of the most encountered health facilities in all the study communities and were usually utilized by those seeking health care as a first resort.

Availability and accessibility of medical resources / facilities and treatment.

Amongst the respondents, 42% agreed that the medical care and drugs were available (Fig 4.53) while 33% confirmed that medical resources /facilities were easily assessible (Fig 4.54). However, they complained of high cost of medical treatment as confirmed by 78 percent of the respondents (Figs. 4.55).

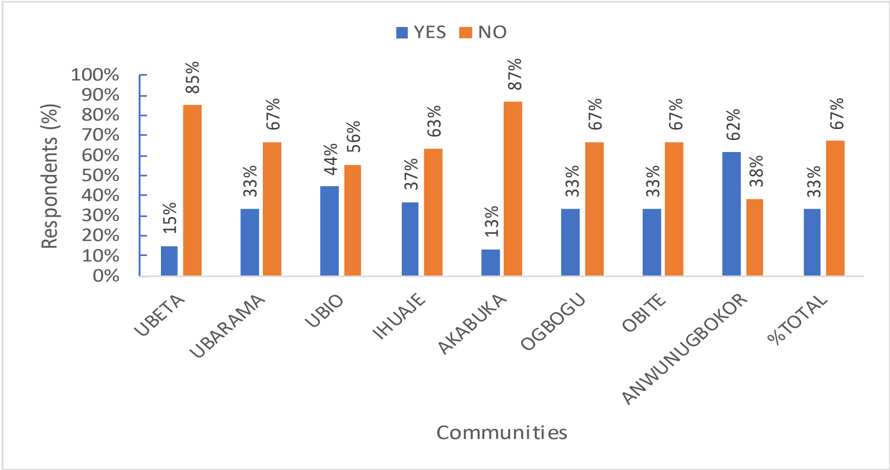


Fig. 4.53: Easy accessibility of Medical resources/facilities by households

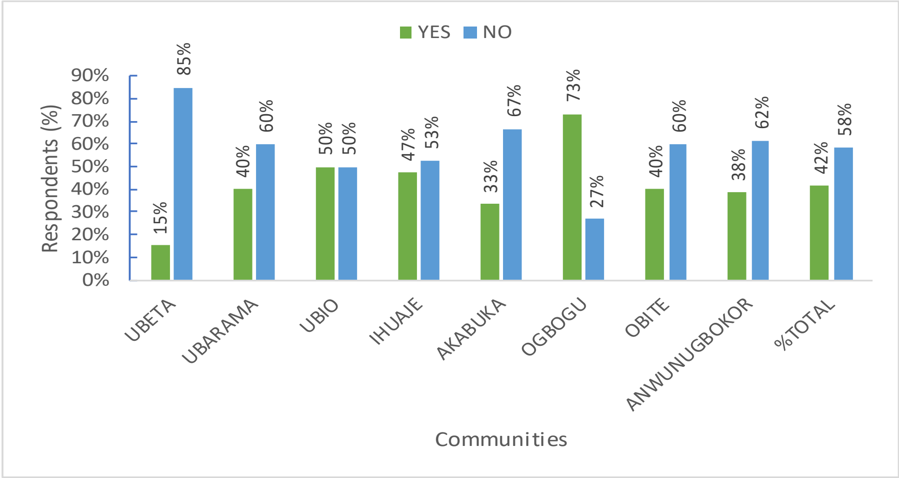


Fig 4.54: Availability of Medical care / drugs in the community

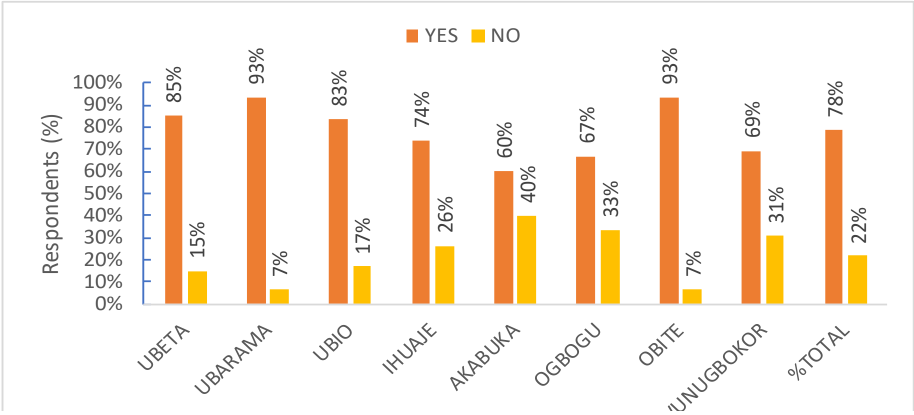


Plate 4.14g: Felix Agbani Health Center at Ubeta 4 (Functional)

Plate 4.14h: Community Health Centre at Ubeta 4 (abandoned and covered with weeds)

Plate 4.14i: Ubarama health Centre (not functional)

Plate 4.14j: Ubio Health Centre (not functional)

Plate 4.14k: Ihuaje Community Health Centre (functional)

Plate 4.14l: Reception area at Ihuaje Health Centre

Plate 4.14m: Akabuka Health Centre (functional)

Plate 4.14n: Akabuka Health Centre record and Consulting room

Plate 4.14o: Reception area at Obite Community

Plate 4.14p: Ogbogu Community Health Centre

Plate 4.14q: Obite community Health Centre

Plate 4.14r: Obite Health Centre Pharmacy

Life Styles and Habits of the people in the project area

Alcohol Consumption

The commonest form of alcohol used in households was beer although some indulge in illicit gin popularly known as spirits or hot drinks. In general, it would appear that at least one out of every three respondents (23%) in the project area consume alcohol. The frequency of consumption was relatively moderate with 57% consuming 2 to 7 bottles/shots in a week while 20% consume more than 14bottles/shots in a week.

Excessive use of alcohol has health effects particularly on the Liver and the neurological system. It is also to be noted that alcohol use has been associated with less care in sexual relationships and may therefore facilitate unprotected sexual intercourse and transmission of STDs.

Cigarette smoking and use of hard drugs

Cigarette smoking is practiced by 4% of the respondents from the households, with frequency of 2 to 7 sticks in a week by 20% of the respondents, while 80% smoke more than 14 sticks in a week (Fig. 4.56). Tobacco use has been associated with diseases such as Lung Cancer, Ischemic Heart Disease, Hypertension and bronchitis among others (Fig. 4.57).

The respondents also confirmed the kind of hard drugs abused by the youths in their communities in the order: Crystal Meth (Ice Mkpurumiri) with 45% > Marijuana (40%) > Cocaine (6%) > Codiene (1%). However, 8% of the respondents did not admit to the use of any of these drugs by their youths (Fig. 4.58).

The use of marijuana and crystal meth has been associated with withdrawal symptoms and increased criminality. The cost of maintaining the habit may also have significant impact on household expenditure and compromise the purchase of essential items like foodstuff and appropriate clothing.

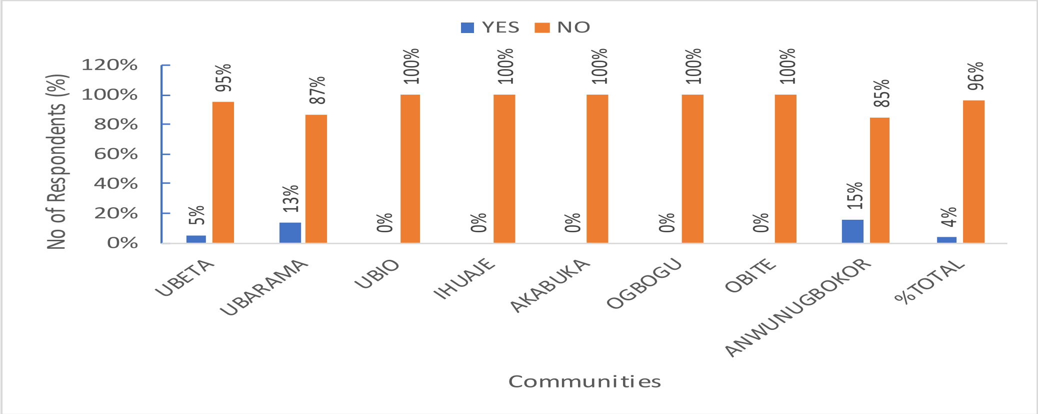


Fig. 4.56: Respondents that smoke cigarette

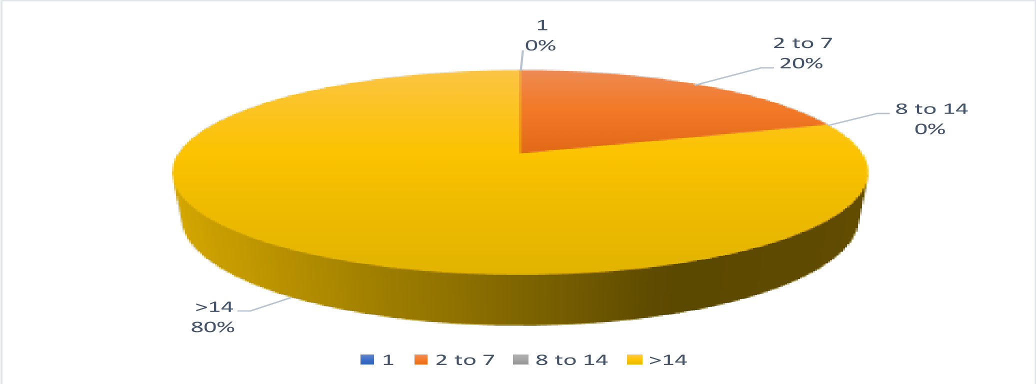


Fig. 4.57: Rate of cigarette smoking (sticks/per week) by respondents in the community

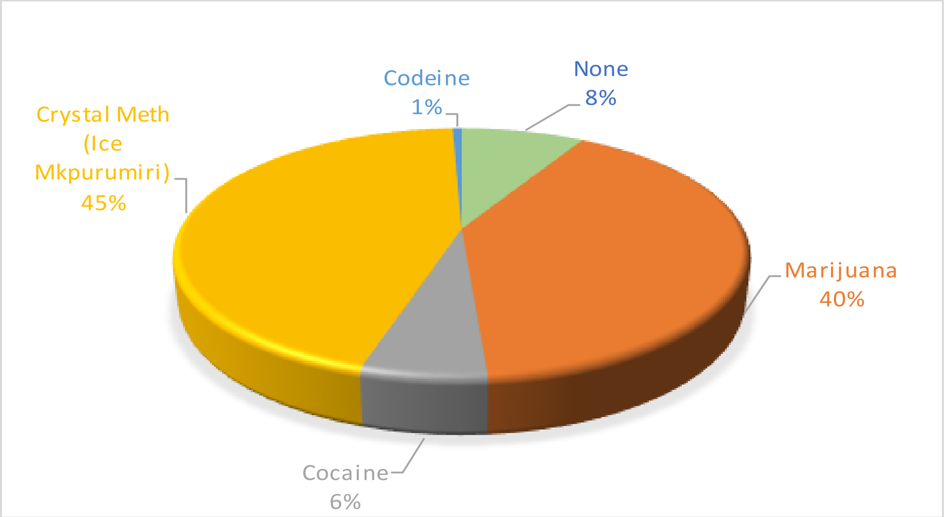


Fig. 4.58: Perception on kinds of hard drugs abuse by the community youths

Communal eating/drinking

The communities by way of social interaction engage in communal eating/drinking of which about 38% of the respondents consented to indulging in it while 62% did not (Fig 4.59).

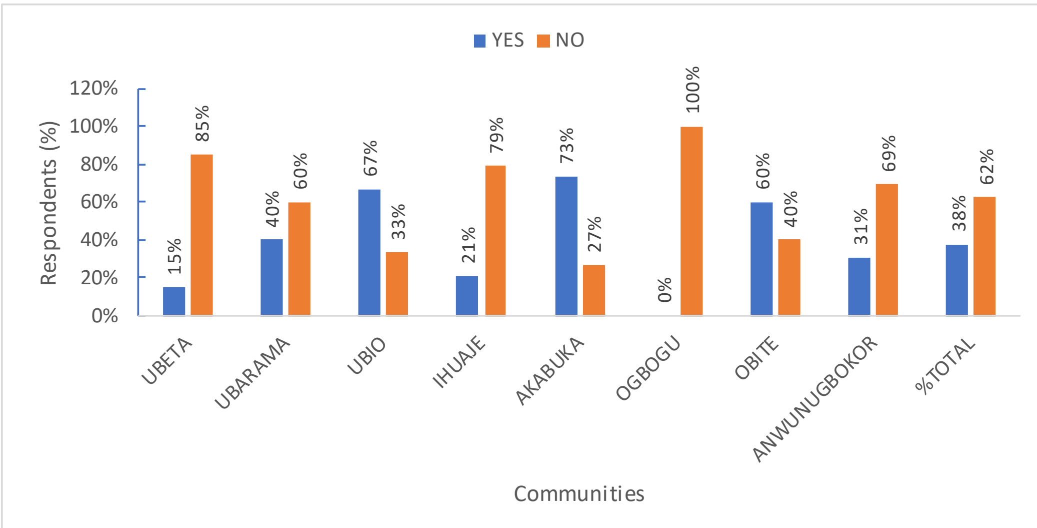


Figure 4.59: Participation in communal eating/drinking by respondents in the community

Recreational habits / hobbies

Football was identified as a major source of recreation in the communities by 33% of the respondents. This is followed by reading, singing, jogging/running and dancing with aggregate of 49% amongst others as shown in Fig 4.60.

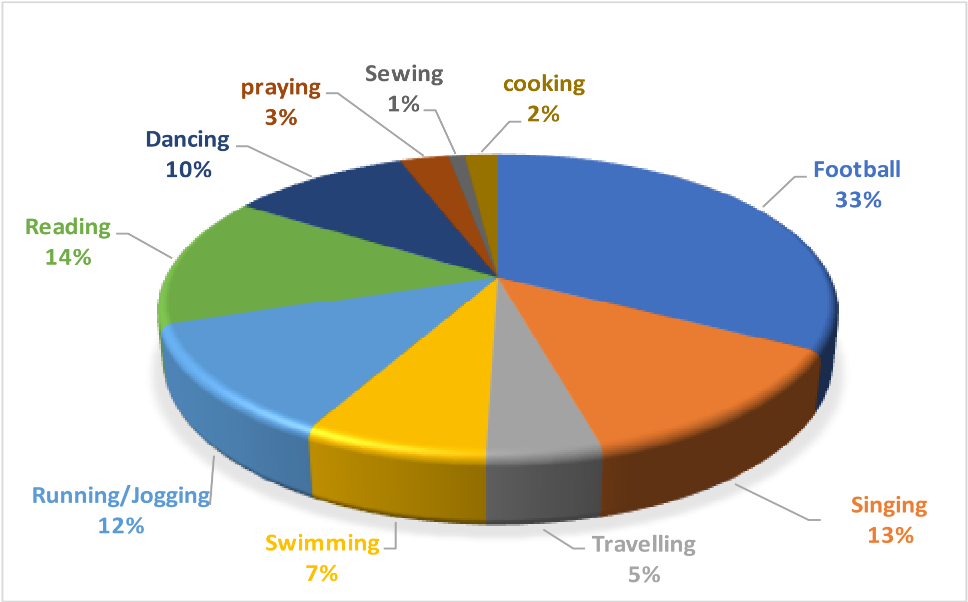


Figure 4.60: Recreational habits / hobbies of respondents in the community

<u>Feeding Habits</u>

The feeding habits in the households from respondent and FGD showed more of carbohydrates-based food with an aggregate of 65% for garri and cassava fufu with soup while beans consumption was 12% (Fig 4.61). However, fish consumption stood out as the basic protein in the soups by about 61% of the respondents (Fig 4.62). The frequency of feeding by households was mostly twice a day according to 59% of the respondents while 29% could afford feeding three times a day (4.63). This was attributed to purely the poor economic situation in their community occasioned by low income and unemployment.

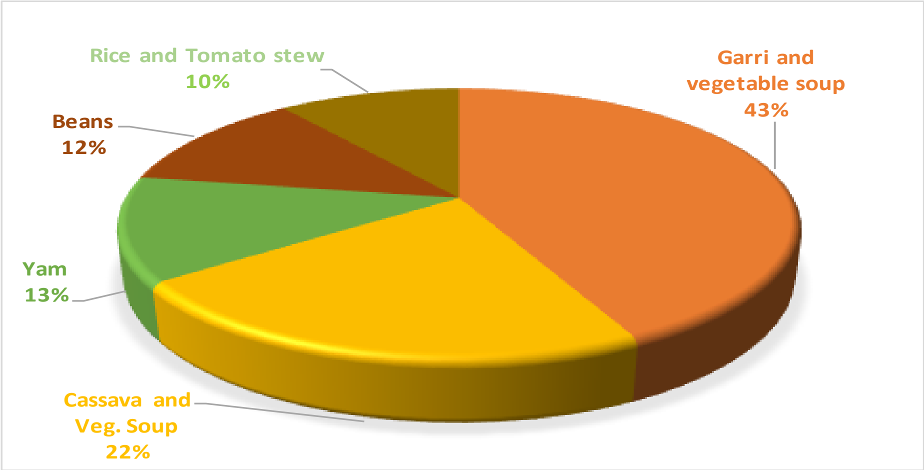


Figure 4.61: Types of diet by households in the community

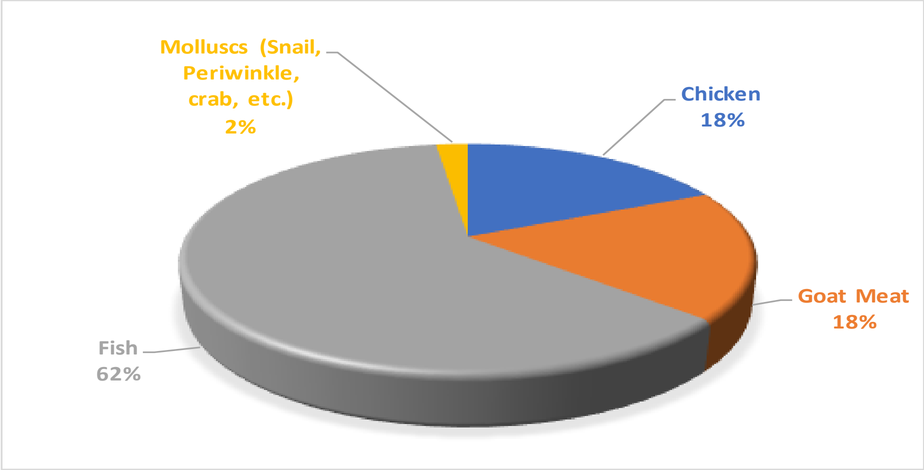
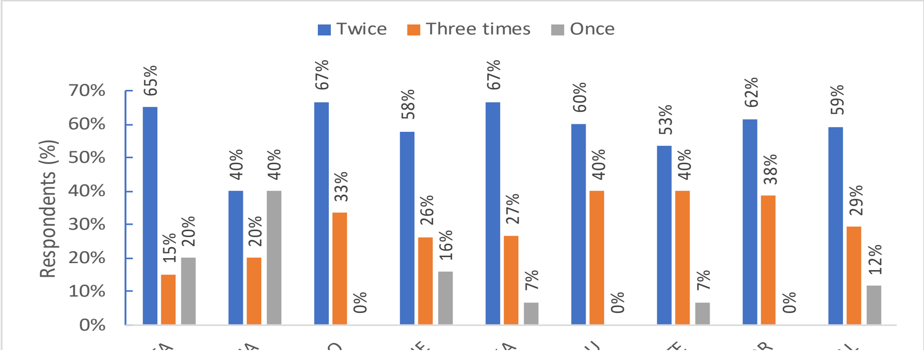


Figure 4.62 Protein mostly in diets of households in the community



Basic Sanitation Issues

The basic sanitation issues encountered during the survey in the host communities for the proposed project area bordered on the following:

Potable Water

The main sources of drinking water in the communities were borehole from community (public taps), private water schemes, hand dug wells and sachet water (popularly called 'pure water').

Availability and access to safe drinking water is a major issue in most of the communities as presented by the respondents. 38% of the respondents from the community accented to use of hand dug wells followed by use of borehole (23%), public tap (21%) amongst others as shown in Fig. 4.64. At Ubio community the public water borehole was not functional and they resort to use of private boreholes and hand dug wells. Obite, Ogbogu and Akabuka communities had at least one functional borehole water scheme developed by TOTAL E&P and they enjoy relatively constant water supply from the water scheme because of regular electricity from TOTAL E&P turbine.

When asked how water from each of these sources in the community is treated before use, 52% of the respondents said the water wasn't treated. However, 29% consented to boiling before use while 13% reported that chemical was used for treatment of their water (Fig 4.65).

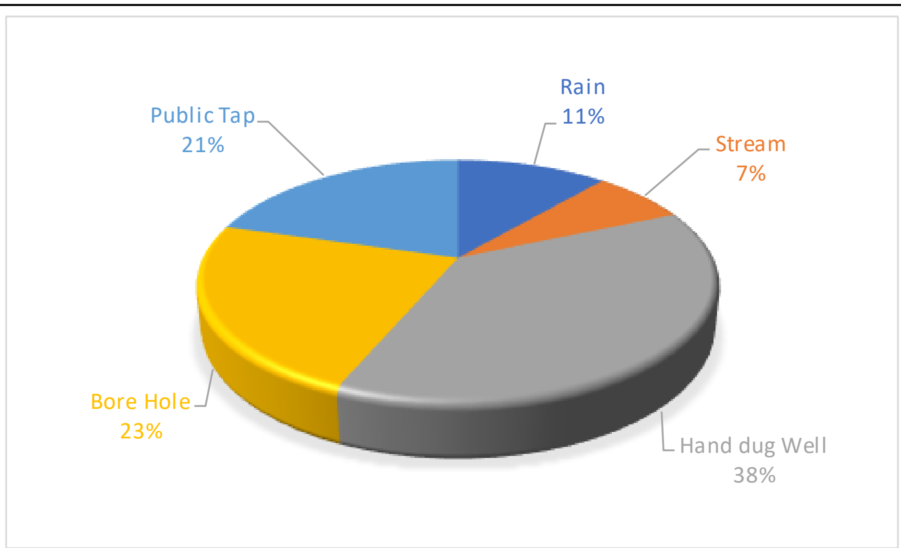


Fig.4.64: Sources of household water supply in the community

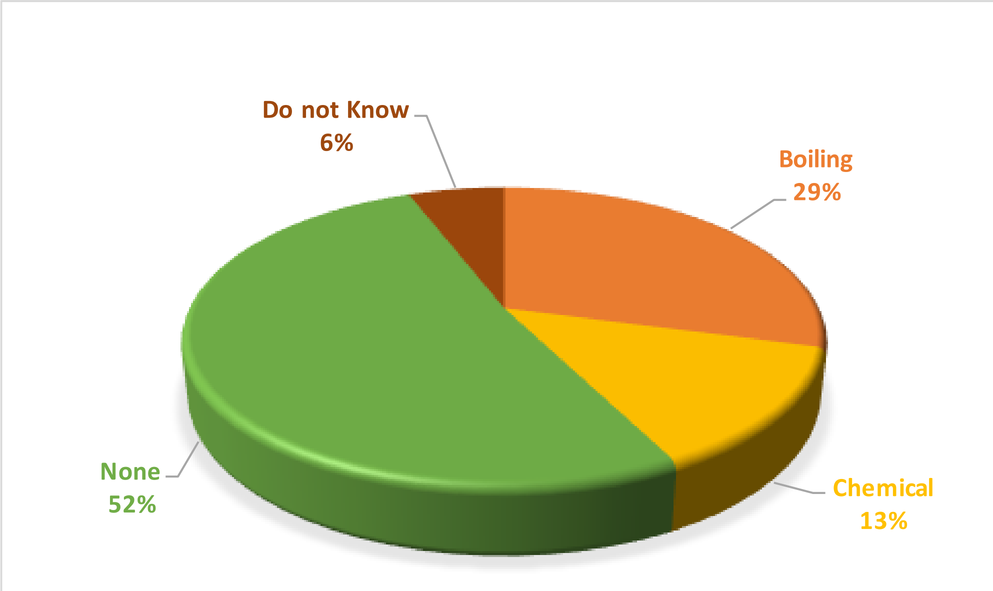


Fig. 4.65: Treatment of household water from sources before use

Sanitary Toilets

Open dumping of faeces into the bush is adopted by 30% of the respondents and their household at one time or the other. About 39% accented to use of pit toilet, while use of VIP ventilate toilet and water system has aggregate of 28% amongst the respondents (Fig 4.66). None of the respondents accented to defecation into existing water channels which is welcome development and should be encouraged.

Solid Waste Disposal

The wastes generated in the communities were mainly garbage and other domestic wastes. The commonest methods of refuse disposal from FGD and direct observations were open dumping behind the living homes, directly into water bodies (rivers or streams) running water behind the compounds or some designated areas, burning and burying of wastes (composite method). The open dumping and burning of waste practice according to the respondents constituted about 80% aggregate of the waste disposal method in the community. The practice of burying wastes and dumping into water bodies constitute 15% and 5% respectively of responses from respondents / their households (Fig 4.67). The open dumping method and dumping into water bodies creates ideal situations for vector, water and air–borne diseases.

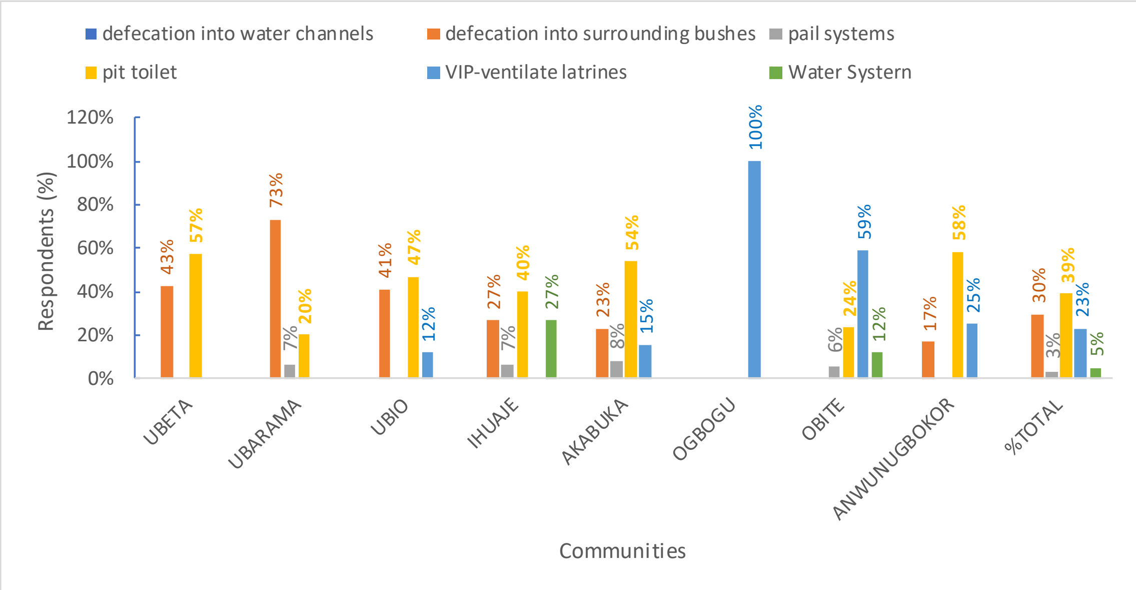
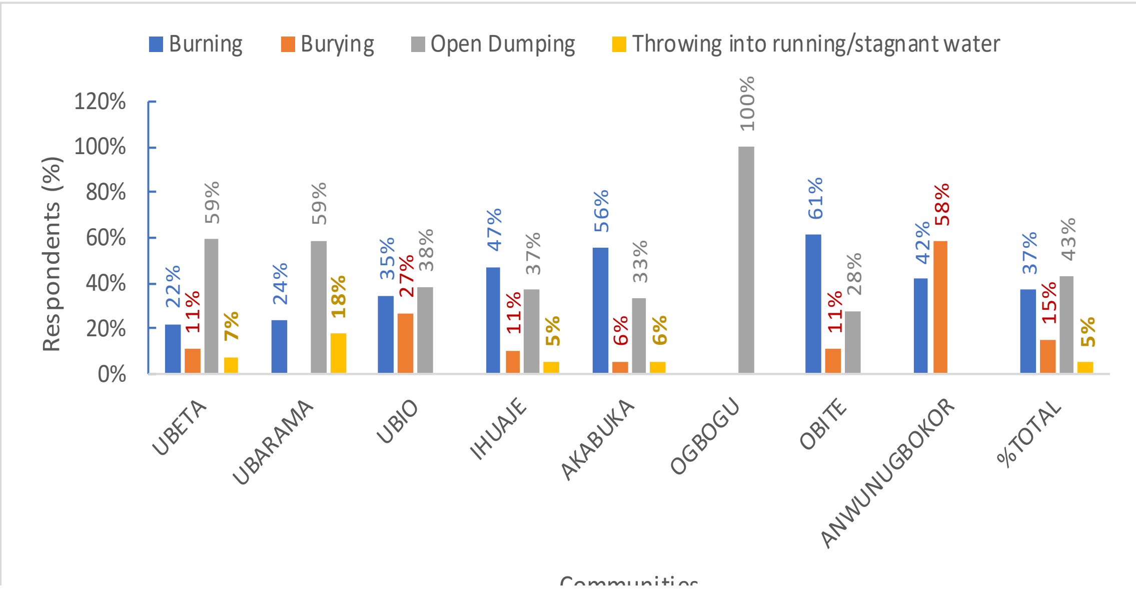


Fig.4.66: Faecal waste disposal method by household



Housing Conditions

Houses in the communities were not closely built, not overcrowded and in most cases well ventilated. There is however concerns from the respondents on inadequacy of the housing to meet present population reality in the communities.

Hygiene of household living environment and surroundings

The living environment and general surrounding in the community were generally clean and tidy from field observation, FGD and in-depth interview. 72% of the respondents also confirmed positively to the aesthetics of their living environment and surrounding (Fig. 6.68).

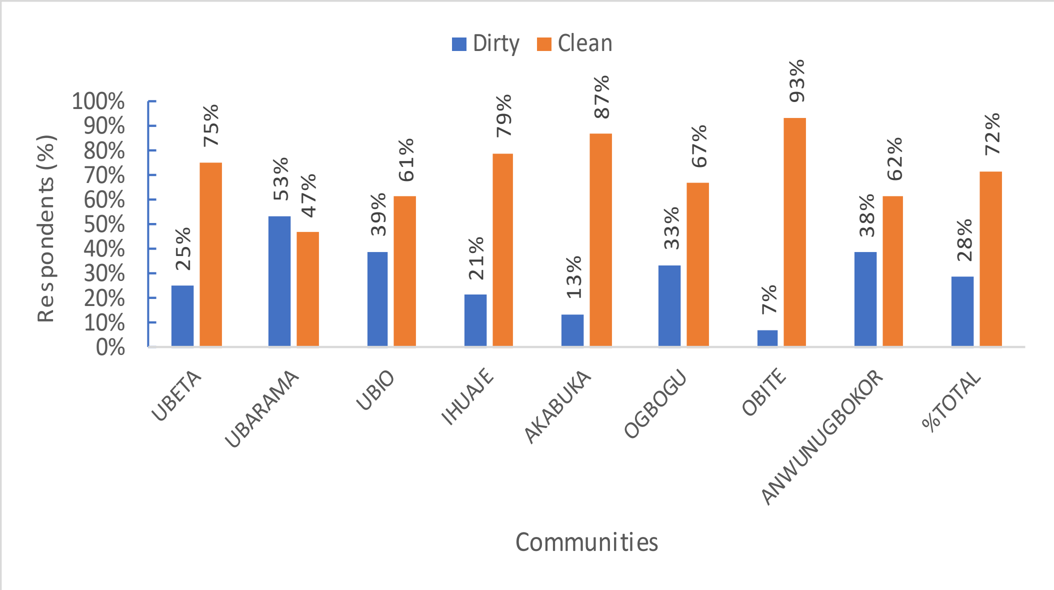


Fig. 6.68: Hygiene of household living environment and surroundings

Environmental Pollution Problems in the community

Oil spills, air pollution, noise pollution, water pollution, insect vectors, flooding & erosion were the key environmental challenges experienced in the communities at varying proportions over the years according to respondents and FGD. An aggregate of 46% of respondents indicated that air pollution and oil spill have been a major issue. They attributed it to the oil and gas activities in their area. The flooding and erosion challenges in the communities was also of very much concern according to 23% of the respondents as shown in Fig. 4.69.

On further injury, an aggregate of about 74%the respondents indicated that the flood levels experienced in their household during rainfall were between 1 to 5 meters while the others have experienced levels greater than 5 meters. The duration of flooding after rains sometimes lasts between 5 to 10 weeks according to 50% of the respondents or in some cases (19%) more than 10weeks (Figs 4.70 and 4.71).

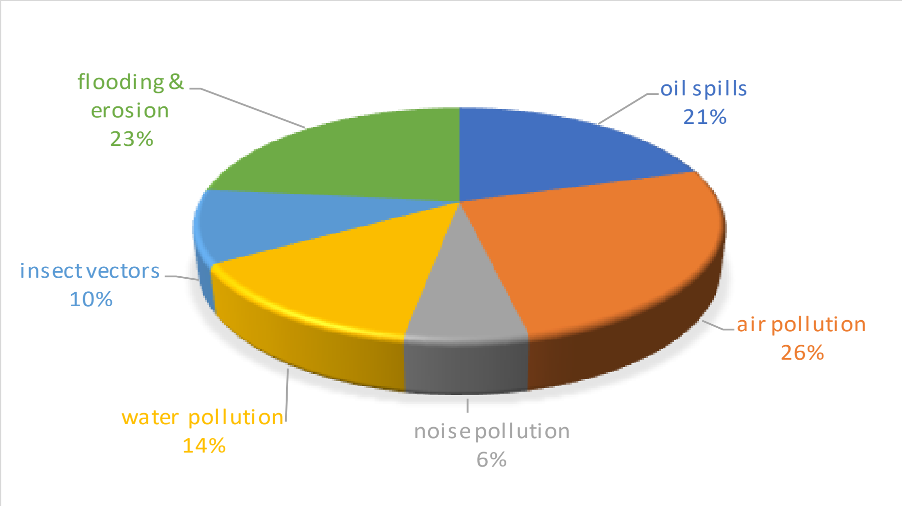


Fig. 4.69: Types of Environmental Pollution challenges in the communities

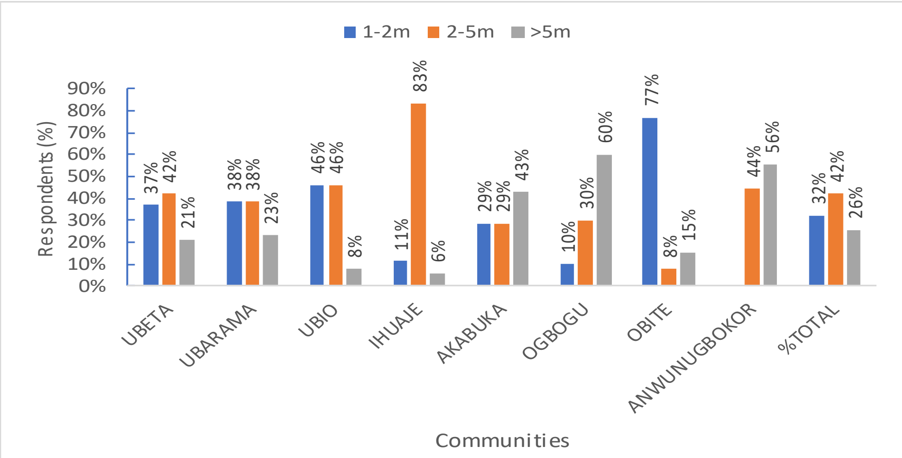
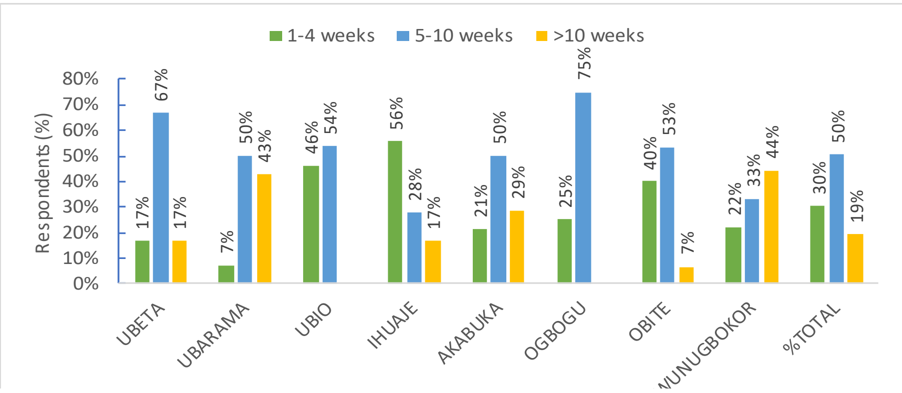


Fig. 4.70 Flooding Levels in households within the communities



The respondents were asked whether they experience increase of some diseases after the flooding but the responses could not be verified from the existing health facilities/private hospitals in the area due to poor record keeping. However, malaria, typhoid, hypertension and chronic cough were prominent in the list of disease from the respondents as shown in Fig. 4.72.

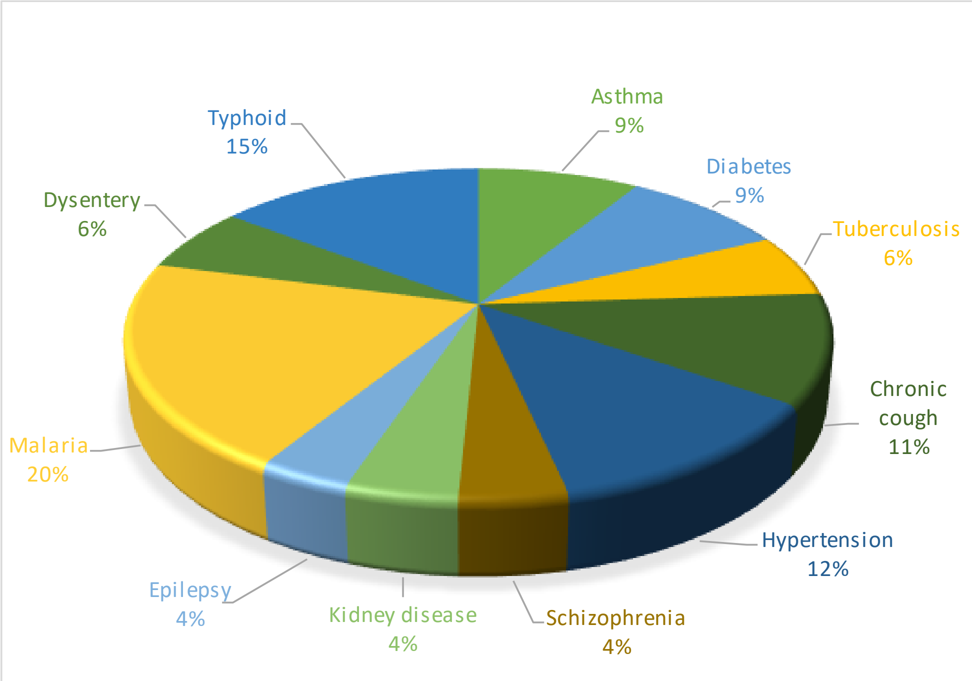


Fig. 4.72: Increase in diseases experienced after flooding by households

Chapter

5

EVALUATION OF EXISTING AND ASSOCIATED IMPACTS

5.1 INTRODUCTION

The Ubeta Field Development project is likely to have biophysical, social and health impacts on the project area. These impacts may be associated impacts (i.e. those that will occur) and/or potential impacts (i.e. those that could occur). The objectives of the impact assessment are to identify the associated and potential environmental, social and health impacts associated with the proposed project activities, evaluate the likelihood of occurrence, magnitude and significance of identified impacts. Mitigation measures will then be proffered for the anticipated negative impacts, while measures would be provided for enhancing the positive (beneficial) impacts.

This chapter identifies and describes these potential impacts and also presents the criteria for predicting the sensitivity, intensity as well as severity of such impacts. It is aimed at qualifying and quantifying the impacts derived from evaluation of results from field work, data analysis, literature search, etc. Stipulated standards of the enabling legislative framework and guidelines for sustainable practices in the infrastructural sector and established facts in relevant literatures, stakeholders' perceptions and evaluations and general observations obtained during field data gathering were also considered in the impact assessments.

5.2 THE IMPACT ASSESSMENT PROCESS

A systematic impact assessment process presented in Figure 5.1 was used to identify, quantify and qualify the impacts of the Ubeta field development project activities on the project environment. This process is based on the methodologies developed by the World Bank and ISO 14001 Standards as well as the Federal Ministry of Environment guidelines as set out in the sectoral guidelines, and TEPNG's recommended methodology for impact evaluation as expressed in various documents including GS EP ENV 120 (Environmental Impact assessment of E&P activities), with an objective to ensure a comprehensive and systematic evaluation of all potential positive and negative effects associated with the project. This is also in congruence with TEPNG"s commitment to high quality EIA process and documentation towards the achievement of a sustainable project. The ISO 14001 method is simple to apply and provides a high level of detail and also relies on limited data. This method was therefore selected for the evaluation of potential impacts for the proposed project. In line with general guidelines for an Environmental Impact Assessment (EIA) process, the following were the basic steps adopted for identification and evaluation of impacts:

- Impact identification
- Impact description
- Impact qualification
- Impact risk and severity rating

The impact assessment methodology adopted for this project consists of the following major steps:

- Exhaustive review of each Effect of the project and classification
- Environmental Sensitivity classification of each receptor
- Severity of Impact definition and Significant Impacts determination

These steps were then further broken down in order to achieve a thorough assessment of the impacts

Step 1: Identification of Project activities/effects (sources of impact), and environmental receptors;

Step 2: Comprehensive preliminary identification of potential impacts;

Step 3: Determination of the effect intensity ("I" from 1 to 4). This involves the detailed assessment of the identified impacts that are likely to be significant through impact quantification/characterization techniques; quantification of impacts to the extent possible and qualitative characterization of impacts that cannot be quantified; and

Step 4: Environmental sensitivity of each receptor determination ("Sen"or SI from 1 to 4)

Step 5: Severity qualification from "Negligible" to "Major". Final assessment of the severity levels of impacts through application of the results of the rigorous quantitative and qualitative characterization of impacts developed in previous steps to a set of objective impact severity criteria; identification of impacts warranting mitigation.

The processes enumerated above involve the use of various impact assessment tools that include: checklists, interaction matrices, and other impact evaluation techniques, etc.

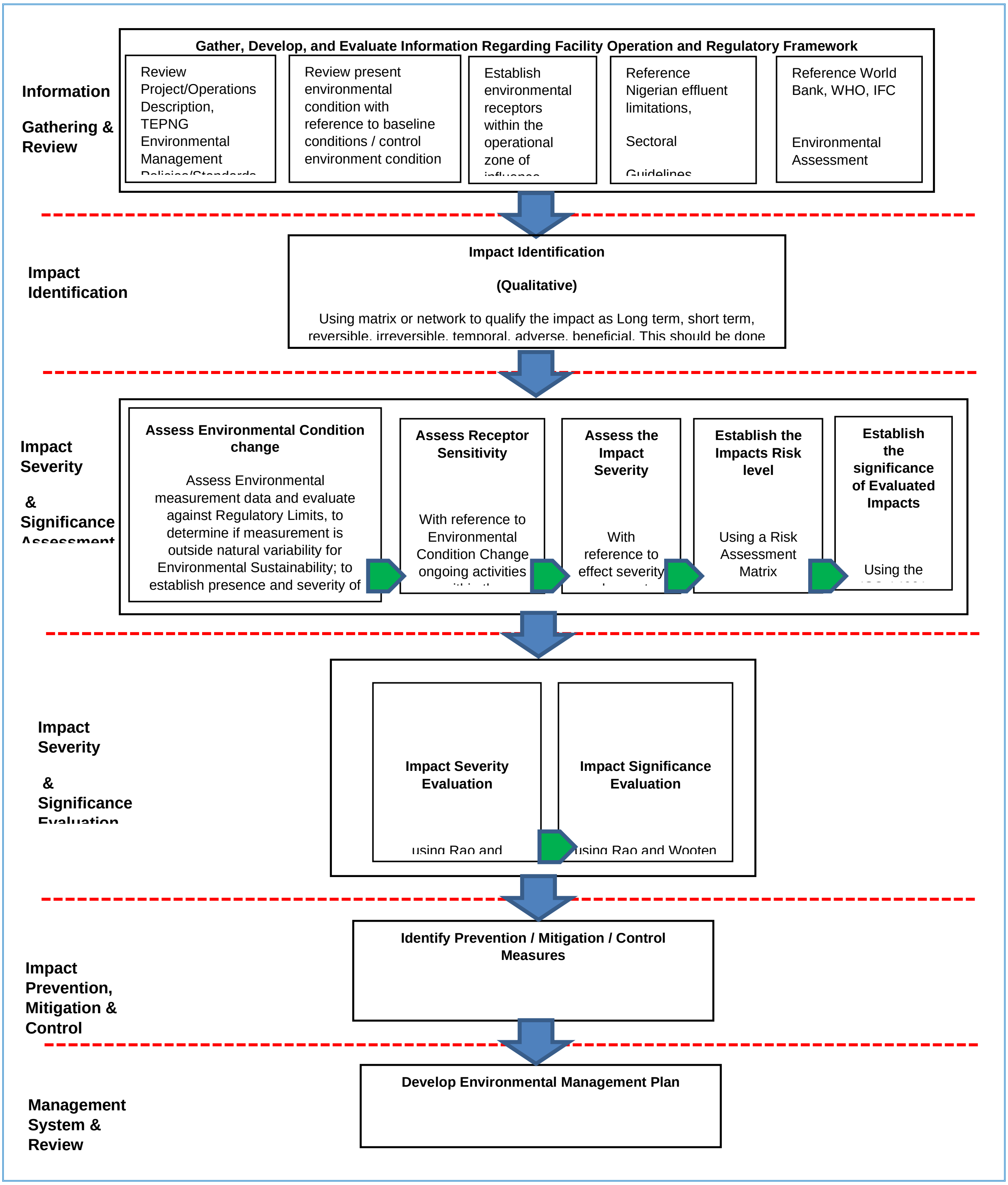


Figure 5.1 Impact Assessment Process

5.2.1. Establishing the basis of Impact Assessment

For the baseline study of the project area, covering the biophysical, social and health aspects, data were collected through field work, laboratory analysis and data interpretation, and these led to the preparation of an integrated environmental (biophysical, social, and health) baseline report which provides understanding of the existing natural and social environment. The baseline infrastructure of the recipient environment has been described in Chapter 4 of this report.

Other bases include:

- the knowledge of the project activities
- equipment types and layout of project facilities
- accumulated knowledge of generic information on potential impacts of similar projects;
- series of expert group discussion/meetings and experience of similar projects.

5.2.2. Identification of Project Activities

A good knowledge of the project activities and the environmental (biophysical, socioeconomic and health) receptors is essential to be able to effectively capture the impacts that will arise from the project. Based on the proposed project which has been described in detail in **Chapter 3**, a list of activities which interact with the social and natural environment in a distinct way either due to their nature or due to timing was compiled. The list of project activities is summarized as follows:

- Pre-mobilization of contractor
- Mobilization
- Operational pigging with foam pigs
- Nitrogen purging of TEPNG's 50km 24" Carbon Steel gas supply line
- Installation of fully rated spades
- Excavation Works.
- Well cluster designed with 10 slots, of which 6 are dedicated to Ubeta gas development,
- 1 HP manifold,
- 1 test header and test separator for well testing and metering,
- 1 Pig Launcher for intelligent pigging (Pig receiver located at Obite TC),
- 1 technical building with electrical, instrumentation rooms and operation office and 1 security building for access control management,
- Chemicals Utilities (corrosion inhibitor & methanol injection package),
- 1 electrical cable for power supply and 1 fiber optics cable from Obite TC for data transmission & remote control / monitoring (telecom mast as radio back-up),

- UPS electricity is to be provided by battery packs,
- 11.1 Km export gas pipeline
- Construction and operation of the drilling camp within the cluster area which will accommodate approximately 100 workers, during the Field Development Project.
- Drilling of six wells using a single rig from the Ubeta Cluster; in a drilling campaign expected to last about 1.5 years from Quarter two of year 2026.
- Construction of an access road and various ancillary equipment (electric cable for power supply, storage area, water tanks, telecom mast and technical building).
- Field coating of pipelines
- Non-Destructive Testing
- Backfilling and compacting
- Physical inspection/ validation of the facilities
- Commissioning and handover
- Site cleanup
- Operational activities
- Decommissioning/abandonment

5.2.3. Preliminary Identification and Screening

In line with the recommended impact assessment approaches (UNEP, 1996; Canter, 1996, Lohani et al., 1997), the first level of impact assessment involves the preliminary identification and screening of potential environmental impacts by anticipating activity-environment interactions. This requires a thorough understanding of the project activities (project description), the project setting (the environmental description), and the interaction with environmental components. ISO / World Bank methodology of assessment was used for the identification and screening. The matrix arrays project activities against environmental (biophysical, social, and health) components, and supports a methodical, comprehensive, and objective identification of the impacts which each project activity may have on each biophysical, social, and health component.

Impact identification is based on Wathern (1988), who defines an impact as "having both spatial and temporal components and can be described as the change in an environmental parameter over a specified period within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initiated".

To further guide the identification and screening of impacts for the proposed Ubeta field development project using the matrix, established environmental impact indicators or indices are developed for each of the environmental interaction categories. Impact indicators are the observable and measurable parameters of each environmental condition. Table 5.1 gives the specific environmental components and sub-elements used and a description of the indicators.

Table 5.1: Environmental, Social and Health Components and Impact Indicators

COMPONENTS	IMPACT INDICATORS
Biophysical	
Biodiversity	Vegetation, wildlife
Groundwater	Changes to groundwater quality indices (physico-chemical properties, hydrocarbons, heavy metals, Microbiology)
Surface Water	Changes to surface water quality indices (physico-chemical properties, hydrocarbons, heavy metals, Microbiology)
Sediment	Changes to sediment quality indices (physico-chemical properties, hydrocarbons, heavy metals, Microbiology)
Hydrobiology	Abundance and diversity
Soil	Changes to soil quality indices (physico-chemical properties, hydrocarbons, heavy metals, Microbiology.
Air	Emissions of NO_2, SO_2, $PM_{2.5}$, PM_{10}, CO, VOC, greenhouse gases (CO_2, CH_4)
Noise	Change in noise levels at sensitive receptors
Social	
Population	Changes in population indices, total population, gender ratio, age distribution
Infrastructure	Improvement or pressure on existing urban/rural infrastructure including waste handling facilities
Macro and micro economy	Change in macro and micro economy, employment, standard of living, occupation,
Social and Cultural Structure	Disruption in local authority and governance structure; change in social behavior, intra- and inter-ethnic clashes
Transportation	Alteration in means of transportation or ability to move efficiently
Education	Change in primary, secondary and tertiary education school enrolment and attendance
Health	
Pollution Related Health Effects	Increase in concentration of air pollutants of concern (NO_2, SO_2, $PM_{2.5}$, PM_{10}, CO, VOC) and contamination of surface waters and potable ground water, increased noise beyond regulatory limits, increased night time beyond acceptable limits

COMPONENTS	IMPACT INDICATORS
Communicable and Non- Communicable	Change in incidence of communicable and non-communicable diseases or disease-causing factors
Morbidity and mortality	Change in health of workers and general public,
Health care / recreational facilities	Changes in availability of and access to health care and recreational facilities
Psychosocial factors	Drug use/abuse, communal violence, crime, suicide, depression and prostitution; changing expectations of quality of life
Accidents / Fires / Explosions/Flood	Changes to rate of occurrence and severity of accidents / fires / explosions/flood

The aim of impact identification is to ensure that both significant and insignificant potential and associated bio-physical, social and health impacts are accounted for. The anticipated impacts were determined based on the interaction between project activities and environmental sensitivities. A check list of the identified associated and potential impacts of the project is listed in **Table 5.2.**

Table 5.2: Checklist of Associated and Potential Impacts of Proposed Ubeta Field Development Project

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts
Pre_mobilization	Land acquisitions and claims settlement	Loss of farmland, fishponds and cultural resources
		Agitation as a result of payment and sharing of claims
		Inter and intra community conflicts
Site Preparation	Bush Clearing	Biodiversity (Vegetation/ wildlife) loss
		Ecological degradation
		Exposure to allergic plants
		Injuries and attacks from wild animals
		Loss of access to farmland
		Opportunity for business
		Third party agitation
Mobilization	Mobilization of personnel, materials and equipment to site by road.	Air/Noise pollution from increased vehicular movement
		Damage to existing access roads
		Kidnappings
		Road traffic accidents with injuries from increased vehicular movements on local roads
	Employment of local labour and award of contracts to members of the host communities	Increased cash flow and stimulation of local economies within the Host Communities
		Inter and intra community conflicts
		Localized economic benefits from materials supplies by local contractors
		Third party agitations
	Influx of workers into the host Communities	Increased in sex traffic
		Socio-cultural conflicts between the construction team and members of the host communities
		Stimulation of local economy and markets from increased demand for food, and other products in the local market.
Construction	Excavation and Trenching	Damage to soil Structure and Texture
		Increase in dust and SPM during dry season.

		Increase in noise and exhaust gases from excavators.
		Temporary vehicular traffic obstruction/diversion at road crossing.
	Installation and positioning of Wellhead Platform	Increase in noise and vibration
		Risk of accident
	Drilling	Impairment of air quality
		Increase in noise and vibration
		Injuries and death from blowout
		Opportunities for business and employment
		Soil and groundwater pollution from chemicals, drill cuttings, and mud
		Increased gas production and revenue
	Pipeline construction (Piping/ flowlines, Welding, Manifold construction)	Loss of biodiversity
		Habitat fragmentation and disruption of wildlife migration route
		Impairment of air quality
		Increase in noise and vibration
		Injuries from accident
		Infringing on social and cultural practices/beliefs by workers
		Risk of kidnapping
		Increased cash flow and stimulation of local economies within the communities
		Air pollutants effects of COx, NOx, SOx from welding and other activities.
		Exposure of welders to heat and light radiation.
		Release of Toxic fumes during welding operations
		Risk of electrocution and burns during welding
	Back filling, Transportation of workers and maintenance of construction equipment's, waste disposal	Impairment of air quality
		Alteration of soil texture and structure through compaction
		Contamination and degradation of soil from discharges and spills of sanitary, construction related solids wastes.
		Onsite exposure of workers to noise and vibration from use of heavy duty equipment
		Road users would be exposed to higher road accidents due to increase in heavy

		traffic. Temporary road obstructions/diversions
		Workplace accidents/incidents
	Operations of machines and vehicles	Emission of exhaust gases from the fuel combustion engines can alter the local ambient air quality.
		Soil contamination and loss of aesthetics from liquid leaks
		Vibrations affecting existing pipelines
	Base camp	Domestic waste from base camp shall cause poor aesthetic if it is dumped on soil and vegetation
	Disposal of industrial and domestic wastes	Odour and aesthetic devaluation may result from improper handling.
Commissioning	Hydrotesting	Discharge of hydrotest water from hydrostatic testing of equipment and interconnecting pipeline with water.
Operation / Maintenance	Maintenance	Release of gases through isolation valves.
	Gas leaks and Pipeline explosion from overpressure	Accidental damage to equipment or fire
	Operations	Third party agitation and kidnapping
		Revenue generation to government and company
		Employment of locals and subsequent stimulation of local and national economy
Abandonment / Decommissioning	Demolition and Excavation of structures and removal of well casings	Soil contamination
		Local content employment
		Return of land to indigenes for farming
	Demobilization of Equipment, Materials and Wastes out of the project site	Occupational and traffic accidents

5.2.4 Impact Description and Qualification

The identified impacts of the project were described based on the following criteria:

- Positive or negative
- Direct or indirect

Negative impacts are those that adversely affect the biophysical environments while positive impacts are those which enhance the quality of the environment. Direct impacts refer to those impacts that are caused by the project activity and occur at the same time and place. Indirect impacts are impacts caused by a project activity but would occur in the future or outside the project area and are reasonably foreseeable. Impacts are qualified either as:

- Short term < 3 months (S) or
- Long term > 3 months (L), or
- Reversible (R) or
- Irreversible (I)

For this study, short term means a period of time less than three months while any period greater than three months is considered long term. Reversible means the environment can revert to its previous conditions while irreversible means the impacts remain permanent even after the activity causing the impact is terminated.
The first stage in the Impact Assessment procedure shown in Figure 5.1 involves the collation and use of various source references to develop and/or establish:

- Checklist of associated and potential impacts;
- Checklist of legal and other requirements; and
- records of consequences, severity, probability and frequency of occurrence of various environmental impacts/incidences.

The key source references used at this stage were:

- FMEnv Sectorial Guideline for the Oil and Gas/Infrastructure Sectors (1995);
- Rivers State Guidelines & Standards on Pollution Control (2001)
- ISO 14001 Environmental Management System;
- Project Risk Assessment Study;
- Project design reports, map and drawings; and
- Environmental and Socio-economic baseline status of the project area acquired both from field work, literature search and information gathered from various data gathering techniques (Oral discussions, small group interviews, Questionnaires) and the project based specific description earlier highlighted in Chapter 3.

5.2.5 Evaluation of impacts and Significance Criteria

In order to objectively review the potential impacts and to determine the likely significance of those impacts when compared to baseline conditions, the general significance criteria shown in Table 5.10 (adapted from WAPCo, 2004) were developed and used. This EIA uses the significance criteria to evaluate impacts, which enables systematic identification and focus on those resources most likely to be impacted by the proposed project. Significance criteria were established to systematically determine whether potential impacts would likely be **positive**, or **negative**. Negative impacts were further classified as **major**, **moderate**, **minor**, or **negligible**. Those issues determined to be inconsequential or not applicable after mitigation were eliminated from or "screened out" from further consideration.

This impact severity assessment considers two main categories of significance criteria: intensity of the impact and the sensitivity of the receptor. Other criteria for the characterization of impact and consideration in the overall severity assessment include: temporal factors (duration, frequency, and reversibility), indirect or secondary effects as well as cumulative effects. These assessment criteria are described as follows, in no order of importance.

5.2.5.1 Temporal Factors

An assessment of certain temporal factors associated with potential impacts is presented as part of the significance criteria listed in Table 5.10. The relative significance level (e.g. **minor**, **moderate**) described under each affected category (e.g., environment, socioeconomic) is a combined assessment of the duration of the impact, the impact reversibility, and the frequency of the impact.

Duration is defined as the time that is estimated for a population or resource to return to "baseline" (pre-project) conditions. The duration is calculated from the time the impact begins, which may coincide with the start of the activity that causes the impact. The duration of an impact may be characterized as follows (**Table 5.3**):

Table 5.3: Showing Duration of Impact Characterization

Significance Level	Description
Major (4)	Long-term impact, recovery not expected to occur within five years
Moderate (3)	Moderate-term impact, recovery time between six months and five years
Minor (2)	Short-term impact, recovery time within six Months
Negligible (1)	Impact or recovery is very short term or immediate

Source: TotalEnergies EP General Specification: GS-EP-ENV-120: Environmental Impact Assessment of E&P Activities)

Characterization of the duration of an impact as **major**, **moderate**, or **minor** includes consideration of the degree of reversibility of the impact. Impacts for which the duration is classified as **major**, as defined above, would be long-term impacts.

Frequency is defined as the number of times an impact is expected to occur over the life of the project. The frequency of an impact may be characterized as follows (**Table 5.4**):

Table 5.4: Showing Frequency of Impact Characterization

Significance Level		Description
Major	4	Continuous impact, impact will occur continuously throughout the life of the project
Moderate	3	Intermittent impact, impact will occur intermittently over the life of the project
Minor	2	Rarely occurring impact, impact will occur a very limited number of times

Negligible	1	Very rarely occurring impact, less than twice in a period of one year

5.2.5.2 Geographical extent

Geographical extent for the purpose of this report refers to the location of an impact in terms of the amount of area affected i.e. Localized versus wide spread. In this EIA, impacts are considered "localized" if they are likely to occur only within 100m of the impact source. The extent may be quantified in units of area affected (e.g., square kilometres). The geographical extent of an impact is characterized in general terms as follows (**Table 5.5**):

Table 5.5: Showing Areal Extent of Impact Characterization

Significance Level		Description
Major	4	Impact to the national, regional, or global environment (e.g., greenhouse gas emissions)
Moderate	3	Impact to the general vicinity of the project site or study area
Minor	2	Impact limited to the immediate vicinity of the project activity
Negligible	1	Impact limited to a very small part of the activity area and is within the project ROW

5.2.5.3 Intensity of effect

The intensity of an impact is partially quantifiable in terms of the percent of resource affected and by the relative concentration at receptor points.

Percent of resource affected is defined as the quantitative intensity of the impact and can be measured as the percentage of a resource or a population within the study area that may be affected by an impact. The definitions of **major**, **moderate**, **minor**, and **negligible** in this respect may vary depending upon the specific receptor. The intensity of an impact is characterized as follows (**Table 5.6**) for this EIA:

Table 5.6: Showing Intensity (magnitude) on Resources or Receptors

Significance Level		Description
Major	4	Large amount of the resource or population is affected. An easily observable and measurable effect
Moderate	3	Moderate amount of the resource or population is affected. Generally measurable and observable effect
Minor	2	Small amount of the resource or population is affected. A low intensity impact may be within the range of normal variation of background conditions
Negligible	1	The amount of resource or population affected is unnoticeable or immeasurably small

Concentration at receptor points may also be defined with respect to quantitative or semi-quantitative criteria, if available and applicable (e.g., noise level in units of decibels, or milligram per cubic meter (mg/m3) of an air pollutant, measured at a particular location). The identified quantitative criteria (benchmarks) would align with standard best industry standards (e.g., for noise impacts, noise exposure limits as set by international standards for worker health and safety), and/or established national standards in the project country. The concentration factor, when quantifiable, may be characterized as follows (**Table 5.7**):

Table 5.7: Showing Characterization of Intensity (magnitude) at Receptor Points

Significance Level		Description
Major	4	Exceeds the quantitative or semi-quantitative benchmark
Moderate	3	At or near the quantitative or semi quantitative Benchmark. Periodically and briefly exceeds this benchmark although generally within the benchmark
Minor	2	Generally, only a fraction of (e.g., less than 75 percent) the quantitative or semi quantitative benchmark
Negligible	1	Impact not detected or at background conditions, or well below (e.g., less than 10 percent of) the quantitative or semi quantitative benchmark

5.2.5.4 Sensitivity of the receptor

This refers to economic, social, and/or environmental/ecological importance of the receptor, including reliance on the receptor by people for sustenance, livelihood, or economic activity, and to the importance of direct impacts to persons associated with the resource. Impacts that directly affect people or vital natural resources are deemed to be more important than impacts that indirectly affect people or vital resources.

The sensitivity of the receptor criterion also refers to potential impacts to Environmentally Sensitive Areas and impacts to species, including loss of endangered species, effects of introduction of invasive species, and similar environmental/ecological impacts. The reversibility or irreversibility of consequence of impact on receptor is also considered in determining the sensitivity of a receptor. It also depends on its local regional or international sensitivity classification and extent of consequence on the resource.

Sensitivity of the receptor has been given a classification from 1 to 4 based on whether the effect could result in significant negative impact on the resource that are limited to the site, local surrounding of the project, regional or international.

Additional impact assessment criteria

Indirect or secondary influence of a primary impact is considered as an additional factor when assessing the significance level of a potential impact. The direct impact of an activity is taken into consideration while considering the key assessment criteria described above. An indirect or secondary influence are those reasonably foreseeable effects that are expected to be "caused" by the proposed action but occur later in time or are removed in distance, such as influences on adjacent or upstream/downstream areas. Therefore, the secondary nature of the impact is considered when evaluating the temporal factors, geographical extent, and intensity of the potential impact.

Cumulative effects are those that result from the incremental consequences of an action when added to other past and reasonably foreseeable future actions. The cumulative effects of a particular project activity must be considered when assessing the overall significance level of that impact.

5.2.5.5 Significance Levels and Criteria

Table 5.8 is arranged to show the general media category across the rows of the table (i.e. Physicochemical Environment, Biological Environment, Socioeconomic Environment, and Health and Safety). Each significance level category is indicated by a gray separator row, beginning with "negligible", then describing "minor", "moderate", and "major" negative significance. Each major significance level includes a short discussion of the specific criteria outlined above.

Positive impacts are not ranked in terms of significance levels for this severity assessment. If an impact is deemed to be positive, rather than neutral or negative for any of the general media types, it is given a "positive" label and is described qualitatively and where possible quantitatively in the impacts discussion.

Table 5.8: Negative Impact Significance Levels and Criteria

Significance Criteria	Physicochemical Environment	Biological Environment	Socioeconomic Environment	Health and Safety (Personnel and Public)
Negligible (negative)				
Temporal	Very temporary effect, even less significant than periodic stress by nature. The duration of the effect is likely to be naturally reversible within a short period of time (less than one week). The frequency of the impact is extremely low (less than two times/year)	The duration of the effect is likely to be naturally reversible within a short period of time (less than one week). The frequency of the impact is extremely low (less than two times/year)	Temporary influence (impact discernable for less than one week). The effects are completely reversible and of extremely low frequency (less than two times/year)	No discernable health effects for any period of time.
Geographical	The impact to the land, air, and water is localized, existing only within the pipeline ROW or facility boundary.	Some impact localized on a community or individual level, but not distinguishable from natural background perturbation.	Localized, isolated change in socioeconomic conditions or commercial activities; not affecting persons other than project personnel.	No discernable health effects in any area.
Intensity	Little or no change in physical environment, barely measurable above background conditions (less	Little or no change in biodiversity, habitat availability, or community	Unlikely to have any measurable impact.	No discernable health effects to any part of the population.

Significance Criteria	Physicochemical Environment	Biological Environment	Socioeconomic Environment	Health and Safety (Personnel and Public)
	than five percent change from background). Concentration at receptor points is well below (e.g., no more than ten percent of) identified industry benchmark levels or established national standards.	Structure and function in comparison to background levels.		
Moderate (negative)				
Temporal	The duration of the effect is more than six months but less than five years and reversible within that period of time. Frequency of impact may occur from five to ten times per year.	The duration of the effect is more than six months but less than five years and reversible within that period of time. Frequency of impact may occur from five to ten times per year.	For single events, duration of the effect is more than six months but less than five years, and fully reversible after that period of time. For recurrent events, duration of each event is no more than a month, impacts are reversible after each event, and frequency of impact is from five to eight times per year.	For single events, duration of the effect is more than six months but less than five years, and fully reversible after that period of time. For recurrent events, duration of each event is no more than a month, and frequency of impact is from five to eight times per year.
Geographical				

Significance Criteria	Physicochemical Environment	Biological Environment	Socioeconomic Environment	Health and Safety (Personnel and Public)
	Localized, relatively isolated change in physicochemical environment. Impact consequence is realized up to 500m from ROW or facility boundary.	Local to widespread change in habitat availability or quality, likely to modify abundance or distribution of species. Impact consequence is realized up to 500m from ROW or facility boundary.	Impacts affecting not only project personnel but also surrounding population, local communities/public up to 500m from ROW or facility boundary.	Impacts affecting not only project personnel but also surrounding population (public) up to 500m from ROW or facility boundary.
Intensity	Local modification of considerable severity in atmospheric, surface, or subsurface conditions. Significant measurable change from baseline conditions (10 to 20 percent change from baseline). Concentration at receptor points is at, near, or periodically exceeds identified industry benchmark levels or established national standards.	Impact evident at community or population level, significant change in population density (e.g., decline in fish species abundance), habitat quality, etc	Pronounced change in socioeconomic conditions, livelihood, living conditions, or social structure, likely to result in significant hardships or reduction in living standards for a significant portion (but less than half) of the affected community population. Impacts too severe to be overcome or ameliorated with existing individual or community resources.	Injury or illness affecting less than half of the affected population to a greater or lesser degree, with a few cases requiring hospitalization and/or resulting in long-term disability.
Major (negative)				
Temporal	The duration of the effect is long-term (greater than five years) or is not reversible (permanent). Frequency of the impact may occur more than ten times/year	Long-term (greater than five years). Modification will persist beyond the duration of the project or is not reversible. Frequency of the impact may occur more than ten times / year.	The effect is long-term or likely to last more than five years, or is not reversible. For recurrent events, duration of each event is greater than a month; impact frequency is high (more than eight times / year) and impact durations may overlap.	Effects are of long-term duration (more than five years) or permanent, i.e., not reversible. For recurrent events, duration of each event is greater than a month; impact frequency is high (more than eight times / year) and impact durations may overlap.

Significance Criteria	Physicochemical Environment	Biological Environment	Socioeconomic Environment	Health and Safety (Personnel and Public)
Geographical	Widespread modification of considerable severity in atmospheric, surface, or subsurface conditions. Geographical extent of impact consequence is realized beyond 500m of ROW or facility boundary.	Widespread change in habitat availability or quality, which would likely modify natural abundance or distribution of species beyond 500m of ROW or facility boundary.	Widespread (possibly even beyond study area communities).	Impacts affecting not only project personnel but also surrounding population (public) more than 500m from ROW or facility boundary; may cause regional effects.
Intensity	Modification of considerable severity in atmospheric, surface, or subsurface conditions. Significant, measurable change from baseline conditions (more than 20 percent change from baseline when applicable). Concentration at receptor points exceeds identified industry benchmark levels or established national standards.	Impact to affect organisms at or above the ecosystem level.	Very pronounced change in socioeconomic conditions, livelihood, living conditions, or social structure, likely to affect the majority of people in the affected communities and result in serious hardships, reduction in living standards, or impoverishment. Impacts overwhelm the ability of individuals or communities to recover or overcome.	Impacts affect a large portion or even the majority of the affected population to a greater or lesser degree, with some cases of permanently disabling injury / illness; chronic and irreversible health impacts that may shorten life expectancy, or immediate fatalities.

5.2.6 Severity Criteria

The severity of the impact is defined by comparing the intensity of the effect of the project and the sensitivity of the environmental receptors. It is qualified according to a scale which ranges from "negligible" to "major", based on the World Bank's definitions (**Table 5.9**).

The severity value was derived as Severity = Intensity X Sensitivity. This is expressed in the severity matrix.

Table 5.9: Impact Severity Categorization according to World Bank

Severity	Criteria
Major	Substantial adverse changes in an ecosystem or resource. Changes are well outside the range of natural variation and assisted rehabilitation is required.
Moderate	Moderate adverse changes in an ecosystem or resource. Changes may exceed the range of natural variation. Potential for natural recovery in the medium or moderate term is good. However it is recognised that a low level of impact may remain.
Minor	Minor adverse changes in an ecosystem or resource. Changes might be noticeable, but fall within the range of normal variation. Effects are short-lived and Minor natural recovery takes place in the short term, however, it is recognised that a low level of localised impact may remain.
Negligible	Changes in ecosystems or resources that are unlikely to be noticeable (i.e. well within the scope of natural variation).
Positive	Changes resulting in positive, desirable, or beneficial effects on a resource.

Source: TotalEnergies EP)General Specification: GS-EP-ENV-120: Environmental Impact Assessment of E&P Activities

5.2.6.1 Likelihood Criteria

To obtain a measure of the severity associated with each potential negative impact, the likelihood criteria shown in Table 5.10 were developed. These likelihood criteria were applied to all potential negative impacts to determine whether they can be prevented, mitigated, or are unavoidable. The likelihood of the impact occurring, *not* the activity occurring is evaluated here. The severity of an impact is defined by its significance (or consequence) and its likelihood of occurrence. For example, a **moderate** impact that has a **high** likelihood of occurrence would be more severe than a **major** impact with a very low likelihood of occurrence.

Table 5.10 Likelihood Criteria

Significance Level		Description
Very Low	1	Impact has less than 1 or 2 percent likelihood of occurring: impact not known to have previously occurred in similar circumstances in the industry
Low	2	Impact highly unlikely, given the controls in place (e.g. between 2 to 20 percent likelihood of occurring, impact has been known to occur, but only very rarely, in similar circumstances).
Moderate	3	Impact could occur infrequently during normal operations, but given a breakdown of the safeguards and controls (i.e. lack of maintenance for a protecting device) it could occur more readily (e.g. between 20 to 70 percent likelihood of occurring, impact has been known to result in many similar circumstances, but does not result routinely.
High	4	Given the controls in place, the impact is likely to occur during normal operations (e.g. over 70 percent likelihood of occurring, impact has been known to result routinely, though not necessarily in all similar circumstances)

5.2.6.2 Severity Matrix and Conclusions

The Severity Matrix presented in Table 5.11 is constructed by placing the sensitivity ranking on the y-axis and the effects intensity ranking on the x-axis. Assigning an intensity ranking and a sensitivity ranking to each impact allows for semi-quantitative evaluation of the severity of the impact.

Table 5.11 Severity Matrix

	X	Intensity			
		NEGLIGIBLE	MINOR	MODERATE	MAJOR
Sensitivity	VERY LOW / NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	MINOR	MODERATE
	MINOR / LOW	NEGLIGIBLE	MINOR	MODERATE	MODERATE
	MODERATE	NEGLIGIBLE	MINOR	MODERATE	MAJOR
	HIGH	MINOR	MODERATE	MAJOR	MAJOR

Impact sensitivity **X** Impact intensity = Impact severity

Key:

1-2	NEGLIGIBLE
3 - 4	MINOR
5 - 9	MODERATE
>9	MAJOR

Intensity	X
SEVERITY	Z
Sensitivity	Y

5.2.6.3 Impact Significance

The overall severity of an impact, for this EIA is defined by its intensity and the sensitivity of the receptor. Using an indication of severity to comparatively assess and evaluate impacts enables this EIA to systematically identify and focus on those resources most likely to be at risk as a result of the proposed project. This overall severity of impacts is presented in Table 5.12.

The overall impact severity level is indicated by the position on the impact severity matrix. For example, impacts placed within the red boxes have a high likelihood of occurrence and serious consequence; thus they have a **high** severity rating. These high-severity impacts become high priority issues for further evaluation or management action. Similarly, impacts in the yellow category are **moderate** impacts, with a medium priority. Impacts in the **blue** boxes are low/minor and the lowest priority is negligible which is given in **green**.

The criteria and severity matrix set forth in this section are widely applicable to all the types of events and impacts identified. A high-severity rating for a given impact in this chapter does not mean that the project will definitely cause that high impact, but rather the impact is potentially high and warrants additional mitigation.

Table 5.12: Impact Severity Calculation Table

General Activity	Specific Activity Description	Environmental Receptors												
		Environmental								Socio-Economics			Health and Safety	
		Land Use	Terrestrial Biodiversity & Ecosystem Services	Soil, Topography and geology	Surface Water	Ground water	Air Quality & Noise/Vibration	Sediment	Aquatic Biodiversity & Ecosystem Services	Transportation and Infrastructure	Security (Third party agitation & Kidnappings	Social, and Cultural Conditions	Public Health and Safety	Workers' Health and safety
Pre-Mobilization	Land acquisitions and claims settlement	2 2 1									2 4 2	1 1 1		
Site Preparation & Mobilization	Bush/Vegetation Clearing	2 2 1	2 6 3	1 2 2	1 2 2	2 2 1	2 4 2	1 2 2	2 6 3	1 1 1	2 8 4	1 1 1		2 4 2
	Mobilization of personnel, materials and equipment to site by road.						2 4 2			2 4 2	2 8 4	1 1 1	2 2 1	2 4 2
	Influx of workers into the host Communities									2 4 2	2 6 3	2 6 3	2 6 3	2 6 3
Construction	Excavation and Trenching	2 4	2 4	2 4	1 2	1 2	2 4	1 2	2 6					2 4

General Activity	Specific Activity Description	Environmental Receptors												
		Environmental								Socio-Economics			Health and Safety	
		Land Use	Terrestrial Biodiversity & Ecosystem Services	Soil, Topography and geology	Surface Water	Ground water	Air Quality & Noise/Vibration	Sediment	Aquatic Biodiversity & Ecosystem Services	Transportation and Infrastructure	Security (Third party agitation & Kidnappings	Social, and Cultural Conditions	Public Health and Safety	Workers' Health and safety
		2	2	2	2	2	2	2	3					2
	Installation and positioning of Wellhead Platform		1 2 2	1 2 2			3 6 2				2 4 4	2 6 3		2 4 2
	Drilling		2 4 2	2 4 2	1 2 2	2 6 3	2 6 3	1 2 2	1 1 1		2 4 2			3 12 4
	Pipeline construction (Piping/ flowlines, Welding, Manifold construction)	2 4 2	2 6 3	2 6 3	2 6 3	1 2 2	2 4 2	1 2 2	1 2 2		2 6 3	2 6 3	2 4 2	2 6 3
	Back filling, Transportation of workers and maintenance of construction			2 4			2 4			2 4			2 2	2 2

General Activity	Specific Activity Description	Environmental Receptors												
		Environmental								Socio-Economics			Health and Safety	
		Land Use	Terrestrial Biodiversity & Ecosystem Services	Soil, Topography and geology	Surface Water	Ground water	Air Quality & Noise/Vibration	Sediment	Aquatic Biodiversity & Ecosystem Services	Transportation and Infrastructure	Security (Third party agitation & Kidnappings	Social, and Cultural Conditions	Public Health and Safety	Workers' Health and safety
	equipment's, waste disposal			4			2			2			1	1
	Operations of machines and vehicles		2 **2** 1	2 **2** 1			2 **4** 2			2 4 2				2 4 2
	Basecamp	2 4 2	2 4 2	2 4 2	2 2 1	2 4 2		2 2 1	2 2 1		2 6 3		2 6 3	2 6 3
	Disposal of construction and domestic wastes	2 4 2		2 4 2	2 6 3	2 4 2	2 4 2	2 2 1	2 2 1				2 4 2	
Commissioning	Hydrotesting				2 6 3	2 4 2		2 6 3					2 6 3	2 3
Operations/ Maintenance	Maintenance	1 1 1		2 **4** 2	1 1 1	1 1 1	2 **4** 2							2 4 2
			2	2	1	2	2						3	3

General Activity	Specific Activity Description	Environmental Receptors												
		Environmental								Socio-Economics			Health and Safety	
		Land Use	Terrestrial Biodiversity & Ecosystem Services	Soil, Topography and geology	Surface Water	Ground water	Air Quality & Noise/Vibration	Sediment	Aquatic Biodiversity & Ecosystem Services	Transportation and Infrastructure	Security (Third party agitation & Kidnappings	Social, and Cultural Conditions	Public Health and Safety	Workers' Health and safety
	Gas leaks and Pipeline explosion from overpressure		6, 3	4, 2	1, 1	6, 3	6, 3						12, 4	12, 4
	Generation and Disposal of Waste	1, 1, 1		2, 4, 2	2, 4, 2	2, 4, 2	2, 4, 2	2, 2, 1	2, 2, 1					2, 4, 2
Decommissioning, Restoration and Abandonment	Demolition and Excavation of structures and removal of well casings	2, 4, 2	2, 4, 2	2, 2, 1			2, 4, 2							
	Demobilization of Equipment, Materials and Wastes out of the project site		2, 4, 2	2, 2, 1	2, 2, 1	2, 2, 1	2, 4, 2			2, 4, 2	2, 6, 3			2, 4, 2

key: 1-2 Negligible; 3-4 Minor; 5-9 Moderate; >9 Major

Source: TotalEnergies EP General Specification: GS-EP-ENV-120: Environmental Impact Assessment of E&P Activities

Table 5.12 shows the different severity ratings, which is based on intensity and sensitivity across environmental, socio-economics and health aspects. In the next stage of assessment, the environmental, socio-economics and health aspects will be scaled and weighted according to criteria set by ISO 14001.

5.2.7 Determination of Overall Impact Rating and Significance

The second stage involved evaluation to determine whether or not the impact is significant. The criteria and weighting scale used in evaluating this significance are as follows:

- Legal/regulatory requirements (L)
- Risk factor (R)
- Frequency of occurrence of impact (F)
- Importance of impact on an affected environmental component (I) and
- Public perception/interest (P).

The quantification scale of 1, 3 and 5 was used. This is a modification of the arbitrary scale proposed by Vesilind, *et al.* (1994). The ratings are as described below and are adapted from The International Organization for Standardization ISO 14001 – Environmental Management System Approach.

These criteria and ratings are as follows:

Legal/Regulatory Requirements (L) – Is there a legal/regulatory requirement or a permit required?

Condition	Rating
No legal / regulatory requirement or provision for carrying out project activity or that is related to impact of activity	Low=1
Legal / regulatory requirement or provision exist for carrying out activity or that is related to impact of activity	Medium=3
A permit is required prior to carrying out project activity which may result in impact on the environment	High=5

Risk Factor (R) – What is the risk/hazard rating based on the Risk Assessment Matrix?

Risk	Attribute
Low=1	This means that no further mitigation may be required
Medium=3	This means that the impact can be mitigated with additional controls and modifications

High=5	This means that the impact requires avoidance or major control/mitigation

Frequency of Impact (F) – What is the frequency rating of impact based on the Risk Assessment Matrix?

- 1 = Low frequency (rare)
- 3 = Intermediate frequency (likely)
- 5 = High frequency (very likely)

The frequency of occurrence of each impact was determined from historic records and consensus of experts' opinion.

Public interest/perception (P) – What is the rating of public perception and interest in proposed project and impacts based on consultation with stakeholders?

- 1 = Low interest/perception
- 3 = Intermediate interest/perception
- 5 = High interest/perception

The perception of the general public on each potential impact was determined through consultation and consensus of opinions of environmental professionals.

Importance of affected environmental components and impacts (I) – What is the rating of importance based on consensus of opinions? *Will the impact be localized or spread to cover greater areas of the environmental component?*

- 1 = Low
- 3 = Medium
- 5 = High

The importance of affected environmental component was determined through consultation and consensus of opinions.

This approach was adopted considering its interactive and descriptive analysis of the relationship between the proposed project activities and the ecosystem components. It combines the following factors in assessing the overall impact rating of the project on the environment:

- The sensitivity/vulnerability of the ecosystem components;
- The productivity evaluation/rating of the ecosystem components;
- Knowledge of the possible interactions between the proposed project and the environment;
- Envisaged sustainability of the project environment;
- The economic value of the proposed project; and
- Projected duration of the impact of each project activity on various environmental components.

The overall impact significance rating is determined as shown in Table 5.13. The potential and associated impacts of the project are presented in Table 5.13. All impacts with the Medium and High Ranking are considered significant and will require mitigation measures. Impacts with Low ranking will be addressed by application of the company's Health, Safety and Environment Policy. Impacts rated as positive do not require mitigation and are considered beneficial. Significant and beneficial impacts are discussed in the proceeding paragraphs.

Table 5.13: Impact Value and Rating

Impact value	Cut off values	Impact Rating	Impact Significance
L+R+F+I+P	<8	Low	Not Significant
	≥8 but <15	Medium	Significant
	≥15	High	
F + I	>6		
P	= 5		
Positive		Positive	Beneficial

The frequency of occurrence of each impact was determined from historic records while the importance of affected environmental component was determined through consultation and consensus of opinions. The manner in which the host communities and the general public would perceive each potential impact and its effects were again determined through consultation with the host communities and consensus of opinions of environmental professionals. For this study, the frequency, the importance and public perception were judged to be superior indicators of the impacts. Significant impact was therefore based on the sum of F+I+P+R+L. The maximum possible point from this sum is 25. Impacts whose sum of F+I+P+R+L was less than 8 were rated as low. These impacts were judged not to require mitigation. Those whose sum of F+I+P+R+L was ≥8 but <15 were rated as having medium significance while those whose sum of F+I+P+R+L was greater than 15 were of high significance. For this study, medium and high significant negative impacts were judged to require mitigation. Significant positive impacts were believed to require enhancement. This is in compliance with best professional practice (Cox and Guy, 2002). The combination of these approaches is shown in Table 5.14

Table 5.14: Overall Impact Significance of Ubeta Field Development project

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
Pre_mobilization	Land acquisitions and claims settlement	Loss of farmland, fishponds and cultural resources			X			X		X	1	1	1	3	3	9	4	M
		Agitation as a result of payment and sharing of claims			X		X		X		1	1	1	3	3	9	4	M
Site Preparation	Bush Clearing	Biodiversity (Vegetation/ wildlife) loss			X			X	X		1	3	1	5	3	13	4	M
		Landuse Change			X		X		X		3	1	1	1	1	7	2	L
		Injuries and attacks from wild animals			X		X		X		1	1	1	1	1	5	2	L
		Loss of access to farmland and fishpond			X			X	X		1	1	1	5	5	13	6	M
		Local Content employment			X			X	X									P
		Third party agitation			X		X			X	1	3	3	1	3	11	4	M

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
Mobilization	Mobilization of personnel, materials and equipment to site by road.	Air/Noise pollution from increased vehicular movement			X		X		X		3	1	1	1	1	7	2	L
		Damage to existing access roads			X		X		X		1	1	1	1	1	5	2	L
		Kidnappings			X		X		X		1	3	3	3	1	12	6	M
		Road traffic accidents with injuries from increased vehicular movements on local roads			X		X		X		3	1	1	1	1	7	2	L
	Employment of local labour and award of contracts to members of the host communities	Increased cash flow and stimulation of local economies within the Host Communities			X		X		X									P
		Inter and intra community conflicts			X		X		X		0	1	1	1	1	4	2	L
		Localized economic benefits from materials			X			X		X								P

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		supplies by local contractors																
		Third party agitations			X		X			X	0	1	3	1	5	11	4	M
	Influx of workers into the host Communities	Increased sexual immorality especially among the youth			X			X	X		0	1	1	1	1	4	2	L
		Prevalence of sexually transmissible infections (STIs) including HIV and COVID 19			X			X	X		1	1	1	5	5	13	6	M
		Socio-cultural conflicts between the construction team and members of the host communities			X			X		X	1	3	1	3	3	11	6	M

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		Stimulation of local economy and markets from increased demand for food, and other products in the local market.			X		X		X									P
Construction	Excavation and Trenching	Damage to roads			X		X		X		1	1	1	1	1	5	2	L
		Damage to soil Structure and Texture			X		X		X		1	1	1	1	1	5	2	L
		Increase in dust and SPM			X		X		X		3	1	1	1	1	7	2	L
		Increase in noise and exhaust gases from excavators.			X		X		X		3	1	1	1	1	7	2	L
		Temporary vehicular traffic obstruction/diversion at road crossing.			X		X		X		0	3	1	1	1	6	2	L
	Installation and	Increase in noise and vibration			X		X		X		0	3	3	3	1	10	6	M

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
	positioning of Wellhead Platform	Impairment of air quality			X		X		X		0	3	3	3	1	10	6	M
		Risk of accident			X		X		X		0	3	1	1	1	6	2	L
		Contamination and degradation of soil			X		X		X		0	1	1	3	1	6	4	L
	Drilling	Impairment of air quality			X		X		X		5	1	3	1	1	11	4	M
		Increase in noise and vibration			X		X		X		3	1	3	1	3	11	4	M
		Injuries and death from blowout				X		X		X	0	5	1	5	5	16	6	H
		Opportunities for business and employment			X			X	X									P
		Soil and groundwater pollution from chemicals, drill cuttings, and mud			X		X		X		3	3	3	1	1	11	4	M

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		Increased gas production and revenue			X			X	X									P
	Pipeline construction (Piping/ flowlines, Welding, Manifold construction)	Loss of biodiversity			X			X		X	3	1	3	3	1	11	6	M
		Habitat fragmentation and disruption of wildlife migration route			X			X		X	3	1	3	3	1	11	6	M
		Impairment of air quality			X		X		X		3	1	3	1	1	9	4	M
		Increase in noise and vibration			X		X		X		3	3	1	1	1	9	2	M
		Injuries from accident			X		X	X	X		1	3	1	1	1	6	2	L
		Infringing on social and cultural practices/beliefs by workers			X		X		X		1	3	1	3	5	13	4	M
		Risk of kidnapping			X		X		X		1	5	3	3	1	13	6	M

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		Increased cash flow and stimulation of local economies within the communities			X		X			X								P
		Air pollutants effects of CO_x, NO_x, SO_x from welding and other activities.			X		X		X		3	1	1	1	1	7	2	L
		Exposure of welders to heat and light radiation.			X		X		X		3	1	1	1	1	7	2	L
		Integrity testers exposed to X-rays.			X		X		X		3	1	1	1	1	7	2	L
		Release of Toxic fumes during welding operations			X		X		X		3	1	1	1	1	7	2	L
		Risk of electrocution and burns during welding			X		X		X		0	1	1	1	1	4	2	L
	Back filling, re-vegetation,	Air pollutants effects of dust.			X		X		X		3	1	1	1	1	7	2	L

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
	transportation of workers and maintenance of construction equipment and waste disposal	Alteration of soil texture and structure through compaction			X		X		X		3	1	1	1	1	7	2	L
		Contamination and degradation of soil from discharges and spills of sanitary, construction related solids wastes.			X		X		X		0	1	1	1	1	4	2	L
		Onsite exposure of workers to noise and vibration from use of heavy-duty equipment			X		X		X		3	1	1	1	1	7	2	L
		Road users would be exposed to higher road accidents due to increase in heavy traffic and temporary road obstructions/diversions			X		X		X		1	1	1	1	1	4	2	L

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		Workplace accidents/incidents			X		X		X		1	1	1	1	1	4	2	L
	Operations of machines and vehicles	Emission of exhaust gases from the fuel combustion engines can alter the local ambient air quality.			X		X		X		3	1	1	1	1	7	2	L
		Soil contamination and loss of aesthetics from liquid leaks			X		X		X		3	1	1	1	1	7	2	L
		Vibrations			X		X		X		0	1	1	1	1	4	2	L
	Base camp	Domestic waste from base camp shall cause poor aesthetic if it is dumped on soil and vegetation			X		X		X		3	1	1	3	3	11	4	M
	Disposal of construction wastes	Odour and aesthetic devaluation may result from improper handling.			X		X		X		3	1	1	3	3	11	4	L

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
Commissioning	Hydrotesting	Discharge of hydrotest water from hydrostatic testing of equipment and interconnecting pipeline with water.			X		X		X		3	1	1	3	1	9	4	M
Operation / Maintenance	Maintenance	Release of gases through isolation valves.			X		X		X		0	1	1	1	1	4	2	L
	Gas leaks and Pipeline explosion from overpressure	Accidental damage to equipment or fire			X		X		X		3	3	3	5	5	19	8	H
	Operations	Third party agitation and kidnapping			X			X	X		1	3	3	3	3	13	6	M
		Gas flaring			X			X	X		1	3	3	3	3	13	6	M
		Revenue generation to government and company		X	X			X		X								P

Project Phase	Project Activities / Environmental Aspects	Potential and Associated Impacts	Impact Qualification								Impact Significance Evaluation						Sum	Overall Significance Rating
			Adverse	Beneficial	Direct	Indirect	Short term <3months	Long term >3months	Reversible	Irreversible	L	R	F	I	P	L+R+F+I+P	F+I	Overall Ranking (High/Medium/Low)
		Employment of locals and subsequent stimulation of local and national economy			X			X		X								P
Abandonment / Decommissioning	Demolition and Excavation of structures and removal of well casings	Soil contamination			X		X		X		3	1	1	1	1	7	2	L
		Local content employment			X			X		X								P
		Return of land to indigenes for farming			X			X		X								P
	Demobilization of Equipment, Materials and Wastes out of the project site	Loss of Employment/Income			X			X		X	1	3	1	3	3	11	4	M
		Occupational and traffic accidents			X		X		X		1	1	1	1	1	5	2	L

5.3 DESCRIPTION OF POTENTIAL IMPACTS

The impacts associated with the proposed Ubeta field development project has been identified and evaluated vis-a-vis the recipient environment. They have also been subjected to the impact severity evaluation. The results revealed that the impacts fall into five categories, namely: beneficial, negligible, minor, moderate and high. A description of each of the impacts is provided in the following sections:

5.3.1 Negative impacts

Loss of farmland, fishponds and cultural resources

The area that will be acquired for citing of the Ubeta field development project is within the freshwater water swamp forest within which there are farmland and fishponds.

Potential Impact

During pre-mobilisation phase, land acquisition will lead to permanent loss of farmland and fishponds which will result to loss of livelihood. This impact was ranked as medium However, the loss will be mitigated by the payment of adequate compensation to all affected parties.

Vegetation/ Biodiversity/Habitat loss/fragmentation:

As the baseline information indicated, the spatial project area is within secondary forest home to a number of plant-dwelling and land-based animals (insects, birds, mammals, reptiles and amphibians).

Potential Impacts

During the pre-construction (site clearing), vegetation clearing will lead to loss of habitats for terrestrial fauna and important species, however, clearing will be limited to the ROW so as to limit the impact.

It will rather result in a permanent change in the use of this land space for the lifetime of the project

Site preparation (clearing & excavation) removes the grass cover over the soil leading to increased evaporation that dries the soil (mainly due to increased exposure to the sun). This drying may make the soil less favourable for the fauna of the soil.

Site preparation shall involve removal of limited amount of vegetation to provide space for site camps and equipment parking. The removal of wildlife habitat (vegetation) will lead habitat fragmentation and temporal migration of wildlife.

The high impact of vegetation clearing is as a result of the current emphasis in the release of carbon sequestered in plants, which increases the greenhouse gas emissions that affects climate change. The reduction in vegetation will also reduce the available carbon sinks that aid carbon sequestration.

The back filling of the pipeline may lead to soil inversion. Inclusion of debris in the backfilling material would lead to caving-in. The effect is temporary, reversible and not significant.

The impact on vegetation and biodiversity will be negligible to moderate because the project will be sited within an existing facility. The only effect on vegetation and biodiversity will be along the pipeline ROW. This impact is expected to have been naturally reversed within six months after completion of the backfilling.

Soil

The severity classification of the soil impacts is minor. The potential for these impacts could either be along the pipeline ROW or within the project area.

Back filling involves the dumping of soil back on the pipeline. The working procedure for back filling shall be based on the nature of the soil/terrain. In general, the first stage will be to return the soil in the reverse order. The back filling may affect the drainage pattern of the area if not properly done. The back-filling may induce erosion if soil is not properly re-instated. The effect is non-significant, reversible and has short-term duration.

Soil will be exposed to direct sunlight rays since vegetation has been removed (especially along the pipeline route). This may elicit erosion, high temperature and changes in soil moistures regimes. This will lead to changes in soil physical and chemical characteristics and subsequent death of soil organisms; regeneration of vegetation from seed banks will be impeded. There is also the potential of soil contamination in the event of gas leakage due to pipeline failure as well as improper waste management. Generally, the impact will be short term and localised. The residual impact of the project on the soil quality of the project area is considered negligible.

Traffic/Transportation

The soils of the project area would be compacted if vehicles drive on earth roads. The increase in traffic may increase the rate of exposure to accidents.

It is anticipated that road traffic will increase during mobilization of personnel and equipment to site over a period of time. During the construction phase, intensive movement of personnel and equipment will take place. Given the present condition of the road in the communities, there is the potential for increase in traffic accidents/injuries during these phases. Roads may temporarily be obstructed or diverted as a result of movement of heavy equipment and materials.

Interference with traffic flow revealed a severity rating of low impact and has the potential to occur during mobilization and construction, as well as during abandonment and decommissioning of the project life cycle.

The proposed project will require installation of new pipes and other auxiliary equipment. The mobilization of these equipment and personnel to project site during construction shall cause occasional increased movement/traffic. The severity of the impact from traffic at the road intersection is minor, short-term, and reversible. The interference with traffic by construction vehicles can aggravate the existing situation on the road.

Traffic impacts during the construction phase can be minimized for some large equipment by scheduling delivery during off-peak peroids, pre-mobilization inspection of all vehicles to ensure they are in good condition and enforcing journey management policy and alcohol policy. However, these impacts shall be short term.

Traffic impacts during operational phase of the project will not be different from those impacts experienced historically on that road.

Air Quality/ Noise Level

Air quality remains one of the most significant issues for gas projects. Short term air quality impacts of the project will occur during construction activities as transitory emissions of air pollutants from construction equipment. The potential for air quality impairment as a result of the construction activities of the Project is confined to exhaust emissions from vehicles and equipment and it is low. During operation, pipeline leakage of compressed gases may occur and cause explosion and consequent fire outbreak. These emissions and fire if it occurs will increase the health risk associated with the project. The communicable diseases associated with air quality impairment are respiratory tract infections and skin rashes while the non-communicable diseases are injuries, noise- related hearing loss.

The severity classification for the project is moderate. The contribution to air contaminants from the project will be negligible. The overall assessment of the potential impact on air quality due to the proposed project is considered moderate.

The severity derived for the noise impact is minor. Even though the existing noise-level measurements in the communities of the project area range from 53 to 55 dBA, noise has the potential of causing disturbance and inconvenience to communities. This can be aggravated by noise from site clearing, construction and operational activities due to the use of motorized equipment. Other sources of noise identified around the project area include vehicular traffic.

Insecurity and Kidnapping

Kidnap of personnel which is likely at every phase of the project because of the high rate of insecurity and kidnapping in Nigeria.

Environmental Sanitation and Waste Management

Waste will be generated during some of the project activities such as site clearing, trenching, drilling, pipeline and manifold construction and in the operational and decommissioning/abandonment phases. It is rated medium

Personnel injury/death resulting from malfunction & mal-operation of equipment
Injury and fatality can result from occupational accidents during construction and the operation of the facility. This could result from equipment malfunction or human error.
Accidents resulting in injury/death of personnel
In the event of an accident workers may suffer injury which may result in lost time or even fatality. The likelihood of occurrence of this is low in view of the HSE guidelines and strict operational standards that TEPNG has in place and plans to implement for this project.

Socio-economic Resources
Behavioural influences - Agitation for employment and supply contract by community
The increased movement of persons into the project area and when the community become aware of employment of casual workers, and award of supply contracts for some materials for the construction may result in reactions such as agitation for specific people or for higher number of persons to be employed by the community.
Loss of gainful employment as a result of end in project cycle
At the end of the project life cycle, abandonment and decommissioning of the project may result in loss of gainful employment by some of the personnel
Life style/Habit
As a result of immigration, life style/habit changes involving crime, drug abuse, prostitution will be more pronounced in the communities. This will adversely affect the health status of those involved. Immigrants may, however, introduce beneficial habits/practices into the communities.
5.3.2 Positive impacts

The main objective of Ubeta Field Development Project is to increase gas supply to satisfy the needs of Bonny Nigeria Liquefied Natural Gas (NLNG) plant and the domestic market. It will thus increase gas utilization by TEPNG with resultant reduction in gas flared
It therefore provides an alternative environmental cleaner technology to the gas flaring and diesel generator option. At the same time it contributes to power generation which is another cardinal programme encouraged by the Federal Government towards solving the constant power outage in the country.
Local economy
Finally, the study revealed positive impacts of the planned project on the local economy of the host communities and the nation as a whole, in terms of tax revenue to the three tiers of Government; profit, employment opportunities, the opportunities for contract works and welfare improvements in the host community.

Power generation is a very important part of the programme of the Federal Government of Nigeria and the Rivers State Government.

The overall impacts assessment revealed that Ubeta field development project beneficial impacts outweighed the adverse effects.

Chapter 6

MITIGATION MEASURES

6.1 INTRODUCTION

The environmental impacts linked to the proposed project were evaluated and the impact ratings presented in Chapter Five. The results of the impact assessment were used for the selection of the impacts that would require remedial measures. Remedial measures were provided for those negative impacts rated as medium and high. These were to either reduce the severity of the negative impacts to As Low As Reasonably Practicable (ALARP) or eliminate the contaminant, and also to enhance the positive (beneficial) effects. None significant impacts are expected to be mitigated through effective implementation of TEPNG Safety and Environment policies that will be put in place during the different phases of the project.

The mitigation measures proposed are in consonance with the following:

- Environmental Guidelines and Standards for Petroleum Industries in Nigeria (EGASPIN) (NUPRC, 2018)
- International Union for Conservation of Nature and Natural Resources (IUCN) Guidelines, 1996.
- Harmful Waste (Special Criminal Provisions) Decree, 1998.
- National Environmental Protection (Pollution abatement in industries and facilities generating waste) Regulations, 1991.

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

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

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

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

Factors for determining implementation of mitigation measures are

- Avoiding the impacts altogether by not taking a certain action or parts of an action;
- Minimising impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating or restoring the affected environment.
- Compensating for the impact by replacing or providing substitute resources.
- Feasibility;
- Ease of implementation;
- Local suitability;
- Institutional requirements;
- Training requirements;
- Monitoring requirements;
- Cost (capital and operating); and
- Cost-effectiveness.
- The Required General and Specific Mitigation measures, apply to the Ubeta field development Project includes:
- Pre-construction;
- Site Preparation and Construction;
- Commissioning and Start-up;
- Operations and Maintenance; and
- Decommissioning and Abandonment.
- The mitigation measures are categorized by relevant impact category, potential impact, and affected specific area. The Required General and Specific Mitigation measures are divided into three sections, labelled Environmental, Socioeconomic, and Health and Safety, and subsequently into thirteen categories of potential impacts. These categories of impacts by section are:

Environmental

- Land Use;
- Terrestrial Biodiversity & Ecosystem Services;
- Topography, Geology, and Soils;
- Surface Water;
- Groundwater;
- Sediment;
- Aquatic Biodiversity & Ecosystem Services;
- Habitats, Biological Resources and

- Air Quality and Noise/Vibration).

Socioeconomic

- Transportation and Infrastructure;
- Security (Third party agitation & Kidnappings);
- Social and Cultural Conditions.

Health and Safety

- Public Health and Safety;
- Workers' Health and Safety.

The actions and measures that TEPNG intend to take to reduce (or eliminate) negative impacts and promote positive Environmental, Social and Health impacts of the Project are presented in this chapter.

6.2 MITIGATION MEASURES

A summary of the mitigation measures for the potential impacts is presented in Table 6.1. These measures are recommended to ameliorate all the significant associated and potential impacts for the proposed Project.

Table 6.1 Impact Mitigation Measures

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
Pre-Mobilisation	Loss of farmland, fishponds and agitation as a result of compensation payment and sharing of claims	**Medium**	TEPNG shall; • Conduct a thorough assessment of land requirements • Pay adequate compensation for the loss of land • Pay adequate compensation for the loss of farmland and fishpond	**Low**
Site Preparation	Biodiversity (Vegetation/ wildlife) loss, Loss of access to farmland, Ecological degradation, Exposure to allergic plants, Injuries and attacks from wild animals	**Medium**	TEPNG shall; • Use existing route/path for site survey. • Minimize bush clearing. • Wildlife studies shall be carried out to ascertain the status of endangered/threatened species (species diversity and abundance) shall be carried out one year after major construction activities. • Ensure that appropriate PPEs are provided and used. • Ensure presence of a medic/first aid materials/first aider during the site clearing • Anti- venom shall be provided on site. • Awareness shall be created among site workers and nearby communities on the likelihood of exposure to poisonous wildlife and plants.	**Low**
	Third party agitation	**Medium**	TEPNG shall • Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities.	**Negligible**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			• Require local labour (both male and female, skilled and unskilled) to be employed as a priority to the extent practicable. • Ensure the adherence to Momerandum of understanding (MOU) with the host communities • Any form of agitation is looked into and addressed promptly.	
Mobilization/Demobilization	Potential increase in road traffic incidents	Low	TEPNG shall • Ensure that large and slow-moving vehicles are scheduled for off peak periods. • Raise community awareness of unusual activity. • Carry out a premobilization audit/inspection of operational vechicles. Ensure DDC certification of the drivers • Visible warning signs on roads and vehicles. • Vehicle monitoring device/TEPNG journey management policy/night driving and alcohol policy shall be enforced. • First aid training of workforce and provision of first aid boxes in operational vehicles. • Enforce night driving policy (no night driving except when unavoidable).	**Negligible**
	Increase in noise levels	Low	• TEPNG shall ensure that all vehicles and equipment are well maintained and in perfect condition.	**Negligible**
	Damage to existing access road	Low	• TEPNG shall restore the existing access road if damage is caused by the project.	**Negligible**
	Kidnappings	**Medium**	TEPNG shall • Develop and implement a security management plan for the project	**Low**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			• Work with the Government, communities and other relevant agencies to improve security in the project area. • Ensure that security orientation and awareness is conducted for workforce. • Ensure that staff adhere to instructions on daily journey management plan. Personnel should limit their movements within the perimeter of the company's operations, if possible walk in pairs. • Ensure government approved security personnel are used on transport vehicles when warranted and limit movements of personnel and equipment to daytime.	
	Third party agitations	**Low**	TEPNG shall • Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities. • Require local labour (both male and female, skilled and unskilled) to be employed as a priority to the extent practicable. • Any form of agitation is looked into and addressed promptly.	**Negligible**
	Increase in social vices	**Low**	• Alcohol and drug policy shall be implemented to encourage healthy lifestyle for workers (TEPNG/contractor staff).	**Negligible**
	Prevalence of sexually transmissible infections (STIs) including HIV and COVID 19	**Medium**	TEPNG shall • Provide dedicated accommodation and logistics to all site personnel including local labour to prevent mixing with the	**Low**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			larger community as part of Covid-19 measures throughout the construction phase of the project. • Step-up health education and sensitisation activities prior commencing construction activities • Carry out HIV/AIDS education campaign for workers in line with the National Prevention Program. • Enforce strict Access control within workers camp sites.	
	Increase pressure on existing social amenities and infrastructure	**Low**	TEPNG shall • Provide dedicated accommodation and logistics to all site personnel including local labour to prevent mixing with the larger community as part of Covid-19 measures throughout the construction phase of the project.	**Negligible**
	Socio-cultural conflicts between the construction team and members of the host communities	**Medium**	• Awareness campaign and health education on dangers and problems of unwanted pregnancy and sexually transmissible diseases to members of communities and workers will be provided as part of tool box meeting on site. • Ensure that workers respect the norms and values of the project communities.	**Negligible**
Construction	Damage to roads, soil Structure and Texture, Alteration of soil texture and structure through compaction	**Low**	• Excavated soil shall be backfilled in line with standard construction practices for pipeline. • Ensure that the original topography is maintained as far as practically possible.	**Negligible**
	Increase in noise and exhaust gases from excavators. Air pollutants effects of	**Low**	• Standard machinery with noise levels within acceptable limits (85 dB (A)) shall be used. • Site construction shall be done within the shortest possible time.	**Negligible**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
	COx, NOx, SOx from welding and other activities.		• Acoustic mufflers shall be provided for heavy engines with noise level above acceptable limits • TEPNG HSE policy of wearing ear muffs/ plugs, with signs indicating noisy areas shall be applied in all construction sites. • Sufficient separation distances shall be provided for sources of high energy sound to reduce noise levels • Workers with existing hearing impairment shall not be deployed to site. • Emissions from machineries shall be reduced by the use of standard equipment that meet existing emissions requirements and fume catalysers provided on all suitable equipment. • There shall be regular maintenance of combustion systems (generators etc) • Ambient air quality monitoring programme shall be developed, detailing the monitoring location, parameters (THC particulates CO_2, SO_2, NO_2, SPM and VOCs), methods and frequency. • High efficiency (low energy) motors shall be used.	
	Contamination and degradation of soil from discharges and spills of sanitary, construction related solids wastes.	**Low**	TEPNG shall • Adhere to HSE control framework for waste management • Ensure that generated solid waste is segregated at source by the provision of colour coded bin for different types of waste and disposed of according to TEPNG waste management guidelines. • Ensure that generated paper waste is shredded and transferred to a TEPNG approved paper recycling company.	**Negligible**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			• Ensure that ee-contaminated scrap metals/drums are collected and taken to TEPNG waste recycling depot • Ensure safe Handling of Chemicals cards (SHOC) / Material Safety Data Sheets (MSDS) are available on site to provide information on safe handling of chemicals. • Ensure all maintenance and repair of equipment and vehicles are done in a secure location with clean-up materials (drip pans, containers, absorbent materials etc). • Ensure that appropriate waste management procedures are implemented	
	Impairment of air quality and Increase in noise and vibration	**Medium**	• Ensure that drilling equipment is of high standard and in good condition prior to mobilization. • Ensure that all emission releasing equipment shall be maintained regularly including gensets, cranes, welding machines, etc. • Ambient air quality shall be monitored in line with FMENV/NUPRC requirement (NOx, COx, SOx, and SPM	**Low**
	Injuries and death from blowout during drilling	**High**	TEPNG shall ensure that • Only skilled personnel and certified equipment are used. • Use appropriate blowout prevention fluids. • Use appropriate mud density. • Use high quality chemicals and materials. • Ensure emergency response procedures are in place • Job hazard assessment shall be conducted. • Daily pep talks shall be conducted on identified hazards. • A Blow out Preventer (BOP) will be used when drilling.	**Low**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			• Above mitigation measures are to ensure that there is no blow outs/accidents. However, in the event of blow out/accidents, emergency response in place is activated	
	Soil and groundwater pollution from chemicals, drill cuttings, and mud	**Medium**	TEPNG shall • Recover oil-based drilling mud for re-processing and re-use. • Wells shall be drilled with Water Based Mud in top hole. • Develop and implement waste management plans for all wastes generated in accordance with regulatory requirements and standard practice. • All industrial wastes such as plastics, metals, rubber and wood shall be segregated on site and collected in designated containers. The containers will be transported to to a certified waste center for appropiate treatment and disposal	**Low**
	Loss of biodiversity and Habitat fragmentation and disruption of wildlife migration route	**Medium**	TEPNG shall: • Ensure the utilization of the existing ROWs to avoid habitat disturbances and losses of ecological species. • Ensure minimum land clearing and clearing will be restricted to acquired area • Limit clearing activities to pipeline corridor only • Carry out a biodiversity offset by reforesting of areas outside the ROW corridor	**Low**
	Increase in noise and vibration	**Low**	TEPNG shall: • Use only pre-mobbed and regularly maintained equipment and vehicles • Ensure that generators are fitted with effective silencers • Provide adequate enclosures for noise producing equipment • Use equipment with low noise level • Ensure that appropriate PPEs are provided and used.	**Negligible**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
			• Ensure that ear protection devices (muffs) are provided and worn by construction staff within the working zone.	
	Infringing on social and cultural practices/beliefs by workers	**Medium**	TEPNG shall ensure: • That all personnel are briefed with acceptable social behaviours and taboos of the host community.	**Low**
	Risk of kidnapping	**Medium**	TEPNG shall • Develop and implement a security management plan for the project • Work with the Government, communities and other relevant agencies to improve security in the project area. • Ensure that security orientation and awareness is conducted for workforce. • Ensure that staff adhere tosecurity instructions. • Ensure government approved security personnel are used during construction.	**Low**
	Contamination and degradation of soil from discharges and spills of sanitary, construction related solids wastes.	**Low**	TEPNG shall adhere to HSE framework for waste management	**Negligible**
Commissioning	Effluent discharge	**Medium**	TEPNG shall provide effluent and waste water treatment facilities of adequate capacity and treat effluent to NUPRC standards prior discharge	**Low**
	Discharge of untreated effluents from flowstations /CPF into water	**Medium**	TEPNG shall provide effluent and waste water treatment facilities of adequate capacity and treat effluent to NUPRCstandards prior discharge	**Low**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
Operation / Maintenance	Reduction in air quality as a result of release of gases through isolation valves.	**Low**	TEPNG shall • Ensure that appropriate maintenance programs are in place for all equipment.	**Negligible**
	Accidental damage to equipment or fire	**High**	TEPNG shall • Ensure provision of adequate firefighting equipment • Ensure that emergency response procedures are in place • Ensure a more frequent or rigorous pipeline inspections/testing	**Low**
	Third party agitation and kidnapping	**Medium**	TEPNG shall • Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities. • Require local labour (both male and female, skilled and unskilled) to be employed as a priority to the extent practicable. • Any form of agitation is looked into and addressed promptly. • Develop and implement a security management plan for the project • Work with the Government, communities and other relevant agencies to improve security in the project area. • Ensure that security orientation and awareness is conducted for workforce. • Ensure that staff adhere to security and safety instructions. • Ensure government approved security personnel are used.	**Low**

Project Phase	Description of Impact	Significance Rating Before Mitigation	Mitigation measures	Impact Rating After Mitigation
	Gas flaring	**Medium**	TEPNG intends to employ the of improved technology like the use of Mobile flare as opposed to continuous flaring so as to ensure carbon footprint reduction (CFR)	**Low**
Abandonment and Decommissioning	Loss of employment/Income	**Medium**	TEPNG shall encourage alternative income generation through skills acquisition programmes TEPNG shall implement end- of- job pay	**Low**
	Occupational and traffic accidents	**Low**	• Awareness shall be created on the potential of increased traffic for road users and community members. • TEPNG policy on journey management shall be adhered to (all journey must be approved, no night journeys, speed limits must be obeyed).	**Negligible**

6.3 MITIGATION OF ENVIRONMENTAL, SOCIAL AND HEALTH IMPACT

6.3.1. Socio- Economic

Mitigation measures are measures designed to address the impacts of projects. The measures are largely a function of the adverse social impacts of projects since it is such impacts that require mitigation. The expected impacts of the Ubeta field development Project include the following:

- Demographic Impacts (redirection of labour, inflation).
- Socio-economic Impacts (redirection of labour, inflation).
- Impacts on Lifestyles (sexual laxity, alcoholism, youth militancy).
- Impacts on Cultural Properties (religious sites/shrines, etc).
- Impacts on Social Infrastructure (health care facilities, water supply).
- Impacts on natural resources (disruption of vegetation and farms).

The usual practice is to differentiate these impacts for purposes of analysis. However, in reality they tend to be closely interrelated. For example, an increase in population (demographic impact) can increase pressure on natural resources and social infrastructure. Project activities will be very visible and transient in the communities around the project area during the construction phase. They will be much less visible in these communities during the operation phase. This low visibility should not be seen as reducing the stake of the communities in the project. The company should continue to show interest in these communities after the construction phase for the maintenance of good community relations.

Mitigation Measures

The possible adverse social impacts of the project were spelt out in the previous chapter. These impacts were derived from experience elsewhere and from the views of respondents in the host communities of the project. The impacts provide the basis for the articulation of appropriate mitigation.

Relevant measures needed at each stage of the project, i.e. construction, operation and decommissioning are indicated in the discussion.

Table 6.2: Key Mitigation Measures

	Impacts	Mitigation Measures
1	Population growth due to immigration	Provide a basecamp for accommodation and logistics to all site personnel. Use local labour to minimize additional labour demand from outside the communities.
2	Inflation in the local economy	Provide a basecamp for accommodation and logistics to all site personnel. Use local labour to minimize additional labour demand from outside the communities.
3	Pressure on local infrastructure	There will be low dependence on existing infrastructure as personnel will be camped on site.
4	Sexual laxity	Public enlightenment about potential health risks (STDs).
5	Kiddnapping	• Ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of activities. • Develop and implement a security management plan for the project • Ensure that security orientation and awareness is conducted for workforce. • Ensure that staff adhere to security and safety instructions. • Ensure government approved security personnel are used.
6	Youth militancy/unemployment	Use local labour as much as possible to have the youths gainfully employed.
		Facilitate skills acquisition and scholarship programmes as CSR.

Table 6.2 shows the major mitigation measures required to address each impact. The impact of population growth and others due to immigration, particularly during the construction phase can be mitigated by engaging local labour.

As part of the mechanism to address the societal concerns around within the cluster of communities of the proposed project location. TEPNG has an Active MoU with the community cluster which is currently being implemented. The MoU ensures that local labour is sourced as much as practicably possible during construction phase of projects; trainees for skill acquisition are identified and sent to prequalified centres for training. Scholarships are also awarded to qualified members of the communities.

Programs such as health awareness campaigns are also implemented as part of our social investment in these communities.

6.3.2. Health

The adverse health impacts will require appropriate mitigation measures while the beneficial health impacts will be enhanced. The proposed mitigation/enhancement measures for the respective impacts are summarized as follows:

Environmental Sanitation/Waste Management

The objective here is to achieve proper management of refuse, sewage and vectors of diseases. TEPNG will engage a competent contractor to manage this

Refuse Management

The ultimate goal is refuse collection and segregation. Biodegradable organic matter shall be collected in separate bags from that of non-biodegradable materials (cans, plastics, glass etc.). The biodegradable matter shall be used for composting while the non – biodegradable shall be reused, recovered and recycled.

COVID 19 Pandemic

The transmission of Covid 19 shall be controlled by adhering to all Covid 19 protocols of regular hand washing and use of hand sanitizers

Potable Water

Personnel will be camped on site and potable water will be provided for them as part of their daily feeding arrangement.

Noise

The present low noise level (53 – 55) dBA should be sustained. In the project area, excessive noise from heavy machinery used in construction and operational activities require mitigation as follows:

- Ear protection devices (muffs) should be provided and worn by construction staff within the working zone.
- Deploy low noise type equipment

Health Education

Most of the mitigation measures recommended need proper health awareness amongst workers to succeed. Therefore, modern basic health centers within the project area shall be encouraged to provide good health education to the existing communities and the workforce on the control of infectious diseases, sanitation etc.

6.3.3. Environmental

The adverse environmental impacts will require appropriate mitigation measures. The proposed mitigation/enhancement measures for the respective impacts are summarized as follows:

Loss of biodiversity and Habitat Fragmentation

Biodiversity offset will be carried out by by reforesting of areas in order to compensate for the vegetation that will be cleared during site preparation.

Injuries and death from blowout

Only skilled personnel and certified equipment will be used in order to mitigate against this. Efforts will also be made to ensure that appropriate PPEs and high-quality chemicals and materials are used during drilling, construction & facility operations.

Chapter 7

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 INTRODUCTION

An Environmental Management Plan (EMP) is an important tool that initiates management's strategies and procedure for controlling the potential environmental impacts associated with the proposed project.

Environmental management is concerned with a planned, integrated programme aimed at ensuring that identified and unidentified impacts of a proposed project are contained and brought to an acceptable minimum. It provides confidence on the part of project planners that a reliable scheme will be put in place to deal with any contingency that may arise during all phases of development, from preliminary study to abandonment.

In consonance with the Federal Ministry of Environment regulations, Nigeria Upstream Petroleum Regulatory Commission and TEPNG policy on protection of the environment, this EMP is designed based on the interaction of the proposed project with the various components of the environment.

The EIA of the Ubeta Field Development project has addressed the impacts of the project and its location and confirmed that the impacts of the project are acceptable. As part of the continuing process of management of Health, Safety and Environment issues relating to the project, the issues of monitoring and auditing can now be addressed.

To ensure that the environmental consideration and mitigation recommendations of the EIA for the Ubeta Field Development project are implemented, an Environmental Management Plan (EMP) has been developed. The EMP consists of plans, procedures and programs, covering areas such as:

- The handling of hazardous materials and wastes;
- Emission and discharge monitoring;

- Site inspection and auditing.

The EMP is formulated to ensure that the environmental mitigation requirements outlined in the EIA are central to the operation and management of the proposed project. It has been developed by following international standards for environmental management planning, such as the International Organisation for Statndardization (ISO 14001), or the Health, Safety and Environment Management System (HSE-MS), as developed by the Joint Oil Industry International Exploration and Production Forum. The EMP covers all the phases of the project from project design to project decommissioning. The various responsibilities and tasks involved in implementing the EMP for the development project vary with the project stage and are summarized in Table 7.1.

- **Table 7.1: Summary of Environmental Management Responsibilities for Various Stages of the Proposed Project**

Project Phase	Action
Project Design	Review design compliance with EMP and regulations
Project Planning and Scheduling	Setting up of an environmental focal point
Contingency Planning	Training, plan development and implementation
Project Mobilization	Supervision of the process
Construction Phase Supervision	Supervision including inspection, monitoring, and auditing activities
Construction, Demobilization	Supervision of the process
Operations and Maintenance Phase Supervision	Supervision including inspection, monitoring and auditing of activities
Project Decommissioning	Post project monitoring and auditing

7.2 OBJECTIVES OF THE EMP

The EMP is designed to:

1. Ensure that the impact of the project on the environment is kept As Low As Reasonably Practicable (ALARP) or completely mitigated.
2. Provide part of the basis and standards needed for overall monitoring and review of environmental safety throughout the project lifespan.

These objectives shall be achieved by:

- Ensuring compliance with all legislations on protection of the environment and the environment policy of the Federal Ministry of Petroleum Resources
- Ensuring that environmental concerns are fully integrated into project planning;
- promoting adherence to the provisions of the HSE Policy of TEPNG;

- Promoting environmental management awareness among workers during the construction phase.
- Encouraging adherence to the principles of good housekeeping and the use of best available technologies;
- Ensuring that the Project is successfully and safely implemented with minimal harm to both the environment and the health of the workers;
- Provide standards for overall planning, operation, audit and review; and
- Enable management to establish environmental priorities.

7.3 ENFORCING THE EMP

This project is based on national and international standards and codes which specify environmental safety. Implementation of those guidelines will be encouraged by teams from Federal Ministry of Environment (FMEnv) and Nigerian Upstream Petroleum Regulatory Commission (NUPRC) in administration of the Guidelines and Standards.

7.4 MANAGEMENT STRUCTURE AND ORGANIZATION

TEPNG has an established policy and schedule for responsibilities and training on matters relating to the environment. There is a line responsibility for which all level of staff is accountable. Line management will take full responsibility for environmental issues. The management of TEPNG will ensure that there is total commitment to environmental considerations through the provision of induction and training courses for staff as part and parcel of the Environmental Management System. A focal point will be appointed to co-ordinate HSE performance throughout the lifespan of the project.

The tasks for the focal point shall include:

- The development and maintenance of the Environmental Management Plan (EMP) and associated plans for materials management, waste management, spill preparedness and response, inspection and monitoring and staff training;
- The implementation of the Environmental Management Plan and related tasks;
- Conducting or organizing periodic audits;
- Initiating or organizing corrective actions as and when necessary;
- Preparing and managing documentation related to environmental performance;
- Regular and incidental reporting to the TEPNG management and to the appropriate environmental regulatory authorities.

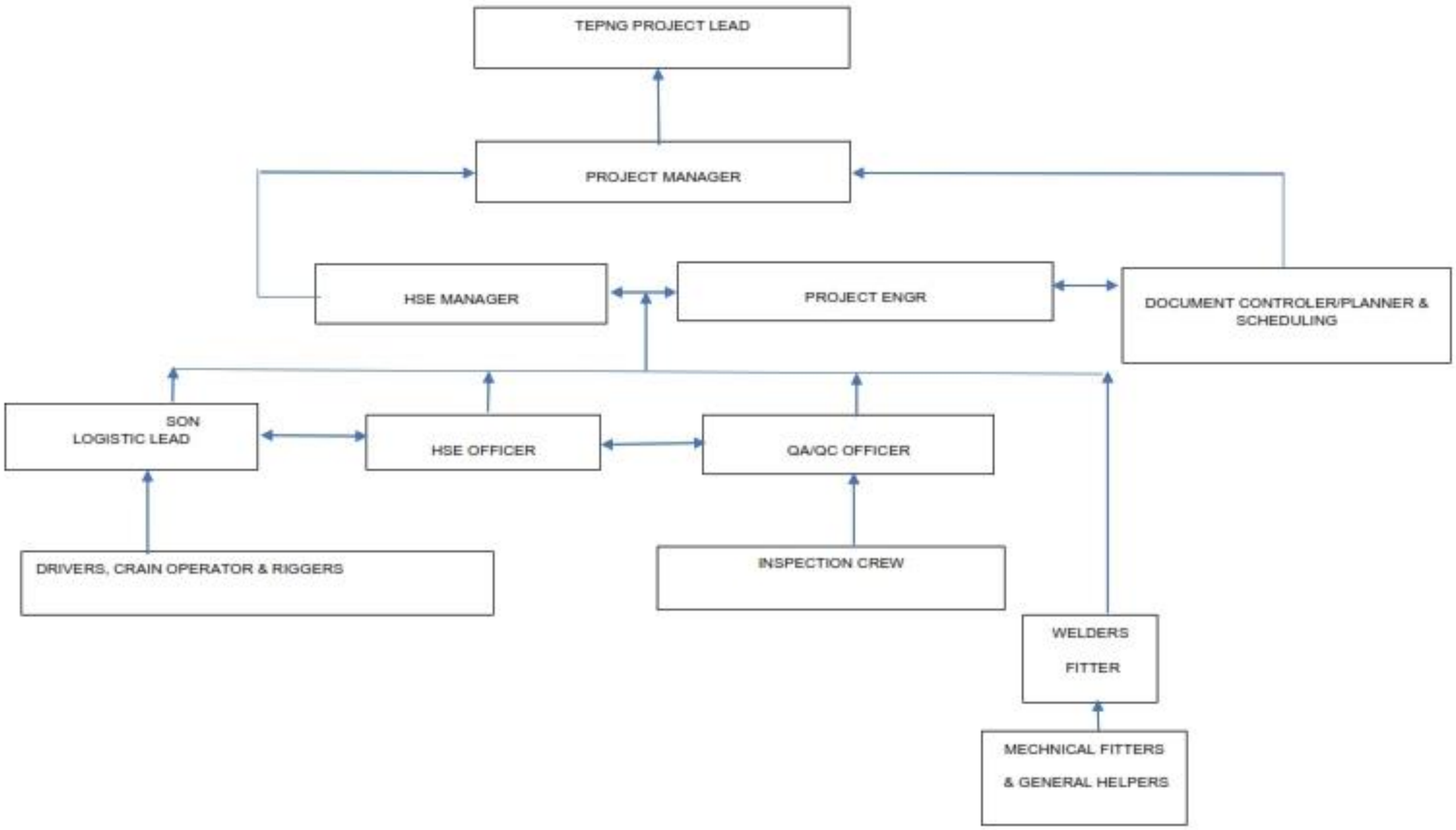
The Environmental Management Plan is a very important management tool and shall be managed according to Figure 7.1. It shall be kept dynamic and be used as focus for the implementation of the Ubeta field development project. The input of all stakeholders will be continuously sought through dialogue at the Weekly Safety Meetings, daily pep talks and through the use of consultant experts. All of these will help ensure constant improvement of all aspects of the plan that may be found deficient.

7.5 IMPLEMENTATION AND REPORTING

TEPNG shall not wait for confrontation either from the Regulatory bodies or the communities to implement all mitigative measures or understanding. In the monitoring program of the EMP, environmental reports of monitoring exercise/incidents shall also be submitted to the Federal and State Ministries of Environment, and Nigerian Upstream Petroleum Regulatory Commission (NUPRC) if incident occur on any part of the project. Both the Regulators and Proponent working in synergy will monitor effective sustenance of the objectives of the EMP, the indicators parameters and frequency as stated in Table 7.2

7.6 GUIDELINES USED FOR PREPARING THE EMP

The Technical Guide prepared in-house by TEPNG environmental personnel was followed in preparing the Environmental Management Plan proposed below (Table 7.2). The logistics for the project was also carefully planned.



- **Figure 7.1 Project Organogram**

- **Table 7.2 Monitoring Program of EMP**

S/N	Impact Parameter	Impact Indicator	Sampling Location	Sampling Method	Sampling Frequency	Monitoring Duration	End Use of Data
1	Air Quality; Ambient Noise	Ambient air quality	Ubeta FDP site and surroundings	In-situ measurement	Weekly during Excavation / construct i o n a n d y e a r l y	Long-term	FMEnv, RSMEnv, NUPRC, Data bank (in-house record)
2	Groundwater quality	Physicochemistry and microbiology	Ubeta FDP site and surroundings	In-situ measurement, ASTM, APHA	Once every week during in line with regulatory compliance	Long-term	FMEnv, RSMEnv, NUPRC, Data bank (in-house record)
3	Surface water quality	Physicochemistry and microbiology	Ubeta FDP site and surroundings	In-situ measurement, ASTM, APHA	Once every month in line with regulatory compliance	Long-term	FMEnv, RSMEnv, NUPRC, Data bank (in-house
4	Sediment quality	Physicochemistry and microbiology	Ubeta FDP site and surroundings	ASTM, APHA	Once every month in line with regulatory compliance	Long-term	FMEnv, RSMEnv, NUPRC, Data bank (in-house
5	Vegetation status	Diversity Morphology Pathology	Ubeta FDP site and surroundings	Field Assessment Taxonomic studies and identification	Once in three years	Long- term	FMEnv, RSMEnv, NUPRC, Data bank (in-house record)
6	Soil quality	Physicochemistry and microbiology	Ubeta FDP site and	AAS PH Meter	Yearly after construction	Long- term	FMEnv, RSMEnv, NUPRC, Data
7	Consultation		All stakeholders	Interviews,	Yearly	Long-term	Openness/constan

FMENV Federal Ministry of Environment

NUPRC Nigerian Upstream Petroleum Regulatory Commission

Table 7.3: Impact Management and Monitoring Plan – Mobilization Phase

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
Site preparation (Land clearing, excavation)	Loss of flora and fauna	Site clearing shall commence from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife	Site clearing inspection records	Daily	Weekly	TEPNG
		Hunting by the workforce shall be prohibited	Compliance records	Weekly	Monthly	TEPNG
		TEPNG shall educate construction workers and host communities on the sensitive nature of the biodiversity of the area and the need for conservation	Records of HSE meetings and community enlightenment sessions	Weekly	Monthly	TEPNG
	Loss of habitat	TEPNG shall limit cleared area to what is required	Site clearing inspection records	Daily	Weekly	TEPNG
		TEPNG shall encourage the re-vegetation of land cleared for temporary use where feasible	Implementation records	One month after site clearance	Three monthlies	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Community unrest	TEPNG shall ensure that all host communities are represented in the employment of locals during land clearing and excavation to avert any conflict that could arise from perceptions of unfairness	Employment records for locals	Weekly	Monthly	TEPNG
		TEPNG shall ensure that land clearing and excavation jobs are reserved exclusively for the host communities	Employment records for locals	Weekly	Monthly	TEPNG
		TEPNG shall abide by all MoUs entered understandings the host communities	Records of compliance with Agreement items	Monthly	Quarterly	TEPNG
	Stress on existing security structures	TEPNG shall ensure that both contractor and TEPNG personnel develop a high level of security consciousness both within and outside the work area	Statistics of security breaches	Weekly	Monthly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
		If required, special security force shall be established and deployed for the project. This shall include deploying some of TEPNG police to strengthen security in the area	Number of special security personnel on site	Weekly	Monthly	TEPNG
		TEPNG shall ensure that a liaison to foster partnership with the community so as to guarantee security for the project is established and sustained	TEPNG- community meetings	Monthly	Monthly	TEPNG
		In order to beef up security for the project, TEPNG shall contact government authorities to improve the strength of the police force and shall consider providing assistance, to ensure improved security	Deployment of police personnel and records of security equipment.	Monthly	Annually	TEPNG
		TEPNG shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized	Records of security workshops	Monthly	Quarterly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Increase in dust and noise	TEPNG shall ensure that nose masks and earmuffs are worn by site workers during excavation	SPM, records of respiratory diseases and noise levels	Monthly	Monthly	TEPNG
		Water shall be sprayed on construction sites to reduce dust levels especially during dry season	Records on compliance, SPM at selected sites within 500m band	Weekly	Monthly	TEPNG
	Potential increase in erosion	TEPNG shall re-vegetate areas not needed for construction as soon as possible.	Records of re-vegetation exercise	Monthly	Quarterly	TEPNG
	Threat to health of workers (snake bites, insect stings, injuries etc)	TEPNG shall provide and ensure usage of PPE by field workers	Compliance records	Weekly	Monthly	TEPNG
		TEPNG shall ensure that an adequate number of trained first aiders are available at work sites	First aid training records and statistics	Monthly	Quarterly	TEPNG
		TEPNG shall ensure that anti-venom/anti-histamine is provided on site to mitigate snake bites and insect stings	Records of anti-venom/anti-histamine at site clinic	Monthly	Quarterly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
		TEPNG shall ensure that awareness is created among site workers on the likelihood of exposure to poisonous wildlife and plants	Awareness records	Monthly	Monthly	TEPNG
Influx of labour and followers (dependents, bounty seekers)	Changes in local population	Prior to commencement of the construction phase, TEPNG shall advertise construction jobs that will be available. This will hopefully discourage unqualified personnel from moving into the project area, thus reducing the rate at which population will grow	Records of applications at employment office and copy of advertisement	Weekly	Monthly	TEPNG
		TEPNG will look into the development of off-site job recruitment to discourage influx of people.	Documentary evidence of implementation	3-months	6-monthly	TEPNG
		Movement of unauthorized persons into camps shall be strictly restricted	Records of access control	monthly	Quarterly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Increase in morbidity (including STIs and mortality)	Health awareness on the mode of transmission of STIs (including HIV/AIDS)	Statistics of health awareness lectures	Intensive phase one to two months prior to mobilization and quarterly there after	Quarterly	TEPNG SD and Occupational Health teams
		As much as possible, psychological support shall be provided to persons living with the HIV virus	Records of HIV support programs	Quarterly	6-monthly	TEPNG SD and Occupational Health teams
		Immunization of workforce as appropriate	Records and statistics of immunization	During mobilization	Quarterly	TEPNG
		TEPNG shall enforce malaria policy	Compliance	Monthly	Annually	TEPNG
		Vector control to reduce incidence of malaria (such as regular spraying of camp and provision of insecticide treated nets) (ITN)	Records and statistics of ITN distribution	Monthly	Quarterly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
		Awareness campaign shall be carried out to enlighten the communities/field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution and the need to sustain cultural values	Statistics of health awareness lectures	Monthly	Quarterly	TEPNG
		Alcohol and drug policy shall be implemented to encourage healthy lifestyle for workers	Records of violations	Monthly	6-monthly	TEPNG
		TEPNG shall support the activities of the state action committee on STIs/HIV/AIDS within the local communities	Records of supportive action	Monthly	Quarterly	TEPNG Occupational Health team
		TEPNG shall provide site clinic to take care of minor illnesses for all workers	Statistics of attendance, morbidity and mortality	Weekly	Monthly	TEPNG
		TEPNG shall provide contraceptives for construction workers	Condoms availability to workers	Monthly	Quarterly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Increase in social vices	Intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol in the communities and among workers throughout the life of the project	Enlightenment campaign/health education statistics; records of cases of abuse in the workforce	At least 3 months before commencement of construction activities then 6-monthly thereafter	Annually	TEPNG
		TEPNG shall ensure that contractor enforces the alcohol and drug policy for staff	Records of violation	6-monthly	Annually	TEPNG
		TEPNG shall support sporting activities	Number of sporting activities	6-monthly	Annually	TEPNG team
		TEPNG shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS	Statistics of health awareness lectures	1 to 3 months before mobilization and then quarterly thereafter	Quarterly	TEPNG
		TEPNG shall support local security systems	Record of TEPNG support	Quarterly	6-monthly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
		TEPNG shall provide contraceptives for construction workers	Number of condoms provided and distributed	Monthly	Quarterly	TEPNG
		TEPNG shall ensure that contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project	Statistics of social and health awareness programmes	At induction and quarterly thereafter	Annually	TEPNG
	Increase in inflation level	TEPNG shall support skill development and enhancement of the local communities through training	Number of beneficiaries of skill acquisition	6-monthly	Annually	TEPNG team

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Changes in culture, lifestyle and habits	TEPNG shall carry out enlightenment campaigns to encourage positive influences on cultural values and healthy lifestyles (e.g. breast-feeding habits, alcohol and drug use, exercise, monogamy, high moral values with regard to sexuality etc) and discourage adverse influences (e.g. prostitution, drug abuse, alcoholism etc)	Records of enlightenment sessions	6-monthly	Annually	TEPNG
Waste generation and disposal	Increase in breeding ground for disease vectors and other agents of diseases	TEPNG waste management policy shall be enforced	Compliance	Weekly	Monthly	TEPNG
	Pressure on existing waste management system	TEPNG shall explore ways to assist the communities in managing wastes	Records of supportive action	Quarterly	Annually	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Increase in noise and vibration levels	TEPNG shall alert communities in advance of the activities that are likely to increase noise and vibration levels	Records of information/consultation sessions	1 month before Work	2 weeks before commencement of Work	TEPNG team
	Contamination of the environment by Work wastes	TEPNG shall ensure regular collection and disposal of wastes in accordance with the TEPNGs waste management plan	Compliance	Weekly	Monthly	TEPNG
		TEPNG shall ensure that disposal of Work wastes is in line with regulatory standards	Compliance	Weekly	Monthly	TEPNG
Construction	Reduction in air quality (emissions)	TEPNG shall ensure that all stationary sources are properly maintained	Maintenance records	Monthly	Quarterly	TEPNG
	Changes in aesthetic quality of the environment	TEPNG shall alert communities on anticipated visual environmental changes during the activities	Records of consultation/information	1 month before the commencement of activities	Once during activity	TEPNG SCD team
		TEPNG shall ensure that the site restoration certificate process is completed	Compliance	3 months after	6 months after	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
				construction works	construction works	
		TEPNG shall re-vegetate areas that are not required for operation and maintenance of the well head cellar	Compliance	3 months after construction works	6 months after construction works	TEPNG
	Contamination of the environment by chemicals	TEPNG shall ensure that chemicals are stored in lined bunded areas in sealed containers with rain protection	Compliance	Weekly	Monthly	TEPNG
		TEPNG shall ensure that SHOC cards/MSDS are available at site to provide advice on clean-up in the event of spills and leaks	Compliance	Weekly	Monthly	TEPNG
	Contamination of the environment by domestic wastes	TEPNG shall ensure regular collection and disposal of wastes in accordance with the project waste management plan	Compliance	Weekly	Monthly	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
	Soil degradation from spills and leaks	TEPNG shall ensure that all maintenance and repair of equipment and vehicles are done in a secure location with clean-up materials etc) are readily available	Compliance	Monthly	Quarterly	TEPNG
	Change in topography	TEPNG shall ensure that the original topography is maintained as far as practically possible	Site inspection reports	Weekly	Monthly	TEPNG
	Exposure to radiation materials	TEPNG shall ensure that adequate safety measures (appropriate PPE and engineering techniques) are put in place to avoid exposure to radioactive materials	Site inspection reports	Daily	Weekly	TEPNG
	Potential for inhalation of welding fumes	TEPNG shall ensure that adequate safety measures (appropriate PPE) are put in place to avoid inhalation of welding fumes	Compliance	Weekly	Monthly	TEPNG
	Potential for conflicts arising from labour issues	TEPNG shall ensure that it abides by agreements reached with the welder's union before their engagement	Compliance with MOUs; Records of complaints and conflicts	Monthly	Quarterly	TEPNG

Table 7.4: Impact Management and Monitoring Plan – Operation and Maintenance Phase

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspection/Monitoring	Frequency of Formal reporting	Action Party
Operation and Maintenance of facility	Increase in noise levels	TEPNG shall encourage Community members Not to settle near the facility	Visual monitoring of the level of encroachment	6-monthly	Annually	TEPNG
		TEPNG shall place warning signs including noise maps at strategic locations within the facility	Display of warning signs and locations	6-monthly	Annualy	TEPNG
		TEPNG shall protect Hearing of Workers through the Enforcement of the Recommendations of Job Hazard Analysis (JHA)	Compliance	6-monthly	Annualy	TEPNG
	Reduction in air quality	TEPNG shall ensure that appropriate maintenance programs are in place for all equipment	Maintenance Records	6-monthly	Annually	TEPNG
	Degradation of soil and surface water from spills and leaks	TEPNG shall provide containment for chemicals and liquid discharges	Compliance	6-monthly	Annually	TEPNG
		TEPNG shall ensure that chemicals are stored in lined bunded areas in sealed containers with rain protection	Compliance	6-monthly	Annualy	TEPNG

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter for Monitoring	Frequency of Inspection/Monitoring	Frequency of Formal reporting	Action Party
		TEPNG shall ensure that SHOC cards/MSDS are available at site to provide advice on clean-up in the event of spills and leaks	Compliance	Quarterly	Annually	TEPNG
		TEPNG waste management policy shall be enforced	Compliance (waste consignment notes)	Quarterly	Annually	TEPNG
		TEPNG shall ensure that a controlled fuelling, maintenance and servicing protocol for operation machinery at worksite is established and followed to minimise leaks and spills	Compliance	6-montly	Annually	TEPNG
	Relative drop in economic activities	TEPNG shall support skill development and enhancement of the local communities through training as agreed in the Stakeholders Plan (SP) and Social Action Plan (SAP)	Compliance with SP and SAP	6-montly	Annually	TEPNG SCD team

Table 7.5: Impact Management and Monitoring Plan – Commissioning phase

Project Activity	Impact (positive or negative	Mitigation/Enhancement	Parameter For Monitoring	Frequency of Inspectional/ Monitoring	Frequency of Formal reporting	Action Party
Commissioning	Threat to health of workers	TEPNG shall ensure that fully equipped first aid facility and trained first aiders are available on site at all times and valve stations	Records of first aid box inventory and health statistics from Retainership clinics	Weekly	Monthly	TEPNG
		TEPNG shall enforce appropriate use of Personal Protection Equipment (PPE)	Compliance	Weekly	Monthly	TEPNG
		TEPNG shall ensure the training of first aiders at least 1:50	Records of first aid training	Monthly	Quarterly	TEPNG
		TEPNG shall ensure that anti-venom/anti-histamine is provided on-site to mitigate snake bites and insect stings	Records and adequacy of anti-venom/anti-histamine	Monthly	Quarterly	TEPNG
	Contamination of the environment by Work wastes	TEPNG shall ensure regular collection and disposal of wastes in accordance with the TEPNGs waste management plan	Compliance	Weekly	Monthly	TEPNG
		TEPNG shall ensure that disposal of Work wastes is in line with regulatory standards	Compliance	Weekly	Monthly	TEPNG

7.7 EMP BUDGETING

To effectively execute this Environmental Impact Assessment (EIA) and ensure comprehensive environmental monitoring, it is essential to develop a detailed and realistic budget for the Environmental Monitoring Plan (EMP). Below is a recommendation for budgeting for the EMP activities at the Ubeta FDP site.

1. Personnel Costs

Funds shall be allocated for staffing needs, which include personnel to conduct in-situ measurements, field assessments, and taxonomic studies, as well as those involved in stakeholder consultations and dialogue.

2. Sampling and Field Equipment Costs

Estimate shall be made to budget for air, water, soil, and sediment quality measurement equipment, including monitors, meters, and reagents for ASTM and APHA standards.

3. Laboratory Analysis Costs

Costs shall be provided for external laboratory analysis services, if the company does not possess in-house facilities for all required tests.

4. Transportation and Logistics

A budget estimate shall be allocated for the associated transportation of personnel to and from the site and the safe transport of samples to laboratories or storage facilities.

5. Data Management and Reporting

A budget estimate shall be provided for the preparation and dissemination of compliance reports to regulatory bodies such as FMEnv, RSMEnv, NUPRC, and for maintaining in-house records.

6. Consultation and Stakeholder Engagement Costs

Budget estimates shall be provided for expenses related to stakeholder engagement, in the course of monitoring.

7. Contingency Funds

A contingency fund shall be incorporated to manage unforeseen costs and ensure flexibility in the EMP execution. This fund shall address unplanned expenses arising from regulatory changes, unexpected environmental impacts, or modifications in monitoring protocols.

8. Budget Formulation

To estimate monitoring costs, all expenses must be categorised by frequency and duration.

7.8 CONTINGENCY PLANNING

Despite all care and diligence exercised in project execution, accidents still do occur. Accidents could occur from equipment failure or third-party error or sabotage, all to the detriment of the environment. Consequently, Gas Contingency Plans are usually made to handle such accidental emissions. Although serious incidents are considered unlikely in this project, TEPNG has in place a Contingency Plan that has been activated, regularly updated through regular and periodic checks conducted by the Nigeria Upstream Petroleum Regulatory Commission (NUPRC). Appendix 7.1

7.9 EMERGENCY RESPONSE PLAN

Detailed emergency response plan for the project is presented in Appendix 7.2

7.10 WASTE MANAGEMENT

7.10.1 Introduction

Waste management is a key aspect of the Health, Safety and Environmental Management System (HSE-MS) in TEPNG. The HSE-MS in place for TEPNG operations are certified to ISO 14001 in line with corporate standards and in compliance with regulatory requirements. The key principles governing waste management in TEPNG are based on waste minimization, recycling, recovery, re-use and/or recovery. Waste will be managed and disposed in line with corporate standards (ISO 14001) and in compliance with regulatory requirement (as outlined in the EGASPIN 2018).

7.10.2 Waste Composition

Site clearing and excavation will result in the generation of large quantity of solid waste, essentially biodegradable vegetation, wood debris and soil. Civil engineering works will generate volume of wastes which will include wood and iron rod cuttings. Mechanical engineering works will generate pipe cutting wastes, welding wastes, x-ray photographic waste, radiation materials container wastes, Electrical works will generate waste cartons, cable cutting etc. Drilling will generate drilling fluids and drill cuttings. Administration wastes are mainly paper from site construction offices and from the Central Processing Facility during operations. Sewage generated during construction will be handled via mobile toilets which shall be placed at specific locations on the pipeline right of way and emptied by sewage trucks. Sewage generated in the construction camps shall be handled by used of sewage treatment plants.

7.10.3 Waste Management

Waste generated throughout all stages of this project shall as a matter of deliberate commitment be managed from cradle to grave. The Proponents of this project will:

- Take all practical and cost-effective measures to minimize the generation of wastes, by implementing the four R's (reduce, reuse, recycle, recover) of waste management through process optimizations, efficient procedure and good housekeeping;

- Minimizing the hazards presented by all wastes and ensuring that all wastes shall be managed and disposed of in an environmentally acceptable manner. This policy implies that:
- All activities planning must, at inception, address waste management, and shall not be approved without this being seen to have been done;
- The management of waste is a line responsibility and key/front -line staff shall be actively involved in controlling the wastes generated by their activities.

7.10.3.1 Construction Phase

The following procedures shall be adopted in handling wastes emanating from the construction stage:

All waste generated shall be classified and registered.

- Waste shall be segregated at site into the following categories:
- vegetation debris (leaves, cut grass, tree branches)
- Construction debris
- Scrap metals and welding off-cuts
- Cable cutting
- Drums
- Spent lube oil
- Oil and fuel filters
- Hazardous wastes e.g. – solvents, drilling fluids and drill cuttings.
- Glass
- Biodegradable domestic wastes
- Office and stationery wastes (toner cartridges, diskettes, etc.)

All wastes shall be quantified, and the inventory data recorded. The details of the waste category and their volume is provided in Appendix 7.3.

- **Table 7.6: Waste and Management options**

Vegetation debris (leaves, cut grasses, tree branches)	Approved Dumpsite/incinerator
Construction debris	Approved Dumpsite/incinerator
Scrap metals	Recycling
Cable cuttings	Recycling
Drums	Recycling
Spent lube oil	Recycling
Oil and fuel filters (Hazardous)	Approved Incinerator
Hazardous waste; e.g. solvent, thinners (Hazardous)	Approved Facility
Radiation waste (cartridge or radiation source container)	Approved Facility
Glass	Recycling
Biodegradable domestic wastes	Approved Incinerator
Office/stationary wastes (toner cartridge, diskettes, etc.)	Recycling

The cradle to grave waste management strategy will be managed with the use of waste transfer notes.

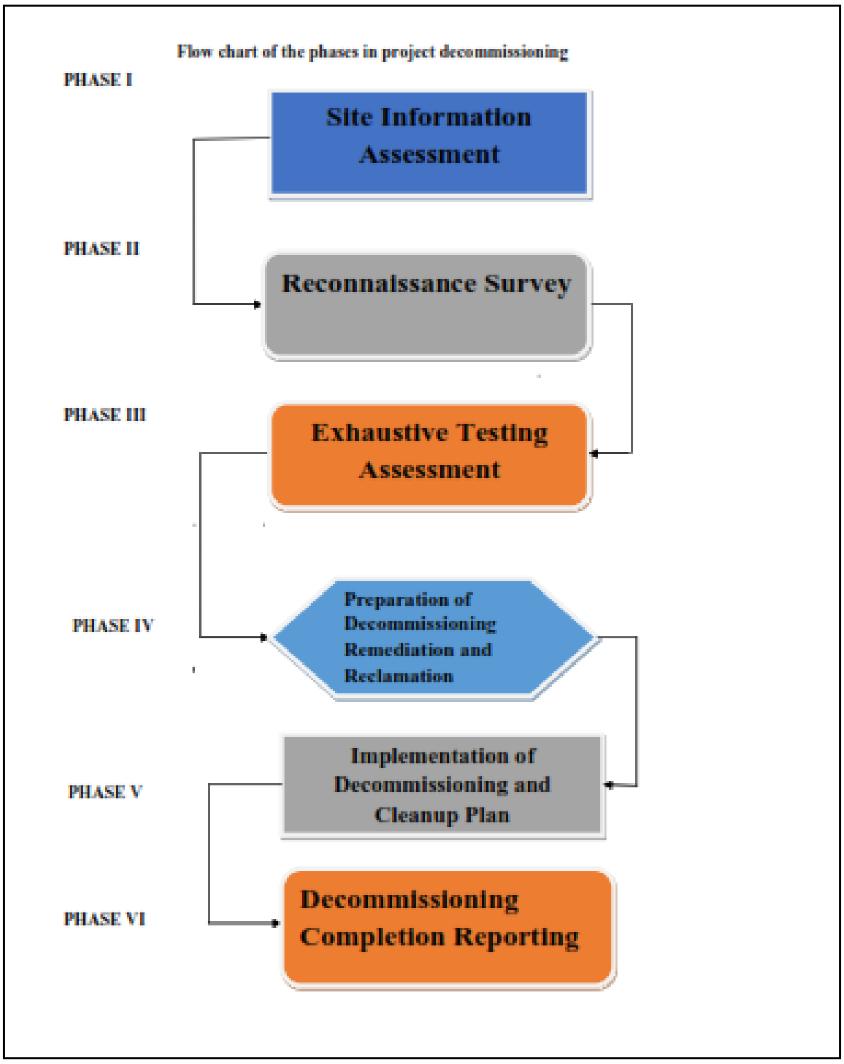
7.11 DECOMMISSIONING AND REMEDIATION PLAN

The decommissioning and abandonment plan will follow the decommissioning/abandonment phases as illustrated by FMEnv (Figure 7.2.) Before abandonment, TEPNG will develop decommissioning plans for:

- Environmental aspects of the decommissioning activity.
- Methods for facility re-use, recycling, disposal, removal or abandonment.
- Proper consultation with all stakeholders (communities, other land users and regulators).
- Efforts to mitigate negative environmental impacts and appropriately rehabilitate the site.
- Programs for restoring the environment in accordance with national (FMEnv and NUPRC) and international best-practices and regulatory requirements.
- Scope of work to assess possible residual impacts of the facility on the environment; specifically, any future restrictions on other activities.

The content of the plan will take into consideration the extent of the decommissioning (temporary or permanent, partial or complete shutdown), plans for future use of the site, and the condition of the site and environment at the time of decommissioning. A detailed post operational study of the impact of the project on the environment will be conducted to determine appropriate restoration and remedial measures.

At this stage, only preliminary plans exist for decommissioning and abandonment. Additional details will be developed as the project progresses. In general, however, decommissioning activities will be conducted in compliance with applicable regulations and guidelines, including FMEnv guidelines and NUPRC EGASPIN, Section VIII-G "Decommissioning of Oil and Gas Facilities", or any other regulations that are in force at the time of decommissioning. The plans will also include regulations and a risk and cost analysis of the various options. The abandonment plan will consider all facilities associated with the Project.



- **Figure 7.2 Decommissioning Phases** (Source: Federal Ministry of Environment)

- **7.11.1 Remediation**

This will entail:

a) A survey of the decommissioned site for contamination;
b) Initial conclusions on the hydrology and geology;

c) Preparation of a Site Assessment Action Process Flow Sheet to be approved by FMEnv and also NUPRC as provided in Fig. VIII-F1 in EGASPIN; and
d) Interim action or remediation designed to confirm applicability and feasibility of one or more potential remedial options: such as application of dispersants or biological treatment using petroleum degrading bacteria or by aeration process.

Finally, the site shall be monitored for compliance and performance to confirm effectiveness to remedial measures. At the end of the site abandonment, the following useful documentations shall be reviewed:

a) The initial abandonment plan
b) The abandonment operations conducted in the project area, along with changes to plan necessitated by field conditions.
c) Toxicity test report carried out on all decommissioned items.

- **7.11.2 Reporting**

As required by regulations, a post decommissioning report (PDR) will be prepared and submitted to the FMEnv and NUPRC. The report will provide the following details:

- Overview of decommissioned facilities.
- Details of methods used for decommissioning.
- Nature of decommissioning (partial or whole).
- Record of consultation meetings.
- Details of recyclable/reusable materials/facility components.
- Decontaminated facilities.
- Decommissioning Schedule.
- State of the surrounding environment.
- Waste Management Plan.
- Plans for restoration/remediation where necessary

Chapter

8

CONCLUSION

A multidisciplinary team of experts has carefully developed and assessed the status and sensitivity of the many ecological and socioeconomic components of the project environment by literature study, field sampling, measurements, and testing within the planned project region.

To identify, characterize, and evaluate the potential and associated impacts, other source references were employed in conjunction with the interactions of the various ecological and socioeconomic components of the existing environment with the known activities of the proposed project.

Mitigation measures were subsequently developed for adverse impacts based on industry best practice, available technology and HSE considerations.

Throughout the project's lifecycle, consultations will be held with the host communities, regulatory bodies, and other stakeholders. The impact analysis of the proposed project, shows that it would have a favorable impact on the socioeconomic well-being of the populace by creating semi-skilled and unskilled jobs and providing social services

Increased gas production which will improve gas supply to satisfy the needs of Bonny Nigeria Liquefied Natural Gas (NLNG) plant and the domestic market will boost the economy of Nigeria and boost revenue generation in the country. It will also

The proposed project will also contribute to significant socio-economic development within the host communities and result in long term economic empowerment for the indigenes, residents and other professionals.

The identified adverse impacts were generally short-term and can be prevented, reduced, ameliorated, or controlled if the recommended mitigation measures are implemented. Further, an Environmental Management Plan (EMP) has been developed to ensure that the identified potential impacts can be reduced to “as low as reasonably practical” (ALARP). The EMP should therefore form the basis for the actual project implementation and future monitoring of environmental components.

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DOCUMENT CONTROL

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COMPANY MANAGEMENT SYSTEM
LEVEL 2 DOCUMENT

JV ASSET OIL SPILL CONTINGENCY PLAN - STRATEGY PLAN

Approval

	Name	Function	Date	Signature
Authors	Nnaemeka MBELE	Affiliate Oil Spill & Remediation Coord	January 2023	Nnaemeka MBELE Digitally signed by: Nnaemeka MBELE DN: CN = Nnaemeka MBELE C = FR O = TOTAL OU = TOTAL SIGNATURE INTERNE Date: 2023.01.09 09:55:37 +01'00'
Reviewed By	Obiora OKIKE	Mgr. Environment	January 2023	Obiora OKIKE J0270977 Digitally signed by: Obiora OKIKE J0270977 DN: CN = Obiora OKIKE J0270977 C = FR O = TOTAL OU = TOTAL AUTHENTIFICATION INTERNE Date: 2023.01.09 14:03:16 +01'00'
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Authorised By	Guillaume DULOUT	DMD, JV Asset	January 2023	Guillaume DULOUT Digitally signed by: Guillaume DULOUT DN: CN = Guillaume DULOUT C = FR O = TOTAL OU = TOTAL SIGNATURE INTERNE Date: 2023.01.27 09:43:40 +01'00'

Revisions history

03	01/23	DMD, JV Asset	Alignment to IMS and OSRL service update
02	05/16	DMD, PHC District	Review in Line with new Organization/Rex on 12” OBG-RUM Export Line spill
01	06/13	DMD, PHC District	Review in line with new district organisation
0		DMD, PHC District	First Issue
Rev.	**Date**	**Authorised by**	**Brief comments**

Contents

1. Purpose

The Oil Spill Contingency Plan (OSCP) is part of TEPNG emergency management documentation. It is designed to assist personnel in providing a response to an accidental hydrocarbon spill that may occur on water (sea or inland waters) or on land during TEPNG-JV Asset activities. The OSCP framework is made of Asset OSCP and site specific OSCPs.

The purpose of the District OSCP is to specifically provide the TEPNG-JV Asset Incident Management Team (IMT) and Crisis Management Cell (CMC) the main procedures to be implemented and the information required during an oil spill response.

The General OSCP consists of 3 volumes:

Volume 1 – Action Plan

Volume 2 – Response Handbook

Volume 3 – Strategy Plan (Non-operational document)

Note that the oil spill emergency contact numbers are contained within the Emergency Response Directory.

The purpose of this volume is to specifically give an overview of the oil spill risks that result from TEPNG-JV Asset oil handling operations and to justify the oil spill response capabilities that have been established.

2. Scope

The Strategy Plan is a non-operational document containing relevant data and information that is not useful during the emergency for the teams on sites but is essential to understand basis of how the OSCP has been developed and response capabilities built. This approach also ensures that the Action Plan and the Response Handbook are concise and succinct.

3. Related documents

3.1. Internal to TotalEnergies Upstream Companies in Nigeria (CMS)

Reference	Title
HLP-HSE/GEN-M01-011	TUCN Health Safety Environment and Quality Policies
HLP - COM - COM - 22	Communication and Media Policy
PRD-COM-COM-10	Issuance of Press Releases Statements Procedure
PLN-HSE/GEN-M07-021	TUCN Crisis Management Plan
PLN - DCD - DCD - 05	JV Asset BOCP Part I Blow Out Contingency Plan
CHA-HSE/GEN-M01-041	TUCN Health Safety and Environment Charter
PLN - HSE/ENV-M05-02	TUCN Waste Management Plan
PRD- HSE/GEN- M03-62	Responsible for Safety and Environment on Site (RSES) Procedure
PRD-HSE/GEN-M02-25	Internal and External HSEQ Communication Procedure
PLN-HSE/GEN-M07-022	JV Asset Emergency Response Plan
PLN-HSE/GEN-M07-025	Affiliate Medical Evacuation Procedure
PRD-HSE/GEN-M08-011	Reporting and management of HSE events and anomalies
PLN-SEC-SEC-50	JV Asset Security Plan
GM-HSE/GEN-M04-38	Principles and Practices of HSE Risk Management in Operations
PLN-HSE/GEN-M07-24	DW OSCP - Vol.1A - Action Plan
PLN-HSE/GEN-M07-25	DW OSCP - Vol.1A – General Context
PLN-HSE/GEN-M07-26	DW OSCP - Vol.1A – Response Handbook

3.2. TotalEnergies Group/E&P documents

Reference	Title
Directive DIR-EP-00	Management of the E&P Standards applicable to Exploration and Production Segment
DIR GR-HSE 001	One-MASESTRO HSE Principles

CR GR-HSE 001	One-MAESTRO HSE Expectations
CR EP FP 270	Blow out Contingency plan
CR EP GIN 301	Geographic Information in Exploration & Production: Organization and Management
CR EP HSE 094	Oil spill preparedness and response policy in Exploration & Production
CR EP HSE 031	HSE risk management in operations
CR EP HSE 035	Site Hygiene Safety and Environment Manager (RSES)
CR EP HSE 041	Technological Risk Management
CR EP HSE 060	Industrial Hygiene and health at work
CR EP HSE 081	HSE Training of Exploration and Production Personnel
CR EP HSE 082	HSE Training for personnel holding job in HSE domain
CR EP HSE 091	Managing emergencies/crisis in affilliates
CR EP HSE 092	Information, notification and communications between affiliates and E&P in case of emergency/crisis
CR EP HSE 093	Large-Scale Exercises (LSE's)
CR EP HSE 501	GIS Deliverables for HSE
CR EP HSE 102	Anomalies, incidents, and occupational illnesses. Definitions, reporting and recording
CR EP HSE 411	Environmental Management and Protection in Operations
GS EP ENV 120	Environmental Impact assessment of E&P activities
CR EP HSE 094	Oil spill preparedness and response policy in Exploration & Production
GM EP HSE 091	Guidelines for Affiliate Emergency Response Plan
GM EP HSE 093	Guidelines for Site Contingency Plan
GM EP ENV 071	Implementation Guide - HSE Management of contractors

3.3. External documents

Reference	Title
NCP, 2000	National Contingency Plan by National Emergency Management Agency (NEMA)
NDRP, 2001	National Disaster Response Plan by National Emergency Management Agency (NEMA)
EGASPIN, 2002	Environmental Guidelines and Standards for the Petroleum Industry in Nigeria by National Upstream Petroleum Regulatory Commission (NUPRC/ NMDPRA)
NOSCP, 2011	National Oil Spill Contingency Plan by National Oil Spill Detection and Response Agency (NOSDRA)
NOSDRA, 2011	S.I. No. 25 Oil Spill Recovery, Clean-up, Remediation and Damage Assessment Regulations
NOSDRA, 2011	S.I. No. 26 Oil Spill and Oily Waste Management Regulations

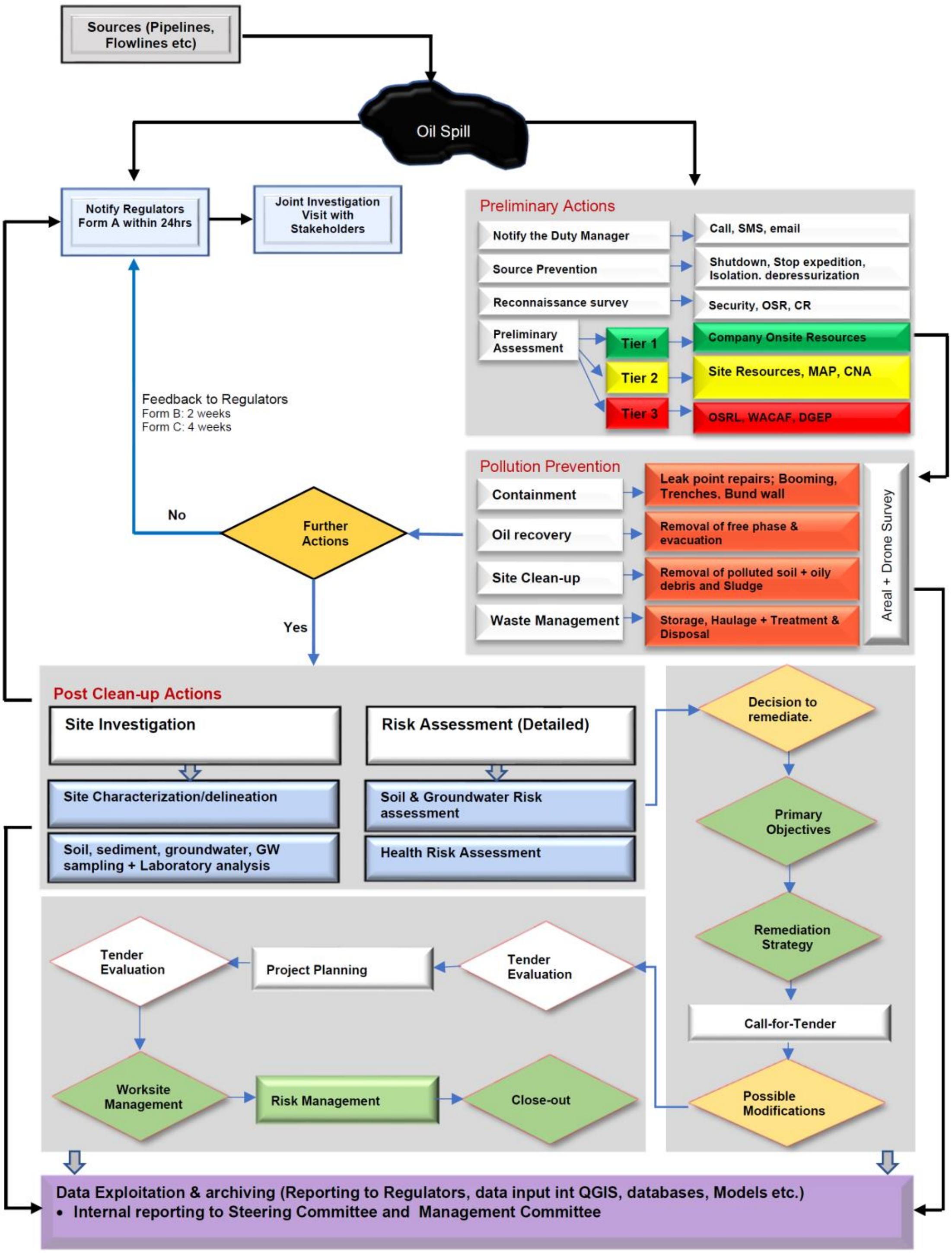
4. Definitions / abbreviations

CEDRE	Centre of Documentation, Research and Experimentation on Accidental Water Pollution
CMC	Crisis Management Cell of the TotalEnergies Group who would be mobilised in a major (Tier 3) oil spill.
CMT	Crisis Management Team who will handled the “strategic” and “media” aspects of an emergency.
CNA	Clean Nigeria Associates who are a Tier 2 provider.
CORAPOL	Coordination of pollution response resources; TotalEnergies Group committee in charge of co-ordinating and improving resources intended to mitigate accidental water pollution.
DGEP	Direction Générale Exploration and Production.
NUPRC	Nigerian Upstream Petroleum Regulatory Commission who regulate the oil and gas industry in Nigeria.
NMDPRA	Nigerian Midstream and Downstream Petroleum Regulatory Agency who regulate the oil and gas industry in Nigeria.
IMT	Incident Management Team who will handle the “technical” aspects of an emergency.
ERIT	Emergency Response Interventional Team, based at an operational site.
FOST	Fast Oil Spill Team; a TotalEnergies specific Tier 3 provider.
MAP	Mutual Assistance Plan where the oil industry in Nigeria have made their Tier 1 resources available to each other.
NOSDRA	National Oil Spill Detection and Response Agency who are responsible for overseeing oil spill response in Nigeria.

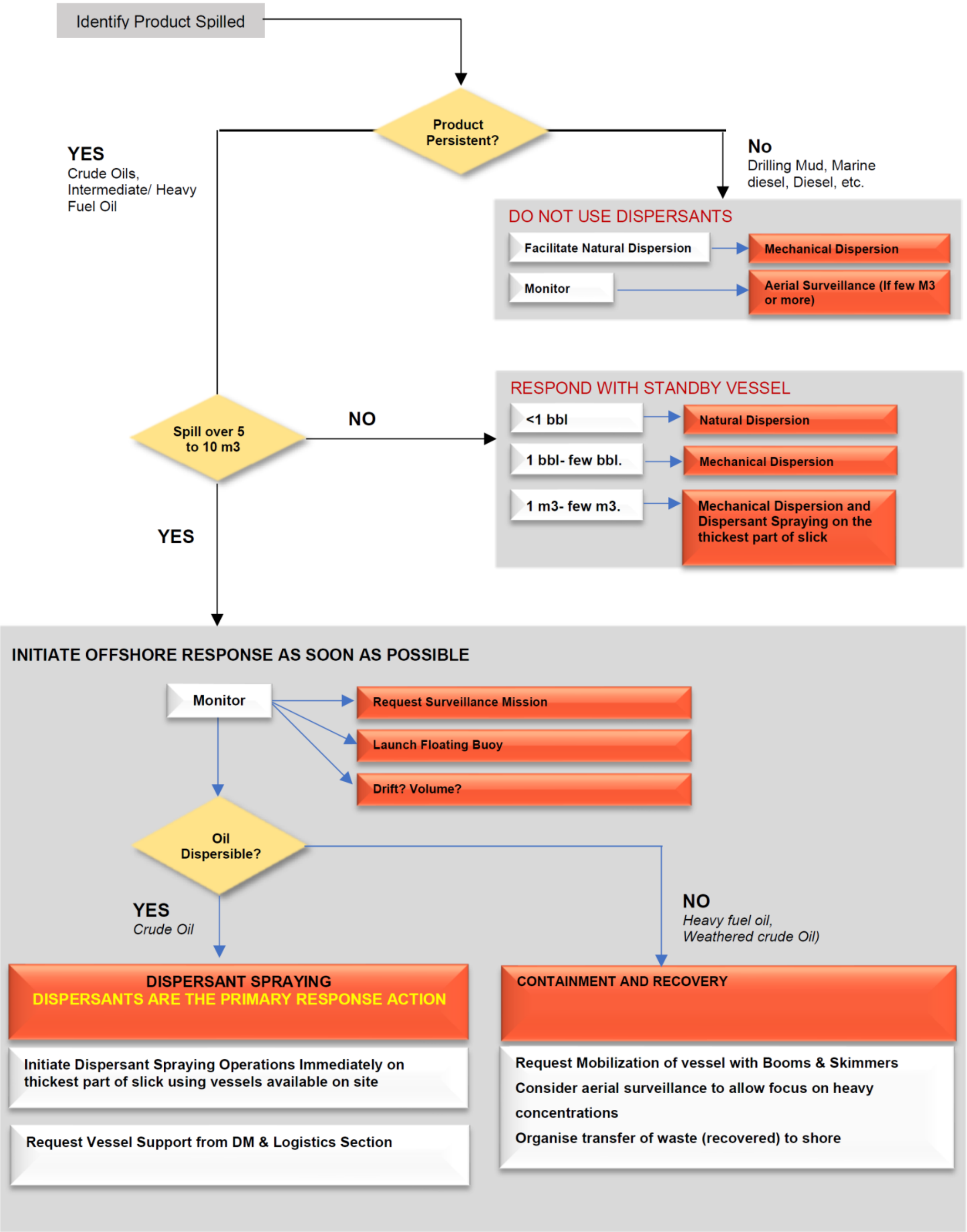
Oil Spill Response Limited	Oil Spill Response Limited (ex OSRL/EARL); a Tier 3 provider.
PARAPOL	Plan to Assist with mobilising Resources for Pollution Response; TotalEnergies Group crisis procedures.
RSES	Responsible for Safety and Environment on Site; the person responsible for emergency response at an operational site.
TEPNG	**"TEPNG",** "**TotalEnergies Upstream Companies in Nigeria"** or **"The Affiliate"**: designates all of the TotalEnergies Upstream Companies registered in Nigeria.
WASP	West Africa Surveillance Platform for Aerial Surveillance Service operated by Oil Spill Response; a Tier 2 service.

5. Flowchart

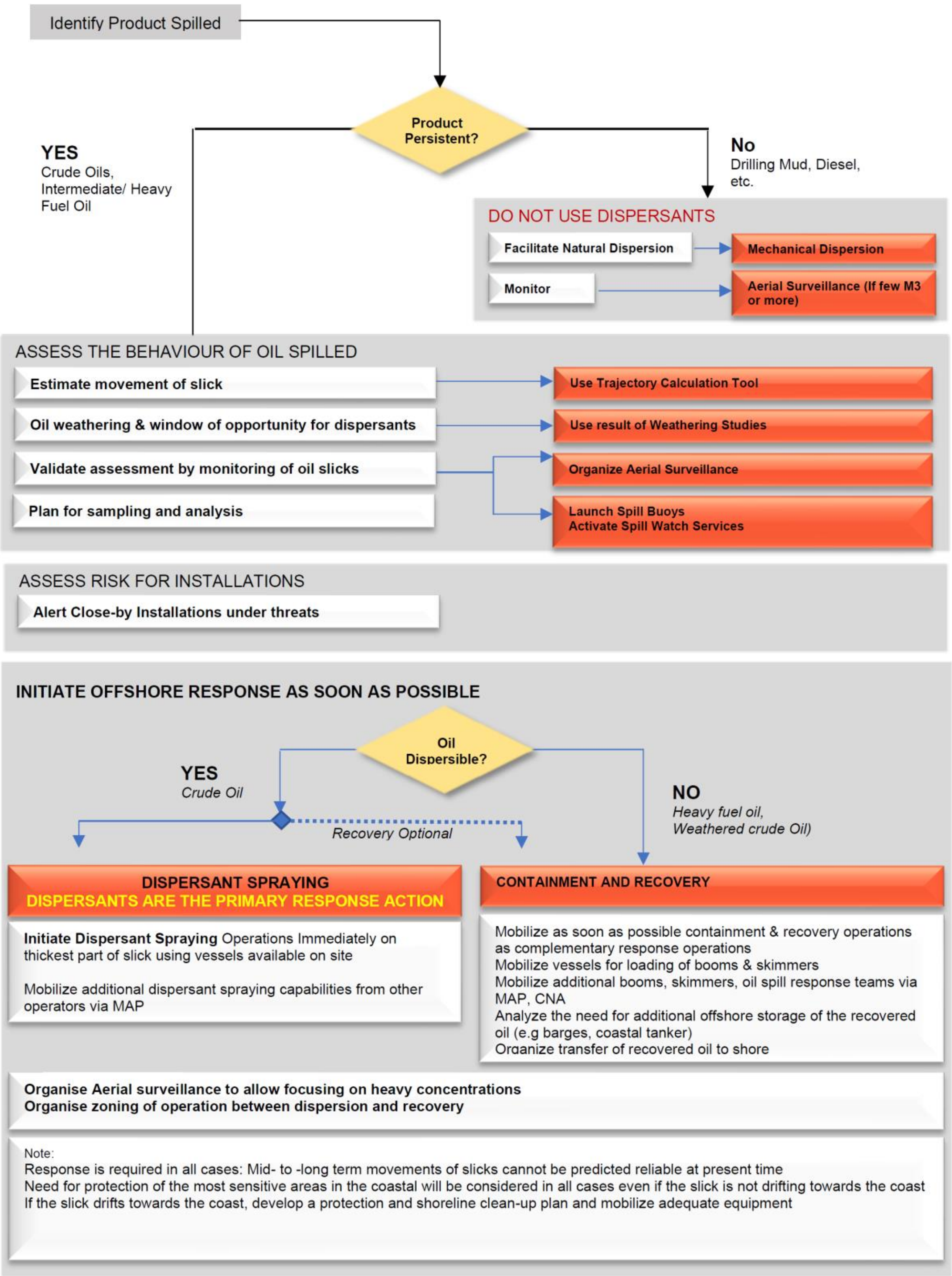
5.1. Onshore Oil Spill Management Guide



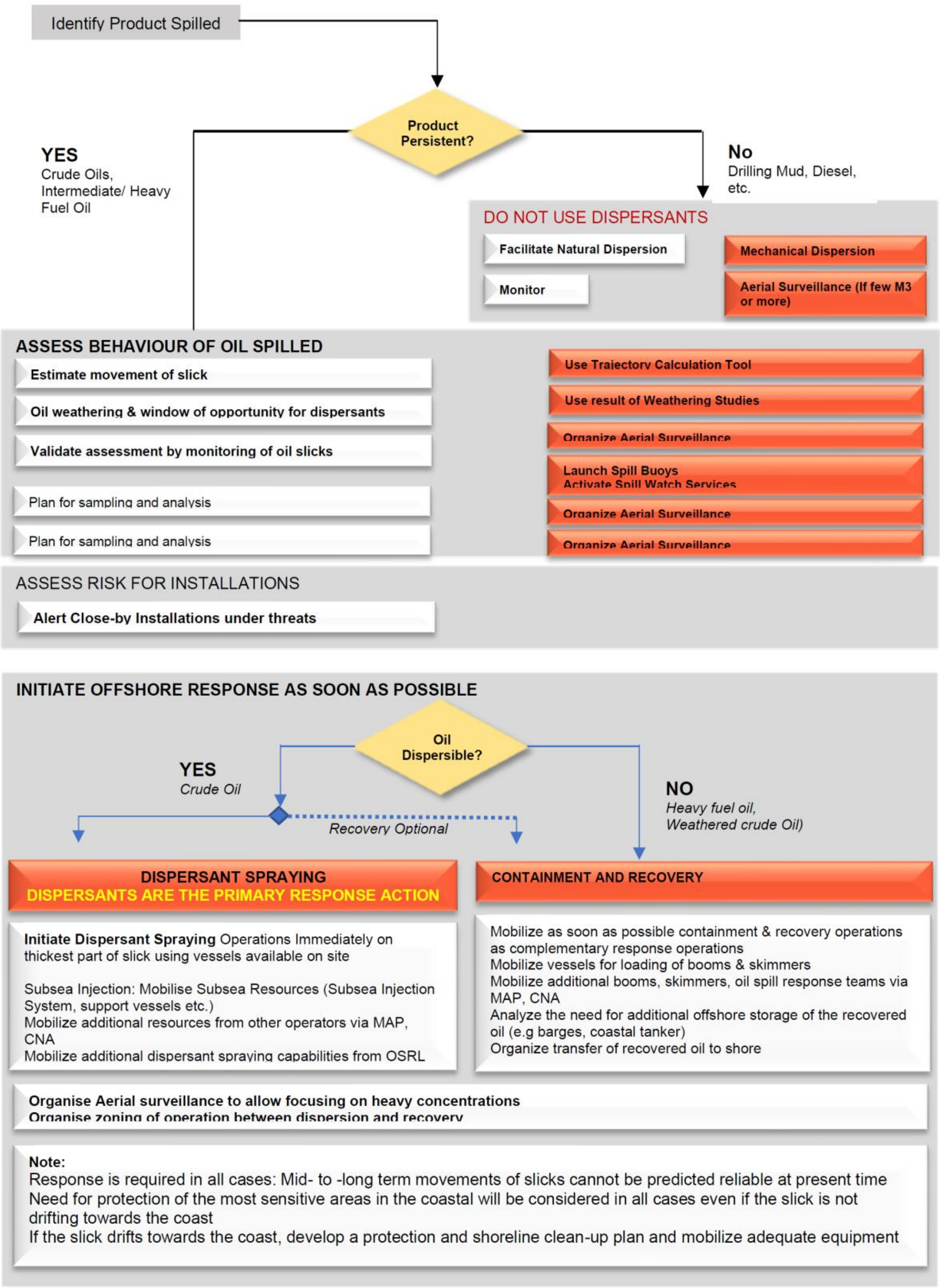
5.2. Tier1 Offshore Oil Spill Response Guide



5.3. Tier 2 Offshore Oil Spill Response Guide



5.4. Tier3 Offshore Oil Spill Response Guide



6. Responsibilities

6.1. Affiliate Oil Spill/Remediation Coordinator

- The Oil Spill Coordinator shall review and update this plan regularly.
- Ensure the expertise to identify and prepare oil spill response capabilities (equipment, contingency plans, specific incident management tools, etc..
- Train the personnel of TEPNG for oil spill response, particularly according to the Company rules and standards.
- Provide a technical expertise during an emergency involving an accidental pollution

6.2. Manager Environment

- The Environment Manager shall ensure the regular and timely update of this plan and the availability of necessary resources for its implementation in the district.
- Ensures that the reporting is in line with the requirements of the Authorities,
- Ensures this procedure is maintained in-line with the JV Assert Contingency Plan, and key information that may be used during an emergency is accurate and up to date as soon as possible after any change. This responsibility is delegated to Oil Spill Coordinator,

6.3. DGM Environment & Industrial Hygiene

- Approves the Volume 1B of Action plan after each update (update of contacts, list of equipment, etc.) prior to its dissemination.
- Ensure that resources are available for the review, update and implementation of this plan

6.4. EGM Health Safety Environment and Quality

- Identifies and validates the personnel assigned as potential members of the Oil Spill Planning Team, authorises them to participate to Oil Spill Planning Team Induction, trainings and exercises.
- Facilitates the participation of the identified members to the activities of the Oil Spill Planning Team,
- Ensures that any problem identified by Oil Spill Planning Team members is taken into account and immediately addressed / communicated to JV Asset MACOM
- .

6.5. Statutory and Regulatory Framework

6.5.1. International Conventions

Nigeria has ratified the following international conventions that are related to oil spill contingency planning and response:

- International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC)
- Civil Liability Convention 1992 (CLC) (amended with 1992 Protocol)
- Fund Convention 1992
- The United Nations Convention on the Law of the Sea (UNCLOS 1982)
- International Convention on Civil Liability for Bunker Oil Pollution damage (BUNKER) 2008

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 and updated by amendments since then.

The Convention includes regulations aimed at preventing and minimising pollution from ships, both from accidental pollution and that from routine operations, and currently includes six technical Annexes:

- Annex I Regulations for the Prevention of Pollution by Oil
- Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
- Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
- Annex IV Prevention of Pollution by Sewage from Ships (entry into force date 27 September 2003)
- Annex V Prevention of Pollution by Garbage from Ships
- Annex VI Prevention of Air Pollution from Ships (adopted September 1997 - not yet in force)

Parties must accept Annexes I and II, but the other Annexes are voluntary. In the case of Nigeria Annexes III, IV and V have been adopted.

The convention requires ships to have a Shipboard Oil Pollution Emergency Plan (SOPEP), in accordance with IMO guidelines and approved by the government of the state under whose authority the ship is operating.

The SOPEP must include:

- Procedures for reporting oil pollution incidents.
- List of authorities and persons to be contacted in the event of an incident.
- Detailed description of immediate action to be taken to reduce or control discharge of oil following an incident.
- Procedures and point of contact for co-ordinating spill response actions with national and local authorities.

MARPOL also provides guidelines for reporting pollution incidents to the authorities and outlines standard report formats. However most countries have developed their own national guidelines which must be used when reporting an oil spill incident, as is the case with Nigeria.

International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC)

OPRC provides a global framework for international co-operation in combating major incidents or threats of marine pollution. Parties to the OPRC convention must fulfil the following requirements:

- Signatories must have a national contingency plan in place, designate the competent national authority and operational contact points responsible for oil pollution preparedness and response.
- Signatories must establish stockpiles of oil spill combating equipment hold oil spill response exercises and develop detailed plans for dealing with spill incidents, including notification and mobilisation procedures.
- Ships, offshore units, sea ports and oil handling facilities are required to carry Oil Pollution Emergency Plans which must be co-ordinated with national systems for responding to oil pollution incidents.

Nigeria has established the National Oil Spill Detection and Response Agency (NOSDRA) as the lead agency for oil spill response, and has a National Oil Spill Contingency Plan (NOSCP) in place.

Civil Liability Convention 1992 (CLC)

The Convention on Civil Liability for Oil Pollution Damage (CLC 1992) deals with compensation for damages from spills of persistent crude oil and fuel oil from tankers. It does not cover oil spills from offshore installations or inland spills. Persistent oils generally contain a higher proportion of heavy fractions or high-boiling material. Oils which are normally classified as persistent include crude oils, fuel oils, heavy diesel and lubricating oils. Non-persistent oils are those that are generally volatile and made up of lighter hydrocarbon fractions, which tend to evaporate rapidly. Non-persistent oils include gasoline, light diesel oil and kerosene.

Tanker owners are held strictly liable for damages (within the EEZ of the State in question), up to an amount determined by the gross tonnage of the tanker causing the spill. Strict liability means that the tanker owner is liable regardless of whether or not they were at fault. Neither the organisation chartering the tanker nor the owner of the cargo involved in an incident has any liability to pay compensation.

However, in practice, even if TotalEnergies is not associated with the tanker or cargo, if an incident occurs in the Nigerian EEZ there may be strong business, political and ethical reasons for TotalEnergies to play an active role in the oil spill response.

The Convention states that tanker owners must be able to meet their maximum potential liability, which is normally achieved through insurance from a P&I Club so damage claims can be made directly against the insurer.

Fund Convention 1992

In the instances where claims exceed the tanker owner’s liability as defined under the CLC, additional compensation is provided by the Fund Convention (1992). This Fund is financed by oil companies and States receiving oil by sea, who must make contributions after a spill to pay for the resulting claims. By ratifying the CLC, Nigeria has automatically become a Member of the 1992 Fund and so can have access to the full amount of Fund compensation following a large tanker spill in its EEZ.

Admissible damage claims under the CLC and Fund include “preventative measures” and oil spill cleanup operations (including waste disposal). However, claims are only admissible under the Convention if cleanup measures are considered technically justified i.e. they are based on a technical appraisal and not done purely for public relations purposes. The International Tanker Owners Pollution Federation (ITOPF) (although primarily representing shipowner / P&I Club interests), can provide technical advice on the reasonableness of costs and claims.

In the event of a major spill, it is important to distinguish early on between blame (for causing the incident), responsibility (for response activities) and liability (for costs and claims). Even if TotalEnergies is not the party that caused the spill it may be advantageous for them, whilst denying blame for causing the pollution and liability for meeting claims, to accept responsibility for co-ordinating and funding cleanup operations and facilitating claims handling. It must be emphasised that acceptance of financial liability and/or responsibility for the spill response in no way implies acceptance of fault in the cause(s) of the incident.

The United Nations Convention on the Law of the Sea (UNCLOS 1982)

The United Nations Convention on the Law of the Sea (1982) also referred to as the Law of the Sea Convention or the Law of the Sea treaty, is the international agreement that defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine resources. UNCLOS came into force in 1982, Nigeria ratified the convention in 1986.

International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2008

Nigeria ratified the Bunker Convention in 2010. The Convention ensures adequate, prompt and effective compensation is available for damage caused by oil pollution from ships bunkers. The Convention applies to persons, territory (including territorial sea) and exclusive economic zones (EEZ) of State Parties.

6.5.2. Regional Agreements and Transboundary Incidents

Nigeria is a contracting party to the Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (the Abidjan Convention) and its Protocol Concerning Co-operation in Combating Pollution in Cases of Emergency. The objective of this is to facilitate the development of regional arrangements to supplement national arrangements for the effective combating of major spillages of oil and other harmful substances from ships. The provisions cover the development of legislation and contingency plans, exchange of information, reporting of incidents and mutual assistance.

There are no specific agreements oil spill incidents that may impact a neighbouring country’s waters. In the event of an oil spill event being of a magnitude whereby a neighbouring country is threatened or impacted, NOSDRA would be the lead agency managing the response under the NOSCP and would liaise with the respective government agencies of the respective country.

6.5.3. Nigerian National Legislation – Oil Spill Response Arrangements

The three main governmental agencies with oil spill response jurisdiction are the National Oil Spill Detection and Response Agency (NOSDRA), Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and Nigerian Midstream and Downstream Petroleum Regulatory Agency (NMDPRA).

- NOSDRA are responsible for overseeing an oil spill response to ensure compliance with environmental legislation. NOSDRA also undertake monitoring, surveillance and the coordination of spill response activities throughout Nigeria. They are responsible for the management of the National Oil Spill Contingency Plan (NOSCP), 2010.

- NUPRC/ NMDPRA regulates the oil and gas industry in Nigeria and is responsible for overseeing the export of oil, gas and condensates. They are also responsible for the fundamental regulatory requirements related to oil spill contingency planning as detailed in the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) 1991, Revised 2018. It is Part VIII, entitled “Standardisation of Environmental Abatement Procedures”, that contains guidance and requirements related to OSCPs; “Contingency Planning for the Prevention, Control and Combating of Oil and Hazardous Substance Spills”.

This JV Asset OSCP and the associated site specific OSCPs have been developed in accordance with both the NOSCP and EGASPIN. Both the NOSCP and EGASPIN give volumetric criteria for defining the severity of an oil spill, however they are not consistent. Their definitions are provided below:

Tier	Volume of Oil
1	<50bbl
2	>50bbl to <5000bbl
3	> 5000bbl

NOSDRA Tier Definitions from the NOSCP (2003)

Spill Location	Minor / Tier 1	Medium / Tier 2	Major / Tier 3
Land	<250bbl	>250bbl to <2500bbl	>2500bbl
Inland Waters	<25bbl	>25bbl to <250bbl	>250bbl
Coastal and Offshore	<250bbl	>250bbl to <2500bbl	>2500bbl

NUPRC/ NMDPRA Tier Definitions from EGASPIN (Revised 2018)

It is worth noting that in EGASPIN, oil spills are classified as ‘Minor’, ‘Medium’ or ‘Major’, however it can be inferred that the scaling corresponds with the three-tiered approach to oil spill preparedness and response.

TEPNG have taken both sets of definitions into account and follow the more stringent reporting definition for each level. As such, the TEPNG tier level definitions are as follows:

Spill Location	Minor / Tier 1	Medium / Tier 2	Major / Tier 3
Land	<50bbl	>50bbl to <2500bbl	>2500bbl
Inland Waters	<25bbl	>25bbl to <250bbl	>250bbl
Coastal and Offshore	<50bbl	>50bbl to <2500bbl	>2500bbl

TEPNG Tier Level Volumetric Definitions

6.6. Environmental Context

6.6.1. Climatology and Meteorology

Onshore

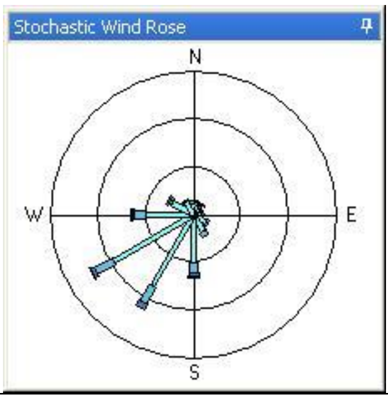
The climate is humid and hot, with two distinct seasons; the wet and dry. The wet season, which is the dominant season, begins in April and ends in October and is typified by southwest trade winds, which are laden with moisture from the Atlantic Ocean. The dry season lasts from November to March and is characterised by the hot and dry northeast trade winds, which also brings the harmattan (dry trade wind from the Sahara). There could be slight rainfall even during the dry season and the rains may extend into November or even December. The lowest temperature is known to occur during the rainy season and the highest in January during the dry season.

Offshore

Offshore, the mean annual air temperature is about 26°C and the hottest month is February (mean temperature of 28°C) while the coolest month is July or August (mean temperature of about 23°C). The daily ranges of temperature are small seldom more than a few degrees, and near coastline/onshore night minimum temperatures of about 20°C can occur in all months. The temperature of surface seawater shows a double peaked cycle, coinciding with the cycle of solar heights. Sea temperature ranges between 27°C and 28°C in the months of October to May while during the rainy season of June and October, the range is between 24°C and 25°C.

The offshore winds are fairly consistent and never very strong, except during squalls associated with thunderstorms. Wind is predominantly southwesterly with wind speeds mostly between 0 and 5m/s. There is some variation between wet and dry season winds offshore. The below wind roses show the percentage likelihood of different wind speeds and directions for January (representing the dry season) and July (representing the wet season). The wet season shows a greater dominance of strong southwesterlies when compared to the dry season.

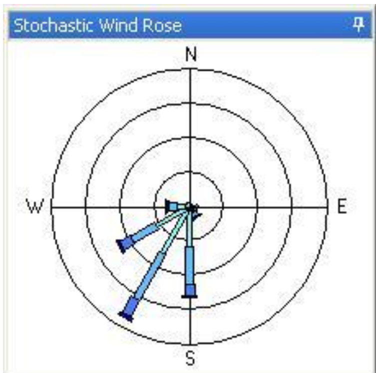
January Wind Data – Dry Season



Key

	Speed (kts)	Colour
0	10.000	
1	16.000	
2	27.000	
3	33.000	
4	64.000	

July Wind Data – Wet Season

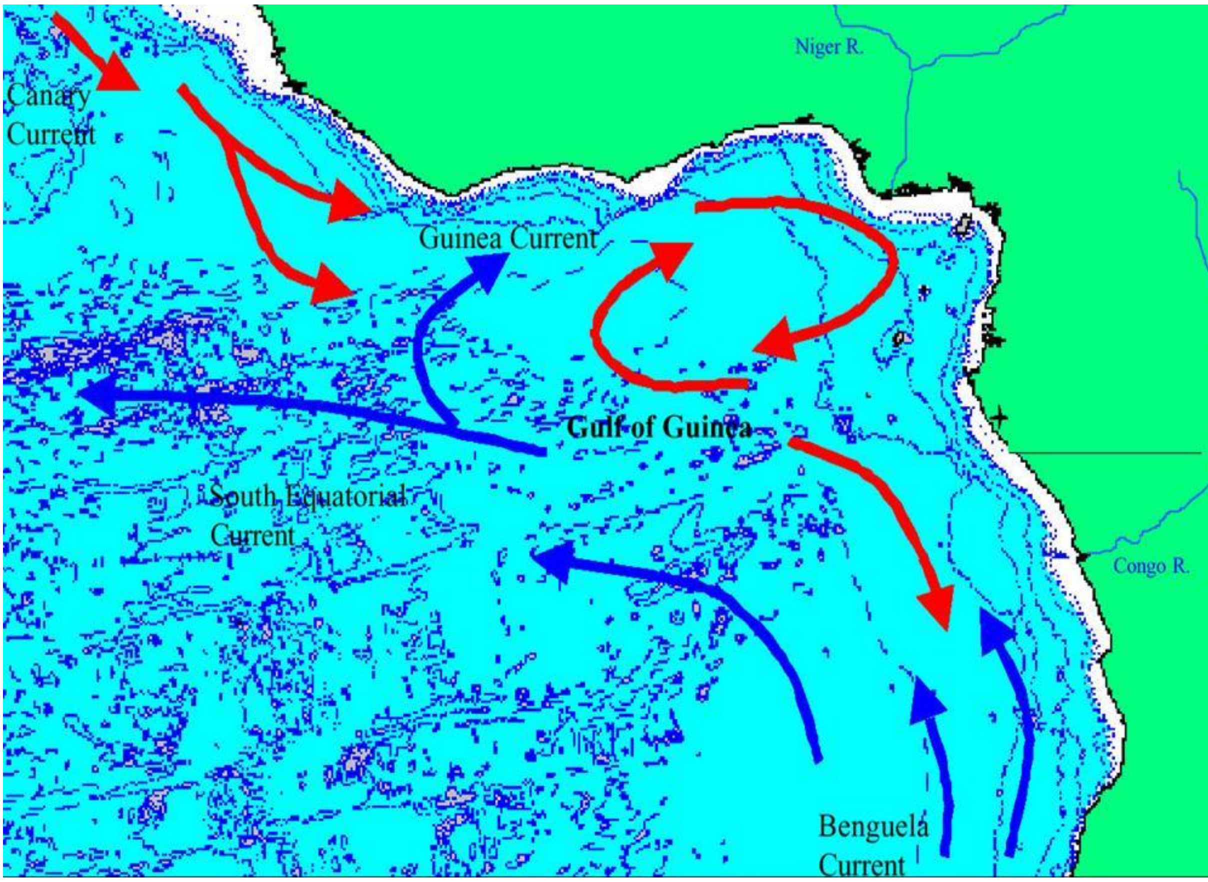


Wind data for Offshore Nigeria, taken from the Africa Pilot Volume 1, United Kingdom Hydrographic Office, 14th Edition, 2006.

6.7. Oceanography

The surface oceanic circulation systems in the Gulf of Guinea derive their origin from the two gyral currents of the North and South Atlantic, which are fuelled by the prevailing wind systems. From the north, the southward cold current of Canary flows along the coasts of Mauritania and Senegal and progressively warms up and splits into a westward North Equatorial Current and the Guinea current which continues along the West African coast. This turns progressively eastward to join the Equatorial Counter Current that transports eastward the saline and warm waters formed along the southern edge of the North Atlantic eddy. The principal currents are almost constantly oriented but are subjected to the influence of various migrating water masses.

From the south, the cold Benguela Current flows northwards along the coast of Angola and extends in the Gulf of Guinea through the westward South-Equatorial Current. The warm current streams up near the equator till it hits the Bight of Bonny where it probably contributes to the reversals of the Guinea Current. The Equatorial Counter Current, which flows eastwards, is embedded between the North and South Equatorial Currents with its landward end contributing to the eastward flowing Guinea Current. The seasonal dynamics of the principal oceanic currents depend on the large-scale oceanic and climatic seasonal exchanges.



Surface Currents in West and Central Africa

Along the Nigerian coast, tidal streams are semi-diurnal, reversing their direction four times daily with the vertical tidal range increasing eastwards. Off the open coast away from the entrances to rivers, the tidal streams tend to set easterly to northeasterly on the rising tide and south or east on the falling tide, parallel to the coast. These tidal streams are only appreciable inshore and even these are usually weak. More than a few kilometres from the coast, water movement is controlled by currents and tidal streams can be considered negligible. Tidal flows are at their strongest around the shallow mouth sand bars at river entrances to the Niger Delta and the marginal island-lagoon complex. Here tidal currents can reach 1.5 - 2m/s (3-4 knots) decreasing to 0.5m/s approximately 15km offshore. Tidal flow sets towards the river mouths on a flood tide and away from the river mouths on an ebb tide. In general, the out-going stream on the falling tide is greater during the rainy season than the in-going stream because of the great volume of fresh water flowing from the rivers; the duration of the outflow is also greater than the inflow at this time.

The longshore drift is usually generated by the southwesterly waves which strike the Nigerian coast at an oblique angle. Due to the orientation of the coast, longshore currents move eastward from Brass and westwards from Akassa.

6.8. Oil Fate and behaviour

Onshore

The fate / behaviour of oil when spilled on land or inland waters differ from the results in the open sea. The behavior of oil on land differs greatly with its behavior in water. The fate of the spilled in the environment depends on several factors such as; spilled volume, the type of oil, weathering characteristics of the oil, terrain, receiving media and weather.

The table below summarises the results of experimental weathering and dispersibility study of TEPNG onshore crude oil conducted at 26°C: (*Source: Report of weathering and dispersibility study of 7 crude oils in simulated Nigerian weather conditions, CEDRE, 2010-Appendix 1)*

	OBAGI	*OML58 blended Products*
Max. Water Content (%)	30	35
Presence of free water	no	no
Initial Viscosity (mPa.s)	32	26
Max. Viscosity (mPa.s)	350	250
Initial density	0.838	0.838
Max.density	0.940	0.940
Asphaltenes Content	0.9%	0.9%
Presence of air in the emulsions	no	no
Evaporation rate (% wt.)	45	50
Emulsion stability	unstable	unstable
Bioremediation	yes	yes
Chemical dispersibility/ hours	yes / one week	yes / one week [4]
Natural dispersion	yes	yes
Mechanical recovery	yes	Yes
Time before recovery operations	12 hours	12 hours

[4] natural dispersion is liable to affect the Total Dispersity of the oil (no oil remaining after 96 hours during the experiments)

Offshore

Crudes: When spilled at sea, crude oil is subjected to weathering processes such as evaporation, emulsification, dispersion and photo-oxidation. These processes occur under natural conditions due to sea surface agitation by wind, waves and currents and to the exposure of the oil to solar light. In its weathering stage, the state of the oil is continuously changing in terms of chemical composition and physical properties. The oil can become more and more viscous and can become a new persistent pollutant in the environment. Its behaviour is often different from the original oil and understanding these transformations is a key element in understanding the potential impacts and in optimizing the emergency response to spills

The table below summarises the results of experimental weathering and dispersibility study of offshore crude oil conducted at 26°C: (*Source: Report of weathering and dispersibility study of 7 crude oils in simulated Nigerian weather conditions, CEDRE, 2010)*

	AFIA	***OFON***	***Export blended Pdts from FSO***	***AMENAM***
Max. Water Content (%)	25	50	20	30
Presence of free water	no	yes	no	yes
Initial Viscosity (mPa.s)	45	12	12	13
Max. Viscosity (mPa.s)	600	2000	700	200
Initial density	0.903	0.838	0.820	0.814
Max.density	0.950	0.980	0.900	0.920
Specific Gravity @ 15℃	0.9168	0.8439	0.8241	0.9092
Asphaltenes Content (%)	0.2	0.2	0.6	0.6
API @ 15℃	22.8	36.2	40.1	43.4
Presence of air in the emulsions	No	Yes	No	No
Evaporation rate (% wt.)	25	40	50	60
Pour Point	>2	19	2	22
Emulsion stability	unstable	unstable	unstable	unstable
Bioremediation	yes	yes	yes	yes
Chemical dispersibility/hours	yes / one week	yes / one week [1]	no [2]	yes / one week [1,3]
Natural dispersion	yes	yes	yes	yes
Mechanical recovery	yes	yes	Yes [5]	Yes [5]
Time before recovery operations	12 hours	12 hours	12 hours	12ours

[1] samples weathered at the laboratory scale showed poor dispersibility
[2] chemical dispersibility proved to be low whereas natural dispersion was very significant (no oil remaining at the surface after 72 hours)
[3] natural dispersion is liable to affect the Total Dispersivity of the oil (no oil remaining after 53 hours during the experiments)
[5] oil is liable to get solid at ambient temperature; recovery equipment and storing capacities should be adapted. The use of nets should be considered.

Summary of other offshore crude oil samples

Field/Station	Specific Gravity @15°C	Density @ @15°C	API @15°C	Pour Point (°C)
OML100-EDD (Edikan)	0.8902	0.8897	27.5	>4
OML100-IMD (IME)	0.9233	0.9228	21.8	>2
OML100-ODD (Odudu)	0.8808	0.8803	29.3	>2

Summary of Condensate Properties

Field/Station	Specific Gravity @15°C	Density @ @15°C	API @15°C	Pour Point (°C)
OML99-AMP (Amenam)	0.9092	0.808	43.4	22

The Amenam condensate is relatively heavy, with a high pour point which will be due to a high wax content. The light ends will evaporate within the first few hours when spilled at sea, most likely leaving a waxy persistent residue which will probably not be amenable to dispersant

6.9. Sensitivities to Oil spills

6.9.1. Onshore

OML58 is located in seasonal rain forest swamp of the Niger Delta and drained by the Sombreiro and Orashi Rivers, creeks and streams. During the wet season, the rain forest becomes a swamp / wetland characterised by surface water. Any mobile surface water will eventually flow into the Sombreiro River or the Elele Alimini River. The export pipeline from Obagi to the Rumuekpe Metering Station crosses the Sombreiro River near Ahoada, and the pipeline from Olo to the tie-in crosses the upper swampy reaches of Elele Alimini River. The area where TEPNG has assets (wells, flowlines, pipelines, facilities, etc) is typically tropical rain forest with fringes and patches of fresh water swamps along the rivers and creeks. There are several towns in the area, and the land-use activities of the communities inhabiting the area consist mainly of subsistence farming and some fishing.

Vegetation

The vegetation of OML58 is classified as moist lowland forest or tropical rain forest. Based on vegetation type, OML58 can be divided into five distinct areas:

Area	Description
Dry land mature rainforest	consist primarily of evergreens with leafy crowns of the mature forest trees arranged in layers or storeys typifying the primary forest. These layers include the upper storey and the lower storey with layers of shrubs layer as well as herbs.
Galloping swamp forests	dense fresh water swamp forest with raffia plants as the dominant plant species. They are also part of the aquatic ecosystem and in some areas, the ground is irregular with frequent patches of water pond
The aquatic ecosystem	consists of freshwater ponds with stagnant and running waters, especially during the rainy season with water lettuce and water lily floating on the pond surface, bank side vegetation
Farmlands	mainly smallholdings of cassava-based farms with maize and other crops e.g. yams, cocoyams, melon, pepper, pumpkins, bananas, plantains and okra
Bush fallow lands	fallow lands containing plant species at varying stages of succession and this constitutes the light bush / secondary forest. This is the dominant vegetation type of OML58 and constitute above 70% of the Total vegetation type

Wildlife

There are nearly a 100 vertebrate wildlife species resident in the area around OML58, including;

- 26 mammalian species from 15 families.
- 39 avian species from 18 families.
- 22 reptilian species from 12 families.
- 5 amphibian species from 3 families.

The mammalian fauna within OML58 is dominated by thryonomids viz (a cane rat), followed by the bovids (duikers and antelopes) and Suids (bush-pigs). The thryonomids are widely distributed in cultivated farmland where they devour cassava tubers at night. The bovids keep to the bushes and secondary forest batches in the neighbourhood of the farmlands from where they also make nocturnal incursions into the farms.

OML58 has a diverse assemblage of avifauna which frequently visits cultivated farmlands and pipelines routes for insects, fruits and seeds, and forest for resting, perching and cover during a rain. The most abundant and ubiquitous species included the Allied Hornbill, Pied Crow, Swifts, Hawks, Kites, and the passerine forms.

Lizards of the family Agamidae and Skinks family Scincidae are found in abundance in OML58. They readily colonised such habitats as cassava peel dumps, timber piles, oil palm fruit heaps, garbage dumps, buildings, operational sites etc., where plentiful insects for food are present. Snakes are also present, most of which are poisonous. Species include the cobra, mamba, viper and python.

Several breeding grounds for amphibians are present in the vicinity of the operational sites in OML58. Amphibians are abundant in stagnant water swamps, streams, pools, and wet grasses in the area. The commonest of the amphibian fauna is the African toad.

Most animals are likely to avoid an oiled area, especially when a response is active and causing a commotion. Animals that rely on water are most at risk of being oiled, with birds being particularly vulnerable with oiled plumage resulting in possible drowning and ingestion during preening resulting in potential lethal results. Mammals that enter an oiled area may end up with oiled fur which will reduce thermal properties. Ingestion during subsequent self-cleaning may result in the animal being poisoned.

Socioeconomic Sensitivities

Within OML58 there are various villages and communities that could be impacted if there was oil spill, both economically and socially. Any oil spill event is likely to strain relations with local communities and careful negotiations will be required to open access for a response. Economic activities of local communities may be potentially impacted as a result of a spill. Such activities that occur in OML58 are influenced to a large extent by the lands and land resources. The Egi and Elele Alimini areas are predominantly dry land and are used for farming and hunting. Fishing activity is relatively small in OML58, especially compared to farming which is the traditional and dominant occupation of the area. Though a vast area of the land mass is used for farming, there are still large areas of forests and bush fallows, which yield raw materials for craftsmanship. The women engage themselves in weaving mats and baskets that are commonly sold to fishermen in the neighbouring communities of Usomini.

6.9.2. Offshore

Environmental Sensitivity Index (ESI) mapping has been conducted for the Nigeria coastline commissioned by TEPNG, with a summary presented in this subsection (see Volume 2 – Response Handbook for the actual ESI maps). The fundamental basis of ESI is related to the vulnerability of particular environments to spilled oil, based on their geomorphology, exposure and biological productivity. Distinct shoreline segments are colour coded and ranked on a scale of 1-10 in order of increasing sensitivity to spilled oil, and in the context of Nigeria this equates to:

ESI 1 – Manmade structures

ESI 2 – Eroding mud beach

ESI 3 – Fine sand beach

ESI 4 – Medium to coarse sand beach

ESI 5 – Mixed sediment beach

ESI 6 – Saline flats

ESI 7 – Grassland

ESI 8 – Degraded freshwater wetland

ESI 9 – Sheltered tidal flats / vegetated low banks

ESI 10 – Mangroves

A summary of the ESI for each coastal region is presented below:

Coastal Region	Coastline	ESI
Badagry – Lagos	Medium to coarse sand beach Exposed rip-rap / sea wall	4 1
Lekki Lagoon – Mahin (Atijere)	Mangrove Barrier sand	10 3
Mahin – Forcados River	Mangrove Barrier sand	10 3
Ramos River – Kulama	Mixed sediment beach Fine sand beach Eroding mud beach Exposed sea wall / rip-rap	5 3 2 1
Fishtown River – Bartholomew River	Mangrove Barrier sand	10 3
Sombreiro River – Imo River	Mangrove Barrier sand	10 3
Imo River – Cross River / Rio del Rey	Fine sand beach Exposed rip-rap / sea wall Fine sand beach Exposed sand beach	3 1 3 3

Summary of the ESI for each Coastal Region of Nigeria

The main features of each region are detailed below:

- **Badagry – Lagos Area:** This is the westernmost part of the barrier beach-lagoon complex, and comprises sandy barrier beaches backed by a network of creeks and beach ridges. Topographically, a continuous, wave-beaten barrier beach broken only at the entrance to the Lagos Harbour, fronts the zone. The barrier beach widens eastwards, and at the eastern extremity of the area, the Lekki Peninsula, it is approximately 5km wide. Various crops are grown on the 110km stretch of sandy barrier beach, including, coconut palm, bananas, cassava and cocoyams. West of the Lagos, there are extensive areas along the seashore covered with coconut palms and also areas of natural vegetation.

- **Lekki Lagoon – Mahin (Atijere) Area:** The geomorphology of this region is similar to that of the Badagry - Lagos region, except at the eastern edge. The barrier beach here is wider, ranging from 22km at the western edge (Ikosi - Iwerekun axis) to 10km at the boundary with the Mud coast. It is narrower (2km) south of Lekki Lagoon. The Mud coast lacks an active barrier beach. Spring high tides result in the coastbelt being frequently inundated. The vegetation sequence here is similar to that in Badagry – Lagos area. Large lagoon systems are still present and the largest ones are the Ikosi and Lekki Lagoon. North of Lekki and outside of the coastbelt is the Omo Biosphere Reserve while further east of the area is the Eba Island Forest Reserve, located in a freshwater swamp forest. All throughout the area, freshwater swamp forest borders the beach sands with mangroves. The freshwater swamp is narrower in the western than in the east. On the extreme eastern tip of the region, peaty mud flats are present that are bordered by mangrove.
- **Mahin Area - Forcados River:** This area is commonly termed the `Transgressive Mud Coast' due to the regular sea incursion into and inundation of the area. The coastline consists mostly a peaty mud. Elevations are low, especially in the region of the adjacent towns of Awoye and Molume, and are lower than the highest tides. Landward, is a 2km wide band of saline alluvial soils that extend southeastward, terminating at the north bank of the Benin River estuary. There are extensive freshwater swamps north of the Benin River estuary, but the whole of the southern side, landward of the barrier island bounded by the Benin and Escravos Rivers is a low-lying tidal saline swamp. As in the Badagry - Lagos area, the backshore of the barrier beach has silty soil, is subject to impeded drainage and is covered by freshwater swamps. This backshore grades into the mangrove in the more low-lying areas subject to tidal inundation. The rivers and creeks have elevated mud banks, which constitute levees. The presence of the levees worsens the drainage condition within the inter-levee areas.
- **Ramos River – Kulama:** This is the Niger Delta section where the coast trends south-southeast towards the tip of the delta. The Ramos River in the north and the Dodo River in the south bound the region. The region is bounded seaward by two barrier islands: Ramos - Dodo and Dodo-Penington. The longest of the barrier islands, at 35km is the Ramos-Dodo Island. The widest is the Forcados-Ramos Island which is 10km wide. As on the other barrier islands and beach ridges, the shoreline consists of beach sands backed by ridges. The backshore slopes more gently toward the mangrove, and is usually waterlogged during the long rainy season on account of silty soils and impeded drainage. Freshwater swamps gradually supersede the mangrove further inland with the rise in the elevation of the land. These latter areas also have impeded drainage due to levee formation by the numerous creeks and rivers of the area, and are subject to flooding by rainfall or high water levels. Tidal incursion over distances in excess of 50km occurs along the Forcados River up to Warri.
- **Fishtown River – San Bartholomew River:** This area consists of many barrier islands containing ‘active’ and ‘abandoned’ beach ridges but with most of the latter located in the backshore, and significantly eroded by tidal currents operating through the network of tidal channels landward of the barrier islands. The beach ridges decrease in size eastwards from Bengatoro River towards Fishtown River. In this area, the beach ridges are almost completely eroded. The beach ridges widen again from the Fishtown River towards the Brass River – Nicholas River area with widths in excess of 3km. The narrow barrier islands have elevations of about 3m above mean sea levels. There is a vast mangrove swamp beyond the backshore of the beach ridge-barrier islands. These swamps are invariably bounded by levees. Towards the west, the mangrove grades into freshwater swamps and high forest at 15km away from the coast, but eastward, the mangrove band is wider and is in excess of 25km.
  - **Sombreiro River – Imo River:** This is the most easterly section of the Niger Delta and is bordered in the east by creeks connecting the Bonny River, Andoni River and Imo River. There are numerous barrier islands with sand beaches in the area, with the greatest concentration being around the estuary of the new Calabar River – Bonny River. Here the barrier islands are narrow

and appear to be remnant beach ridges, which have been subjected to significant tidal erosion especially through the many short creeks in the backshore of the beach ridges. Thus, the area of freshwater vegetation fronting the sea is limited in this region, and may continue to decrease, being succeeded by saline mangrove species.

- **Kwa River – Cross River / Rio del Rey:** This area consists of narrow (<1.5km), gently sloping barrier beach. The barrier beach is narrower (<1km) west of River Kwa Ibo and terminates landward at an extensive creek that virtually connects River Kwa with River Imo. In this area, three small estuaries of the creek break the barrier beach. To the east of River Kwa, the barrier beach extends unbroken for approximately 25km to the estuary of Cross River. The barrier is slightly wider here (approx. 1.5km). As in the Niger Delta, tidal creeks have penetrated the backshore of the barrier beach to cause erosion and a succession from freshwater to mangrove swamps. This is very evident landward of the Ibeno-Okposo beach ridge (River Kwa – River Cross). Here, the Stubbs and Widenham Creeks are associated with a low-lying large expanse of degraded mangrove and nipa swamp. Around the River Cross estuary, the mangroves are full-grown pure stands. The mangroves in the strand coast zone are however not as extensive as in the Niger Delta.

Wildlife

Various marine animals and birds are at risk in the event of a major oil spill. The main animals at risk are cetaceans, manatees, turtles and birds. Cetaceans, manatees and turtles are unlikely to be adversely impacted by spilled oil as they are likely to avoid the area and are generally not frequently seen. Impact may occur should an individual surface to breath in a spill. Turtle nesting sites, for example on Bioko Island, are at most risk in the event of a spill. There are a number of coastal bird species that could become oiled in a spill. Birds are particularly vulnerable to oil pollution with oiled plumage resulting in birds drowning and ingestion during preening resulting in potential lethal results.

In general, the most important factors that will affect the vulnerability of animals to oil spills are:

- Conservation status of any of the species.
- Migratory patterns - are the animals actually using the site?
- Relative size of individual animal groups and how close they are to shoreline.
- Feeding behaviour - do they have much direct contact with water?
- The quantity, type and weathering of the oil - Light oil products can be more toxic and heavier oils may be less easy for the animal to remove.

Socioeconomic Sensitivities

Along the Nigerian coast and in the Delta there are various villages and communities that could be impacted if there was oil spill, both economically and socially. Any oil spill event is likely to strain relations with local communities and careful negotiations will be required to open access for a response. Economic activities of local communities may be potentially impacted as a result of a spill, particularly fishing. Nigerian waters are noted to be rich in fish and shrimps due to the upwelling resulting from the influence of the Benguela currents and Equatorial counter currents on the Guinea currents. According to Nigerian Institute for Oceanography and Marine Research (1986), the total animal value of these commercial species is estimated at $233.57m - $531.64m. There are more than 700 species of fish in the maritime and salt waters of Nigeria, and among these species, there are commercially important pelagic species consisting mainly of sardine, tuna and anchovies. The predominant living marine resources exploited for food in the Nigeria waters are the fin and shell fisheries, which can either be pelagic, eurybathic or demersal.

Fish and shellfish populations are at greatest risk from oil spills when the water depth is very shallow or they live in the intertidal zone (e.g. mud crabs, oysters, clams etc.). Deeper than 10m, in open waters, it is very unlikely that fish will be affected. In shallow or enclosed waters, however, high concentrations of fresh dispersed oil can kill some fish and have sub-lethal effects on others. Juvenile fish in nursery areas are at greatest risk. The oil can also taint the flesh with an oily taste and make it unpalatable. This tainting is the main cause of damage to fisheries after an oil spill, because they may need to be closed for a period until the taste of oil is lost, 'depuration'. This process happens naturally once the oil concentrations have dropped to background levels. The depletion time depends on the fish species, but can range from a few days to many weeks. Even if there is no actual impact of an oil spill on the fish or shellfish themselves, it is still possible for the fishery to be affected by the adverse publicity created by the spill. It is possible for the market to be affected for long periods, with both commercial and social impacts. Fishing gear and boats are also at direct risk from oil slicks on the water surface.

6.10. Risk Assessment

6.10.1. Risk Assessment Methodology

Evaluating Oil Spill Risks

One of the most important initial steps in the contingency planning process is the risk assessment. Evaluating oil spill risks requires considerations of two factors, namely the probability of an oil spill occurring, and the consequence. Once the oil spills scenarios have been identified, the likely fate and behaviour can be assessed along with the environmental sensitivities and potential effects in order to determine appropriate spill response strategies. This process will be developed throughout this Strategy Plan.

Probabilities of an oil spill occurring can be inferred from TEPNG and industry historical data. Since this information is based on averaging statistics over a period of time it can be misleading. This is due to the following factors not always being taken into account, which may increase or decrease the risk of oil spills:

- Developments in technology, which would normally decrease the risk of spills.
- Types of preventative measures in place.
- Variables which are unique to a particular field and operating environment (e.g. offshore deep water E&P operations have different associated risks than those in shallower water).
- For a given spill with a risk of occurring only once in 100 years, that risk, however small, still does exists and could happen at any time.

As such, the specific details of each operation in question have been considered that may reduce, eliminate or add new risk factors to the historical data.

Historical Spills from Industry

In addition to using historical TEPNG oil spill data for ranking scenarios in terms of probability, the use of wider industry data can be also be utilised. There are no Nigerian or global oil spill databases for exploration and production activities, however the United Kingdom Government has compiled comprehensive statistics on the drilling and production operations for the North Sea over a 25 year period. This data provides a useful indication on the types of spills and spill volumes that may occur during drilling and production operations. It shows that if the number of oil spills is normalised against the number of fields, the frequency of spills is seen to level off to approximately 1.5 spills per field per year. The data also indicates that the quantity of oil spilled has decreased greatly during the 1990s, with the most common spill size being between 0.1 tonnes and 1 tonne, and large spills being very uncommon, with there being no major North Sea oil spills in the past 20 years.

ITOPF manages a global database for oil spills associated with tankers, combined carrier and barge operations. This database contains information on over 10,000 spills, 85% of which were less than 7 tonnes. Approximately 34% of the spills in category 7 to 700 tonnes occurred during routine operations, with 27% occurring during loading or discharging. For larger incidents, groundings and collisions account for over 63% of the incidents over 700 tonnes.

The Macondo incident of 2010 from drilling operation was unprecedented in the industry as much as the response. It opened a new horizon in oil spill response and well capping operations. Though specifically for deepwater operations, the JV Asset has learnt from this incident.

6.10.2. Oil Spill Scenarios

Oil spill scenarios have been identified for each TEPNG operational site. A scenario is a sequence of events leading to a potential accidental oil spill incident. A range of spill scenarios has been identified to reflect spills that occur in TEPNG's operations onshore and offshore. Scenarios are subdivided on the basis of location:

Onshore Operations	**Offshore Operations**
- Infield - Obagi Flow Station - Obite Gas Plant - Ibewa Well Cluster - Olo Flow Station (Production Stopped and oil evacuated from crude oil storage tanks to Obagi Flowstation)	- Onne Site - OML99 - OML102 - OML100 - *FSO Unity* and CALM Buoy - At-sea

Onshore – Infield

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
1.	Drilling / producing production wells.	Blowout.	Sabotage, equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Crude or condensate. Percentage of produced water significantly varies between wells.	Depends on well characteristics, for example some wells producing around 440m^3 of oil per day and others <5m^3 of oil per day. There are around 70 functional wells.	Wetland, swamp, river, on land. Community impact possible. Sombriero River system could be impacted.	Greater chance of a blowout during drilling as opposed to normal production operations.
2.	Infield flowlines.	Rupture.	Sabotage, corrosion, civil engineering earthworks, structural failure, over-pressurisation.	Crude or condensate. Percentage of produced water significantly varies.	Taking 6” diameter, for a 500m line, loss could be ~9.1m^3 and for a 10km line ~182.5m^3. Volume for a 6” average flowline would be ~220m^3. Amount released would be controlled by flowline topography.	Wetland, swamp, river, on land. Community impact possible. Sombriero River system could be impacted.	Length of lines range from 500m to 10km with an average being ~3km and diameters being 4” or 6”. ESDV would initiate instantaneously at either end. Taking 6” diameter, for a 500m line loss could be ~9.1m^3 and for a 10km line ~182.5m^3. Volume for a 6” average flowline would be ~220m^3. Loss of entire volume extremely unlikely; almost impossible for longer routes due to topography.
3.	Infield flow lines.	Minor loss.	Sabotage, corrosion, civil engineering earthworks, structural failure, over-pressurisation.	Crude or condensate. Percentage of produced water significantly varies.	Less than 5m^3, but to 10s of m^3 possible in lager events.	Wetland, swamp, river, on land. Community impact possible. Sombriero River system unlikely to be impacted.	Records of previous oil spills provide an indication of the amount released.
4.	Diesel road tanker.	Tanker rollover.	Road accident, human error, sabotage / attack.	Diesel.	Up to 45m^3.	Roadside; on land, ditches, vegetated areas. Community impact possible.	Maximum volume of road tankers in the region is 45m^3.
5.	Drilling localities.	Loss of oil based mud transport.	Road accident, human error, sabotage / attack.	Oil based mud containing up to 60% base oil (EDC 99-DW).	Up to 45m^3.	Roadside; on land, ditches, vegetated areas. Community impact possible.	Oil based muds are transported from the Ibewa Mud Plant to the drill site by road tanker with a maximum volume of around 45 m^3.

Onshore – Obagi Flow Station

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
6.	Anywhere within the Flow Station.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, etc.	Crude, condensate, lube oil, hydraulic oil or diesel.	Less than $1m^3$.	Within confines of Obagi Flow Station, possibly in a bunded area.	Likely occur during routine operations for example maintenance, pigging, handling oils, diesel import, etc. Volumes will be small, certainly no more than a $1m^3$ and more likely to be less than 1bbl.
7.	Drum store.	Damage / loss of oil drum.	Human error, poor storage, rusted drums.	Lube oil and hydraulic oil.	Less than 1 barrel.	Within the bunded confines of the drum store.	Volume of lube oil spilled will vary depending on scale of incident. Unlikely more than 1 barrel would be damaged unless part of a wider emergency.
8.	Process line.	Minor loss from a process unit.	Equipment failure, human error, process malfunction, corrosion.	Crude.	Loss likely to be $1m^3$.	Within Obagi Flow Station in a bunded area or directly onto the ground.	Daily site inspections will indentify potential causes.
9.	Process line.	Major loss from a process unit.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an attack.	Crude.	Volumes could be in the range of a few m^3 to 10s of m^3 of crude.	Within Obagi Flow Station in a bunded area or directly onto the ground. Spill may enter closed drain system.	Exact loss likely to vary depending on source, incident and time to shut down.
10.	Process unit.	Loss of inventory.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an attack.	Crude.	Loss of entire volume would represent worse case. Smallest unit is $42m^3$ and largest is $116.4m^3$.	Within Obagi Flow Station in a bunded area or directly onto the ground. Spill may enter closed drain system.	Separators and gas boot range in size. Depending on the incident, more than one vessel may be lost.
11.	Storage tank.	Loss of inventory.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion or an attack.	Crude.	Single tank volume is $5,000m^3$.	Any spill should be contained within bunded area, however in the event of a wider emergency the bund may fail or in the event of tank structural failure oil may overtop.	There are 4 tanks, 2 of which are used as production tanks (Tanks 2 and 4) which are filled to capacity prior to export. When one inventory is being exported the second will be filled – i.e. under normal operations both tanks

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
							are not at maximum capacity simultaneously. Other tanks used for allowing water to settle out (Tank 3) and receiving produced water (Tank 1) for reinjection.
12.	API separator pit.	Overflow / pit failure.	May result from human error, structural failure of process systems malfunction.	Oily water.	Volume of oily water up to $10m^3$.	Contamination of surrounding ground. Spill may enter closed drain system.	Maximum volume of pit $10m^3$. Highly unlikely entire volume would be lost.
13.	Diesel storage tank.	Loss of inventory.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion or an attack.	Diesel.	Tank volume is $40m^3$.	Spill contained within the bund.	In the event of a wider emergency the bund may fail or in the event of tank structural failure oil may overtop.
14.	Closed drain system.	Overflow of sump tank.	Excessive rain fall and failure to regularly empty tank.	Oily water.	Likely to be no more than $1m^3$.	Contamination of surrounding water courses possible.	Volumes likely to depend on quantity of oil washed into drains. If a scenario such as #11 has occurred with the bund failing, impact may be significant with community relations impacted.
15.	Flare lake.	Flare carry over.	Process malfunction.	Crude as a sheen.	Volume not likely to be greater than $1m^3$.	Spill contained in flare pit lake.	Pollution of surrounding water courses unlikely.
16.	Obagi-Rumuekpe Export Line	Full rupture.	Sabotage, corrosion, civil engineering earthworks, structural failure, over-pressurisation.	Crude.	Amount released would be controlled by pipeline topography and time till detection. Previous spill indicate a spill of $>40m^3$ worse case.	Wetland, swamp, river, on land. Community impact possible. Sombriero River system could be impacted.	Pipeline has a 12" diameter and is 30km long. Static volume is approximately $2,200m^3$. Amount that would be released depends on shut down time and pipeline topography. There are no remote or ESDVs.

Onshore – Obite Gas Plant

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
17.	Anywhere within the Gas Plant.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, etc.	Condensate, lube oil, hydraulic oil or diesel.	Less than $1m^3$.	Within confines of Obite Gas Plant, possibly in a bunded area.	Likely occur during routine operations for example maintenance, pigging, handling oils, diesel import, etc. Volumes will be small, certainly no more than a $1m^3$ and more likely to be less than 1bbl.
18.	Process line.	Minor loss from a process unit.	Equipment failure, human error, process malfunction, corrosion.	Condensate.	Loss likely to be $1m^3$.	Within Obite Gas Plant in a bunded area or directly onto the ground.	Daily site inspections will identify potential causes.
19.	Process line.	Major loss from a process unit.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an attack.	Condensate.	Volumes could be in the range of a few m^3 to 10s of m^3 of crude.	Within Obite Gas Plant in a bunded area or directly onto the ground. Spill may enter closed drain system.	Exact loss likely to vary depending on source, incident and time to shut down.
20.	Process unit.	Loss of inventory.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an attack.	Condensate.	Loss of entire volume would represent worse case. Smallest unit is $21.8m^3$ and largest is $65.54m^3$.	Within Obite Gas Plant in a bunded area or directly onto the ground. Spill may enter closed drain system.	Separators range in size. Depending on the incident, more than one vessel may be lost.
21.	Diesel storage tank.	Loss of inventory.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion or an attack.	Diesel.	Tank volume is $69.38m^3$.	Spill contained within the bund.	In the event of a wider emergency the bund may fail or in the event of tank structural failure oil may overtop.
22.	Closed drain system.	Overflow of sump tank.	Excessive rain fall and failure to regularly empty tank.	Oily water.	Likely to be no more than $1m^3$.	Contamination of surrounding water courses possible.	Volumes likely to depend on quantity of oil washed into drains.
23.	Flare stack.	Flare carry over.	Process malfunction.	Condensate showering.	Volume not likely to be greater than $1m^3$.	Release likely to be a fine mist.	No water courses would be impacted.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
24.	Obite – Obagi Pipeline	Full rupture.	Sabotage, corrosion, civil engineering earthworks, structural failure, over-pressurisation.	Condensate.	Static volume 194m^3. Amount released would be controlled by pipeline topography.	Wetland, swamp, on land. Community impact inevitable.	ESDVs at Obite and Obagi would close instantaneously. 8" diameter pipeline, 6km long. Loss of entire volume extremely unlikely if not impossible due to topography.

Onshore – Ibewa Well Cluster

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
25.	Anywhere within the facility.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, etc.	Condensate, lube oil, hydraulic oil or diesel.	Less than 1m^3.	Within confines of facility, possibly in a bunded area.	Likely to occur during routine operations for example maintenance, pigging, handling oils, diesel import, etc. Volumes will be small, certainly no more than a 1m^3 and more likely to be less than 1bbl.
26.	Drilling / producing production wells.	Blowout.	Sabotage, equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Crude or condensate. Percentage of produced water significantly varies between wells.	Depends on well characteristics. Worse case producing well is 5,500bbl dry condensate per day.	Ibewa Well Cluster would be impacted. Drain systems potentially overwhelmed.	Greater chance of a blowout during drilling as opposed to normal production operations.
27.	Process line.	Minor loss from a process unit.	Equipment failure, human error, process malfunction, corrosion.	Condensate.	Loss likely to be 1m^3.	Within facility in a bunded area or directly onto the ground.	Daily site inspections will indentify potential causes.
28.	Process line.	Major loss from a process unit.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an	Condensate.	Volumes could be in the range of a few m^3 to 10s of m^3 of crude.	Within facility in a bunded area or directly onto the ground. Spill may enter closed drain system.	Exact loss likely to vary depending on source, incident and time to shut down.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
			attack.				
29.	Process unit.	Loss of inventory.	Equipment failure, human error, process malfunction, corrosion, wider emergency such as an explosion or an attack.	Condensate.	Loss of entire volume would represent worse case. Test separator is the only significant volume; 12.6m^3.	Within facility in a bunded area or directly onto the ground.	Spill may enter closed drain system.
30.	Mud plant.	Loss of inventory.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion or an attack.	Base oil (EDC 99-DW) or oil based mud containing up to 60% base oil.	Largest storage tank is 83.6m^3.	Within facility in a bunded area or directly onto the ground. Spill may enter closed drain system.	There are 8 tanks in the mud plant that may contain base oil / oil based mud mix. The smallest is 71.5m^3 and the largest 83.6m^3.
31.	Closed drain system.	Overflow of sump tank.	Excessive rain fall and failure to regularly empty tank.	Oily water.	Likely to be no more than 1m3.	Contamination of surrounding water courses possible.	Volumes likely to depend on quantity of oil washed into drains. In the event of a major spill (such as a blowout) the drain system would be overwhelmed.
32.	Ibewa – Obite Pipeline	Full rupture.	Sabotage, corrosion, civil engineering earthworks, structural failure, over-pressurisation.	Condensate.	Static volume 146m^3. Amount released would be controlled by pipeline topography.	Wetland, swamp, on land. Community impact inevitable.	ESDVs at Obite and Obagi would close instantaneously. 12" diameter pipeline, 2km long. Loss of entire volume extremely unlikely if not impossible due to topography.

Offshore – Onne Site

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
33.	Onne Logistics Base / Mud Plant.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, damage to oil storage etc.	Diesel, utility oil, hydraulic oil, base oil (EDC 99-DW) or oil based mud containing up to 60% base oil.	Volumes will be small, <1m^3.	In an inspection shed, lube oil store, warehouse, pipe yard, bunded area or quayside. Possible release into dock.	Likely to occur during routine operations for example maintenance, handling oils, handling drums, transferring oil, loading operations etc. Retention pits / closed drain systems will contain any spill.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
34.	Mud Plant.	Loss of a storage tank.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion.	Oil based mud containing up to 60% base oil (EDC 99-DW) or neat base oil.	Maximum tank volume is 340m^3.	Within the mud plant, in a bunded area. If bund damaged as part of the emergency, spill will enter drain system, with worse case being released into the dock.	Largest single base oil inventory on site is 340m^3. The two mixing tanks are ~60m^3.
35.	Mud Plant.	Loss during transfer.	Flange failure, human error, hose being run over and ruptured, lack of maintenance.	Oil based mud containing up to 60% base oil (EDC 99-DW).	<1m^3 assuming loading operation stopped almost instantly.	Quayside, with oil based mud reaching the water.	Hoses are laid on quayside to vessel, thus at risk of being run over / damaged. Hose is approximately 120m long and 4" diameter. Static volume 1m^3, shut down is manual but should be almost instantaneous as operators constantly visually monitor line.

Offshore – OML99

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
36.	Any platform.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, damage to oil storage etc.	Condensate, diesel, utility oil or hydraulic oil.	Volumes will be small, <1m^3.	Likely to occur on deck and contained, for example in a skid. Unlikely to reach the sea.	Likely to occur during routine operations for example maintenance, handling oils, pigging, etc.
37.	Drilling platform; AMD1 or AMD2.	Blowout.	Equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Condensate.	As an indication of possible release rates, the well for each drilling platform with the maximum liquid delivery potential is; AMD2 15,000bpd and AMD1 8,000bpd.	Subsea. Possible shoreline impact may result.	Greater chance of a blowout during drilling as opposed to normal production operations. Length of release depends on success of shut-down systems.
38.	Bridge between	Full rupture of pipeline.	Large scale vessel collision, process	Condensate.	Static volume of largest pipeline (high pressure	Any point along the 162m bridge. Release to the sea inevitable.	High pressure separator pipeline from AMD2 to AMD1 is 82m long and 16"

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
	AMP1, AMD1 and AMD2.		malfunction, corrosion, lack of maintenance wider emergency such as an explosion or blowout.		separator) is 10.6m^3. Medium pressure pipeline 23m^3 and test separator pipeline 23m^3.		diameter, and from AMD1 to AMP1 is 80m at 24”. ESDVs would initiate instantaneously.
39.	Any platform.	Minor release from a flowline / process unit.	Corrosion, lack of maintenance, operating error, valve failure.	Condensate and water (worse case; 100% condensate).	Loss likely to be less than 1m^3.	Likely to be caught in a skid, or on deck. May be released to sea.	If undetected, chronic pollution may occur.
40.	Any platform.	Major release from a flowline / process unit.	Process failure, human error, wider emergency, large scale vessel collision.	Condensate and water (worse case; 100% condensate).	Largest volume of a single unit is the separator on AMP1; 167m^3	Release to the sea.	Depending on the exact release source, volume of crude will vary. Shut down would initiate instantaneously.
41.	AMP1	Produced water malfunction.	Process failure.	Condensate sheen.	Minor release most likely, no more than 1m^3.	Release to the sea.	Oil lost with produced water discharge.
42.	AMT2	Flare carry over.	Process malfunction.	Condensate sheen.	No more than 1m^3.	Release to the sea.	
43.	AMP1 or AMQ	Loss of diesel storage tank.	Human error, corrosion, lack of maintenance wider emergency.	Diesel.	Diesel storage tank on AMP1 toal is 408m^3. AMQ diesel tank is 22m^3.	Release to the sea.	Worse case would be loss of inventory to sea.
44.	Subsea pipeline to ODP1 (OML100)	Rupture.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement.	Condensate.	Static volume of pipeline 4,500m^3.	Subsea, with plume eventually reaching the sea surface.	Shut down valves present at AMP1 and ODP1 (OML100) that would initiate instantaneously. Loss of entire volume extremely unlikely due to pressure of seawater. Pipeline is 35km long, 16” diameter.

Offshore – OML102

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
45.	Any platform.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, damage to oil storage etc	Crude, diesel, utility oil or hydraulic oil.	Volumes will be small, <1m^3.	Likely to occur on deck and contained, for example in a skid. Unlikely to reach the sea.	Likely to occur during routine operations for example maintenance, handling oils, pigging, etc.
46.	Drilling platform; OFD1 or OFD2.	Blowout.	Equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Crude.	As an indication of possible release rates, the well for each drilling platform with the maximum liquid delivery potential is; OFD1 4,314bpd and OFD2 3,521bpd.	Subsea. Possible shoreline impact may result.	Greater chance of a blowout during drilling as opposed to normal production operations. Length of release depends on success of shut-down systems.
47.	Bridge between OFD1 and OFP1.	Full rupture of pipeline.	Larger scale vessel collision, process malfunction, corrosion, lack of maintenance wider emergency such as an explosion or blowout.	Crude.	Static volume of pipeline is 7.8m^3.	Any point along the bridge. Release to the sea inevitable.	Bridge oil pipeline is 16” diameter, 60m long. ESDVs would initiate instantaneously.
48.	Subsea pipeline between OFD2 and OFP1.	Full rupture of pipeline.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement. Highly unlikely.	Crude.	Entire static volume of pipeline could be lost; 254m^3 however extremely unlikely due to pressure of seawater.	Subsea, with oil surfacing in the vicinity.	Shut down valves present at OFD2 and OFP1 that would initiate instantaneously. 5km long, 10” diameter.
49.	Any platform.	Minor release from a flowline / process unit.	Corrosion, lack of maintenance, operating error, valve failure.	Crude and water (worse case; 100% crude).	Loss likely to be less than 1m^3.	Likely to be caught in a skid, or on deck. May be released to sea.	If undetected, chronic pollution may occur.
50.	Any	Major	Process failure, human	Crude and water	Largest volume of a single	Release to the sea.	Depending on the exact release

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
	platform.	release from a flowline / process unit.	error, wider emergency, large scale vessel collision.	(worse case; 100% crude).	unit is the separator on OFP1; 46.9m^3		source, volume of crude will vary. Shut down would initiate instantaneously.
51.	OFP1.	Flare carry over.	Process malfunction.	Crude sheen.	No more than 1m^3.	Release to the sea.	
52.	OFP1.	Loss of diesel storage tank.	Human error, corrosion, lack of maintenance wider emergency.	Diesel.	Diesel storage tank on OFP1 is 50m^3.	Release to the sea.	Worse case would be loss of inventory to sea.
53.	Subsea pipeline between OFP1 and ODP1 (OML100).	Rupture.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement.	Crude.	Static volume of pipeline 2993m^3.	Subsea, with plume eventually reaching the sea surface.	Shut down valves present at OFP1 and ODP1 (OML100) that would initiate instantaneously. Loss of entire volume extremely unlikely due to pressure of seawater. Pipeline is 41km long, 12” diameter.

Offshore – OML100

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
54.	Any platform.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, damage to oil storage etc.	Crude, diesel, utility oil or hydraulic oil.	Volumes will be small, <1m^3.	Likely to occur on deck and contained, for example in a skid. Unlikely to reach the sea.	Likely to occur during routine operations for example maintenance, handling oils, pigging, etc.
55.	Drilling platform; ODD1, AFD1, IMD1, EDD1.	Blowout.	Equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Crude.	As an indication of possible release rates, the well for each drilling platform with the maximum liquid delivery potential is; ODD1 1,500bpd; EDD1 4,400bpd; AFD1 4,240bpd and IMD1 3,850bpd.	Subsea. Possible shoreline impact may result.	Greater chance of a blowout during drilling as opposed to normal production operations. Length of release depends on success of shut-down systems.
56.	Subsea pipelines between ODP1 and either EDD1, AFD1 or IMD1.	Full rupture of pipeline.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement. Highly unlikely.	Crude.	Entire static volume of pipeline could be lost, however extremely unlikely due to pressure of seawater: ODP1 to EDD1 – 295m^3; ODP1 to AFD1 – 116m^3; ODP1 to IMD1 – 118m^3.	Subsea, with oil surfacing in the vicinity.	Shut down valves present at ODP1 manifolds and respective drilling platforms that would initiate instantaneously.
57.	Bridge pipeline between ODP1 and ODD1.	Full rupture of pipeline.	Larger scale vessel collision, process malfunction, corrosion, lack of maintenance wider emergency such as an explosion or blowout.	Crude.	Static volume of pipeline is 1.1m^3.	Any point along the bridge. Release to the sea inevitable.	Bridge oil pipeline is 8” diameter, 35m long. ESDVs would initiate instantaneously.
58.	Any platform.	Minor release	Corrosion, lack of maintenance, operating	Crude and water (worse case; 100%	Loss likely to be less than 1m^3.	Likely to be caught in a skid, or on deck. May be released to sea.	If undetected, chronic pollution may occur.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
		from a flowline / process unit.	error, valve failure.	crude).			
59.	Any platform.	Major release from a flowline / process unit.	Process failure, human error, wider emergency, large scale vessel collision.	Crude and water (worse case; 100% crude).	Largest volume of a single unit is the separator on ODP1; 66m^3.	Release to the sea.	Depending on the exact release source, volume of crude will vary. Shut down would initiate instantaneously.
60.	AFD1, IMD1, EDD1 and ODP1	Flare carry over.	Process malfunction.	Crude sheen.	No more than 1m^3.	Release to the sea.	
61.	ODP1	Loss of diesel storage tank.	Human error, corrosion, lack of maintenance wider emergency.	Diesel.	Diesel storage tank on ODP1 is 20m^3.	Release to the sea.	Worse case would be loss of inventory to sea.
62.	Subsea pipeline between ODP1 and *FSO Unity*.	Rupture.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement.	Crude.	Static volume of pipeline 788m^3.	Subsea, with plume eventually reaching the sea surface.	Shut down valves present at ODP1 and *FSO Unity* turret that would initiate instantaneously. Loss of entire volume extremely unlikely due to pressure of seawater. Pipeline is 2.7km long, 24” diameter.

Offshore – *FSO Unity* and CALM Buoy

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
63.	*FSO Unity* or CALM Buoy.	Minor operational spill.	Causes likely to include human error, incorrect use of equipment, equipment failing, damage to oil storage etc.	Crude, diesel, utility oil or hydraulic oil.	Volumes will be small, <$1m^3$.	Likely to occur on deck and contained, for example in a skid. Unlikely to reach the sea.	Likely to occur during routine operations for example maintenance, handling oils, pigging, etc.
64.	Any platform.	Minor release from a flowline / process unit.	Corrosion, lack of maintenance, operating error, valve failure.	Crude and water (worse case; 100% crude).	Loss likely to be less than $1m^3$.	Likely to be caught in a skid, or on deck. May be released to sea.	If undetected, chronic pollution may occur.
65.	*FSO Unity.*	Major release from a flowline / process unit.	Process failure, human error, wider emergency, large scale vessel collision.	Crude and water (worse case; 100% crude).	Less than $10m^3$.	Release to the sea.	Depending on the exact release source, volume of crude will vary. Shut down would initiate instantaneously.
66.	*FSO Unity.*	Produced water malfunction.	Process failure.	Condensate sheen.	Minor release most likely, no more than $1m^3$.	Release to the sea.	Oil lost with produced water discharge.
67.	*FSO Unity.*	Tanker collision.	Engine room failure, human error, terrorism.	Diesel.	Loss of one of the *FSO Unity* forward diesel storage tanks. The tank with the largest capacity is $2,581.4m^3$.	Release to the sea.	Tanker could be a passing vessel or one that is to be loaded.
68.	*FSO Unity.*	Tanker collision.	Engine room failure, human error, terrorism.	Crude.	Loss of a crude wing tank. Tanks either of a capacity of $20,587.7m^3$ or $29,409.8m^3$.	Release to the sea.	Tanker could be a passing vessel or one that is to be loaded. Loss of cargo or bunkers from the tanker could also occur. Tankers are usually 2,000,000bbl dead weight.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
69.	*FSO Unity.*	Tanker collision.	Engine room failure, human error, terrorism.	Crude.	Collision resulting in the loss of *FSO Unity*. Total crude capacity (98%) that could be lost is 384,497.12m^3. Diesel capacity (98%) is 5,059.54m^3. Figures represent absolute worse case.	Release to the sea. Shoreline impact probable.	Tanker could be a passing vessel or one that is to be loaded. Loss of cargo or bunkers from the tanker could also occur. Tankers are usually 2,000,000bbl dead weight. Extremely unlikely.
70.	Subsea pipeline between CALM Buoy and *FSO Unity*.	Full rupture.	Full rupture as a result of anchor dragging, over pressure, corrosion or sea bed movement.	Crude.	Static volume of pipeline 583m^3.	Subsea, with plume eventually reaching the sea surface.	Shut down of loading operations would initiate instantaneously. Loss of entire volume extremely unlikely due to pressure of seawater. 24” diameter, 2km long.
71.	CALM Buoy.	Loss from surge tanks.	Human error or system malfunction.	Crude.	Volume lost may range from ~1m^3 to a few m^{3}s.	Release to the sea.	Surge tanks should contain majority of crude but may be overwhelmed.
72.	FSO Unity / CALM Buoy.	Floating hose string failure.	Vessel collision, flange failure, loss during connection / disconnection.	Crude.	Maximum volume for *FSO Unity* hose strings 101.06m^3 and for CALM hose strings, 98m^3.	Release to the sea.	Minor spills most likely, that would occur during hose connection / disconnection.

Offshore – At-sea

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release	Comments
73.	Supply vessel / tug / surfer / jack-up rig.	Small operational spill.	Human error, equipment failure, extreme sea state.	Oil type may range; diesel, utility oils, oil based mud (up to 60% EDC 99-DW), contaminated drill cuttings, etc.	<1m^3.	Deck spill. Unlikely to reach the sea.	Onboard sorbents will mitigate the release.
74.	Supply vessel / tug / surfer.	Loss of materials being delivered.	Human error, equipment failure, extreme sea state.	Oil type may range; diesel, utility oils, oil based mud (up to 60% EDC 99-DW), contaminated drill cuttings, etc.	Depends on storage unit lost.	Release to the sea.	Volumes depends on storage units; barrel, IBC, skip, vessel cargo tanks, etc.
75.	Supply vessel / tug.	Major collision.	Human error, engine failure.	Bunkers and any cargo.	Depending on vessel size volume may be ~1,000m^3 as a maximum. Inventory of cargo may be lost.	Release to the sea.	Collision with platform or another vessel resulting in the loss of the supply vessel and release of bunkers. Search and rescue for personnel may take precedence over oil spill response.
76.	Surfer.	Major collision.	Human error, engine failure.	Diesel.	Around 6.5m^3	Release to the sea.	Exact maximum volume depends on vessel.
77.	Jack-up drilling rig.	Loss of diesel storage volume.	Human error, vessel colliding at speed, lack of maintenance, wider emergency such as an explosion.	Diesel.	Up to 300m^3	Release to the sea, either on route to the drilling location or in the vicinity of a platform.	Maximum volume varies depending on which jack-up rig is used, but inventories ranged between 250 – 300m^3 maximum.
78.	Jack-up drilling rig.	Loss of oil based mud.	Human error, vessel colliding at speed, lack of maintenance, wider emergency such as an explosion.	Oil based mud containing up to 60% base oil (EDC 99-DW).	1,680m^3	Release to the sea, either on route to the drilling location or in the vicinity of a platform.	Max inventory of oil based mud around 8,200bbl, which is stored in 1,000bbl or 1,200bbl tanks.
79.	Helicopter.	Loss of a helicopter	Incident most likely to occur during landing / takeoff at an offshore facility.	Avgas.	Around 1.2m^3.	Release to the sea.	If helicopter collides with a platform, loss of oil may occur. (Search and rescue for personnel would take precedence over oil spill response.)

6.10.3. Onshore and Offshore Risk Assessment Matrices

The risk assessment matrices show the overall oil spill risk profile for the onshore and offshore TEPNG operations. Each individual oil spill scenario that has been identified in section 6.10.2 can be rated in terms of frequency of occurrence and severity / consequence. For each oil spill scenario, the probability and consequence can be qualitatively estimated using TotalEnergies Group definitions as in the tables below, and plotted on the corresponding risk assessment matrix, thus allowing the overall risk profile to be seen. By understanding the operations, the environmental setting and the risk profile, suitable response capabilities can be justifiably designed and established.

Level of Severity	1-Minor	2-Moderate	3-Serious	4-Very Serious	5-Catastrophic	6-Disastrous
Consequence's Definition	Minor spill with no environmental impact	Minor pollution with a very limited environmental impact	Moderate pollution with limited environmental consequences	Pollution having significant environmental consequences	Large-scale pollution of ecosystems having a recognized ecological value	Pollution having massive and durable consequences for vast ecosystems having a high ecological value
Volume of Spill released to environment (in barrels) – *volumes are 'indicative only', see note below for further details*						
Offshore Area (>22km/12nm from coastline)	0<volume<1	1 – 10 (***45, 48, 50, 51, 54, 58, 60, 63, 66, 67, 69, 72, 73, 75, 80, 82, 83, 88***)	10 – 1000 (***47, 56, 59, 61, 68, 70, 74, 81, 85***)	1 000 - 20 000 (***46, 49,52, 53, 57, 62, 65, 71, 76, 79, 84, 86, 87***)	20 000 - 200 000 (***55, 64, 77***)	>200 000 (***46, 78***)
Coastal Area (<22km/12nm from coastline) or **Offshore/Onshore Fragile Area** (with sensitive ecological receptors)	0<volume<0.1	0.1 - 1 (**42, 44**)	1 - 10	10 - 200	200 - 2 000 (**43**)	>2 000
Onshore Area (without sensitive ecological receptors)	0<volume<1 (**7, 17**)	1 – 10 (**6, 8, 14, 15, 18, 22, 23, 25, 27, 31, 33, 34, 38, 39, 40,**)	10 – 100 (**2, 3, 9, 12, 19, 28, 29, 35, 36**)	100 – 2 000 (**4, 5, 10, 13, 16, 20, 21, 24, 30, 32, 41**)	2 000 - 20 000 (**1, 11, 26, 37**)	>20 000
Environmental – Socio-economic Consequences	None measurable/ No impact on nearby communities	None measurable (offshore) / Very limited on environment and local activities (onshore), nearby communities alerted	Very limited (offshore) / Limited on environment and local activities (onshore), <10 people impacted from nearby community	Limited (offshore) / Significant (onshore) <100 people impacted, or evacuation <10 people	Potentially significant (offshore) / Major impact of one or more years (onshore), >100 people in community impacted, >10 people evacuated	Potentially significant (offshore) / Massive and geographically extended, impact of several years

Initial classification of consequence severity of actual or potential incident should be undertaken using indicative volume of spill/material release, sensitivity of the environment, and level of response resources required. Worst applicable case is selected for the ranking.

Frequency Category	Explanation	Frequency Range
Very Likely	Expected to occur several times during plant lifetime	Above 10^{-1}
Likely	Could occur several times during and over plant lifetime	10^{-1} - 10^{-2}
Unlikely	Could occur once for every 10 t0 20 similar plants over 20 to 30 years of plant lifetime	10^{-2} - 10^{-3}
Very Unlikely	One time per year for at least 1000 units. One time for every 100 to 200 similar plats in the world over 20 to 30 years of plant lifetime. Has already occurred in the COMPANY but corrective action has been taken	10^{-3} - 10^{-4}
Extremely Unlikely	Has already occurred in the industry but corrective action has been taken	10^{-4}- 10^{-5}
Remote	Possible event for the whole oil and gas industry	Below 10^{-5}

Damages Frequency Categories (from Technological Risk Assessment Methodology, GS EP SAF 041, January 2012)

Table: Severity matrix

Level of severity	Areas of consequences				
	Human	**Environmental**	**Material**	**Production shortfall**	**Media**
1-Minor	First aid or medical treatment or restricted work days	Minor spill with no environmental impact	< 20 k€	<2 kboe	Local rumour or no media consequence
2-Moderate	Single lost-time injury (LTI) with no permanent disability	Minor pollution with a very limited environmental impact	20 k€ < ... < 200 k€	2 kboe < ... < 20 kboe	Local media[1] Comments on local or national media website Factual information on social media (Facebook, Twitter, discussion forums, etc.) in the country's language(s)
3-Serious	Single lost-time injury (LTI) with permanent disability or multiple lost-time injuries	Moderate pollution with limited environmental consequences	200 k€ < ... < 2 000 k€	20 kboe< ... < 200 kboe	News briefs in the national media + press agency dispatches Negative comments on social media and/or input from national influencers[2] in the country's language(s) or Company's official languages[3]
4-Very serious	Internal: Single Fatality and/or several permanent disabilities Public: Permanent disabilities	Pollution having significant environmental consequences	2,000 k€ < ... < 10 000 k€	200 kboe< ... < 1 Mboe	Reported in the national media Very numerous negative comments on social media and/or input from national influencers in the country's language(s) of the country or Company's official languages
5-Catastrophic	Internal: 2 to 5 Fatalities Public: 1 Fatality	Large-scale pollution of ecosystems having a recognized ecological value	10 000 k€< ... < 100 000 k€	1 Mboe< ... < 10 Mboe	Reported in the international media Negative comments on social media and/or input from international influencers The event is used by political, NGO or other public figures, followed by negative trending
6-Disastrous	Internal: >5 Fatalities Public: >1 Fatality	Pollution having massive and durable consequences for ecosystems having a high ecological value	> 100 000 k€ >10 Mboevast		Reported in the international media for a prolonged period Negative comments on social media and/or input from international influencers The event is used by political, NGO or other public figures, followed by negative trending.

Print media, radio, TV. [2] Influencers: people with more than 5,000 followers on Facebook or Twitter, [3] English and French, The severity matrix are **based** on the Universal Risk Matrix detailed in the CR EP HSE 001.

Risk Assessment Matrix Conclusions

As with all oil spill handling operations, there is an inherent risk that oil may be spilled. TEPNG takes various preventive measures to minimise the likelihood of a release and also has in place mitigative measures to minimise any impact. The risk assessment matrices show that there are only three “high risk” scenarios, all of which are a result of factors beyond TEPNG’s control; sabotage. Scenario 16, Obagi-Rumuekpe Export Line rupture, is a high risk. This is because its rupture would cause a stop in export operations for a period greater than a month. As a result it has to be considered a ‘catastrophic’ event. Due the number of attacks on the line, the scenario has to be considered as ‘frequent’. Scenarios 24 and 41, Obite-Obagi Pipeline rupture and Olo-Odhiaje tie-in point pipeline rupture respectively, would not stop production operations, hence the lower severity rating compared to Scenario 16. They have a lower frequency rating as well, as the lines have not yet been sabotaged to the point of rupture. Scenario 32, Ibewa-Obite Pipeline rupture, has a lower frequency than Scenarios 24 and 41 as the pipeline is short in length and between two TEPNG facilities; i.e. it is likely any attack would be spotted and apprehended. There are no “high risk” operations offshore.

6.10.4. Offshore Oil Spill Modelling

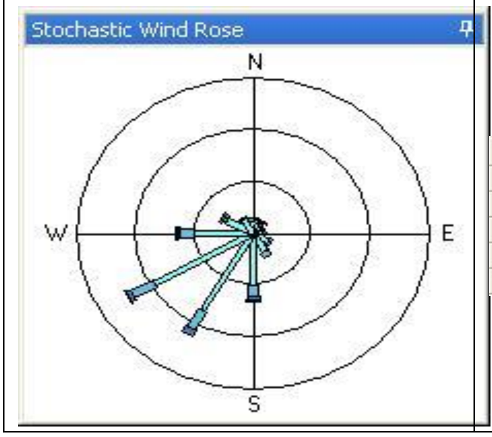
Oil spill modelling has been conducted to predict where impact may occur for certain scenarios identified in the risk assessment. The model programme used was the Oil Spill Information System (OSIS). OSIS was developed by BMT Cordah Ltd and is a fully validated and calibrated oil spill model based upon extensive research conducted by Warren Spring Laboratories and subsequently AEA Technology plc. Its weathering model has been validated against controlled actual spills at sea and real spill events supported with laboratory calibration. OSIS is widely held and used by major oil companies, governments and response organisations around the world. The modelling results are to be used for guidance purposes only. Model outputs should not be based solely on modelling results. As with any other model, results are dependent on the quality of the environmental parameters and scenario inputs used.

Stochastic and trajectory modelling has been conducted for each chosen scenario. Stochastic modelling simulations predict probable behaviour of potential oil spills under historical meteorological and oceanographic conditions expected to occur offshore Nigeria. Trajectory modelling is a deterministic approach used to predict the movement of an oil spill on the sea surface, based on a single set of meteorological and oceanographic conditions. It predicts the fate and effects of oil spilled on the water and the time it takes for oil to beach. The worst case wind direction and speed was taken from the stochastic modelling and used to generate an absolute worst case situation. All the modelling results are illustrative only and assume that no intervention has been undertaken.

Modelling Parameters

Modelling has been undertaken for the wet season, from April to October, and the dry season, from November to March. Historical wind records that detail the frequency of wind speed and wind direction were taken from the Africa Pilot Volume 1, United Kingdom Hydrographic Office, 14th Edition, 2006. The wind roses used for the wet and dry season stochastic models are shown below:

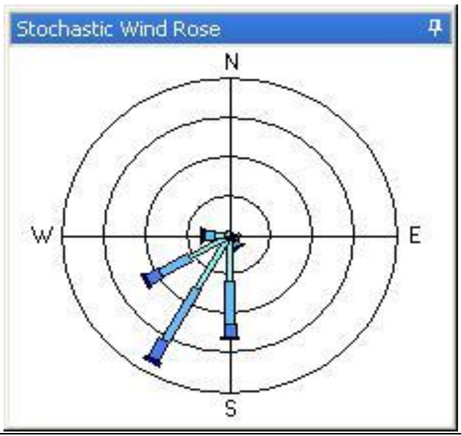
January Wind Data – Dry Season



Key

	Speed (kts)	Colour
0	10.000	
1	16.000	
2	27.000	
3	33.000	
4	64.000	

July Wind Data – Wet Season



Wind data for Offshore Nigeria, taken from the Africa Pilot Volume 1, United Kingdom Hydrographic Office, 14th Edition, 2006.

The wind data for the trajectory modelling was taken from these wind roses also, with the worst case wind speed being used for each season. The wind direction was orientated towards the nearest land. This assumes absolutely worse case where there is a consistent Force 7 for the dry season and a Force 12 for the wet season persistently blowing to shore for the duration of model.

Air and sea temperatures will vary depending on the season. During the wet season average air temperatures are in the region of ~23°C and for the dry season ~28°C, according to various Environmental Impact Assessments that have been conducted for the TEPNG facilities. Average sea surface temperatures for the dry season are 28°C and for the wet season 26°C, according to the Africa Pilot Volume 1.

The hydrodynamic data used reflects the current systems found in the Nigeria offshore region and was developed by the National Oceanographic Data Centre (NODC) with a resolution of 1 degree.

Scenarios Modelled

Out of all the oil spill scenarios identified for TEPNG's offshore operations a number have been selected and modelled. The worst-case crude scenario has been selected for each field and for the *FSO Unity*. The worse case diesel scenario has also been selected to give an indication of the likely behaviour and fate of a diesel spill. The scenarios modelled are detailed below:

Scenario	Release[1]	
4 – Uncontrolled blowout	OML99, AMD2	15,000bpd (net oil delivery potential) for 10 days[2]
18 – Uncontrolled blowout	OML102, OFD1	4,055bpd (net oil delivery potential) for 10 days[2]
33 – Uncontrolled blowout	OML100, EDD1	2,850bpd (net oil delivery potential) for 10 days[2]
54 – Loss of *FSO Unity*	OMl100, *FSO Unity*	384,497.12m^3 over 24 hours
12 – Loss of diesel storage tank	OML99, AMP1	408m^3 diesel over 2 hours

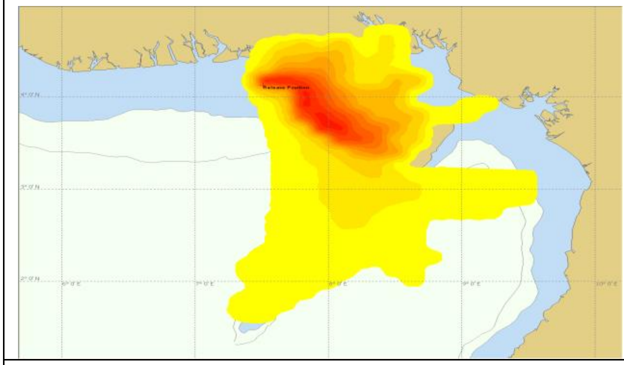
[1] Representative crudes from the OSIS Oil Database, that offer the closest match to the TEPNG crude properties, were used for the modelling

[2] 10 days taken as an arbitrary figure until well brought under control

Modelling Results # 4 – OML99, AMD2 – Uncontrolled Blowout

DRY

Stochastic Result



Trajectory Result

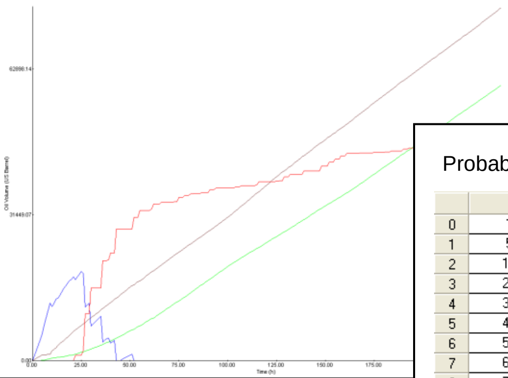
Evaporated volume: 76,137bbl / 12,005.34m^3

Dispersed volume: 59,434bbl / 9,448.54m^3

Time till beaching: 22 hours

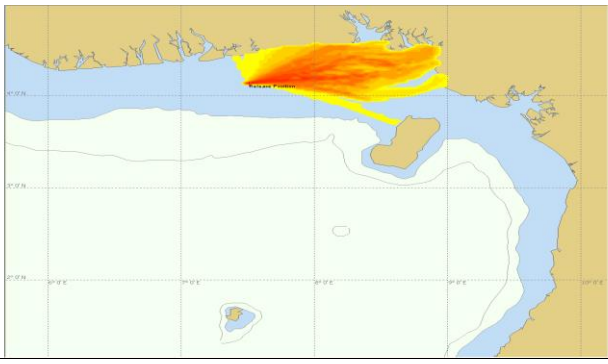
Volume beached: 48,089bbl / 7,979.9m^3

Trajectory Mass Balance



WET

Stochastic Result



Trajectory Result

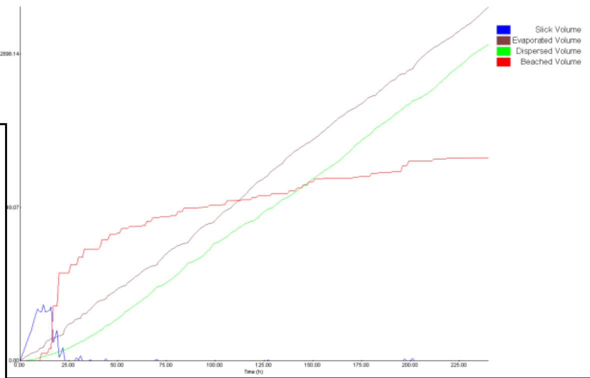
Evaporated volume: 72,589bbl / 11,620.69m^3

Dispersed volume: 64,923bbl / 10,327.93m^3

Time till beaching: 11 hours

Volume beached: 41,624bbl / 6,331.54m^3

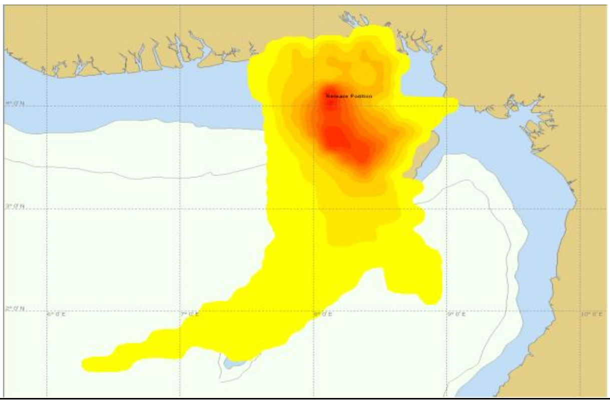
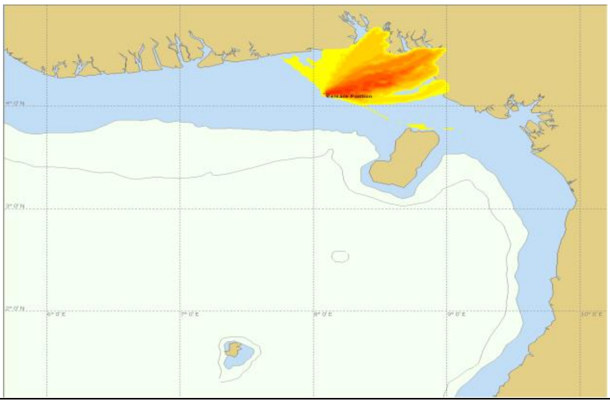
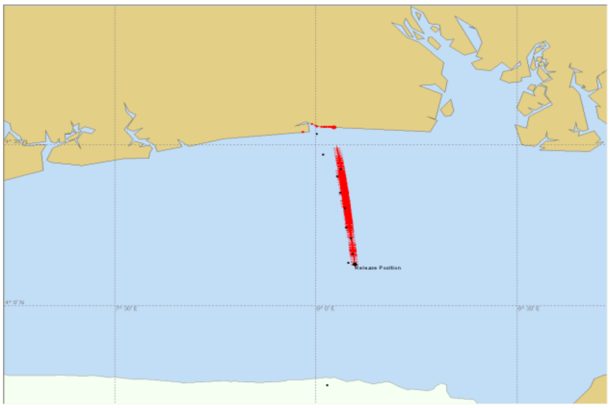
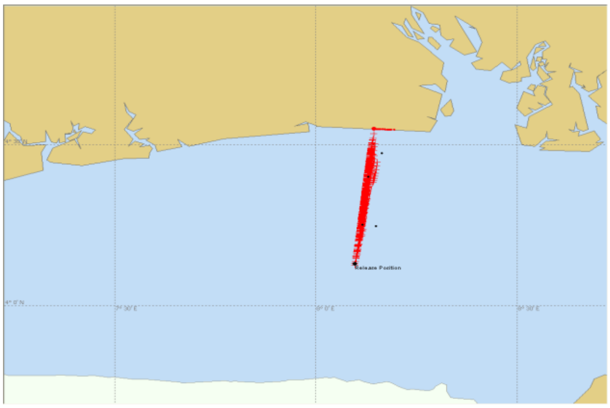
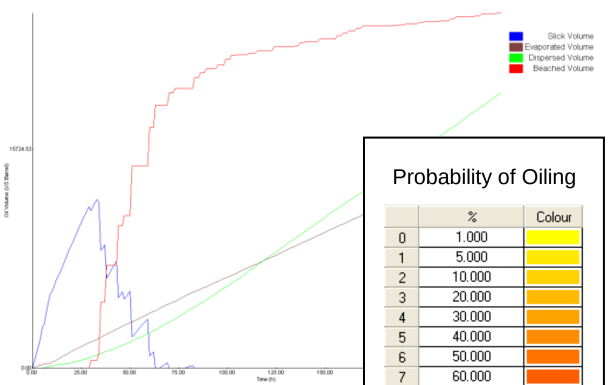
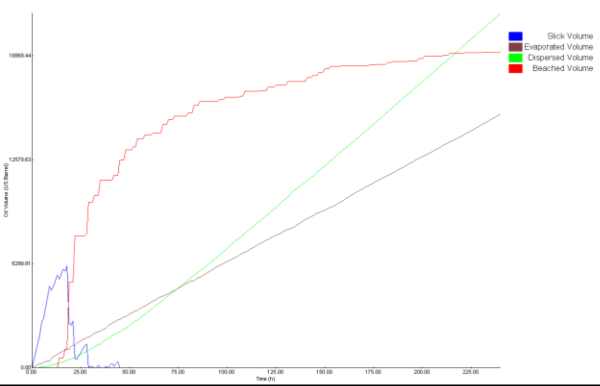
Trajectory Mass Balance



Probability of Oiling

	%	Colour
0	1.000	
1	5.000	
2	10.000	
3	20.000	
4	30.000	
5	40.000	
6	50.000	
7	60.000	
8	70.000	
9	80.000	
10	90.000	
11	100.000	

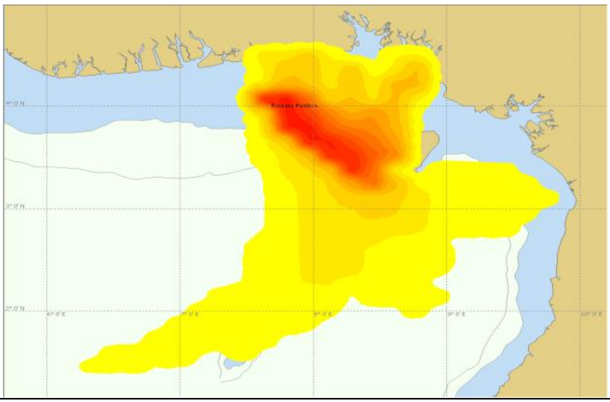
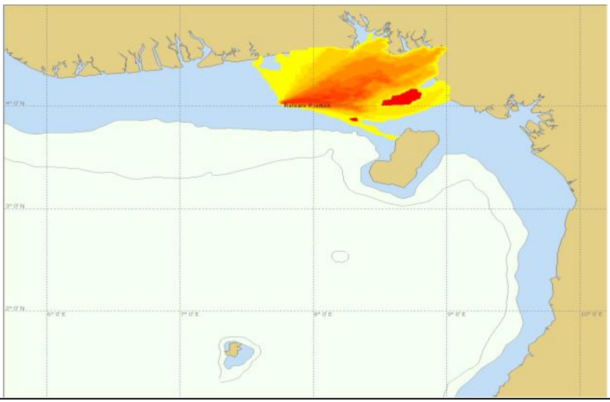
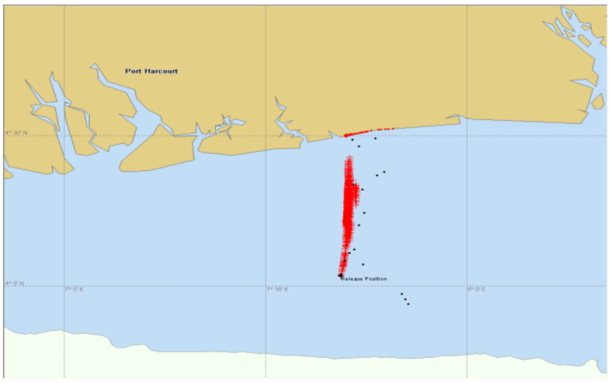
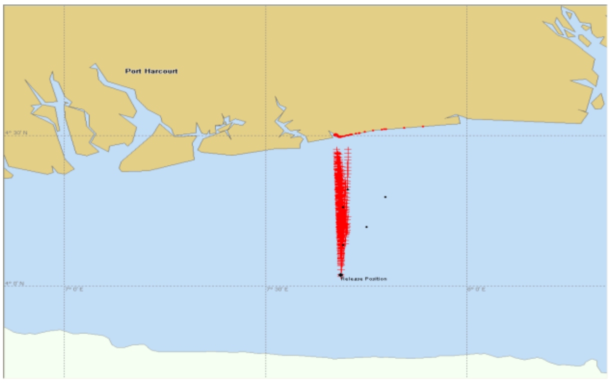
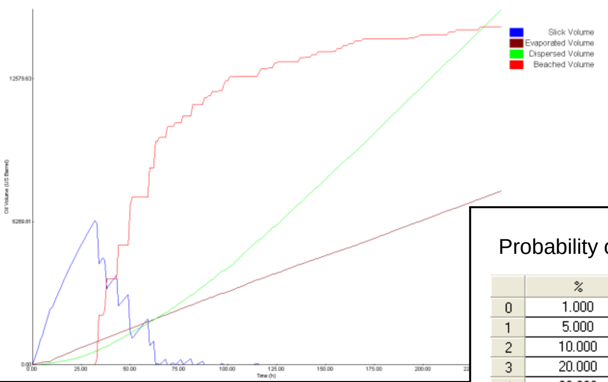
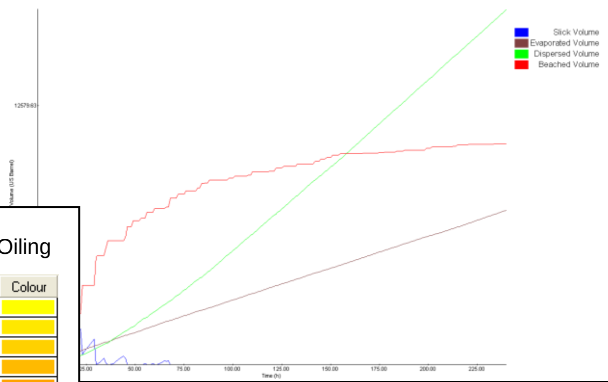
Modelling Results # 18 – OML102, OFD1 – Uncontrolled Blowout

DRY	WET
Stochastic Result 	Stochastic Result 
Trajectory Result  Evaporated volume: 15,673bbl / 2,491.91m^3 Dispersed volume: 19,770bbl / 3,143.22m^3 Time till beaching: 30 hours Volume beached: 25,452bbl / 4,046.65m^3	Trajectory Result  Evaporated volume: 15,322bbl / 2,436.13m^3 Dispersed volume: 21,413bbl / 3,404.48m^3 Time till beaching: 14 hours Volume beached: 19,058bbl / 3,030.00m^3
Trajectory Mass Balance 	Trajectory Mass Balance 

Probability of Oiling

	%	Colour
0	1.000	
1	5.000	
2	10.000	
3	20.000	
4	30.000	
5	40.000	
6	50.000	
7	60.000	
8	70.000	
9	80.000	
10	90.000	
11	100.000	

Modelling Results # 33 – OM… …ntrolled Blowout

DRY	**WET**
Stochastic Result 	Stochastic Result 
Trajectory Result  Evaporated volume: 7,651bbl / 1,216.43m^3 Dispersed volume: 15,628bbl / 2,484.74m^3 Time till beaching: 33 hours Volume beached: 14,872bbl / 2,364.49m^3	Trajectory Result  Evaporated volume: 7,500bbl / 1,192.44m^3 Dispersed volume: 17,248bbl / 2,742.35m^3 Time till beaching: 16 hours Volume beached: 10,720bbl / 1,704.41m^3
Trajectory Mass Balance 	Trajectory Mass Balance 

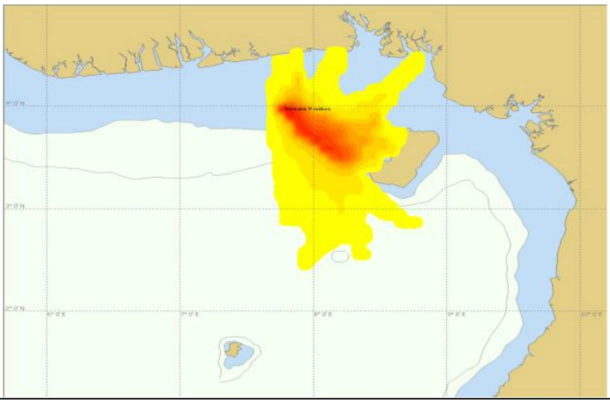
Probability of Oiling

	%	Colour
0	1.000	
1	5.000	
2	10.000	
3	20.000	
4	30.000	
5	40.000	
6	50.000	
7	60.000	
8	70.000	
9	80.000	
10	90.000	
11	100.000	

Modelling Results # 54 – OMI100, *FSO Unity* – Loss of *FSO Unity*

DRY

Stochastic Result



Trajectory Result

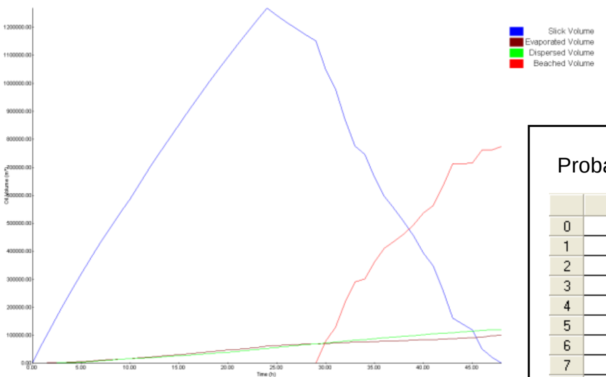
Evaporated volume: 626,624.6bbl / 99,625m^3

Dispersed volume: 755,010bbl /120,037m^3

Time till beaching: 30 hours

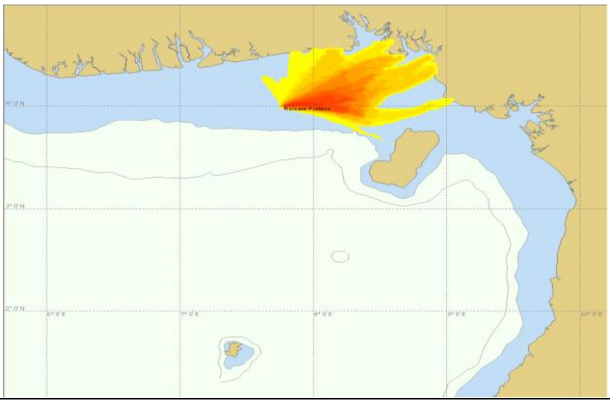
Volume beached: 4,867,505bbl / 773,387m^3

Trajectory Mass Balance

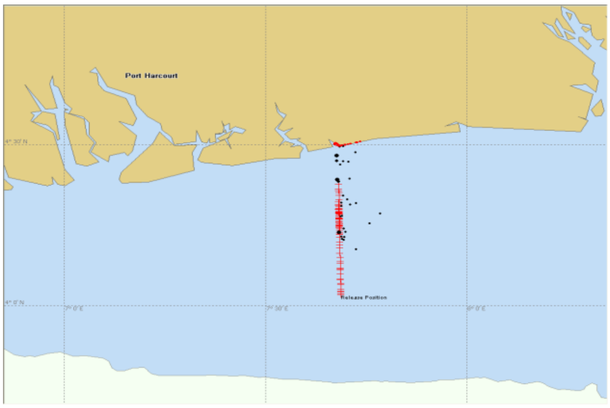


WET

Stochastic Result



Trajectory Result



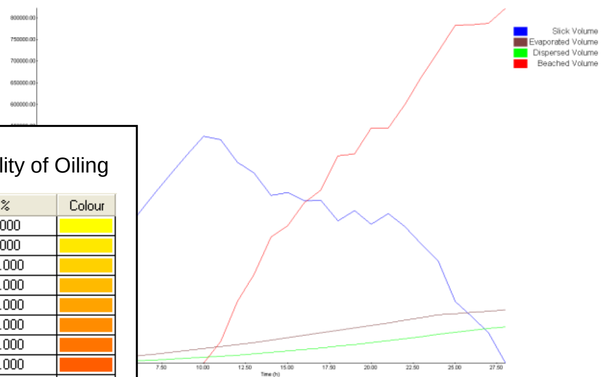
Evaporated volume: 783,438.9bbl / 124,556m^3

Dispersed volume: 533,447.8bbl / 84,811m^3

Time till beaching: 11 hours

Volume beached: 5,171,488bbl / 822,200m^3

Trajectory Mass Balance



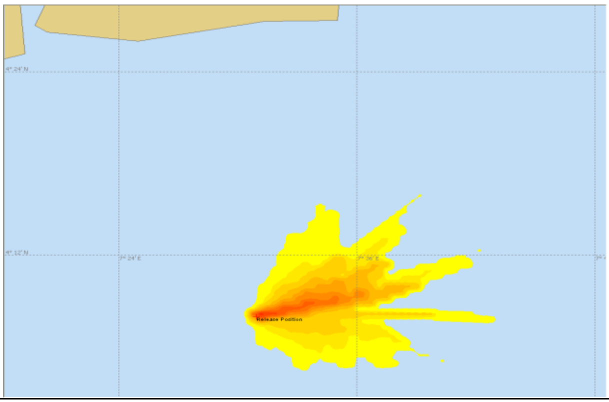
Probability of Oiling

	%	Colour
0	1.000	
1	5.000	
2	10.000	
3	20.000	
4	30.000	
5	40.000	
6	50.000	
7	60.000	
8	70.000	
9	80.000	
10	90.000	
11	100.000	

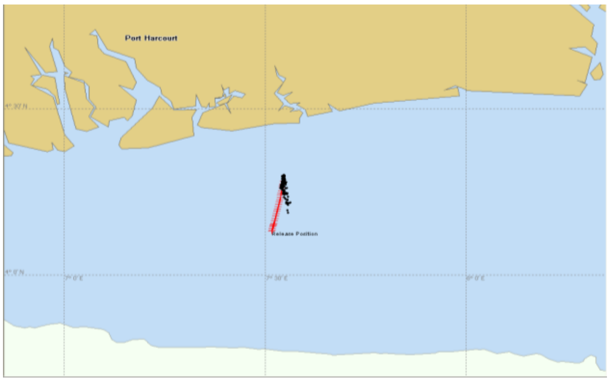
Modelling Results # 12 – OML99, AMP1 – Loss of Diesel Storage Tank

DRY

Stochastic Result



Trajectory Result



Evaporated volume: 1,036.78bbl / 164m^3

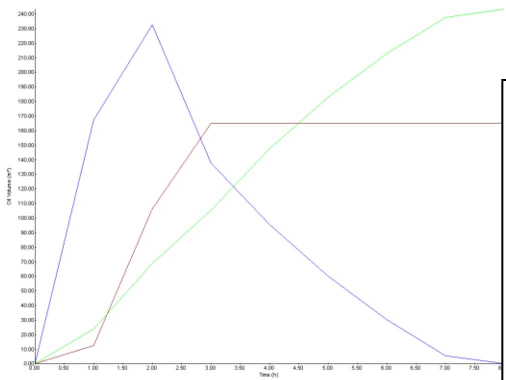
Dispersed volume: 1,529.46bbl / 243m^3

Time till beaching: no beaching

Time till natural dissipation: 8 hours

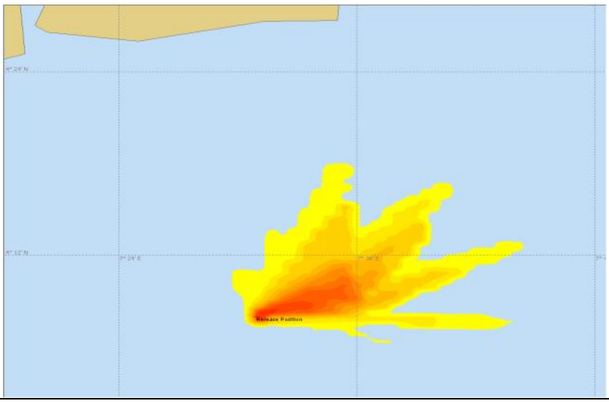
Slick travelled 19km

Trajectory Mass Balance

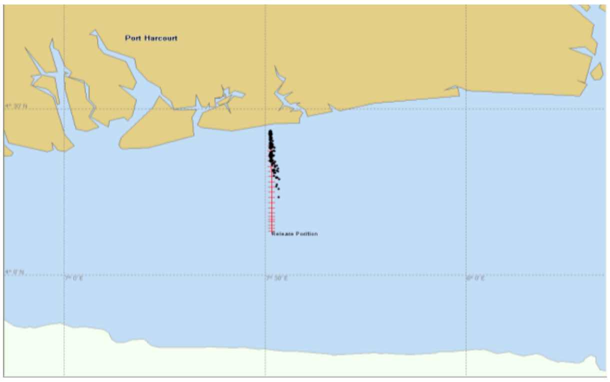


WET

Stochastic Result



Trajectory Result



Evaporated volume: 1,081.03bbl / 171m^3

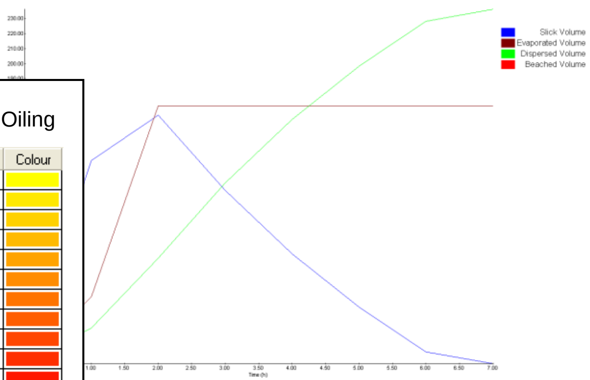
Dispersed volume: 1,485.21bbl / 236m^3

Time till beaching: no beaching

Time till natural dissipation: 7 hours

Slick travelled 35km

Trajectory Mass Balance



Probability of Oiling

	%	Colour
0	1.000	
1	5.000	
2	10.000	
3	20.000	
4	30.000	
5	40.000	
6	50.000	
7	60.000	
8	70.000	
9	80.000	
10	90.000	
11	100.000	

Oil Spill Modelling and Risk Assessment

The stochastic oil spill modelling provides a useful indication of which areas are at risk of oiling in the event of a spill, based on environmental data and oil properties. There is a marked difference between seasons, with the eastern Niger Delta, west Cameroon and the Equatorial Guinea islands of Bioko and Principe being at risk in the dry season, whereas in the wet season Equatorial Guinea is not predicted to be impacted but Nigeria and Cameroon still are. For all dry season crude scenarios there is a clear dominant direction of oil movement to the south east. In contrast, the dominant direction of oil movement in the wet season is to the north east. This corresponds to the wet season wind data showing a greater dominance of strong southwesterlies compared to the dry season.

The crude oil trajectory results show that beaching may occur quicker in the wet season than the dry season. In the dry season, under worse case conditions, shoreline impact may occur within 20 – 35 hours depending on the exact scenario. In the wet season, under worse case conditions, shoreline impact may occur within 10 – 20 hours. These figures are estimated under the assumption that there is a constant worse case wind for the model duration and that no intervention occurs.

The diesel scenario modelling results demonstrates that shoreline impact would not be anticipated, even under worse case conditions. This is due to the properties of diesel where it will naturally dissipate rapidly.

6.11.Response Strategies

6.11.1. Contingency Planning Guiding Principles

TotalEnergies Energies oil spill response strategy has been developed with consideration to the following aspects in line with the reference documents listed in section 3.1 and 3.2 of this document;

- Net Environmental Benefit Analysis
- Tiered preparedness and response framework
- Specific parameters related to TEPNG operations (type of oil produced, local sea and weather conditions & drift prediction, location of operations, presence of environmentally sensitive areas and socio-economic activities) – Sees sections 6.5 to 6.9

Net Environmental Benefit Analysis (NEBA)

The NEBA methodology provides a qualitative approach to determine response strategies which has been used as a standard in the oil and gas industry worldwide*, recognizing that "The aims of oil spill response are to minimize damage to environmental and socioeconomic resources, and to reduce the time for recovery of affected resources by achieving an acceptable standard of cleanliness." (IPIECA Technical guidelines – Volume 10).

The aim of NEBA is to assist response planners and incident commanders in the selection of a response strategy which has been informed by a systematic assessment and evaluation of multiple factors, with input from a number of stakeholders (IPIECA-IOGP 2015). NEBA may be used during pre-spill planning as well as during response operations:

- NEBA has been used for the development of TEPNG OSCP in order to ensure that response strategies for planning scenarios have been well informed.
- During a response, the NEBA process will be to ensure that evolving conditions are taken into consideration, so that the Incident Action Plan (IAP) can be adjusted as necessary to manage individual response actions and end points.

6.11.2. Oil Spill Response Techniques

The following response techniques have been investigated for TEPNG to predict their effectiveness and relative impact modification potential in the context of TEPNG activities and installations.

Onshore response techniques

TECHNIQUES (TE)	CORRESPONDING ACTIONS
#1- ASSESSMENT OF THE OIL SPILL INCIDENT TO	Ascertain the extent of the spill Confirm the nature of the oil spilled Identify the risk of impact of sensitive areas Use of the Shoreline Clean-up assessment technique (SCAT)
#2- PROTECTION OF SENSITIVE AREAS AT RISK THROUGH APPROPRIATE TECHNIQUE	Use of booms to stop the flow of oil into river mouths, Swamps, lagoon, etc.
#3- JOINT INVESTIGATION VISIT (JIV)	This visit must be implemented within 24hrs of spill incident with all relevant stakeholders to Jointly determine cause of incident Volume of oil spilled and nature of impact
#4- CLEAN-UP OPERATIONS	Concentration of oil to areas suitable for oil recovery operations using - booms to concentrate oil slicks floating at river mouths and on the shoreline - booms to divert the oil towards areas where recovery of the oil can be organized - trenches dug in the beach to divert oil into for easier recovery Recovery of bulk accumulations of oil - Use of pumps, skimmers, sorbent materials, etc. on water - Use of earth moving equipment and / or manual techniques on land and on the beaches - Use of low-pressure flushing techniques
#5- TEMPORARY STORAGE OF WASTE ON SITE	Use of temporary storage tanks (Fastanks) - On riverbanks, at suitable identified sites and at the top of the beach - As buffer close to main tracks, before evacuation to main storage site Use of pre-identified storage areas located in the vicinity of accesses to the shoreline in the case of beach clean-up Use of trenches, protected by a lining on land and at top of beaches
#6- TRANSPORT AND DISPOSAL OF WASTE	Use of trucks and vacuum trucks for transportation of oily wastes The final storage of collected oily wastes must be a licensed waste management facility.
#7- SITE RESTORATION	Depending on the nature of the oil spill, long term restoration measures might have to be implemented

Offshore response techniques

TECHNIQUES (TE)	CORRESPONDING ACTIONS
#1- MONITORING AND EVALUATION OF SPILL	Whether moving in an offshore or an onshore direction, all oil slick(s) should be monitored (using vessel and or more preferably helicopter as more efficient) until it can be safely assumed that the oil no longer poses any threat to sensitive areas or offshore installations. Monitoring can be the only response needed in the following cases: - Oil slicks are not threatening any offshore installations or any sensitive areas, in particular in the case of small volumes of oil (a few barrels) being spilled and/or oil slicks drifting in an offshore direction. - The product spilled will evaporate within few hours. - The product spilled can constitute a fire/explosion hazard and will disperse rapidly. In such a case, any work in the hazardous zone must be prevented and, in particular, concentration of the product must be avoided. - ***Note**: The monitoring only option is a valid strategy as per the provisions of the National Oil Spill Contingency Plan.*
#2- TRACKING AND DRIFT PREDICTION	- In order to anticipate threatened resources, drift prediction can be carried-out by using specific software. As required by HSE/EP, Spill watch service shall be mobilized for Tier II spill incident - Tracking can also be performed by using specific devices transmitting a GPS signal - The movement of the slick can also be assessed a posteriori using Radar satellite imagery
#3- PROTECTION OF ASSETS AND/OR SENSITIVE AREAS	This strategy aims at protecting assets and/or sensitive areas which could suffer from impact of oil. It consists of: - Deflecting the spill using water guns (e.g. FiFi equipment). - Deploying floating booms to protect coastal sensitive areas. - Using sorbent materials (sorbent booms or loose sorbent in conjunction with floating booms).
#4- MECHANICAL DISPERSION	The principle of the strategy is to break the slick to facilitate its spreading and per consequence the evaporation and natural dispersion. This technique can be only applied on fresh oil (not on an emulsified oil). - This technique is relevant for low volume < 5 m3 and for diesel spill.
#5- USE OF DISPERSANTS	This technique consists of: - Using vessels and/or aircraft (helicopter or airplane) to spray dispersants on the slicks in order to enhance the natural dispersion of oil, therefore setting up conditions for a quicker biodegradation of the oil into the marine environment. - Monitoring the effectiveness of the dispersion operation.
#6- CONTAINMENT & RECOVERY	Containment and recovery of the oil involves: - The containment and concentration of oil using floating booms. - The recovery of oil using skimmers (and/or sorbent when appropriate, e.g. small patches of oil). - The temporary storage of the recovered oil at sea, before its evacuation for final disposal, using storage capacities available from tanks on board vessels /or floating storage tanks which can be mobilized from Company or other operators in Nigeria through the MAP agreement.

- The transportation of the recovered oil towards a final storage or a disposal site

6.11.3. Overall Oil Spill Response Strategies

During an oil spill the final strategy proposed will be based on the PEARL methodology which aims to assess the impact on People – Environment – Assets & Activities – Reputation – Liability in order to define objectives, strategies, and adapted response operation with relevant resources.

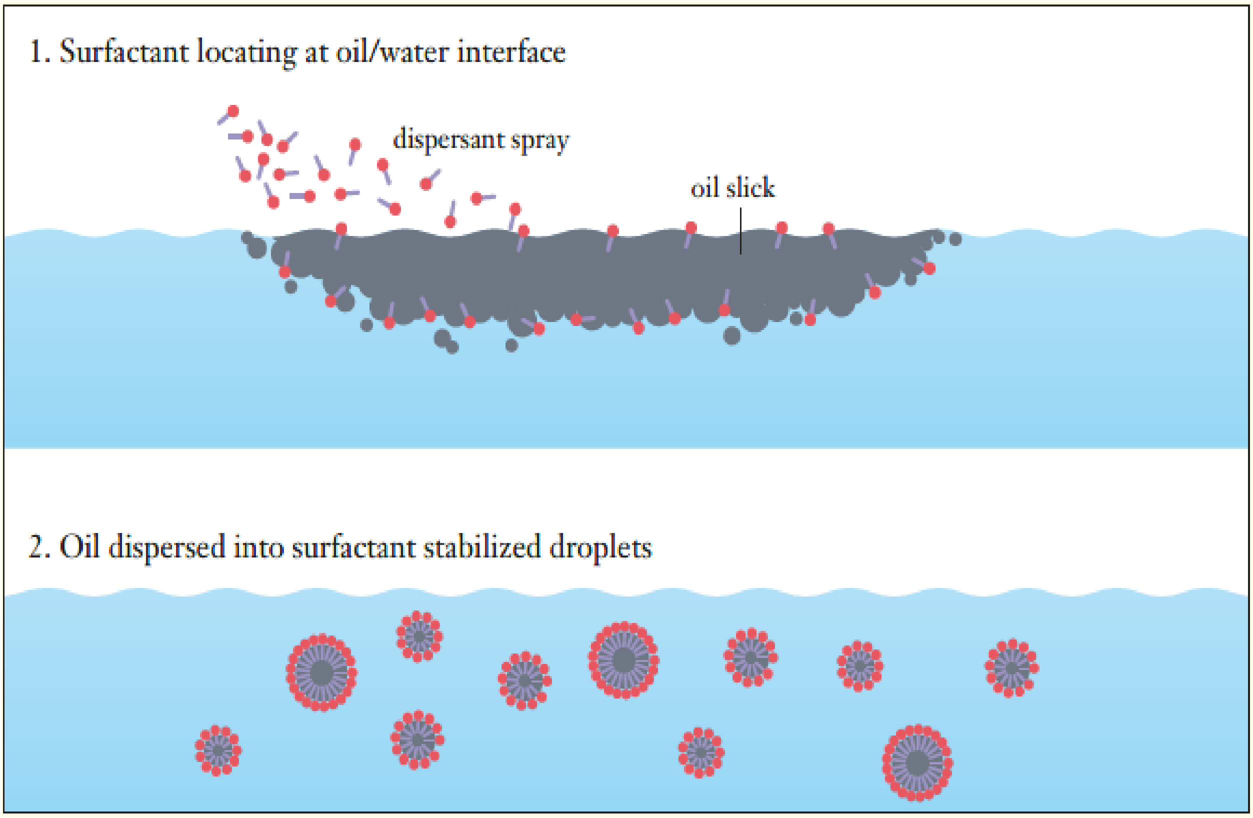
The overall oil spill response strategy for Tier 1, 2 and 3 (incidents offshore or onshore) which could occur as the result of incidents at the offshore & Onshore installations operated by TEPNG or of third-party spills to which TEPNG could be requested to respond is outlined in the table below:

Strategy	Applicable Techniques
Monitoring of the movement of oil slicks	In cases where the **oil is not threatening** any installations or sensitive areas (and/ or in case of very small volume spilled): **Monitoring of the movements of the oil slicks** and the behavior of the oil spilled until such time that the oil has degraded on the sea surface and/or that it can safely be assumed that no installations or sensitive areas are at risk any longer.
Monitoring of the movements of the oil slicks; drift prediction and tracking	In cases where the **oil poses a threat to** installations or sensitive areas, the oil spill response strategy consists of :
Limiting/ avoiding impact of sensitive areas, by responding at sea as soon as possible	**Offshore response strategy is based on chemical dispersants as the primary response option for crude oil (see section 6.11.1)**. Dispersion operations should start as soon as possible for spill upper then 5 to 10m3: time opportunity for dispersion is limited in the best cases (calm weather) and decreases rapidly with the increase of viscosity caused by the increase of the speed of the wind Given the various spill scenarios identified during the risk analysis and the limited time opportunity, **containment and recovery (see section 6.11.2)** operations might be needed to replace and/ or to complement the spraying of dispersants. Mechanical dispersion is efficient for very low volume of oil spilled (< 5m3) and on light products such as marine diesel oil.
protection of coastal sensitive areas	Initiating the protection of coastal sensitive areas which could be affected by the oil slicks, as soon as it is assessed that an impact could occur. Special attention should be given to sensitive natural areas, fisheries and fishing villages. Coastal sensitivity maps approved National Oil Spill Detection and Response Agency will be used as support for decision making
Mobilizing resources for shoreline clean-up	Initiate mobilization for shoreline clean-up when the assessment leads to a possible impact of the coastal area.

Containment & Recovery	This shall be implemented using booms and skimmers Use less sensitive sandy beaches as "sacrificial" areas to contain and recover the oil

6.11.1. The Use of Dispersants

Spraying dispersant on the oil enhances its natural dispersion in micro-droplets by the wave actions. They retard the re-coalescence of droplets into slicks because they contain surfactants (surface active agents) which reduce interfacial tension between oil and water. The dispersed micro-droplets can then be biodegraded more easily and more rapidly by naturally occurring marine micro-organisms and bacteria in the sea water.



From Operational point of view, dispersants have the following advantages

- Provided that a sufficient amount of dispersant, properly equipped vessels and adequate spraying equipment are available on site, a large amount of oil can be treated rapidly.
- Dispersant application is more efficient for sea response than containment and recovery operations. Experience has shown that, due to various limitations (weather conditions, logistics, etc.), it is usually not possible to recover more than 10% of the amount of oil initially spilled.
- Dispersant application by boat can be done (even in mediocre weather conditions). Dispersion should therefore be possible under the Block 17 prevailing MetOcean conditions.

- Dispersed oil is removed from the wind action. This can avoid slicks to land on the shore in case of onshore winds (depending on the strength and direction of the current).
- Dispersant application saves having to manage oily wastes at sea.

Nigeria Context for the use of dispersant

The use of dispersants is authorized in Nigeria in offshore water zone >5km from the shoreline therefore all TEPNG facilities offshore is located within a zone considered safe for chemical dispersion.

However, authorization must be obtained from NUPRC, NMDPRA and NOSDRA before use of dispersants in the event of an oil spill incident.

TUCN owns a stock of INIPOL 90, Corexit and Dispolene 36S tested successfully on TEPNG Crude oil (Source: weathering study performed by Cedre):

- In case of a Tier 2 oil spill, it might be necessary to supplement the Company stock by calling assistance from other Nigerian operators available through MAP agreement.
- In case of Tier 3, additional dispersant will be shipped from abroad.

6.11.2. TEPNG Oil Spill Capabilities

TEPNG follows international best practice regarding oil spill response and adheres to the three-tiered approach to Tiered Preparedness and Response as defined by the International Petroleum Industry Environmental Conservation Association (IPIECA). Tier 1 resources, people and equipment, are in place both onshore and offshore and if these capabilities become overwhelmed TEPNG has arrangements in place for additional support at the Tier 2 and Tier 3 levels, as described below.

Onshore Capabilities

Strategy	Tier 1	Tier 2	Tier 3
Monitor and Evaluate movements of the soil slicks	Monitoring shall be done with Pedestrian	Use of Bristow helicopters	Use of Bristow helicopters
Containment and Recovery of Oil on Permeable / Impermeable Ground	Use of sorbents / manual recovery or use of the vacuum truck, and use of local contractors to supply vacuum trucks / earth work machinery.	CNA and use of local contractors to supply vacuum trucks / earth work machinery.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Containment and Recovery in Ditches / Streams	Using various locally available materials. Skimmer systems held at Obagi and the vacuum truck offer a range of options.	CNA / MAP.	Oil Spill Response or FOST managing, using various locally available materials.

Containment and Recovery in Rivers	Booms held at Obagi may be suitable for smaller / slower rivers. Skimmer systems held at Obagi and the vacuum truck offer a range of options.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Containment and Recovery in Swamps	Booms held at Obagi suitable. Skimmer systems held at Obagi and the vacuum truck offer a range of options.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.

Offshore Capabilities

Strategy	Tier 1	Tier 2	Tier 3
Monitor and Evaluate	From a platform / vessel / use of Bristow helicopters.	From a vessel / use of Bristow helicopters / WASP/Satellite surveillance.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Containment and Recovery	Resources held on *FSO Unity.*	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Dispersant Application	Resources held on *FSO Unity* / on support vessels.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Aerial Surveillance / Dispersant Application	Helibucket at Port Harcourt (currently not operational).	WASP.	Oil Spill Response.
Shoreline Protection	Not applicable.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Shoreline Clean-up	Not applicable.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.
In Situ Burning	In situ burning would use fire booms to contain oil on the water surface, which would then be ignited and allowed to burn. This strategy is presently outlawed in Nigeria.		
Subsea Injection	Capability is not available locally in Nigeria OSRC can provide support, though not necessary for PHCD because we use Jack- up Rigs.		

6.11.3. Justification of Main Onshore Strategies

TEPNG have the capability to employ a number of oil spill response strategies for an oil spill event of any severity. The main strategies available to TEPNG are listed below.

Location	Main Strategies Available to TEPNG
Impermeable Ground	Manual recovery and cleaning oiled areas
Permeable Ground	Manual recovery, mechanical recovery and recovering oil from groundwater
Ditches / Streams	Damming and oil recovery
Rivers	Booming and oil recovery

Swamps	Damming, booming and oil recovery

The use of such strategies are well documented in the oil spill response industry, for example:

- "A Field Guide to Inland Oil Spill Clean-up Techniques", Concawe 1991.

The limitations of each strategy have been extensively researched by the industry. For TEPNG the main limitations are firstly gaining access from the local community to the affected site, mobilising equipment to remote areas and ensuring there are no security concerns. The main limitations centre on booming oil on flowing water. In currents over 2.5 knots the length of boom required to take account of current usually becomes unmanageable, and oil will escape from a boom laid perpendicular to the flow if the relative current strength is above 0.6 knots.

6.11.4. Justification of Main Offshore Strategies

TEPNG have the capability to employ a number of oil spill response strategies for an oil spill event of any severity. The main strategies available to TEPNG are listed below.

Location	**Main Strategies Available to TEPNG**
Offshore	Monitor and Evaluate and Aerial Surveillance
	Containment and Recovery
	Dispersant Application
Coastal	Shoreline Protection
Coastal	- Shoreline Cleanup: - Manmade Structures (ESI 1) – mainly pressure washing - Sedimentary Shores (ESI 2 – 6) – mainly manual and mechanical recovery, and possibly natural recovery or low pressure washing - Vegetated Shores (ESI 7 – 9) – mainly natural recovery with monitoring and low pressure washing - Tidal Flats (ESI 9) – mainly natural recovery with monitoring and low pressure washing - Mangroves (ESI 10) – mainly natural recovery with monitoring and low pressure washing

The use of such strategies are well documented in the oil spill response industry, for example:

- "A Filed Guide to Coastal Oil Spill Control and Clean-up Techniques", Concawe 1982
- "A Field Guide to the Application of Dispersant to Oil Spills", Concawe 1988
- "Manual on Oil Pollution", International Maritime Organization 2005
- "Technical Information Papers Series", International Tanker Owners Pollution Federation Limited 1981 – 2008

Each offshore strategy has various limitations. For all strategies the weather and sea state have a direct control on what is actually possible to safely undertake. It is well documented that containment and recovery is only likely to recover 10 – 20%, because of the logistical difficulties in encountering oil that is fragmenting and spreading thinly over an increasingly wide area. For this reason TEPNG also have a dispersant application capability, but this too has limitations. The main one is the "window of opportunity" which is the time period after initial release that the oil is amenable to dispersant. Beyond this, the effect of dispersant will be reduced. Coastal strategies are mainly limited by the weather conditions and sea state. In addition, access in regards to mobilising equipment to remote sites, personnel safety, security and community approval, are major limitations.

6.11.5. Justification of Tier 1 Capability – Onshore

The sites in OML58 are surrounded by dense jungle which in the wet season generally becomes a wetland with streams and pools of water. As such oil spill response equipment in the Tier 1 stockpile consists of booms and skimmers specifically designed for such an operating environment. Access to contaminated infield sites is an issue, for example limited road access, and as such the Tier 1 equipment is small enough so that it can be safely transported manually. The size of the stockpile has been designed around there being enough personnel for two Tier 1 sites to be safely managed simultaneously. In addition, basic, non-specialised resources are also available, for example damming materials, PPE and manual cleanup tools. Such equipment is ideal for inland spill scenarios where oiled soil and vegetation may need to be removed. A 8m^3 capacity vacuum truck is also available. Full details of the Tier 1 equipment are given in the Anti Pollution Equipment Stockpile COR-PLA-HSE/ENV/21.

The Tier 1 spill volume for inland scenarios depends on the locality. For incidents on land it is 50bbl (7.95m^3) and for incidents on inland waters, the volume definition is 25bbl (3.975m^3). The vacuum truck can hold 8m^3 and each of the two Fastanks can hold ~7m^3. Assuming ideal conditions and trained operators, the recovery rate of the skimming main units, Komara 12 and Komara 20, are said to be 12 tonnes/hour (approximately 12m^3/hour)and 20 tonnes/hour (approximately 20m^3/hour) respectively.

6.11.6. Justification of Tier 1 Capability – Offshore

The main offshore oil spill response resources are held on *FSO Unity* in OML100. Containment and recovery is the primary response option. Refer to the Anti Pollution Equipment Stockpile COR-PLA-HSE/ENV/21 for the full equipment listing and specifications. In the event of a spill in OML99 or OML102, infield vessels in OML100 will be loaded with response equipment and will sail to the incident location. Sailing time from OML100 to OML102 is 2 hours, and for OML100 to OML99 is 1hr 35 minutes. The spill risk in OML99 and OML102 is lower than OML100, as the main oil spill risk is associated with the exporting of oil from *FSO Unity*. Hence, the equipment is stockpiled in OML100.

The Tier 1 spill volume definition is 50bbl (7.95m^3) and TEPNG has more than sufficient resources to meet this assuming it is still within the operational limits of the Tier 1 capability. The containment and recovery equipment consists of 500m of boom and an offshore skimmer that in ideal conditions and being operated by trained personnel, can recover 50 tonnes/hour (approximately 50m^3/hour). The offshore recovered oil storage consists of the 100m^3 floating storage tank and the onboard storage on the tug *Bourbon Rhodes* which is 116m^3. Both storage volumes exceed the TEPNG Tier 1 definition.

Should containment and recovery not be suitable or sufficient, TEPNG have two infield vessel dispersant application systems with a stock of dispersant held on the *FSO Unity*. The 9,800 litres (9.8m^3) of dispersant available can treat the following amount of oil assuming conditions are optimal, operatives are trained and oil is fresh:

- Assuming a ratio of 1:20 is sufficient, around 160m^3 (1,006.4bbl) of oil could possibly be dispersed.

If the original NUPRC/ NMDPRA Tier 1 definition is considered, <250bbl (39.75 m^3) which is not as strict for reporting, then the TEPNG Tier 1 resources are still more than adequate to handle such an incident assuming it is still within the operational limits of the Tier 1 capability.

TEPNG can respond to more than one offshore incident at a time. The limitation is the number of vessels. The *Bourbon Rhodes* would be required in containment and recovery operations, along with a surfer or the *Lamnalco Eagle* tug. The Viksospray system could be installed on another surfer or the *Lamnalco Eagle* tug if available for simultaneous dispersant spraying.

6.12. End of oil spill response operations

The oil spill response operations can be stopped when an acceptable level of clean-up (particularly for the shoreline clean-up operations and on land) has been achieved.

At the end of the operations, a visit of the clean-up work sites should be organized by TEPNG with representatives of the Nigerian authorities who will have the authority to validate the termination of the clean-up operations.

6.13.Waste management and site restoration

6.12.1 Storage of waste on site

During oil spill response operations, a great amount of oil and oily waste can be recovered. Sufficient temporary storage on site must be provided to ensure that recovered waste can be temporarily stored, before evacuation is organized

For onshore sites, temporary storage on site (using free standing flexible storage tanks, Plastic Tanks or drum) is used to store oil directly recovered with skimmers, pumped from the trenches or collected manually.

Intermediate storage tanks or Jute bags can be used to centralize the waste from the temporary storage before evacuation

For offshore, the storage tanks onboard the vessels and floating storage tanks, will be used for the temporary storage of the waste as well as for the evacuation of the waste through a vessel to Onne port or any other designated location.

6.12.2 Transport and disposal of wastes

In case of a major clean-up operation, the number of oily wastes generated by clean-up operations can rapidly become very large and the entire disposal chain must be organized as soon as possible from the transportation of the oily wastes to a treatment storage site and final disposal in line with regulatory requirements.

Note. It is recommended to segregate the different types of contaminated wastes (e.g. soil, vegetation, oily sediments, liquid wastes, etc.) to allow for different solutions for the disposal of these wastes.

6.12.3 Site restoration & Post monitoring

Following an onshore spill and depending on the type of oil and ground conditions, and the outcome of post clean-up inspection assessment, site remediation strategy might have to be implemented.

A post-incident environmental monitoring can also be implemented to assess the ecological impact of the incident, ecological impact of oil spill response techniques on the environment and degree of rehabilitation of the ecosystems affected by the spill.

TotalEnergies EP Nig Ltd.		

UBETA PROJECT

UBETA EMERGENCY RESPONSE PLAN

Rev.	Status	Date	Revision memo	Issued by	Checked by	Approved by
01	AFU	17 March 2024	Approved For use	A. TOBIN	H. IKPA	L. EKE
00	AFU	14-Aug-2023	Approved For Use	A. TOBIN	H. IKPA	L. EKE

Table of Contents

1. GENERAL

1.2 INTRODUCTION

The Emergency Response Plan is an operational document drawn up in anticipation, identifying the key points for response to a major event on sites such as an event affecting the health and safety of personnel, a security event resulting from harmful actions committed by third parties and events that may affect the environment.

The purpose of this Emergency Response Plan is to provide an action-oriented plan to effectively control and manage emergencies while executing activities related to Ubeta project. The emergency response plan is applicable to all locations (Contractor yard, Site and Company).

Specific objectives are to:

- Describe the project Emergency Response Organization
- Define the roles and responsibilities of the Emergency Response members.
- Define the Emergency Scenarios.
- Describe the Emergency Response measures established for alert, muster, evacuation and rescue.
- Describe the emergency response communications organization.
- Describe measures established to bring emergency situations under control and post event recovery.
- Provide a basis for the training of personnel to ensure that competent personnel are able to undertake their assigned duties during an emergency.

This plan is based on principles and methods of emergency response management as one of the methods applicable to the recovery phase of hazards and effects management process in HSE management system.

It describes the process, roles and responsibilities of entities response to emergency involving assets, personnel, visitors, sub-contractors, and support services involved in the execution of the project in an efficient and professional manner that effects on personnel, assets and environment are prevented or minimized.

It applies to all offices, worksites and sites that will be utilized throughout various stages of the life of the project and for personnel in transit from site to site travelling on behalf of the project. Sites are further categorized as follows:

- TotalEnergies Operated Sites (Nigeria)
- Contractor Operated Sites (Nigeria)

This plan defines:

- The response organization for incidents on TOTALENERGIES operated sites, including offices in Lagos.
- The response arrangements for 3rd party incidents affecting Project personnel and sites.
- References and interfaces with other plans and documentation, including contractor site plans.

1.3 FIELD OF APPLICATION

This Plan applies to all emergency situations (Safety, Medical or Security related) at the Project offices, worksites, sites and transit of personnel between offices, worksites and sites.

1.3.1 TOTALENERGIES Sites

All Ubeta emergency activities will be managed by the UBETA resident emergency team and escalated through the PMT and OML 58 management organization.

Project personnel based in TUCN authorized offices or sites in Nigeria, will be covered by the relevant site emergency response plans.

If any of the sites/office emergency response plan is activated for an incident in which Ubeta Project personnel are affected, then this plan will be activated in support.

1.3.2 Contractor Sites

All main contractor sites where Project personnel will be stationed must have an Emergency Response Plan in place verted and approved by PMT.

The Ubeta Project Package Manager will be responsible for ensuring that contractor's plan is fit for purpose.

A bridging plan must be developed to bridge the contractor plans with this plan. The responsibility for the development of these bridging plans lies with the Ubeta Project Package Manager.

These plans should be kept simple and be of flowchart design and contain.

- Key contact details in case of emergencies.
- Method of activation and response.
- Local interface between project and contractor emergency organization.

A copy of the contractor site emergency response plans, or equivalent document, and any other relevant emergency related plans, i.e., medical, crisis management, security and evacuation, must be provided to PMT for inclusion.

The Ubeta HSEQ Manager is responsible for ensuring that a duty person is always available to liaise directly with Contractor and notification to the District's Duty Manager in the event of emergencies.

If the contractor emergency plans are activated for an incident in which Ubeta Project personnel are affected, then this plan will be activated in support.

1.3.3 Project Personnel in Transit

The originating Project Package must track staff, contractors, and visitors, travelling on behalf of the project. Basic journey management protocols must be applied for all personnel where procedures are not already in existence, i.e., itinerary, destination arrival confirmation, contact details, etc. In the event of travel related incidents where a threat to safety of the traveler/s exists, or relevant corporate and / or contractor emergency plans are activated, then this plan will be activated in support.

1.4 RESOURCES

To ensure comprehensive emergency management at both TotalEnergies Site and Contractor Yard locations, a range of essential resources must be in place to address any unforeseen situations promptly and effectively. These resources include, but are not limited to:

- Clearly Defined and Prominently Marked Muster Points:
- Trained and Proficient Emergency Response Team:
- Robust Communication Infrastructure:
- Comprehensive Emergency Plans with scenario based reflex card
- Arrangement with retainer clinics
- Adequate perimeter security and response plan

2. REFERENCE DOCUMENTS

Unless otherwise stipulated, the applicable version of the reference documents listed below, including the relevant appendices and supplements, is the latest revision published.

E&P Referential

Reference	Title
HSE Charter	Exploration and Production HSE Organization Charter
CR EP HSE 001	Rules for Implementation of the DGEP HSE Policy: MAESTRO
CR GR HSE 100	HSE Reporting
CR EP HSE 091	Affiliate Emergency Response Plan
GM EP HSE 091	Guideline for Affiliate Emergency Response Plan
CR EP HSE 092	Notification and Liaisons DGEP - Affiliates in Case of Emergency
GM EP HSE 006	Directeur de Permanence DGEP
CR EP HSE 101	Investigation of major accidents
GS EP MED 061	Medical Support for E&P Sites

TUCN (TEPNG & TUPNI)

Reference	Title
PLN-HSE/GEN-M07-022-Rev03	PHC District Emergency Response Plan

PLN-HSE/GEN-M07-021-Rev 3	TUCN Crisis Management Plan
HSE-GENERAL MAESTRO 07	Affiliate Medical Evacuation Procedure
PLN-HSE/ENV-M05-04	General Oil Spill Contingency Plan
PLN-HSE/ENV-M05-014-Rev 3	JV Asset Oil Spill Contingency Plan – Action Plan
PLN-HSE/ENV-M05-16-Rev 3	JV Asset Oil Spill Contingency Plan - Strategy Plan
GS EP PJC 401	Health, Safety and Environment on construction and installation
NG-UBM-00-UBSE-00014	Contractor HSE Assessment and Implementation Plan
PRD-HSE/GEN-M01-25-Rev 0	HSEQ Awareness and Communication Procedure
INT-PLN-58-HSE-037 Rev06	OML58 OIL SPILL CONTINGENCY PLAN-1 Action Plan
INT-PLN-58-HSE-037 Rev06	OML58 OIL SPILL CONTINGENCY PLAN-2 Response

Ubeta Project

Reference	**Title**
NG-UBM-00-UBSE-00002	Project HSE Plan
NG-UBM-00-UBSC-00001	Project Security Plan

3. DEFINITIONS

Company (CPY)	Means TotalEnergies Upstream Nigeria Limited.
Contractor (CTR)	An awardee of an EPC contract
Alarm	Sound or visual device meant to warn of existing or imminent danger
Alert	Verbal information made to a person or an entity that takes part to the response process
Crisis	Any incident, series of events, or set of circumstances that threatens to fundamentally affect or alter the way the district chooses to do business
Emergency	An unforeseen combination of circumstances that disrupts normal operating conditions and poses an actual or potential threat to human life, health, property or the environment if not controlled, contained, or eliminated immediately.
Incident	An event, series of events or set of circumstances that interrupts normal operating procedures and has the potential to precipitate an emergency or crisis.
Notification	Information made to a person or an entity that needs to know about.

Supplier(s)	Subcontractor(s) and/or Vendor(s). Subcontractor is in charge of manufactured product (specific Scope of Work) delivery and Vendors is in charge of Standard product delivery.
ERIT	Emergency Response and Intervention Team

4. ABBREVIATIONS

CMR	Crisis Management Room
CR	Company Rule
DGEP	Direction Générale Exploration & Production
DGM	Deputy General Manager
DMD	Deputy Managing Director
EMP	Emergency Management Plan
EMT	Emergency Management Team
ER	Emergency Response
ERC	Emergency Response Centre
ERIT	Emergency Response Intervention Team
ERP	Emergency Response Plan
FSE	Full Scale Exercise (TOTALENERGIES definition for a full-scale emergency exercise)
GPA	General Panel (or Platform) Alarm
HSE	Health, Safety and Environment
JV	Joint Venture
LOS	Lagos – referring to TOTALENERGIES facilities and operations in Lagos
LTI	Loss Time Injury
MAESTRO	Management and Expectation Standards Towards Robust Operations
MEDEVAC	Medical Evacuation
MEDICO	Medical Communications
MTC	Medical Treatment Case
OSC	On Scene Commander
OSCAR DELTA	TUPNI DM (based in PHC for response to JV Operations incidents)
OSCP	Oil Spill Contingency Plan
PHC	Port Harcourt District (referring to TOTALENERGIES facilities and operations in Port Harcourt)
PIC	Person in charge
GM	Project General Manager
PMT	Project Management Team (Ubeta)
RSES	Responsible for Safety and Environment on Site

RSES-D	RSES Delegate
RTA	Road Traffic Accident
RWDC	Restricted Workday Case
TEPNG	TOTALENERGIES Exploration & Production Nigeria
TUCN	TOTALENERGIES Upstream Companies in Nigeria (TEPNG & TUPNI)
TUPNI	TOTALENERGIES Upstream Nigeria Ltd

5. RESPONSIBILITIES

The responsibilities for implementation of this Plan are stated below:

5.2 ALL PERSONNEL

- Any observer of an incident should follow the local site procedures and ensure that the alarm is raised and the person in charge of Emergency Response is alerted.
- All personnel are to respect the emergency response process by mustering when required and staying clear of the scene or IP for the Crisis and ERIT Teams to perform their duties without interruption or escalation.

5.3 RSES

- In an emergency, the RSES of the site or operation is to be informed, as per the site emergency response procedures (site contingency plans). The RSES then becomes the On-Scene Commander (OSC).
- The RSES is responsible for ensuring that all urgent notifications are made within the site's defined area. This includes the notification / alert of sites or units that may be affected or called upon to support the incident.
- The RSES of the affected site is responsible for notifying Oscar Delta / PMT as soon as practicably possible of any incident with an actual severity >=2 and / or potential severity 3 or above.

5.4 RSES DELEGATE (RSES-D) AND PERSON IN CHARGE (PIC)

- Delegate RSES, company representatives and contractor representatives are required to report all emergencies to the RSES for the area / site.
- Act in the capacity of the RSES in the case where the RSES is unavailable or unable to carry out his duty.
- During an incident, RSES-D provides regular updates to the OSC, he also requests support from the OSC who still coordinates the field response.

- The OSC deploys the necessary local resources and may request additional support through Oscar Delta if a severity level 2 is reached, or likely to be reached and then through the EMT when activated.

5.5 OSCAR DELTA

- Oscar Delta assesses the situation and makes the decision on whether to mobilize the appropriate/full duty emergency team members.
- Whenever possible, this decision will be made in conjunction with the duty EMT leader or duty deputy EMT Leader.
- Oscar Delta will liaise directly with JV duty personnel for the purpose of notification and activation and mobilization of immediate support requirements.

In all cases the Emergency Response Coordinator (Oscar Delta) shall be informed by phone.

PRIMARY CHANNELS	EXT	GSM	THURAYA/INMARSAT
Through TUCN desk phone (Short Code) Oscar Delta	7111	0807 017 3111 **Mobile:** 08034024111 (Primary Line) 08055998062 (Alternative Line)	TETRA 31 111 Thuraya +8821654200982
OML58 OIM/RSES	8118	08037610341	+8821654253277, short code 5027
OML58 Obagi OPM/RSES-D	8165	08037610342	+8821654202561
CCR Obagi	8188		+870776503514
OML 58 Obite RSES-D	8017	08037610343	
CCR Obite	*8018*		+870772546370
Security Manager	8899	08037610345	
Head of HSE	8144	08037610347	

5.6 PROJECT MANAGER

The Ubeta Project Manager is ultimately responsible for the management of Health, Safety and Environmental issues for the Project; therefore, he shall ensure that sufficient resources are available to fully comply with the Project Emergency Response Plan.

5.7 PROJECT PACKAGE MANAGER

THE PACKAGE MANAGERS SHALL:

- Ensure that there is an efficient Emergency Response Plan in place at all Contractor sites where Project personnel are assigned to work.
- Ensure their Contractor sites Emergency Response plans are subjected to regular drills.
- Ensure that their personnel are aware of the emergency response plan in place at the Contractor sites.
- Ensure the Project Emergency Response Plan is disseminated to their personnel.
- Ensure that a bridging document is developed by their contractors involved in installation; integration; hook-up; commissioning and operations activities.

5.8 HSEQ MANAGER

The HSEQ Manager shall be responsible for:

- Ensuring this Plan is widely known in the Project
- Ensuring the implementation of this Plan in the Project as a whole.
- Establishing the required organization

5.9 PROJECT HSE HEAD

The Project HSE Head shall:

- Ensure the conformity of this plan to related Company Rules and Guide manuals.
- Ensure the dissemination of this plan to all Project personnel.
- Ensure weekly call out sheets are prepared and disseminated
- Review Contractor sites Emergency response plans and bridging documents for all activities
- Review this plan when necessary.
- Ensure drill plans are issued and monitor implementations

5.10 PACKAGE HSE LEAD

The Package Lead HSE shall:

- Manage all Emergency response activities within his designated package
- Review Contractor and Sub-contractor sites emergency response plans
- Ensure the effective implementation of this plan by organizing regular drills to test its' effectiveness

- Review all bridging documents between Company and Contractors, as well as between Contractors and Sub-contractors.
- Participate actively in the activation of the Contractor site plans.
- Identify areas of improvement
- Provide Package Managers and Project HSEQ Manager with the necessary information to ensure adequate resources are provided in a timely manner to ensure efficient emergency response.
- Disseminate Contractor site Emergency Plans to all Project personnel working on those sites
- Assist the Company Site Representative in the implementation of this plan.

5.11 UBETA DUTY OFFICER / HSE COORDINATOR

- The Ubeta Duty Officer (on 24/7 duty) located in Port Harcourt will be first point of contact for all incidents on Contractor yards/offices.

He is responsible for:

- Alerting / notifying Security Control room for any incidents within Ubeta Project Port Harcourt locations with actual severity > 2
- Alerting / notifying Oscar Delta as soon as possible for incident occurring on contractor yards and Contractor offices.
- For Ubeta related incidents for which the JV EMT is mobilized, the Ubeta Duty Officer may be called out to join the EMT at the PHC Emergency Response Centre (ERC).

Personnel nominated as Duty Officers for the Project must be available to respond in Port Harcourt during the period of their duty.
At all sites, the RSES or Company Site Representative (RSES-D) will be the duty focal point on site.
Contact details of all duty personnel must be kept up to date.

- UBETA representative in the EMT will be nominated by the UBETA Project Manager
- UBETA Duty Officers will be nominated by UBETA HSEQ Manager

5.12 COMPANY SITE REPRESENTATIVE (RSES-D)

The Package Company Site Representative Shall:

- Manage all Emergency response activities within his designated site
- Review Contractor sites emergency response plans
- Be the focal point for all the Emergency response matters on his site
- Monitor the effective implementation of the site emergency plan

- Provide Package Managers and Package HSE Lead with the necessary information to ensure adequate resources are provided in a timely manner for efficient emergency response

6. UBETA PROJECT EMERGENCY AND CRISIS MANAGEMENT ORGANIZATION

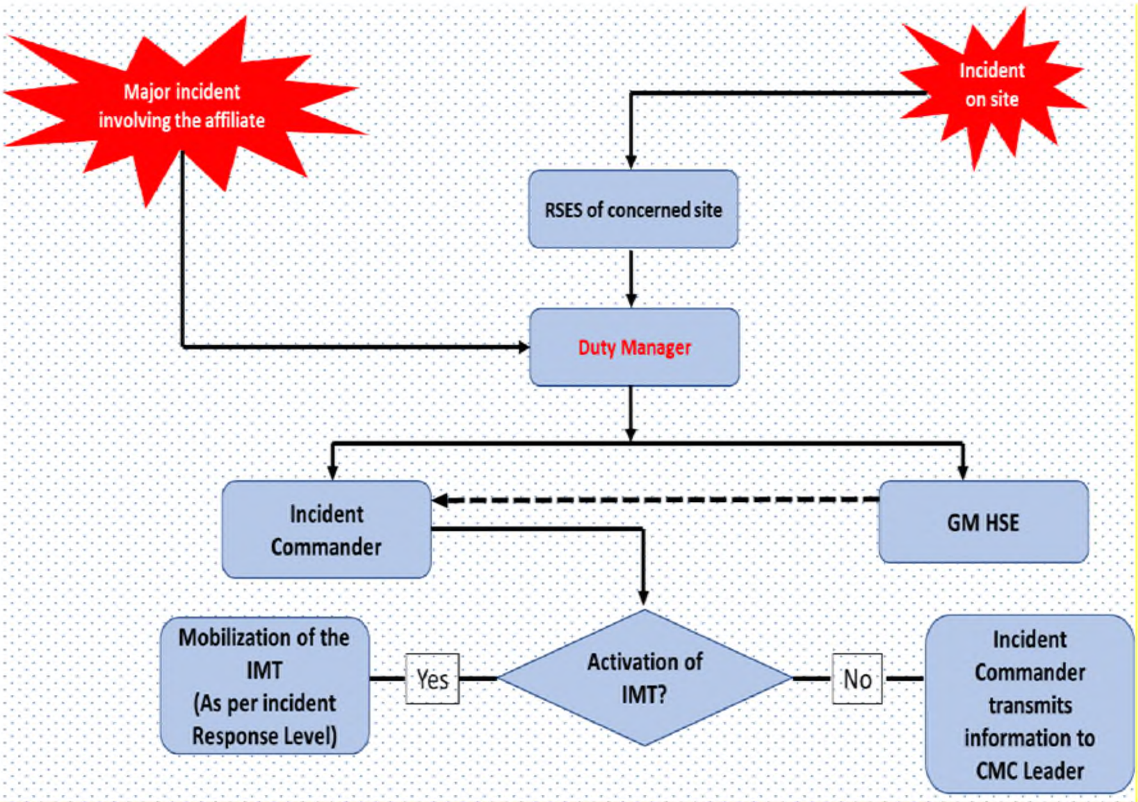
The Ubeta Project Emergency Response flow process shall be in line with the District's Emergency Response Plan as indicated below:

6.2 PORT HARCOURT DISTRICT ALERT PROCEDURE

In an incident, or potential incident, the Emergency Response Coordinator (Oscar Delta) will be notified according to the established notification and alerting procedure. The Emergency Response Coordinator will provide the Incident Commander with the necessary information to enable the severity, or potential severity, of the situation to be assessed. The Incident Commander will then determine whether the AERP will be activated and the extent to which the IMT and other resources will be mobilized.

In general, the alert procedure may be activated in one of three ways:

1. Activation of the site contingency plan on one of the sites
2. Activation of site contingency plan and need for additional assistance if the on-site means are not sufficient any longer to control the event.
3. Unexpected serious event, involving affiliate personnel, or affiliate head office or 3rd party.



6.3 INCIDENT REPORTING, NOTIFICATION AND ACTIVATION OF THE ORGANIZATION

Initial notification of all incidents that will occur at site level. Activation and Reporting should occur as per the local site procedures. If the local site organization and procedures are activated, then

- For UBETA project incidents: the **RSES / RSES (D)** are responsible for immediately notifying **Oscar Delta**
- For various Contractor yard in PHC: the CSR or HSE Lead notifies the UBETA Project Duty Officer / HSE Coordinator and Oscar Delta

This initial notification should be verbal via the relevant duty mobile contact numbers. This requirement is in addition to normal reporting requirements in line with established procedures, e.g., Echo report.

On Contractor sites, a local bridging procedure for emergency response at the site is to identify how the:

- Company Site Representative is notified of incidents
- Company Site Representative is integrated into the local and / or contractor site emergency management organization / team

All site bridging procedures must indicate the **UBETA** Duty Officer / HSE Coordinator as an immediate **verbal** notification for all incidents.

6.4 INCIDENT SEVERITY MATRIX

Severity Level	Response Levels	Classification	Description/Consequence: Human	Environmental	Material or Production	Media[1]	Who should be informed / activated
1	Level 1	Minor	First aid.	Temporary exceedance of an emissions standard; accidental spillage below the Group's statistical reporting threshold.	< 20 k€	No reaction.	Emergency Response Coordinator/ informed Consider escalation potential
2		Moderate	Recordable incident without lost time, medical treatment including restricted work.	Very localized pollution with minimal impact on the environment <50bbl (Onshore & Offshore) <25bbl (Inland Water Spills)	20 k€ - 200 k€	Local media. Comments on local or national media websites. Information on social networks (Facebook, Twitter, discussion forums, etc.) in the local language(s).	
3	Level 2	Serious	Recordable incident with lost time, including temporary disability (without permanent disability).	Pollution of small area with limited impact on the environment. 50 – 2,500bbl (Onshore & Offshore) 25 – 250bbl (Inland Water Spills)	200 k€ - 2 m€	"Notices" in the national media + press agency dispatch(es). Negative comments on social networks and/or intervention by national influencers[2] in the local language(s) or the Group's official languages[3].	Alert process applied. IMT activated If severity 3 for Media: - CMC activated - On-call Corporate Communications alerted
4	Level 3	Very Serious	Internal: permanent disability or a fatality.	Pollution with significant environmental impact. > 2,500bbl (Onshore & Offshore) >250bbl (Inland Water Spills)	2 m€ - 10 m€	"Report" in the national media; Numerous negative comments on social networks and/or interventions by national influencers, in the local language(s) or the Group's official languages	IMT and CMC activated Country Chair informed Corporate/Branch on-call Functions (HSE, Comms, Security) alerted
5		Catastrophic	External: injuries among local population.	Large-scale pollution in ecosystems of recognized ecological interest.	10 m€- 100 m€	"Report" in international media; Negative comments on social networks and/or intervention by international influencers;	Branch Geographic / Activity Director and HSE Director informed CSC Activated as required
6		Disastrous	Transport or security related third-party fatality.	Pollution with massive and lasting consequences for vast ecosystems of high ecological interest	> 100m€	Reuse of the event by personalities (political, NGOs, etc.) followed by negative mobilization.	

6.5 SITES AND WORKSITES ALERT PRINCIPLES

6.6 DECLARATION OF AN EMERGENCY

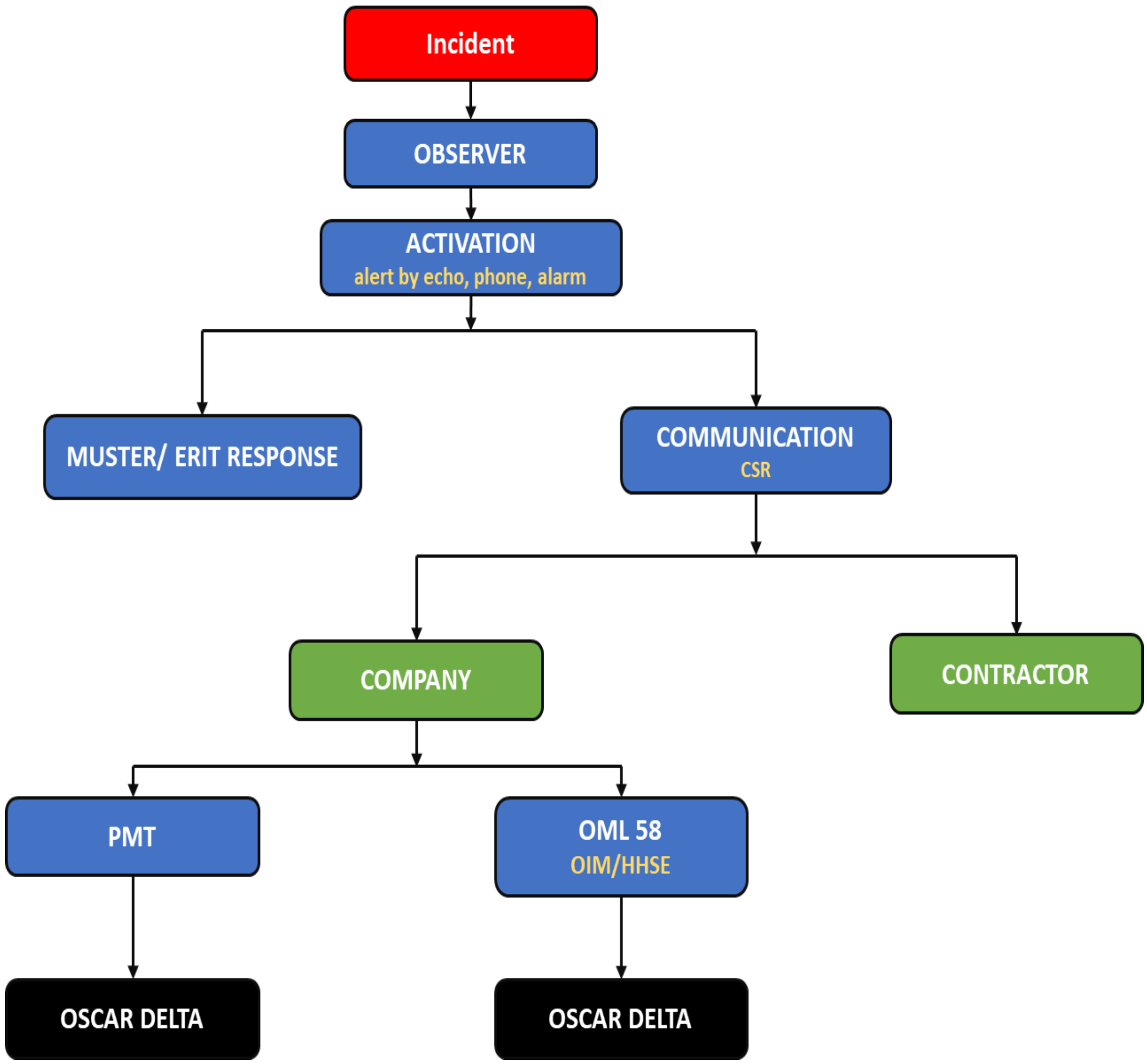
The RSES decides when to declare an emergency. If the RSES is unable to perform this function, his appointed deputy (RSES-D) will assume this responsibility according to the following priority:

- Package Manager
- Package HSE Lead

6.7 ALERT PRINCIPLES

The Alert principles are:

- Observer shall raise alert by verbal (face to face / voice echo), manual call point, Manual Alarms or phone
- Further alert shall be done by phone to Oscar Delta and PMT, alert must be acknowledged by the receiving party.
- SMS texts, answer-phone messages, email or fax messages are not to be considered reliable for alert purposes and must therefore be followed up by verbal confirmation.



6.8 ERIT TEAM COMPOSITION

The Emergency Response Team (ERIT) on each site shall be nominated by the RSES (or RSES-D) and Coordinated by the Head HSE or his Delegate. Composition of this team shall have the following at minimum.

- Emergency team leader
- First Aid Team leader – Medic
- Muster checker
- Firefighting team members – 4 pax

- First Aid Team members – 4 pax

6.9 CATEGORIES OF EMERGENCY & CRISIS EVENTS

An Emergency or Crisis situation is an event, or incident, occurring unexpectedly with the following consequences:

- An immediate threat to people, environment, assets that cannot be contained and dealt with by the Site Personnel,
- Where there are no immediate repercussions, but a given event could escalate and generate serious failures or significant hazardous situations,
- Sensitive aspect, with potential impact on human, economic or ecological aspects in the location where the emergency occurs,
- Potential to affect the project and TOTALENERGIES corporate image.

Therefore, in line with the above, an emergency or crisis event can include anyone, or combination, of the following incidents.

- Medical evacuation or rescue
- Serious Injuries and / or fatalities
- Major fire and / or explosions in construction yards
- Loss of well control
- Transportation incidents (RTA, Marine, Air)
- Oil / Chemical spillage
- Gas releases
- Loss of, or damage to, a radioactive source
- Political or civil unrest, Security incidents, including any of the following:
    - Site invasion
    - Robbery or armed attack
    - Kidnapping or hostage taking
    - Bomb explosion and/or bomb threat.
- Severe weather leading to structural damage
- Naturally occurring disasters
- Contagious diseases / pandemic situations

It should be noted that the above list contains examples; therefore, it is not exhaustive. In order to assess the severity of any emergency or crisis event, and hence implement the appropriate level of response and management, it is necessary to categorize the potential events or situations. The project, in line with the TUCN Emergency Response and Crisis Management Plan, defines three levels of severity, which are minor, serious and major.

6.10 MINOR EVENTS – LEVEL 1

The first level of severity can be categorized as a minor emergency or crisis event when it corresponds to a situation where:

- The worksite/site Emergency Response Intervention Team (ERIT) personnel can cope with it totally,
- The immediate and future consequences, with respect to human, ecological, technical aspects and media, are perceived as being limited,
- The consequences present no potential to result in or have serious impact on the project / company and / or TOTALENERGIES Group's public image or reputation.

6.11 SERIOUS EVENTS – LEVEL 2

The second level of severity can be categorized as a serious emergency or crisis event and corresponds to a situation where:

- The immediately available ERITs and facilities, at a given location, are inadequate to solve the problem in a safe and timely manner,
- The consequences even if they are assessed as minimal at the time of the incident, could escalate into a major incident, with significant human, ecological, asset or production loss,
- The consequences present the potential to result in or have serious impact on the project / company and / or TOTALENERGIES Group's public image or reputation.

6.12 MAJOR EVENTS

The third level of severity can be categorized as a major emergency or crisis event and corresponds to a situation where:

- The human, ecological, asset or production loss has already occurred,
- The consequences present the potential to result in, or have major impact on the project / company and / or TOTALENERGIES Group's public image or reputation

A debriefing will be held immediately with all the members of the CMC, and if required with the JV EMT / CMT. A full debriefing meeting, with all CMC Members and key players (support staff, liaison officers, contractors, etc.), is to be held within 24 hours of demobilization.

Figure 1 below provides a conceptual illustration of how the three levels of response are addressed within TotalEnergies.

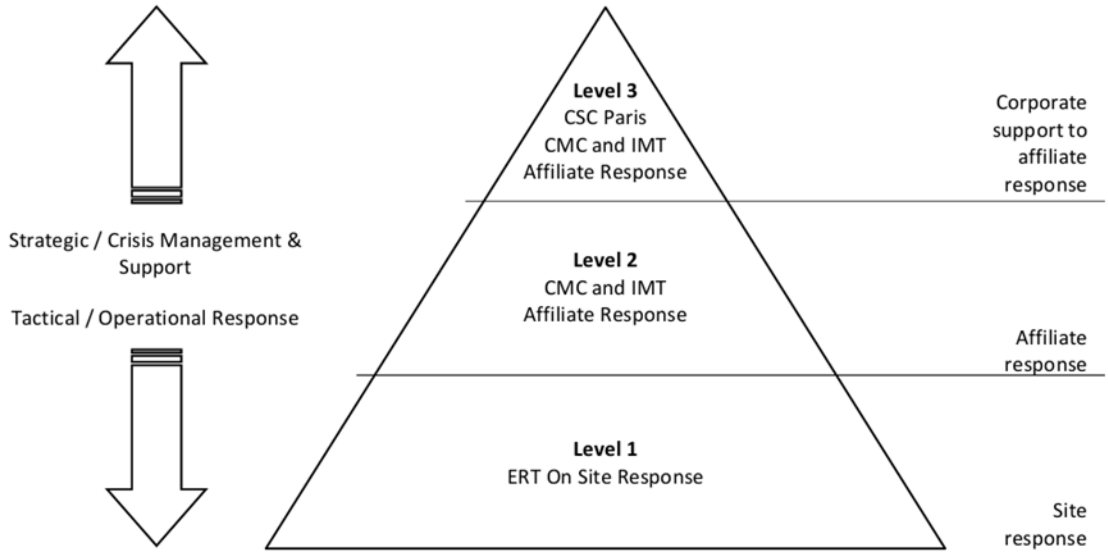


Figure 1 Levels of Emergency Response

7. GENERAL ARRANGEMENTS

7.1 TOTALENERGIES LOCATIONS

All MEDEVAC of Project personnel deployed in TotalEnergies offices and Ubeta (OML 58) field shall be under the TUCN medical evacuation system. The receiving hospital shall be:

- TotalEnergies Lagos Clinic for UBETA TotalEnergies personnel in Lagos area (Company Office, Worksites – Contractor offices, yards, etc.)
- TotalEnergies PHC Clinic for UBETA TotalEnergies personnel in Port Harcourt area (Company Office, Site – OML 58, Worksites - Contractor offices, Contractor yards, etc.)
- Retainership Clinics / Hospitals for Contracted personnel in Lagos and Port Harcourt area.
- Contractor personnel working at SITE (Ubeta project - OML 58) shall be transferred to their Company retainership clinic/ hospital or medical team in PHC after personnel has been stabilized by site medic.

MEDEVAC of Project personnel and contractors deployed on the Ubeta project are to be reported via Oscar Delta. Each contractor will be required to provide the following information:

- Formal name of Contractor in Nigeria
- Scope of Medical Evacuation Procedure (e.g., project or across whole affiliate, etc.)
- Duration of bridging arrangements
- Default hand-over location(s)
- Full list of site contact numbers and office contact numbers

- Duty contacts in Nigeria (if no representation in Nigeria, information goes to HR / CMO only)
- Resources contractor provides (e.g., Clinic, Medics, etc.)
- Contracts held with any TotalEnergies E&P approved medical facilities in Nigeria
- Arrangements for sub-contractors

7.2 CONTRACTOR WORKSITES

Project personnel deployed on Contractor worksites will be under the contractor medical facilities, arrangements and medical plans at the site. This system must provide local treatment and / or stabilization and medical transportation of:

- TotalEnergies personnel to a TotalEnergies retained clinic or hospital
- Contracted / Contractor personnel to be transferred from worksite clinic to an arranged medical facility as per the contractor medical policy.

Note: Contractor worksite medical plans must be provided to UBETA HSEQ Dept for review and verting.

7.3 PERSONNEL IN TRANSIT

Personnel in transit must have appropriate medical and travel insurance cover:

- TotalEnergies Staff are to ensure they carry the TotalEnergies medical emergency card
- Contracted / Contractor Staff to be issued with a medical emergency card by the contractor / agent. Medical insurance policies must cover travel, when individuals are required to travel for business purposes (including rotation, mobilization, demobilization, etc.).

7.4 IMPORTANT INFORMATION & DATA

The Project HR must identify and maintain the following important data:

- List of Project personnel (TotalEnergies and contracted), contractor personnel and visitors present on all project locations
- Contact details for the families, next-of-kin and / or emergency contact, of all project personnel (specifically identifying those residents in Nigeria)

Local project personnel onboard (POB) and on-site lists are to be maintained and distributed to the UBETA HR Department and UBETA HSEQ Manager.

Personnel journey management lists are also to be maintained and provided with POB's for each location (personnel itineraries). This is the responsibility of each RSES/D, UBETA Project Company Site Representative and Package Manager.

A Project Personnel Database is to be maintained by the Project HSEQ Department. The database should be kept up to date with information from initial joining forms, contractors and agents contracts, and daily POB's. A list of all project contractors, vendors, and agents 24/7 emergency contact details must be maintained up-to-date and provided to the UBETA Duty Officer.

8. MUSTERING AND EVACUATION PRINCIPLES

The subject of this sheet is the description of the implementation of mustering and evacuation procedures, in case of emergency. The Muster Checker is responsible for the success of this operation.

Site management must endeavor to carry out planned emergency drills to constantly test for gaps in emergency scenarios and close out the gaps

8.2 POB MANAGEMENT

The POB is the list of Personnel on Board – Present withing incident site area. The POB list must be constantly updated. The POB must be pre-established, and a list of people present on the site, including visitors and contractors, must be available.

The POB is used during mustering and evacuation steps, to check present people and to

identify missing people.

8.3 MUSTERING

On each site, one or several muster points shall be defined. A muster point should be large

enough to accommodate all the personnel on board (POB) or present including day visitors. There should be strict monitoring of the POB daily and a POB forecast assessment so that POB does not exceed the emergency response capacity of the location.

During the alert or emergencies personnel with no specific role in the ERIT shall proceed to their assigned muster points or the main muster point.

The Muster Checker is then responsible for taking a head count of personnel present and communicate this number to the RSES or ERIT to reconcile present with expected POB. Missing persons shall be identified and search for missing personnel shall be activated with appropriate risk evaluation.

In the case of a security emergency, personnel shall be immediately directed to muster at the safe heavens and not the regular muster points. ERIT teams shall also muster at the safe heaven and await further instruction from the RSES/RSES-D.

8.4 SEARCH FOR MISSING PERSON

If some personnel are missing at the muster point, the Muster checker informs the Control Room (RSES) to organizes a team to search and rescue missing persons. This is dependent on the level of escalation of the incident.

The search and rescue teams must consist of at least two (2) personnel from the Fire Fighting Team and must always be adequately protected with PPE, communication tool (radio) and extra emergency equipment where applicable.

Search and rescue team must be monitored, and continuous communication must be maintained with the RSES or RSES-D.

8.5 EVACUATION

The RSES will decide when to perform partial (non-essential personnel) or complete evacuation of the site dependent on the evolution of the emergency. Evacuation shall be done in an orderly manner.

9. SENARIOS

9.2 FIRE / GENERAL INCIDENTS

ACTIONS REQUIRED BY INDIVIDUALS

- On hearing the alarm and notice of Fire/General incidents proceed directly to your allocated Muster Station.
- Ensure to Tag for POB management.
- Remain silent to assist the Muster Checker to complete the head count.
- Listen for any further instructions made on the Public Announcement.
- Follow any instructions requested in an orderly manner.

ACTIONS REQUIRED BY ERIT

- Prepare for response, assemble at dedicated ERIT muster point
- Team to don appropriate PPE
- Ensure functionality of communication equipment
- Await instruction from RSES

9.3 MEDICAL INCIDENTS

ACTIONS REQUIRED BY INDIVIDUALS

- All personnel are to proceed directly to their allocated Muster Station.
- Ensure to Tag for POB management.
- Remain silent to assist the Muster Checker to complete the head count.
- Listen for any further instructions made on the Public Announcement.

- Follow any instructions requested in an orderly manner.

ACTIONS REQUIRED BY ERIT

- Prepare for response, assemble at dedicated ERIT muster point
- Team to don appropriate PPE
- Ensure functionality of communication equipment
- Await instruction from RSES

9.4 SECURITY / SITE INVASION

ACTIONS REQUIRED BY INDIVIDUALS

- On hearing the security alarm proceed directly to **Safe haven** *(Security Muster should be completed within the five (5) Minutes)*
- Remain silent to assist the Muster Checker to complete the head count.
- Listen for any further instructions made on the Public Announcement.
- Follow any instructions requested in an orderly manner.

ACTIONS REQUIRED BY ERIT

- On hearing the security alarm proceed directly to **Safe haven**
- Remain silent to assist the Muster Checker to complete the head count.
- Listen for any further instructions made on the Public Announcement.
- Follow any instructions requested in an orderly manner.

10. OIL SPILL RESPONSE

10.2 OIL SPILL SCENARIOS

An oil spill risk assessment has been developed for all onshore activities which is described in full in the TUCN District General OSPC PLN-HSE/ENV-MOS-15. This section provides an overview that can be used to obtain an indication of potential spill scenarios and volumes.

#	Facility / Activity	Scenario	Possible Causes	Oil Type	Volume	Location of Release
1.	Drilling / producing production wells.	Blowout.	Sabotage, equipment malfunction, well kick during drilling, unexpected reservoir conditions.	Crude, Natural Gas or condensate. Percentage of produced water significantly varies between wells.	Depends on well characteristics, for example some wells producing around 440m3 of oil per day and others <5m3 of oil per day.	Wetland, swamp, river, on land. Community impact possible. Community Farms and Recreational areas
2.	Diesel road tanker.	Tanker rollover.	Road accident, human error, sabotage / attack.	Diesel.	Up to 45m3.	Roadside; on land, ditches, vegetated areas. Community impact possible.
3.	Drilling localities.	Loss of oil based mud transport.	Road accident, human error, sabotage / attack.	Oil based mud containing up to 60% base oil (EDC 99-DW).	Up to 45m3.	Roadside; on land, ditches, vegetated areas. Community impact possible.
4.	Diesel storage tank.	Loss of inventory.	Catastrophic failure, human error, corrosion, wider emergency, such as an explosion.	Diesel.	Tank volume is 50m3.	Spill contained within the bund.

10.3 TIERED RESPONSE

The TotalEnergies Group has adopted the internationally recognized tiered approach to oil spill response and has oil spill response capabilities available at each level. In specific relation to TUCN, the definition of each tier level and the resources available are given below. A full inventory of all response capabilities is provided in TUCN PHC District Anti-Pollution Equipment Stockpile, (SPE-HSE/GEN-MO9-55) and the strategies they offer are summarized in sections

Tier 1 **(Low Severity)**	A spill that can be mitigated by the onsite resources without the need for external assistance. Such incidents are usually small in volume and have a negligible impact. Onshore Tier 1 resources include containment and recovery equipment, temporary storage, and the use of local contractors.
Tier 2 **(Medium Severity)**	A spill that overwhelms the onsite Tier 1 resources. Commonly they are larger in volume than a Tier 1 incident, however, could still be relatively small but where the oil has migrated beyond the reach of Tier 1 resources. Regional Tier 2 resources would be required to supplement the Tier 1 resources. The Tier 2 resources available to TUCN include: Clean Nigeria Associates (CNA) an organization funded by the industry operators and can provide onshore, estuarine, swamp and offshore response capabilities. Mutual Assistance Plan (MAP) is where the Nigerian oil industry operators have entered into an agreement to make some of their respective Tier 1 resources available to one another in the event of an oil spill incident.
Tier 3 **(High Severity)**	A spill that overwhelms all Tier 1 and Tier 2 resources. Commonly, Tier 3 spills are extremely large and affect a wide area. Such incidents may include a blowout. Tier 3 resources available to TUCN are: Oil Spill Response who can mobilize expert personnel and specialized equipment to Nigeria in the event of an incident.

	Oil Spill Response Limited has the capability to mobilize resources to enable a wide range of response strategies to be employed including offshore containment and recovery, aerial / vessel dispersant application, shoreline protection and clean-up, and inland strategies. Equipment is stockpiled in Southampton in the UK, Bahrain and Singapore. Fast Oil Spill Team (FOST) which is the Total Group's oil spill response organization who are based in Rognac, France. FOST can mobilize people and specialized equipment to respond. Capabilities include containment and recovery, small scale aerial dispersant application and shoreline cleanup.

Available Onshore Tiered Response Strategies Strategy	**Tier 1**	**Tier 2**	**Tier 3**
Containment and Recovery of Oil on Permeable / Impermeable Ground	Use of sorbents / manual recovery or use of the vacuum truck, and use of local contractors to supply vacuum trucks / earth work machinery.	CNA and use of local contractors to supply vacuum trucks / earth work machinery.	Use of all Tier 2 resources and Oil Spill Response / FOST.
Containment and Recovery in Ditches / Streams	Using various locally available materials. Skimmer systems held at Obagi, and the vacuum truck offer a range of options.	CNA / MAP.	Oil Spill Response or FOST managing, using various locally available materials.
Containment and Recovery in Rivers	Booms held at Obagi may be suitable for smaller / slower rivers. Skimmer systems held at Obagi, and the vacuum truck offer a range of options.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.

Containment and Recovery in Swamps	Booms held at Obagi are suitable. Skimmer systems held at Obagi, and the vacuum truck offer a range of options.	CNA / MAP.	Use of all Tier 2 resources and Oil Spill Response / FOST.

10.4 GENERAL CONSIDERATIONS

In the event of an oil spill that progresses outside the confines of the Ubeta Project facilities, there are some key issues that need to be considerations:

- The local community will need to be consulted and permission to access sought. This has the potential to significantly delay a response.
- A security escort will need to be arranged for the response teams.
- Access to the affected site may be limited due to thick vegetation, muddied tracks, etc.
- Oil Spill response for major oil spill shall escalate to the OML58 Oil Spill Response Plan for manpower and equipment.

10.4.1 CONTAINMENT AND RECOVERY ON IMPERMEABLE GROUND

Tier 1 Suitable Resources	• Sorbents Pads • Pumps • Temporary storage tanks • 8,000-liter capacity vacuum truck • 6m3 Vikotanks • Hand tools (shovels, etc.) • Earthworks machinery from local contractors
Consideration	• Ensure safety is considered; stop any ignition sources and ensure gas monitoring is undertaken. • The primary focus in spill response on land is to prevent the migration of oil into any waterway as a spill would rapidly spread and potentially impact a large area. • Ensure oil does not enter open drain systems. • Care should be taken to ensure that blocked drains or channels do not pose a flooding risk during rainy periods.

	• Within the Ubeta Project facilities, hard surfaces (concrete, bunds, etc.) are likely to be contaminated more so than soil. • If oil is spilled on impermeable ground, it will spread and pool in depressions.
Technique	• Use small dams formed from soil, sandbags, sorbents to protect inlets and drains. • Seal drain gratings with plastic bags and sand. • In TUCN facilities, it may be preferable to gently flush oil into closed drain systems so that the sump pumps can be used to collect the oil. • Use sorbents to recover oil from concrete areas, ditches, etc. • Vacuum systems can be used to recover oil, especially where oil has pooled – these areas should be a priority in soil areas. • Steam cleaning concrete may be necessary with contaminated water collected by sorbents or washed into closed drains or spill tanks. • In bunded areas, a water bottom can be introduced to aid recovery operations. • Where oil has been spilled on soil, earthworks machinery should be used to move any contaminated soil and free oil into lined pits / trenches for temporary storage / recovery.

10.4.2 CONTAINMENT AND RECOVERY ON PERMEABLE GROUND

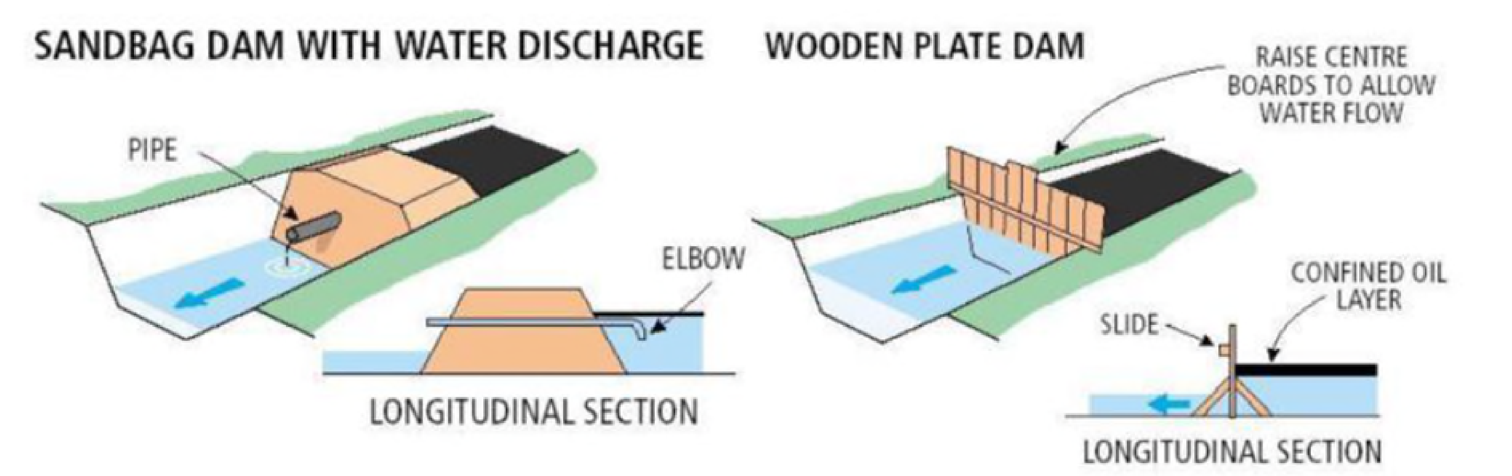
Tier 1 Suitable Resources	• Sorbents • Skimmer systems: Vikoma Komara 12 Skimmer can recover around 12m3/hour and • Vikoma Komara 20 Skimmers around 20m3/hour, assuming perfect conditions and that they are being operated by trained personnel. Both systems can be manually carried to site. • 6m^3 Vikotanks • 8,000-liter capacity vacuum truck • Hand tools (shovels, etc.) • Earthworks machinery from local contractors
Considerations	• Ensure safety is considered; stop any ignition sources and ensure gas monitoring is undertaken.

	• The lighter crudes, condensate, diesel, base oil and utility oils have the potential to penetrate permeable soils and migrate downwards under the influence of gravity and capillarity. The rate of penetration is dependent on both the type of oil and type of soil. The combination of low viscosity oil and coarse gravel will result in the fastest penetration rate. Groundwater movement is very slow; usually between 0.5m and 1.5m per day, thereby giving time to mount a suitable restoration project. • Ensure oil does not contaminate water courses. • Avoid driving over contaminated areas as it will increase the penetration rate and spread pollution. • Do not flush oil down drains / inlets. • Do not use excavators on areas with free oil.
Techniques	• Concentrate oil so it can be transferred to temporary storage units. • Use sorbents to limit spreading and to recover surface oil. • If the area is contained, introduce a water bottom to limit infiltration. • Remove contaminated ground material for disposal / remediation. • Dig a trench to intercept horizontal movement of spilled oil, see the adjacent image. Points to remember are: o Trenches can be built if the water-table is situated less than 3m below the ground. o The water level in the trench should be reduced about 30 – 40cm to prevent escape of inflowing oil and to speed up the inflow of further free oil. o An impermeable membrane or sorbent should be placed on the down-flow side of the trench to limit the escape of oil. o The TUCN sorbents, skimmers, pumps and vacuum truck can be utilized to recover oil. • Temporary storage pits should be excavated and impermeably lined to store oil and also assist in transferring oil from remote areas.

10.4.3 CONTAINMENT AND RECOVERY IN DITCHES / STREAMS

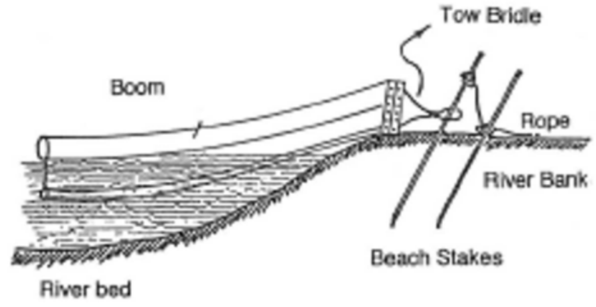
Tier 1 Suitable Resources	• Sorbents • Skimmer systems: Vikoma Komara 12 Skimmer can recover around 12m3/hour and • Vikoma Komara 20 Skimmers around 20m3/hour, assuming perfect conditions and that they are being operated by trained personnel. Both systems can be manually carried to site.

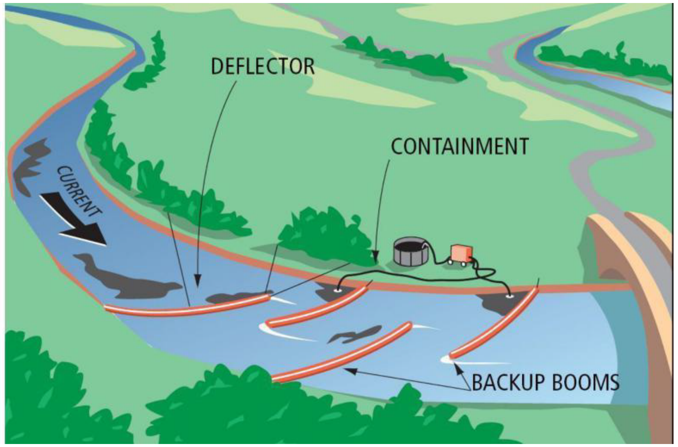
	• 6m 3 Vikotanks • 8,000 liter capacity vacuum truck • Hand tools (shovels, etc.) • Locally materials; wooden planks, plastic sheeting, piping, sandbags, etc.
Considerations	• Ensure safety is considered; stop any ignition sources and ensure gas monitoring is undertaken. • There are two basic types of dam; those which allow water flow to continue and those which seal it off. The latter is easier to construct, however may lead to flooding and the subsequent oil pollution of surrounding areas. Some dams may require the bank to be reshaped. • Contaminated banks will need to be cleaned following removal of bulk oil. • The use of dams can be employed where the width of the ditch or stream is narrow enough with a gentle flow for one to be safely constructed. Damming is only suitable where the width is no more than 2m and depth 1m. • Once constructed, the pooled oil can be recovered using skimmers. • The riverbed may be scoured at the dam discharge point.
Technique	• Construct the dam where there is good access and high banks. • Ensure the dam is of sufficient width or fixed into the bank to withstand the hydrostatic pressure. • Ensure the dam is monitored so that water does not overflow. • When using discharge pipes, ensure that the upstream inlet is close to the bed so not to draw oil from the surface. • A sandbag or earth dam is particularly useful if other materials are unavailable. • Once oil is pooled it can be recovered by skimmer or sorbents. • The main damming systems that could be employed at Ubeta Project Site are detailed below:



10.4.4 CONTAINMENT AND RECOVERY IN RIVERS

Tier 1 Suitable Resources	• Sorbents • River booms • Fence booms – 1000m total length • Skimmer systems; Two. Vikoma Komara 12K Skimmer can recover around 12m3/hour, One Vikoma Komara 20 Skimmers around 20m3/hour, and three (3) Komara duplex Skimmers that can recover around 30m3 per hour assuming perfect conditions and that they are being operated by trained personnel. Both systems can be manually carried to site. • 6m3 Vikotanks • 8,000-liter capacity vacuum truck • Hand tools (shovels, etc.)
Considerations	• Ensure safety is considered; stop any ignition sources and ensure gas monitoring is undertaken. • Fast flowing rivers will put high loads on the booms, making anchoring difficult. • It is not always practical to boom the river with a single length of boom.

	• Smaller booms may not be that durable and will be prone to damage from floating debris. • In currents over 2.5 knots the length of boom required to take account of current usually becomes unmanageable. • Oil will escape from a boom laid perpendicular to the flow if the relative current strength is above 0.6 knots. • If oil enters a fast-flowing waterway TUCN resources may be rapidly overwhelmed and support from CNA will probably be required.	
Technique	• Ensure the boom is securely anchored to the bank either by it being staked to the ground or attached to a tree. • Stakes should be angled away from the boom and secured to each other from the top of the bank stake to the bottom of the back stake, as in the diagram. • There should be a good seal between the boom and the bank. Sorbents should be utilized to ensure oil does not escape. • If there is a not a suitable point for recovery, the bank can be excavated to create an area of calm, sufficiently deep water for recovery. • For wider rivers, the use of anchors may be required to keep the boom in the correct figuration. • For currents between 0.6 and 2.5 knots, the boom must be set at an angle to the water flow so that the oil will not escape, but be deflected along the boom.	

	• For currents below 1.2 knots, the boom should be 1.5 times the width of the river as a minimum. • For currents of 1.2 and 1.4 knots, the total length of boom will range from twice to approximately 4 times the river width. • It is more effective to boom at a wide slow position than on a narrow fast stretch of water. • Booms should be deployed to deflect oil from the faster outer-side of the river to the slower inner-side of the river for recovery. • The boom should have a smooth profile and preferably have a bottom tension wire on which anchors can be placed. • Once oil is pooled at the bank in an area of calm water, the skimmer should be used for recovery. • Debris, such as vegetation, can clog up skimmers / pumps and impede recovery, but this can be overcome by using screens / mesh around the skimmer / suction hose.	 **Overview of River Booming**

11. INCIDENT DECLARATION FORM

TOTAL
Total Upstream Companies in Nigeria.

Health, Safety, Environment & Quality — PRD - HSE/GEN - M10 - 12 - Rev.3

Incident, Near-Miss Incident & Anomaly Declaration Form

RISK

Event Type	Domains of Consequences		Highest Severity - NMI / Incident		Human Loss
			Actual	Initial Potential	
☐ Anomaly	☐ Human	☐ Environment	☐ 1 - Minor	☐ 1 - Minor	☐ First Aid
☐ Near-Miss (NMI)	☐ Material	☐ Production Shortfall	☐ 2 - Moderate	☐ 2 - Moderate	☐ Medical Treatment Case
☐ Incident	☐ Media		☐ 3 - Serious	☐ 3 - Serious	☐ Restricted Work Day Case
☐ Occup. Illness			☐ 4 - Very Serious	☐ 4 - Very Serious	☐ Lost Time Injury
- Yellow Zone only -			☐ 5 - Catastrophic	☐ 5 - Catastrophic	☐ Permanent Disability
			☐ 6 - Disastrous	☐ 6 - Disastrous	☐ Fatality
					☐ Multiple Fatality

1 - Immediate notification by RSES to Duty Manager; 2 - Email within 24 hours to &E-NG-EP-ECHO-ECHO

Date:	Time:	Discipline:
Site:	**Exact Location:**	**Site report No:**

Mandatory — 1. Description*:

include details of victims if any

Optional — 2. Causes:

Key Type of Event (Tick at least one)

☐ Explosion, fire, flash	☐ Position loss /collision
☐ Internal leak > limits	☐ Subsea diving event
☐ Internal leak ≤ limits	☐ Natural event
☐ Leak - LOPC	☐ Non occupational injury
☐ Potential LOPC	☐ Occupational injury
☐ Well event	☐ Equipment difficulty
☐ Air transportation	☐ Falling/dropped object
☐ Land transportation	☐ Handling/Lifting event
☐ Man overboard	☐ Production/process upset
☐ Marine transportation	☐ N/A or other

Mandatory — 3. Immediate actions Taken:

Golden Rule(s) concerned

☐ Risk	☐ Permits	☐ Excavation
☐ Traffic	☐ Lifting	☐ Work at height
☐ Body	☐ Power	☐ Change
☐ PPE	☐ Confined	☐ Simops

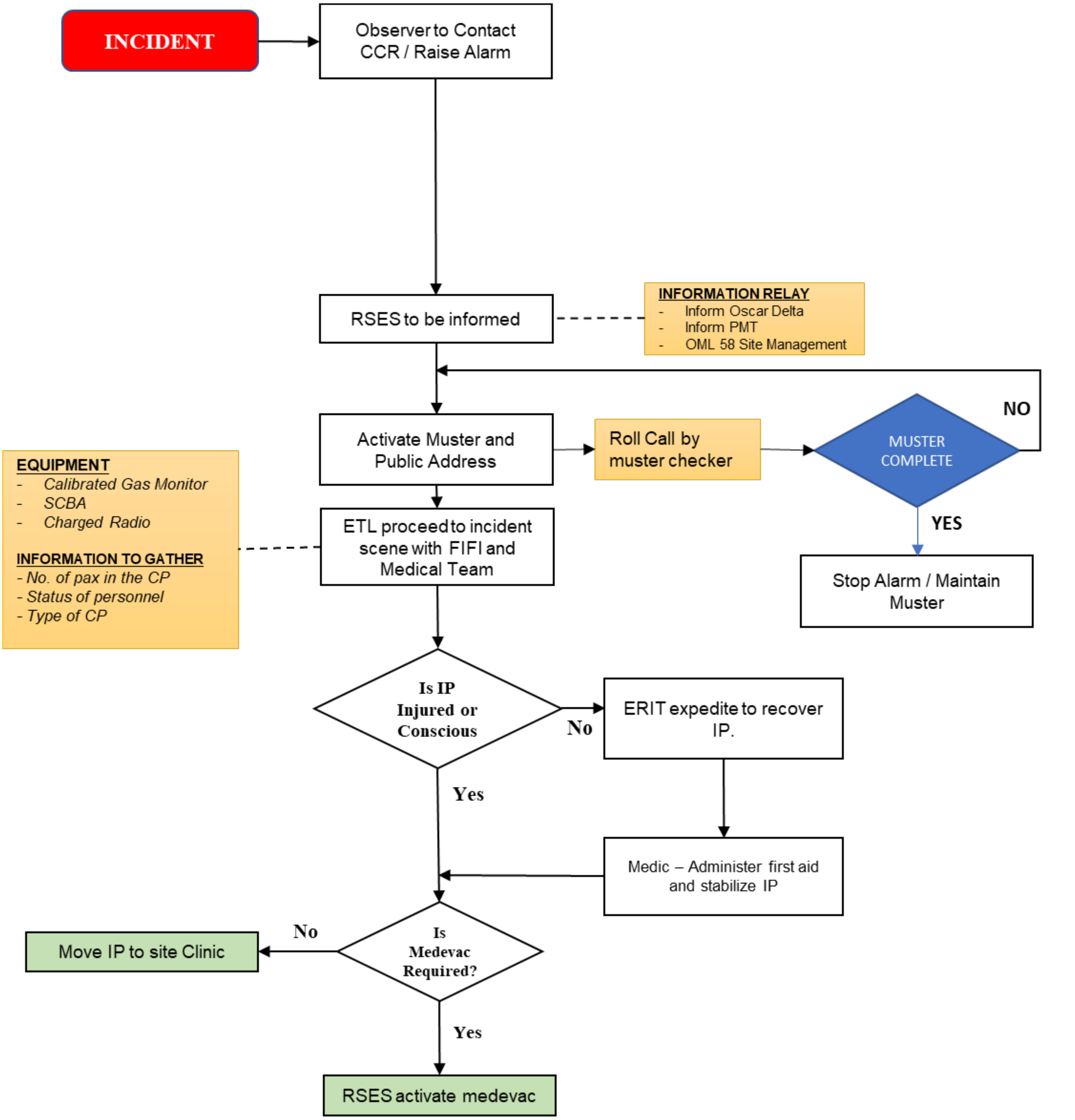
Optional — 4. Proposed Remedial Action(s)	Responsible	Deadline
Reported by: Name: ____________ Signature ____________ (Anonymous reports are accepted for Anomaly)	Title:	Date :
Endorsed by: Name: ____________ Signature ____________	Title: **RSES/RSES-D**	Date :

Tick ☒ if entry into Synergi is required | Synergi: Case Owner: ____________ Event no:______

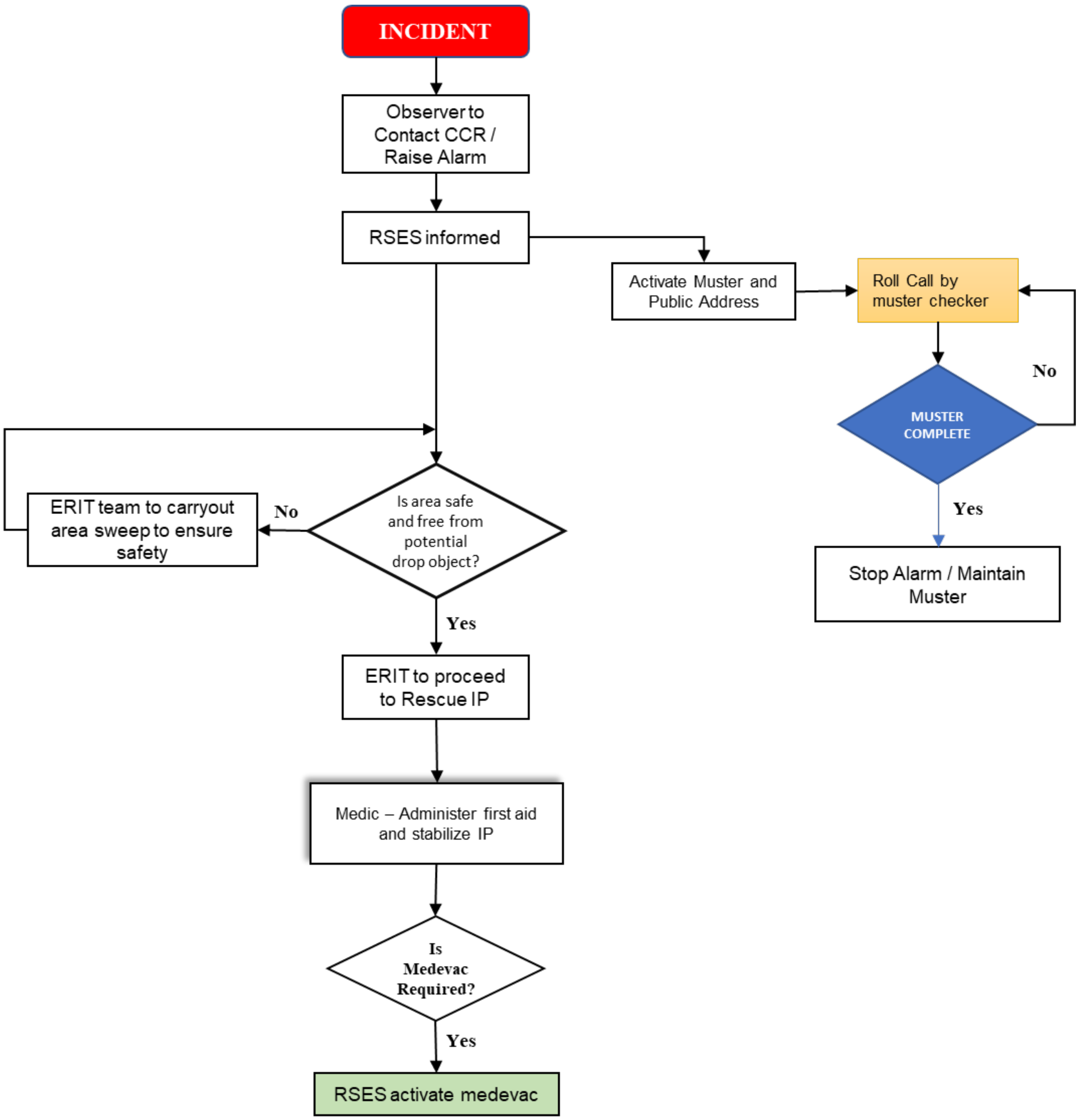
You may submit your anomaly by email: use EP-NG-DW.DW-LOS-Anomaly@total.com in Lagos, EP-NG-PHC.PHC-Office-Anomaly@total.com in PHC and EP-NG-ABJHSE.ABJHSE-Anomaly@total.com in Abuja

12. REFLEX CARDS

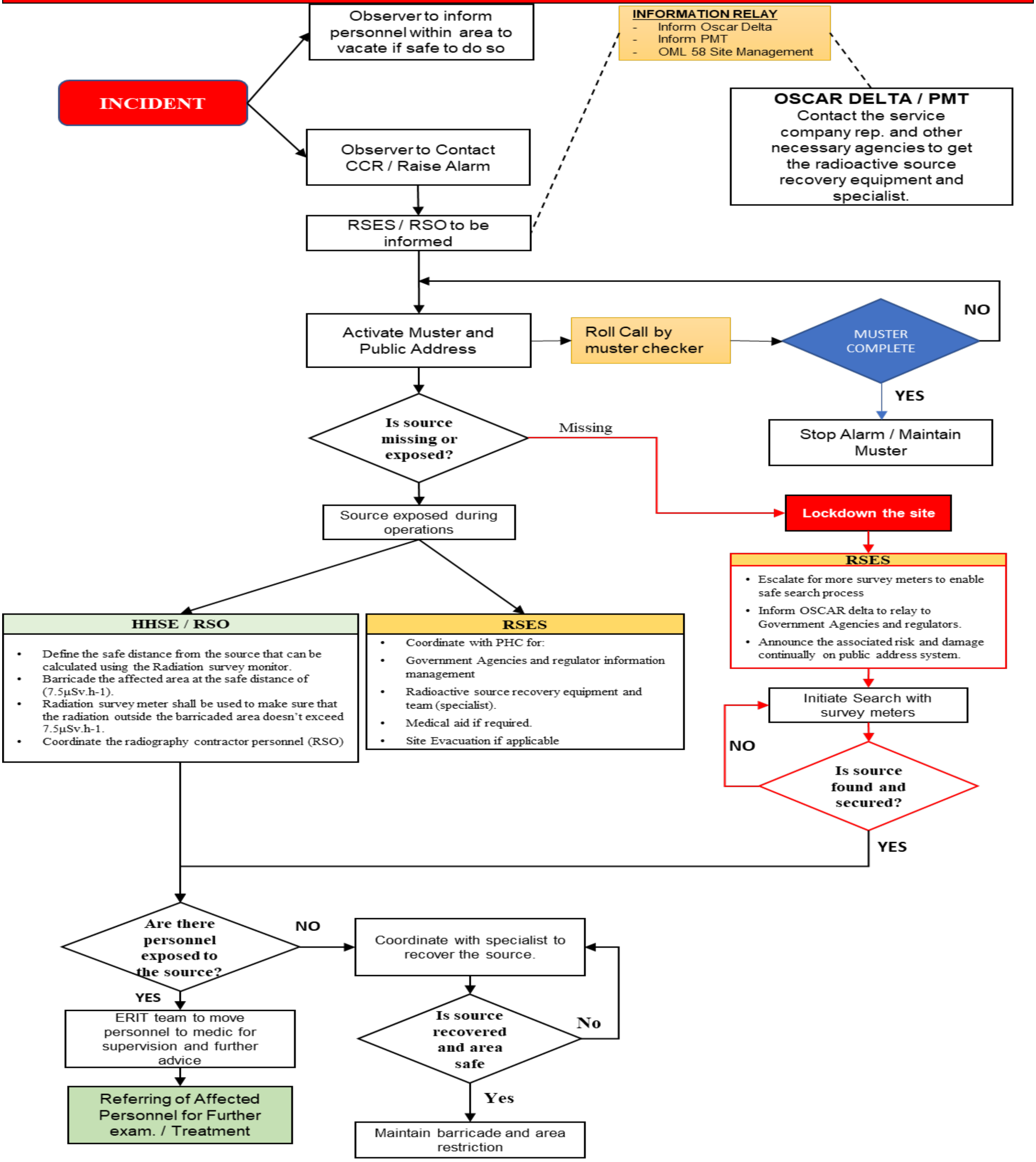
CONFINED SPACE REFLEX CARD



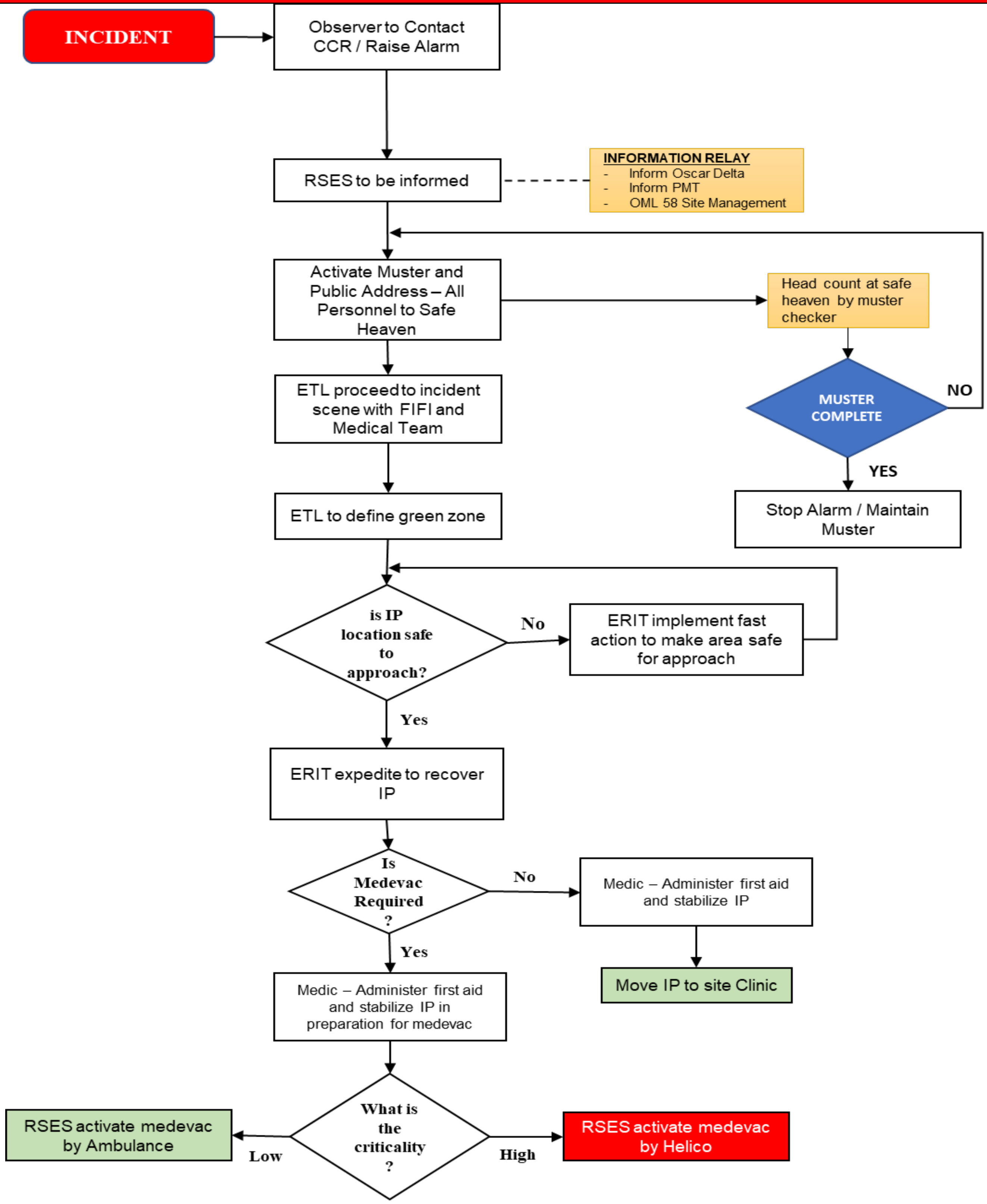
DROPPED OBJECT REFLEX CARD



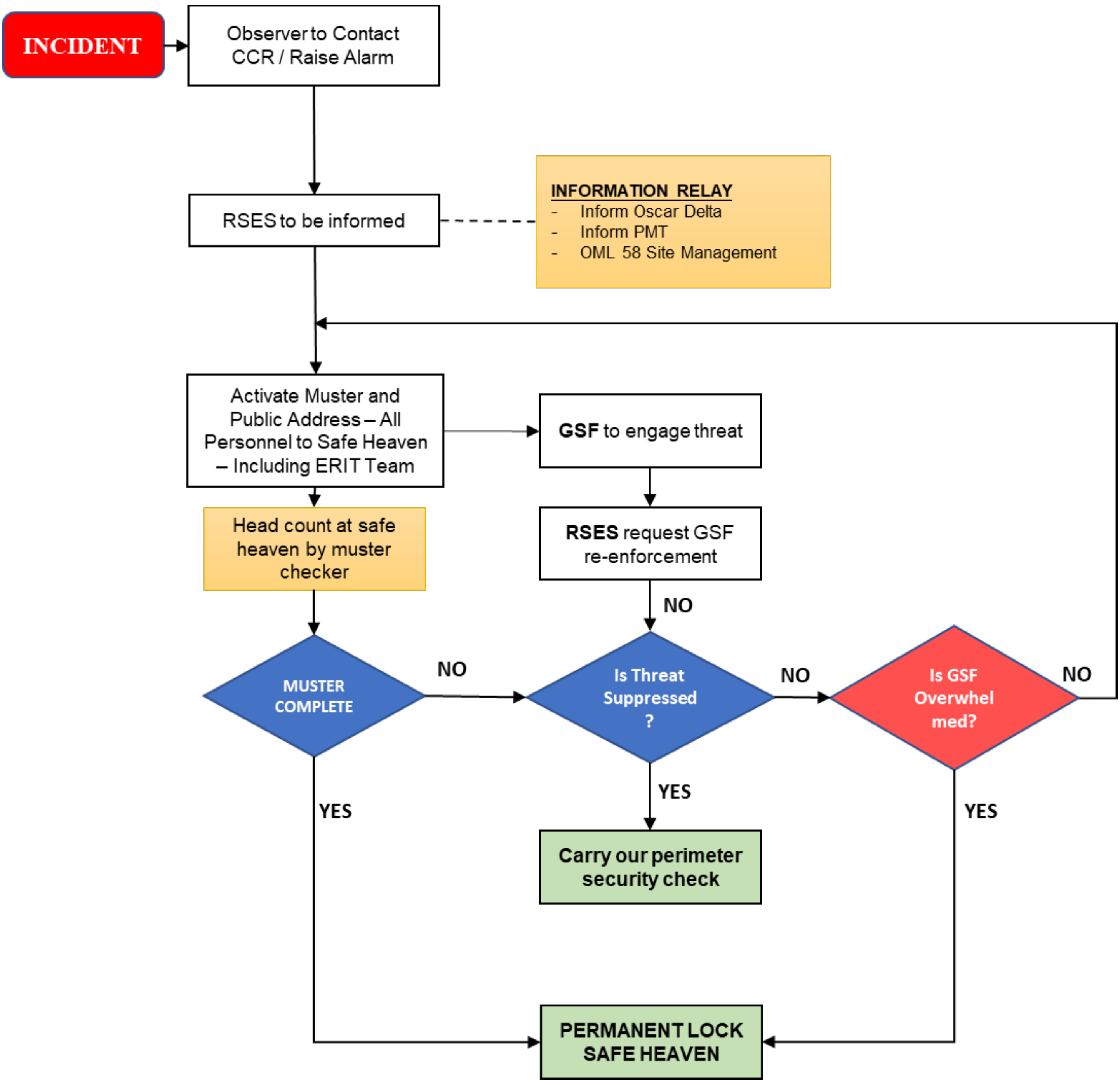
MISSING/ EXPOSED RADIOGRAPHY SOURCE REFLEX CARD



MEDICAL EMERGENCY REFLEX CARD



SECURITY / SITE INVASION REFLEX CARD



COMPANY MANAGEMENT SYSTEM
LEVEL 1 DOCUMENT

TUCN -WASTE MANAGEMENT PLAN

Approval

	Name	Function	Date	Signature
Author	O. BRAIDE	Mgr Environ & IH PHC		Opakirite BRAIDE J0103623
	G. ADAMS	Environment Engineer DW		Digitally signed by godleads.adams@total.com DN: CN = godleads.adams@total.com Date: 2019.11.14 09:18:14 +01'00'
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Reviewed by	P. OTIGBAH	GM HSE DW		Digitally signed by patrick.otigbah@total.com DN: cn=patrick.otigbah@total.com Date: 2019.11.15 10:17:12 +01'00'
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Revisions history

2	15 October 2019	MD	CMS review cycle and One-MAESTRO HSE MS
1	31 March 2016	MD	Align with Company Rule CR EP HSE 052 and change in organisation
0	May 2011	MD	First Issue
Rev.	**Date**	**Authorised by**	**Brief comments**

Contents

1. Purpose

The purpose of this Plan is to document the method by which TUCN, referred to as the "Company" herein after; collects, registers, transports, reuses, recycles, treats and disposes solid and liquid wastes (hazardous and non-hazardous) generated from its activities i.e. cradle to grave management of waste. The document is also to safeguard the health of people whose work may require them to handle waste or be exposed to it, to protect residents and to preserve the environment around sites hosting activities. The Plan also assigns responsibilities to persons connected with waste management; contracting any aspect of the waste management process does not release the Company of responsibilities as the waste producer. The Plan also provides the framework from which site/project specific waste management procedures shall be developed.

2. Scope and Locations

This Plan applies to all Company assets and locations in Nigeria and to all waste management services performed on behalf of the Company by contractors. It covers solid and liquid wastes encountered in the Company's operations such as exploration/seismic, drilling/completion, production, maintenance, logistics, decommissioning and abandonment.

Each site/location, field development/upgrade project and developmental drilling project shall use this document as a framework to develop a waste management procedure specific to their site/location and activity; putting into consideration recommendations from related Environmental and Social Impact Assessments. This plan shall be updated regularly to adapt to regulatory changes, changes in Company Rules/General Specifications, and significant change in the Company operation.

Contractors working for the Company shall have waste management procedure which shall be consistent with the Company waste management plan else a bridging document shall be developed.

Affiliate's Sites and Locations

The Affiliate is divided into three Districts: Port Harcourt, Deepwater and Abuja.

Sites and locations under Port Harcourt District include:

- Amenam (OML 99)
- Odudu and FSO Unity (OML 100)
- Ofon (OML 102)
- Obagi, Obite, Olo (OML 58)
- Owaza, Rumuji (NOPL)
- Onne Logistics Base
- Port Harcourt Administrative Office and Residential locations

Sites and Locations under Deepwater District include:

- Akpo and Egina (OML 130)
- Lagos Administrative Office and Residential locations

Sites and Locations under Abuja District include:

- Abuja Administrative Office and Residential locations

3. Related documents

3.1. Internal to Total Upstream Companies in Nigeria (CMS)

Reference	Title
HLP-HSE/GEN-M02-07	TUCN HSE Policy
PRD-HSE/IHY-M04-041 PLN	Hazardous Materials Management Procedure
- HSE/ENV - M05 – 11 PLN -	Contaminated Site Remediation Procedure
HSE/ENV - MO5 – 14 PLNPLN	PHC District Oil Spill Contingency Plan 3
- HSE/GEN - M09 - 84	DW OSCP - Vol. 2 - Response Handbook

3.2. Total Group/E&P documents

Reference	Title
CR EP HSE 052	Waste Management in Exploration and Production activities
DIR-GR-ENV-003	Waste Management
CR EP HSE 001	Implementing the E&P branch HSE policy: MAESTRO
CR EP HSE 051	Respecting the environment in Exploration & Production processes
CR EP HSE 060	Industrial hygiene and health at work
CR EP HSE 121	HSE Recording, Reporting, Key Performance Indicators and Feedback
GS EP ENV 001	Environmental requirements for projects design and E&P activities
GS EP ENV 120	Environmental impact assessment of E&P activities
GS EP ENV 421	Landfill design and operation for E&P sites
GM EP APP 008	Decommissioning of production facilities
GM EP HI 063	Prevention of asbestos-related risks
GM EP HI 067	Prevention of risks from natural radioactivity
CR EP HSE 062	Personal Protective Equipment
CR EP HSE 094	Oil spill preparedness and response policy in Exploration and Production
CR EP HSE 067	Prevention of health risks due to radiation
CR EP FP 470	Non Aqueous Based Mud
GS EP MED 062	Hygiene on onshore bases and offshore living quarters
REG GR DSI 001	Representatives dealing with Public Officials
GS EP MED 060	Onsite medical structures

3.3. External documents

Reference	Title

DPR	DPR Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN), Revised edition 2018
FMENV	Environmental Guidelines and Standards for Pollution Control in Nigeria, 1991.
FMENV	EIA Sectoral Guidelines on Oil and Gas Industry Projects, 1995.
FMENV	FEPA EIA Procedural Guidelines, 1995.
BAMAKO CONVENTION	Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Waste in Africa
BASEL CONVENTION	Control of Transboundary Movements of Hazardous Waste and their Disposal, 1992
IPIECA vol. 12	Guidelines for oil spill waste minimization and management IPIECA Oil Spill Report series Volume 12, IPIECA, February 2004
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, modified by the 1978 Protocol related thereto, and modified by various subsequent revisions of Annex V, particularly by resolution MEPC.201(62) of July 15, 2011, and resolutions MEPC.219(63) and MEPC 220(63) of March 2, 2012

4. Definitions/abbreviations/Acronyms

Biodegradable	Substances that can break down into simpler – soluble or gaseous – compounds by micro-organisms in the soil, water or atmosphere.
Bottom wastes	Solids and emulsions which collect in the lower sections of slop tanks, crude oil stock tanks, closed water drain tanks, open water drain tanks and other bottom storage and separation vessels as well as in produced water storage or emergency pits such as the burn pit.
Bq/g	Becquerel per gram is unit of measurement of radioactive decay which is equal to 1disintegration per second
Company	**"TUCN", "Total Upstream Companies in Nigeria"** or **"The Affiliate"**: designates all of the Total Upstream Companies registered in Nigeria.
Deep Offshore	Waters situated at more than fifty (50) kilometres from the shoreline and greater than two hundred (200) meters depth
Disposal/Discharge	Deposit, injection, dumping, spilling, leaking or placing of waste material into or on any land, underground or water body so that such waste, or constituent thereof, may enter the environment.
Elimination	Any permanent storage operation, controlled landfill, burial, injection, physic-chemical processing or incineration leading to the immediate or ultimate destruction or disappearance of the waste.
Encapsulation	The enclosure of waste by a non-permeable substance. Waste constituents are not chemically altered but their transport will be impeded.
Extraction	The use of solvents to extract oil from oily solids or sludge.
Generator	In this context, individual(s) who produce the waste stream and is responsible

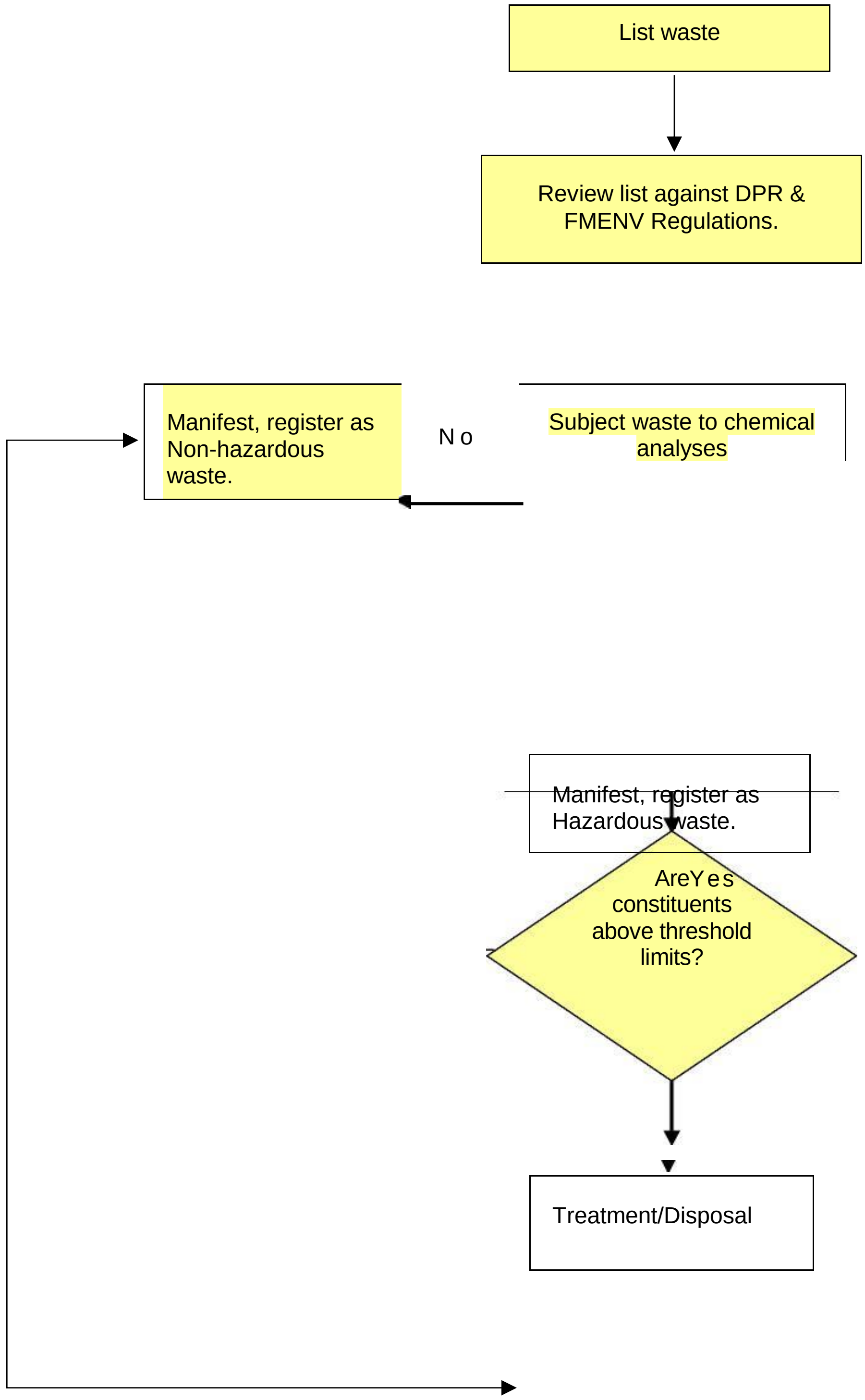
	for placing the waste in the relevant segregated bin.
Hazardous waste	Any waste or combination of wastes regardless of its origin that has one or more properties likely to render it harmful. This kind of waste produced by industrial or economic activity may present a physic-chemical risk (ignitability, corrosivity, reactivity, radioactivity, toxicity etc.) and /or a risk to health and/or the environment. Such waste is processed and transported via suitable means.
Inert Waste	Any waste that cannot undergo any significant physical, chemical or biological transformation; which does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact, in a way that will likely give rise to environmental pollution or harm to human health. The total leachability and pollutant content of the waste must be insignificant (e.g. rubble, gravel, paving blocks, sand, cement, concrete etc).
	In this context, representing the accounting for the equation of incoming products and resulting generated waste products.
Materials balance	Brackish and saline waters subject to tidal influence, including five (5) kilometres of the high seas from the shoreline e.g. swamp estuary and coastal waters.
Near -Shore	Treatment processes designed to limit the mobility and solubility of waste while locking the waste within a solidified matrix
Stabilisation/Solidification	Any waste, regardless of its origin, presenting no properties likely to render it harmful. (e.g. paper, cardboard, glass, unsoiled plastic, metals etc).
Non-hazardous waste	Naturally Occurring Radioactive Materials: Designates substances which although contain naturally radioactive elements, are not utilized for their radioactive properties. TENORM (Technologically Enhanced NORM) designates more specifically NORM that has been concentrated by industrial activities.
NORM	
	Waters situated between five (5) kilometres and fifty (50) kilometres from the shoreline.
Offshore	Offshore area that is twelve (12)nautical miles (or 22km) away from the shoreline and of water depth greater or equal to two hundred (200) feet (or 61meters)
Offshore Discharge Zone	Any fixed or floating offshore installation or structure engaged in gas or oil exploration, exploitation or production activities, storage, loading /offloading of oil.
Offshore Unit	Land location.
Onshore	Environment reporting system used by the E&P branch
Pl@net	Waste treatment process by which manufacturing residues or materials from a former product, now at the end of its life, can be reintroduced into the production cycle of a new, similar item.
Recycling	All waste management operations, with the aim of extracting materials from a waste, with the purpose of applying such for other uses, consequently reducing the quantity of waste generated.
Recovery	The action of re-using a product, substance or material for its initial purpose, without transforming its state.
	Reduction of the quantity of the wastes that are generated at its Source.
Re-Use	
Source Reduction	

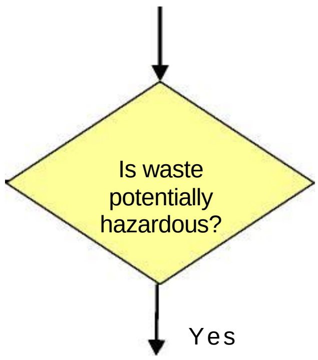
Synergi	WEB client intranet application for recording HSEQ events and action plans from any operating site. The data entered is saved in a central server in E&P headquarter, and can be utilized in many formats in real time.
Treatment	Any operation that precedes recovery or disposal i.e. re-use, recycling, volume reduction (e.g. dewatering) etc.
Waste	Any substance, material or product that a waste holder is disposing of or intends /is obliged to dispose of. This includes but not limited to: • Liquid, solid or gaseous residues arising from a process / activity • Off-spec products • Accidental spillage and associated remediation materials • Contaminated materials
Waste handling	Activities associated with management of a waste, prior to storage, transfer and ultimate disposal.
Waste Handler	Person or corporate entity charged with the management of waste from generation to final disposal.
Waste Holder	Any natural or legal person in possession of waste. The status of waste holder extends to the waste producer.
Waste Producer	Any natural or legal person whose activity produces waste (initial waste producer) or any person who performs pre-processing, mixing or other operations that change the nature or composition of waste.
WEEE	Waste electrical and electronic equipment including batteries and electric bulbs (fluorescent, and incandescent)
Waste Injection	Disposal of waste stream down hole, direct into a disused well or annular.
Waste Management	The discipline associated with the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste in a manner that complies with the best principles of public health, economics, engineering, conservation, aesthetics and other considerations.
Waste Minimisation	Any technique, process or activity which either avoids, eliminates or reduces waste.
Waste Register	The inventory of the waste streams, both in terms of composition and quantity, produced at each of the facilities.
Waste Manifest	Quintuplets form to record waste generation and transfer of that waste.
Waste Coordinator	Head of HSE/HSE Supervisor or nominated individual at a facility/site, responsible for overseeing the management of waste.
CMS	Company Management System
CEO	Chief Executive Officer
DPR	Department of Petroleum Resources
DWD	Deepwater Water District
EGASPIN	Environmental Guidelines and Standards for the Petroleum Industry in Nigeria
ED	Executive Director
EGM	Executive General Manager

EIA	Environmental Impact Assessment
EMS	Environmental Management System
ENV	Environment
FEPA	Federal Environmental Protection Agency
FMENV	Federal Ministry of Environment
GD	Guide
DGM	Deputy General Manager
GM	General Manager
HSEQ	Health Safety Environment and Quality
IBC	Intermediate Bulk Containers
IST	Information System Technology
MD	Managing Director and Chief Executive Officer
NEGAS	National Environmental Guidelines and Standards
OSL	Operation Safety Lead
PHC	Port Harcourt
PHCD	Port Harcourt District
PPE	Personnel Protective Equipment
PLN	Production
RSES	Responsible for Safety and Environment on Site
SON	Standard Organisation of Nigeria
TLV	Threshold Limit Value
IDHL	Immediate Danger to Life and Health
HWFS	Hazardous Waste Fact Sheet
TCLP	Toxicity Characteristics Leaching Procedure
WMP	Waste Management Plan
WMS	Waste Management System

5. Flow Chart

Flowchart for Hazardous Waste Identification and Evaluation Process





Is waste potentially hazardous?
Yes

6. Responsibilities

A simplified chart regarding Waste Management Plan responsibilities is presented in Table 1.

Table 1 Waste Management Plan Responsibility Matrix

#	Step	Responsible	Accountable	Consulted	Informed
1	Ensure the overall implementation of this procedure, its review and audit. Report progress on waste management issues to top management; ensure the implementation of all corrective actions from audits.	RSES, Environment and Industrial Hygiene Manager PHC or Head Environment DW	GM HSE PHC and GM HSE DW	EGM HSEQ Corp	ED PHCD ED DWD
2	Make resources available for implementing this procedure.	RSES	GM Onshore/Offshore PHC GM PRD DW GM GENERAL SERVICES PHC GM GENERAL SERVICES DW	EGM HSEQ Corp	-
3	Review and audit this procedure.	Environment Manager PHC or Head Environment DW	GM HSE PHC and GM HSE DW	EGM HSEQ Corp	-
4	Ensure that waste reports are prepared as at when due, publish all waste reports to interested stakeholders and oversee selection of waste handlers and contractors.	Environment and Industrial Hygiene Manager PHC or Head Environment DW	GM HSE PHC and GM HSE DW	EGM HSEQ Corp	ED PHCD ED DWD
5	Provide adequate staff and resources for the development and implementation of site-specific waste management plans, using this procedure as guide.	RSES	GM GM PLN Onshore/Offshore PHC GM PRD DW GM GENERAL SERVICES PHC GM GENERAL SERVICES DW	EGM HSEQ Corp	-
6	Select waste handlers and contractors.	Environment and Industrial Hygiene Manager PHC or Head Environment DW	GM HSE PHC and GM HSE DW	EGM HSEQ Corp	ED PHCD ED DWD
7	Ensure that site staff, has the appropriate training to carry out the requirements of this procedure	RSES	GM Onshore/Offshore PHCD GM PRD DWD GM GENERAL SERVICES PHCD GM GENERAL SERVICES DWD	EGM HSEQ Corp	-
8	Develop and maintain site specific hazardous waste register	Head HSE Site, RSES	Manager Environment & IH PHC or Head Environment DW	EGM HSEQ Corp	

Each site/location, field development/upgrade project and developmental drilling project shall appoint a Waste Coordinator to monitor the implementation of the Waste Management Plan specific to their site/location and activity.

6.1. Executive General Manager, HSEQ Corp

The Executive General Manager HSEQ Corp shall function as top management representative in all waste management issues and shall carry out the following;

- Ensuring the overall implementation of this procedure, its review and audit.
- Reporting of progress on waste management issues to top management
- Ensuring the implementation of all corrective actions from audits and

inspections. These roles may be delegated to GM HSE PHCD/ GM HSE DWD.

6.2. The Environment and Industrial Hygiene Manager PHC &Head of Environment DW

The Environment and Industrial Hygiene Manager PHC and Head of Environment DW shall be responsible for:

- Ensuring that this waste management plan is maintained and implemented.
- Ensuring that this Plan is reviewed and updated periodically.
- Ensuring that monthly, quarterly and annual waste reports are prepared as at when due.
- Publishing all waste reports to interested stakeholders.
- Ensuring Call for Tender is carried out to select competent waste handlers and contractors.
- Auditing compliance to this Plan, as directed by the GM HSE PHCD/ GM HSE DWD.
- Ensure that adequate staff and resources for the development and maintenance of the Hazardous Waste are provided.

6.3. RSES/Site Manager

Their responsibilities include;

- Providing adequate staff and resources for the development and implementation of site-specific waste management plans, using this plan as guide.
- Ensuring that their staff, has the appropriate training to carry out the requirements of this Plan.
- Ensuring proper implementation of this Plan on their premises.
- Ensure the development and maintenance of a site specific hazardous waste register.
- Ensure that analysis of all identified hazardous wastes is carried out, risk assessed and documented.

6.4. Assets HSE Managers, Project HSE Managers and Operation Safety Leads

The Asset HSE Managers, Project HSE Managers and Operation Safety Lead shall be responsible for;

- Ensuring delivery of appropriate waste management materials to site.
- Ensuring transmittal of the site(s) waste report to the Environment department.
- Liaising with Environment Department for refresher courses on site.
- Scheduling and coordinating waste management audits of their sites/locations.
- Ensuring follow-up and close-out of all inspection/audit actions.

6.5. Site Head HSE /Site HSE Supervisor

Their responsibilities include:

- Acting as site waste coordinator.

- Developing and maintaining a waste inventory (list of solid and liquid wastes) generated on site/location.
- Developing site-specific waste management plans and work instructions.
- Develop site specific hazardous waste register.
- Maintain and update the hazardous waste register
- Coordinating site teams involved in waste management.
- Gathering and reporting relevant waste management related data including waste management reports and treatment certificates
- Ensuring proper waste manifesting and transfer.
- Participating in waste inspections and audits.
- Ensuring follow-up and close-out of all inspection/audit actions.

6.6. Environmental Officer

The Environmental officer shall be responsible for;

- Periodic reviewing, updating and maintaining this waste management plan.
- Collating and producing the monthly, quarterly and annual waste report of the Company.
- Following up of Head HSE Site/Supervisor on the development and maintenance of site specific waste management plan.
- Managing and coordinating waste management courses and awareness programmes.
- Monitoring audit and inspection corrective actions close-out progress.
- Monitoring and tracking of waste inventories.
- Develop and maintain a corporate hazardous waste list.
- Participate in the risk assessment of all identified hazardous wastes.
- Assist sites/locations in the development of site specific hazardous waste register.

6.7. Waste Handler/Contractor

The waste management contractor shall be responsible for;

- Verifying data entered in the waste manifest in quantity and packaging, before waste evacuation.
- Filling, signing and recordkeeping of relevant copies of the waste manifest.
- Reporting any observed anomalies to the Head HSE Site/Supervisor or the Responsible Environment Officer.
- Managing each waste stream in line with applicable legislation and this Plan.
- Submitting monthly report to the Responsible Environmental Officer.

6.8. Personnel

All personnel working in any of the Company facilities has a “Duty of Care” to handle waste generated in line with this procedure and shall be responsible for;

- Cooperating with all responsible persons to ensure proper implementation of this Plan.
- Putting waste in appropriate waste containers provided
- Participating in waste management programmes.
- Informing ahead of time the responsible person for waste management; on activities likely to generate wastes.
- Prompt reporting of all anomalies observed.

6.9. Security Manager/Coordinator

The Security Manager/Coordinator shall:

- Implementing this waste management plan as applicable to the security department.
- Ensuring that the Security copy/blue copy of waste manifest is submitted by waste contractors to the Security personnel at the perimeter gate before waste evacuation.
- Ensuring waste under temporary storage within TOTAL facility is properly secured from theft.
- Ensuring no unauthorized waste evacuation out of TOTAL facility.
- Ensuring entry and exit of waste contractor personnel from TOTAL facility.

6.10. Contract Manager/Contract Engineer

The Contract Engineer shall be responsible for:

- Ensuring contract technical specification is according to this Plan, Company Referential and requirements specific to relevant regulations/legislations.
- Coordinating Call for Tender to select competent waste management contractors.
- Ensuring smooth administration of waste management contracts in accordance with regulatory/legislative requirements and Company requirements.

7. Detailed Plan

7.1. Compliance to Laws, Regulations, Company Rules and General Specifications

The Company and contractors involved in waste management on behalf of the Company shall comply with all relevant local regulatory and legal requirements, requirements of relevant International Conventions and requirements specific to the Group, as specified in Company Rules and General Specification.

Contractor shall as a minimum possess:

- Valid Department of Petroleum Resources (DPR) Permit(s)/Approval(s).
- Valid Federal Ministry of Environment Permit(s)/Approval(s).
- River State Ministry of Environment Permit(s)/Approval(s) for operation in Rivers State.
- Lagos State Ministry of Environment Permit(s)/Approval(s) for operation in Lagos State.
- Valid Nigeria Port Authority/INTELS Access Permits for Offshore waste management.

The Contractor shall report immediately to the Company all regulatory non-compliance

issues. **7.2. HSE Consideration**

As a minimum;

- A Job Risk Assessment (JRA) with regards to the waste management activity shall be carried out.
- All mitigation measures recommended in the JRA, shall be implemented.
- All waste contractor personnel shall go through site HSE Induction on their first visit a Total facility and as required by the Company.
- Appropriate PPEs shall be provided and used by personnel involved in waste management, in accordance with CR EP HSE 062.
- All Incident and Nearmisses shall be reported immediately to the Company.
- Existence of waste contractor personnel responsible for co-ordinating emergency response.
- Presence of qualified First Aider.

- Regular personnel medical checkup.
- Development and implementation of a waste contractor HSE plan.
- Existence of a document on the waste treatment facility, detailing the layout and storage location of each hazardous waste.

7.3. Training

Company personnel involved in waste management shall receive training appropriate for their level of involvement (responsibilities) in the waste management process. Contractors are required to recruit competent personnel and continually ensure the competency of the workforce through adequate training. Contractor shall submit to the Company Curriculum Vitae of all her personnel for Competency assessment.

7.4. Record Keeping

All activities in the course of implementing this Plan shall be documented both in hardcopy and electronic copy. All documents shall be treated as confidential and shall not be disposed without due approval.

7.5. Meeting

A Kick off meeting and periodic meetings shall be held between the Company and the waste contractor to express Company expectation, clarify technical queries and address administrative concerns.

7.6. Waste Identification

Waste shall be identified and classified according to local regulatory classification requirements and classification given by GS EP ENV 001. In the absence of local regulatory classification requirements, waste shall be identified and classified at least into hazardous, non-hazardous and inert waste so as to facilitate its appropriate collection, segregation, temporary storage processing and treatment.

Each site, project or contracted service, shall maintain a list of solid and liquid wastes generated from its activities. Head HSE Site/Supervisors have the responsibility of developing this list.

The list of wastes encountered in each location shall be retained in the Waste Management File.

7.6.1 Hazardous waste identification and evaluation

Hazardous Waste identification shall be in accordance with the following;PLN

- Reviewing applicable hazardous waste regulations by FMENV/DPR, identifying potentially hazardous waste streams and requirements and recommendations of CR EP HSE 060.
- Conducting physico-chemical analyses of the potentially hazardous wastes streams to confirm their hazardous characteristics in line with DPR regulations.
- Developing hazard identification and risk assessment report of the hazardous waste streams

The hazardous nature of a given kind of waste shall also be determined by referring to the technical datasheet (e.g. MSDS) of the products from which the waste originated.

7.6.1.1 Review of Regulations

The major regulations guiding the management of hazardous waste in Nigeria as applicable to the COMPANY include:

[1] FEPA Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991

[2] DPR Environmental Guidelines and Standards for the Petroleum Industry In Nigeria, Revised edition 2018.

[3] FEPA Management of Solid and Hazardous Waste Regulation, 1991

A review of these regulations is presented in Appendix 8.3. The review provides guidance to the listing of potentially hazardous waste streams encountered in the COMPANY operations.

Regulation [1 and 3] defines hazardous (dangerous) waste of different toxicity thresholds, and also provides list of some categories of hazardous wastes.

Regulation [2 and 3] defines hazardous waste with dependence on some physico-chemical characteristics, and does not contain any list of such wastes.

The specifications and scope of hazardous wastes as in [1 and 3] is more encompassing and detailed than as in [2]. This makes regulations [1 and 3] more stringent than [2].

Whereas [2] require a list of hazardous waste with data sheets in line with her specifications, [1] does not require such as a monitoring strategy.

In view of these, this plan only covers minimum requirement of both regulations.

7.6.1.2 Waste Analyses & Identification

7.6.1.2.1 Physico-chemical Analyses

Chemical tests/analyses shall be carried out on all potentially hazardous waste streams. Potentially hazardous waste streams are derived from the review of the DPR EGASPIN and FMENV guidelines on Hazardous Waste Management. See Appendix 8.3.

The results of the chemical analyses shall be compared to the conditions for which waste is confirmed Hazardous. These conditions are spelt out in Section 7.6.1.2.2 below.

7.6.1.2.2 Hazardous Waste Identification

Hazardous substances shall include but not limited to any element, compound, mixture, solution which because of its quantity and/or concentration, or physical, chemical or infectious characteristics, may:

- Cause or significantly contribute to an increase in mortality or an increase or incapacitating reversible illness, or
- Pose substantial hazards to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed and
- Are ignitable, corrosive, reactive or toxic by satisfying the following conditions

a) Ignitability – A waste is ignitable if:

- It is a liquid, other than a solution containing less than 24% alcohol in water and has a flash point less than 60°C.
- It is not a liquid and under normal conditions of temperature and pressure is capable of causing fire by spontaneous chemical changes, by adsorption of moisture or through friction and, when ignited, burns so vigorously and persistently that it creates a hazard.
- It is an ignitable compressed gas, or
- It is an oxidizer.

b) Corrosivity - A waste is corrosive if:

- It is aqueous and has a pH less than or equal to 2, or greater than or equal to 12.5.

c) Reactivity - A waste is reactive if:

- It reacts violently with water;
- It forms potentially explosive mixtures with water;
- It is normally unstable and readily undergoes violent changes without detonating;
- When mixed with water, it generates toxic gases, vapours, or fumes in a quantity sufficient to present a danger to human health or the environment;
- It is cyanide or sulphide bearing waste, which when exposed to pH of 2 to 12.5, can generate toxic gases, vapours, or fumes in a quantity sufficient to present a danger to human health or the environment.
- It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement; or,
- It is readily capable of detonation or explosive decomposition under normal conditions (standard temperature and pressure).

d) Toxicity - A waste is toxic if :

1. With laboratory testing, the substance is found to contain any of the contaminants listed in EGASPIN at a concentration equal to or greater than the respective values given in this legislation.

e) Radioactivity - A waste is radioactive if it contains:

- Equal to or more than 0.37 Bq/g of Radium for solids;
- Equal to or more than 0.37 Bq/g of Radium for liquids.

f) Bio-hazardous - A waste is bio-hazardous if it contains:

- whole or part human or animal tissue, blood or other bodily fluids, excretions, drugs or other pharmaceutical products, swabs, dressings, syringes, needles or other sharp instruments;
- any other waste arising from investigation, treatment, care or collection of substances which may cause infection to any person coming into contact with it.
-

7.6.1.3 Risk Assessment

Risk evaluation shall be carried out for each hazardous waste streams. This shall be achieved by referring to standard references for data and guidelines on the following qualities:

- Permissible Level of Exposure
- Threshold Limit Values (TLV)
- Explosion and Flammability Ranges (Lower and Upper Explosive Limits)
- Immediate Danger to Life and Health (IDHL) Level (maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.)
- Personnel Protection and Sanitation
- Route of entry/Target Organs
- Symptoms of Exposure
- First Aid and Measurement Methods.

7.6.1.4 Hazardous Waste Fact Sheet

Hazardous waste fact sheets (Appendix 8.4) shall be used to record the physico-chemical characteristics as listed in Section 7.6.1.2.2, as well as the result of the risk assessment carried out.

7.7. Identification of Sites/Locations for Waste Collection

All sites/locations where waste shall be collected for haulage shall be identified by the Company; waste contractor shall be officially informed of the sites/locations. A familiarization visit shall be made by the Company and the waste contractor to sites/locations where waste shall be collected. At each site/location, issues to be addressed shall include identification of all waste collection points (e.g. waste bin/basket/skip locations), waste segregation point, waste quantification point, site access procedure and requirements, community relations and contact details of the Company representatives at the site/location.

7.8. Waste Evacuation Schedule

Contractor shall honour request from the Company, within the context of established Contractual agreement, to collect, safely transport and dispose Company generated waste. Waste collection schedule shall be established between the Company and the waste Contractor; this shall include the day of the week, when waste collection and evacuation shall take place. Delivery/collection of waste containers shall be independently assessed for each of the facilities based on their waste generation. However, in order to minimize build up, delivery/collection shall be undertaken a minimum of once a week, where appropriate. The distance of waste transportation for the purpose of processing shall be kept to a minimum; waste treatment facilities should be as close as possible to the origin of waste.

Where possible, waste between sites shall be transferred on pre-determined days of the week. Waste transfers shall not be dependent on delivery of other stock or other reasons. Such transfers shall be arranged and managed by Logistics/General Services department, as applicable. They shall inform the Head HSE Site/Supervisor of the planning of such transfers and the latter shall inspect to ensure that the schedule is complied with. Where additional transfers may be required, the Logistics/General Services shall arrange such transfers as and when required.

Anomalies with respect to waste transfers shall be reported to the Head HSE Site /Supervisor and maintained in the Site Waste Management File.

7.9. Site Entry and Exit Procedure

Waste contractor shall have a representative responsible for direct supervision of other Contractor personnel involved in waste collection, segregation and haulage. It shall be mandatory for all waste contractor personnel while working within Company facility to wear visibly both the Company provided Identification Card and their Contractor Identification Card issued to them by the waste contractor. The waste contractor shall be informed of the time range when the Company facility can be accessed. Waste contractor shall not enter site restricted areas without approval and supervision.

7.10. Waste Collection

Waste shall be collected in waste bags, skips, baskets, drums, or any other container which meets the specifications/requirements below;

- Be sufficiently sized;
- Be leak proof;
- Be fitted with a cover or placed under a tarpaulin in the event of heavy rain/wind and/or transportation;
- Be made from materials with a low flammability;
- Be clearly marked with their contents and the appropriate safety/risk warnings;
- Stand stable on the ground;
- Be easy to handle;

- Be inspected on a regular basis to ensure that integrity is maintained.

Waste shall be labelled and packaged appropriately for its type and in compliance with the regulations in force. Containers holding liquids shall meet each of the above criteria and, in addition, shall be stored, closed, sealed and right side up (ideally on a pallet). Containers holding liquids shall not be thrown haphazardly in the skips/baskets but shall be placed in accordance with the preceding conditions.

In the event that any container is damaged, the substance shall be transferred to a new container. It is recommended that a small reserve of containers/drums be maintained for this purpose (Note: this reserve shall only consist of receptacles that previously contained innocuous substances and have been inspected for their integrity and suitability by the Head HSE Site/Supervisor). GM-HSE/IHY-M06-05 *"Hazardous Materials Management"* shall be referred to when handling, storing and transferring of waste chemicals and other hazardous waste.

Personnel whose jobs involve handling/moving waste shall receive training about the hazards they are exposed to as a result of this work, in conformity with the requirements and recommendations of CR EP HSE 060.

7.11. Waste Segregation

Segregation involves identification and separation of waste streams. Primary separation is undertaken either manually in case of non-hazardous domestic waste streams, or by physical/mechanical means in case of drilling and production waste streams, e.g. use of drill cutting shakers, separation tanks and heaters. Such separation can be improved with secondary treatment such as hydrocyclones, filter presses, gas flotation systems or decanting centrifuges.

All wastes shall be segregated at source. As a minimum waste bags, skips, baskets and bins (generically referred to as containers or receptacles) shall be provided for each of the main waste categories.

The intended contents of each container shall be clearly depicted in both script and pictorial representation of its use. The containers shall also be depicted by their colour as listed below;

- Biodegradable waste: Green in colour with pictogram depicting food.
- Combustible waste: Red in colour with pictogram depicting trash, rubbish, etc.
- Recyclable waste (Paper): Blue in colour with pictogram depicting paper.
- Recyclable waste (Scrap metals and cans): Blue in colour with pictogram of cable/valve/cans
- Recyclable (Glass and Plastics): Blue in colour with pictogram of glass/plastics
- Hazardous waste: Yellow with pictogram depicting battery/bulb.
- Used Fluorescent Tube: Black cylindrical container with yellow cover.
- Medical wastes: Yellow packaging thick all-covered disposable carton.

Where the exact colours of containers depicted above are not readily available, then alternative containers of same specification shall be provided and labelled accordingly with the right colour and pictograms.

Where feasible pliable wastes shall be folded flat, dismantled or crushed to facilitate storage/transportation.

The type and number of waste bags, skips, baskets and bins required by each facility shall be a function of the constituent of the waste, the quantity, the collection frequency and the space available for the placement of such containers.

Wastes shall be deposited in the containers and shall not be allowed to overflow or be stacked up on the ground around the containers. It shall be the responsibility of the Logistics department to ensure that there are sufficient containers at each of the locations and the Head HSE Site /Supervisor will monitor such conditions.

The containers shall be located as close as possible to the source generation assuming that there are no other impediments e.g. fire or access.

A layout plan of the locations of the respective skips and baskets shall be held and maintained by the Logistics/Maintenance Supervisor, with a copy to the Head HSE Site/Supervisor. The plan shall also be affixed to the main notice boards in order that personnel are aware of the location of specific waste management facilities on site.

Replacement containers (corresponding in type and number to those collected) shall be delivered during the same consignment as those collected. No site shall be left without the means to segregate and store their wastes as per the requirements of this procedure.

The respective waste handling facilities shall raise an anomaly report on receipt of any waste that has not been properly segregated. Such reports shall be forwarded to the Head HSE Site / supervisor and a copy kept in the site waste management file.

7.12. Waste Transfer

The delivery/collection of containers shall be independently assessed for each of the facilities based on their waste generation. However, in order to minimize build up, delivery/collection shall be undertaken a minimum of once a week, where appropriate.

In all cases, waste to be transferred shall be accompanied by a waste transfer note/manifest as detailed in section 7.17.

Where possible, waste between sites shall be transferred on pre-determined days of the week. Waste transfers shall not be dependent on delivery of other stock or other reasons. Such transfers shall be arranged and managed by Logistics/General Services department, as applicable. They shall inform the Head HSE Site/Supervisor of the planning of such transfers and the latter shall inspect to ensure that the schedule is complied with.

Where additional transfers may be required, the Logistics/General Services shall arrange such transfers as and when required.

Any anomalies with respect to the transfers shall be reported to the Head HSE Site /Supervisor and maintained in the Site Waste Management File.

Transfer of waste outside the country shall strictly comply with the local laws, the laws of transit countries and destination country. In cases where there are no clear regulatory requirement for exporting a waste type overseas then the Company shall conform with Directive 200/98/EC, EC Regulation number 1013/2006, EC Regulation number 669/2008, and applicable conventions such as Basel Convention and Bamako Convention.

7.13. Unknown Waste

It shall be the responsibility of personnel to ensure that every waste bag/container/drum is clearly identified. Any waste that is not identifiable shall be immediately notified to the Head HSE Site /Supervisor. A sample of the waste material shall be taken by the Head HSE Site / Supervisor and analyzed. Until the properties of the waste are known, maximum precautionary measures (separate storage, PPE) shall be maintained.

7.14. Temporary Storage of Waste

The quantity and duration of waste temporary storage shall be kept to the minimum. The Company shall ensure the safety, security and hygiene of the storage areas and waste handling equipment.

Waste storage areas shall be located with respect to minimizing/eliminating the following:

- Impact with respect to mobilization of dust/particles;
- Runoff;
- Leachate;
- Odour;

- Visual Impact;
- Security

Waste storage areas shall be operated and maintained in accordance with the following principles;

- Hazardous wastes shall be stored and handled as per the requirements of PRDGM-HSE/IHY-M046-0415 "Hazardous Materials Management Procedure" and in accordance with any specific stipulations as stated in the respective MSDS/waste fact sheets.
- Storage areas shall be clearly marked with signs indicating the type of waste being stored there (e.g. Non-hazardous - Biodegradable, combustible, recyclable; hazardous etc.);
- Where appropriate, the MSDS/waste fact sheet shall be displayed in close proximity;
- Suitable fire protection and spill/leak contingency shall be provided;
- Containers and drums shall only be washed out in designated areas. The wastewater from non-hazardous containers can be drained directly to the site drainage system (a fine mesh shall intercept any solids). Hazardous waste containers1 shall not be washed on site. All such containers shall be treated/decontaminated offsite in line with the Hazardous Materials Management Procedure (PRDGM-HSE/IHY-M046-0415).
- Access routes shall be maintained clear;
- Storage areas shall be maintained clean and tidy; and shall be inspected on a daily basis for leaks and spills.
- As a minimum, hazardous wastes shall be stored on an impermeable surface with surround drainage or in a bund, and shall be protected from the elements.
- Fire risk management shall be part of the consideration while setting up a Temporary Storage Area.
- Hazardous storage area shall be separate from non-hazardous storage area and each shall be clearly identified.
- Different waste types shall be stored based on chemical compatibility to prevent chemical reaction in case of accidental mixing.
- Recommendations of GM EP HI 065 shall be followed to prevent exposure to chemical risks.
- Radioactive waste storage shall be according to CR EP HSE 067 and GM EP HI 671.
- Asbestos waste shall be managed according to CR EP HSE 060 and GM EP HI 063

7.15. Waste Quantification

Waste Quantification shall be supervised by an onsite representative of the Company to ensure that the process is carried out according to the Company's procedure and regulatory requirements. Waste shall be quantified using weighing scales, where possible. Where it is not possible to weigh the waste directly on the scales, the following method shall be adopted in estimating the weight of the waste material.

The standard density (kg/m3) of the segregated waste stream and the estimated volume occupied in the basket is multiplied together to represent an estimated quantity of the waste (see Table 2).

It shall be noted that only non-hazardous waste streams shall be estimated in this manner. Hazardous waste streams shall be handled in accordance with the Hazardous Materials Management Procedure (PRDGM-HSE/IHY-M046-0415).

Data shall be entered on the waste manifest; this shall be completed for every waste transfer. Refer to the Section 6.27 for procedure of using the Waste Manifest.

1 It should be noted that preference shall always be given to return of packaging/container of hazardous substances to the Vendor/Supplier.

7.15.1. Volume of Basket

- The size and volume of each type of bin/basket/drum used at the facility/site shall be measured and volume calculated. These shall be recorded in the Site Waste Management Plan. For example: Medium basket (mesh) :1.5m (l) x 0.7m (w) x1m (d) = 1.05 m^3
- In order to calculate the amount of waste in the basket, an estimation of the fill level of the basket shall be made (quarter, half, full etc) For example:
- Half full medium sized basket: 0.5 x 1.05 m^3 = 0.525 m^3

7.15.2. Typical Densities (kg/m3) for Solid Wastes[2]

Table 2 shows the typical densities (weight) per m^3 of various segregated waste streams.

Table 2: Typical densities (weight) per m^3 of various segregated waste streams.

Type of Waste	Typical Density (kg/m^3)
Food Waste	290
Burnable (mixed):	118
Paper	85
Cardboard	50
Plastics	65
Wood	240
Non-burnable (mixed):	300
Glass	195
Tin Cans	90
Mixed burnable and non-burnable	160
Metal scrap (heavy)	1780
Metal scrap (light)	740
Metal scrap (mixed)	900
Oils, tars, asphalt	950
Chemical sludge (wet)	1000
Mixed demolition (non-combustible)	1420
Mixed demolition (combustible)	360
Dirt, ashes, brick etc.	480
Drums/lead batteries/tyres	Number

Worked Example

Having obtained the volume of the waste, it is multiplied by the corresponding density value (refer to table 2) of the segregated waste.

The following is an example of the calculation of the quantity of a waste stream:

Visual Inspection and completion of waste manifest states that medium sized basket is half full of metal scrap. Therefore:

0.5 (half basket) x 1.05 m^3 (Total potential volume) x 900 kg/m^3 (density of metal scrap) = 472.5kg.

Hence 472.5kg metal scrap was transported in this particular transfer.

Adapted from Tchobanoglous et al "Integrated Solid Waste Management" McGraw Hill 1993

7.16. Waste Register/Waste Tracking and Reporting Sheet

The Waste register shall be regularly updated using quantitative and tracking (traceability) information as obtained from relevant waste tracking manifest, waste transfer note, waybill, and waste treatment certificate.

The Waste register shall be completed by the Head HSE Site/Supervisor for every calendar month and a copy shall be maintained by the Head HSE Site/Supervisor in the Site Waste Management File. The register shall be an accurate record of the waste stream composition and quantity.

Where necessary, additional data shall be obtained from direct communication with respective departments (Logistics, General Services, Production, Medical, Maintenance etc.).

Data with respect to the effluent discharges and emissions shall be obtained from the production personnel and annotated for inclusions in the register.

The Waste register shall be sent to the Environment Manager, by the seventh (7th) day of the following month. The, Environment Manager shall review the waste registers upon receipt. He shall ensure that there are no signifi**cant anomalies from previous month's reco**rds. If this is the case, he shall review current handling/treatment process to ensure that it is still suitable for the differing composition/quantity.

7.16.1. Annual Waste Register

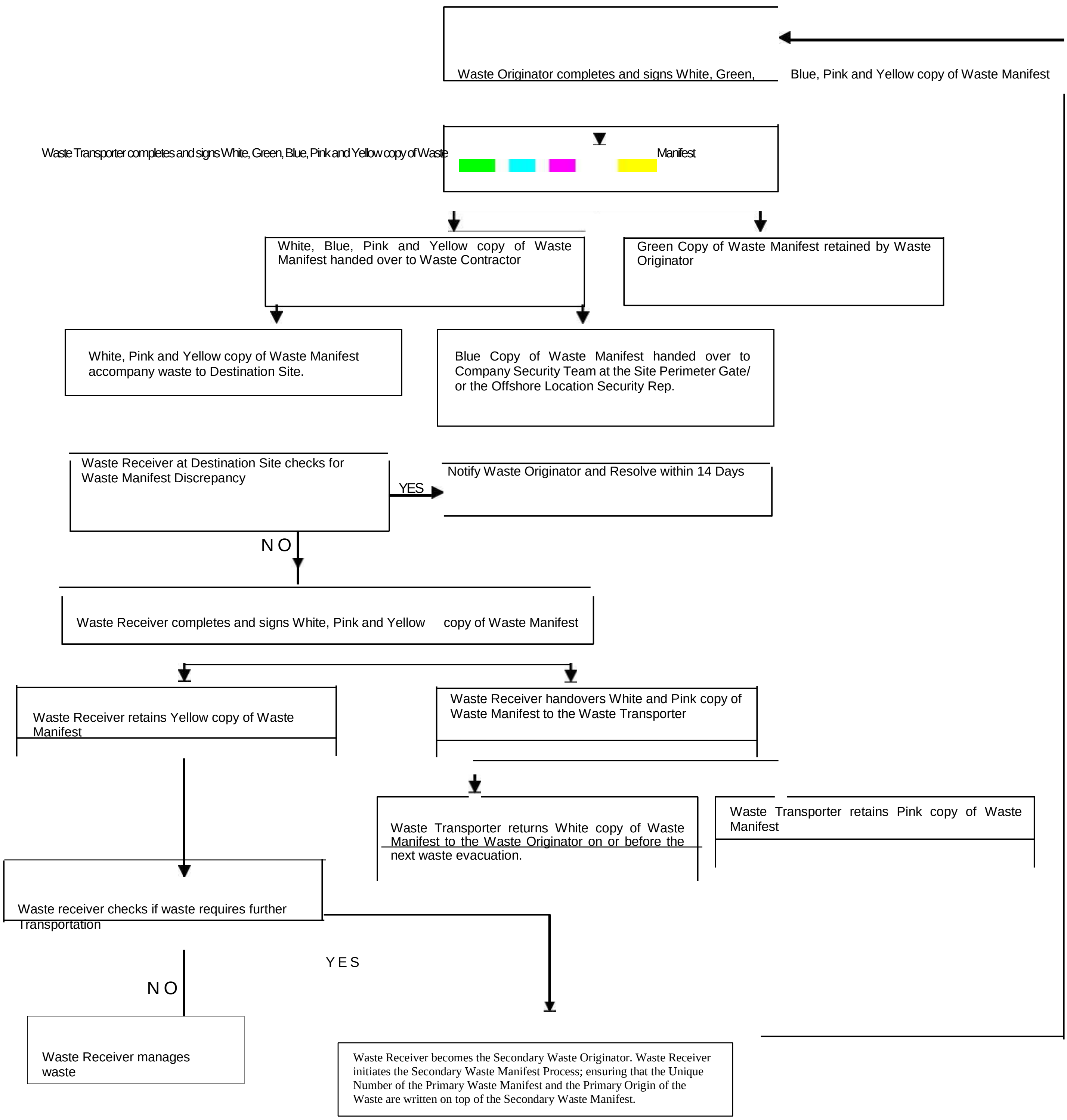
The site Waste registers shall be collated on a monthly basis. Such data shall be used to refine/improve the management strategy of the individual waste streams.

On a yearly basis, each District shall collate the quantities of waste generated at their various sites/locations and provide same to HSE Corporate for collation at Affiliate level. The full Affiliate waste register shall then be published by HSE Corporate to Head Quarter and other stake holders as required by the Company rule and regulatory requirement. Analysis of the Annual Affiliate waste register shall be used to set affiliate level waste management objectives for the subsequent year.

7.17. Waste Tracking (Use of Manifest)

All waste shall be carefully tracked whenever they are moved between sites and from site to the ultimate destination. Traceability of waste shall be implemented using waste tracking manifest, waste transfer note, waybill, and waste treatment certificate. All documents for waste traceability shall not be destroyed for at least five years and shall require the approval of the Company and relevant Regulatory Agent e.g. Department of Petroleum Resources (DPR). The waste coordinator shall fill out the waste manifest before dispatching waste from the site or location. A template of the waste manifest is in appendix B. Completed waste manifests shall be referenced for the completion of the monthly Waste registers.

Figure 1: Waste Manifest Process Chart



7.18. Waste Treatment & Disposal

Alternatives for waste treatment prior to disposal shall be ranked according to the principle of prevention, re-use, recycle and recovery. When disposal is the only option, methods other than controlled landfill are preferable to minimize the environmental footprint.

The practice of open-air waste burning is prohibited; in addition use of existing unauthorized dump sites or proliferation of unauthorized dumping ground is prohibited.

If an external (Contractor) infrastructure does not exist to manage key waste streams then the Company can set up her own facility or in joint project with other International Oil Companies; in compliance with local regulations. In addition waste can be stored long-term pending the development of compliant facility.

The treatment and disposal routes for each of the principal waste streams can be referenced in Appendix A. These will be made site specific through Work Instructions. Wherever feasible, the emphasis shall be on the prevention of waste generation, reduction and reuse of waste products. To this effect, unambiguous site instructions shall be issued with respect to the disposal routes of wastes.

The Head HSE Site/Supervisor shall evaluate the preferred treatment and disposal route with the department(s) involved.

For Project and drilling activities it shall be clearly identified at Contractual stage, if the Company shall directly manage or the Project/drilling Contractors shall manage the various waste streams emanating from concerned Project and drilling activities. Such decision shall be made with input from Environment Department and in compliance with Company Referential and requirements specific to relevant regulations/legislations.

Asset HSE Manager/Project HSE Manager/Drilling OSL with support of Environment Department are responsible for arranging for Third Party transfers and disposal of waste generated. They shall ensure that the appropriate permits have been issued for the treatment and disposal of hazardous waste at the Contractor facilities. The facilities shall also be audited by Asset HSE Manager/Project HSE Manager/ Drilling OSL with support of Environment Department on a regular basis.

Waste manifests shall be completed for any waste removed by a third party for transportation to another location for treatment and/or disposal.

It shall be noted that dilution of any hazardous waste to render it classified as non-hazardous is unacceptable.

The following basic premises are to be complied with for waste treatment and disposal:

- An alternative solution to disposal shall always be sought.
- Hazardous wastes shall never be disposed of directly to the environment – some form of primary and, if necessary secondary or tertiary treatment, shall always be required prior to ultimate disposal.
- Hazardous wastes shall never to be made available to non-authorised external parties (this includes materials containing hazardous products such as asbestos or containers previously containing hazardous substances). Disposal shall only be made to a specialist hazardous waste management contractor.
- Some non-hazardous wastes may be disposed of directly, but where possible, some form of primary treatment in terms of reduction shall be undertaken.

Preference is for waste to be treated and disposed of by experienced and nominated third parties at designated and approved locations.

The waste treatment and disposal areas (including access routes) shall be:

- selected with respect to surface and ground water, soil properties, ecology, sensitivity of the surrounding environment - including local communities – and any safety/risk issues that may arise;
- maintained clean and tidy;
- equipped with emergency equipment;

- secure from trespassers.

7.18.1. Burnable Waste

All Burnable/Combustible waste shall be incinerated using Third Party incinerators accredited by Regulators. Ash collected after the incinerating process shall be fixed in a cement matrix and used for brick making after carrying out leachability and compaction tests.

7.18.2. Non-burnable wastes

Non-burnable wastes shall be stored and transferred as per the requirements of this procedure to where they shall be managed properly as outlined below;

- Plastics shall be returned to plastic industries for reuse/recycling
- Glass shall be returned to glass industries for recycling
- Clean paper shall be returned to paper mills for recycling
- Metal scraps and cans shall be returned to steel mills for recycling.

7.18.3. Inert Waste

Inert wastes shall be used for backfilling/cover material.

7.18.4. Food Waste

Food waste shall not be stored beyond 48 hours before evacuation to minimise foul smell and to minimise health risk. Packaging shall be separated from food waste. For food waste generated offshore, the requirements of GS EP MED 062 shall apply; in addition the requirements of MARPOL 73/78 convention shall also apply; these include comminution of food waste to particle with maximum diameter of 25mm before discharge into the sea. At onshore facility, food waste shall be grinded, dried as compost for land farming or sent to an approved landfill site.

7.18.5. Oil Spill Clean-up Waste

Oil spill clean-up waste shall be managed to the recommendation of the IPIECA vol. 12 and IPIECA vol.3 and in consistence with the oil spill response strategies in CR EP HSE 094; putting into consideration the local regulations.

7.18.6. Oil Spill Clean-up Waste

Radioactive substances generally shall be managed as described in CR EP HSE 067. NORM, radioactive waste and equipment contaminate by NORM or radioactive waste shall be managed based on recommendations from GM EP HI 671 and OGP N0. 412.

7.18.7. Waste Media containing confidential information

Waste media (Paper, Compact Disc, DVD, Hard drive, Flash stick etc) containing information classified as sensitive or confidential shall be managed and destroyed based on the recommendations in GM-GR-SUR-010B. Storage media containing Company confidential information shall not be disposed without the knowledge of Company IST. All paper shall be shredded before disposal.

7.18.8. Medical Waste

Waste from medical activities shall be managed according to GS EP MED 060 and GS EP ENV

001. **7.18.9. Drilling Waste**

Drilling mud/cutting waste and spent base fluid shall be managed based on local regulatory requirements and CR EP FP 470. Water based cuttings waste is recommended to be managed by land farming and stabilization if consistent with local regulation. Drilling cutting can be discharged offshore if permitted by the local regulation. Oil/synthetic based cutting shall be treated onboard to specified conditions, before it can be discharged offshore if permitted by the local regulation, otherwise the Oil/synthetic based cutting shall be evacuated onshore for treatment by thermal desorption unit. Spent Oil/synthetic based mud shall be evacuated onshore for reconditioning and reuse.

7.18.10. Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE) including batteries and electric bulbs (fluorescent, and incandescent) shall be treated as described in REG-GR-DSI-001

7.18.11. Disused Chemical Drums and IBC Tanks Management

All empty chemical containers such as drums and IBC tanks shall be regarded as hazardous waste and be handled strictly; empty drums and IBC tanks shall not be made available to non-authorised Parties. Disposal of empty drums and IBC tanks shall only be carried out by approved hazardous waste management contractors.

7.18.12 Expired Pyrotechnics (Comet light and Smoke Signal)

All expired pyrotechnics shall be managed as follows;

- Compliance with local and international regulations governing its disposal.
- Evacuated from site as special waste and delivered to the TUCN base Security coordinator who will arrange for its transfer to an appropriate authority for disposal.
- Disposal shall be through the Nigerian Police Force (bomb squad) or alternatively, returned to the original manufacturer where feasible.
- Stored in a dedicated storage area outside the office building prior to hand over to an appropriate authority.
- Record of disposal kept with the security coordinator and communicated to the site OIM

7.19. Waste Haulage Vehicle Requirements

Waste haulage vehicle shall be premobed and certified to be in good condition before such can be deployed for use. The vehicle shall be designed, operated and maintained to safely transport waste from the Company's sites/locations to the waste treatment/disposal facility. In addition the vehicle shall:

- Be in good condition (both in appearance and engine status) to safely transport waste without breaking down in the course of transportation.
- Be running on diesel if entering a flow station or an area with similar hazardous condition.
- Possess a spark arrestor if entering a flow station.
- Possess valid documentation to permit its use on Nigeria road.
- Be driven by a driver with a valid driving license, and in good medical condition.
- Be capable of containing the waste
- Possess appropriate label and warning of the waste on board, if hazardous.
- Ensure that the driver and passengers are not exposed to waste in the course of waste transportation.
- Be equipped with minimal material to combat spilled waste; e.g. absorbent material, disinfectant, PPE and packaging bags.
- Possess a system to keep the waste secured from unauthorized access.
- Be adequately fuelled before embarking on a trip.
- Shall be covered with water proof materials to ensure waste is not exposed during haulage.

7.20. Waste Management Facility Requirements

Waste Contractor shall ensure segregated wastes are stored at their facility in designated storage areas. Storage areas shall be properly lined with impermeable materials, and bunded to avoid polluting the immediate environment. Storage areas shall also be covered with roof to prevent moisture and rainfall. Such onsite storage of waste shall be on a temporary basis, after which wastes shall be recycled/reused/treated/disposed. While wastes are at the waste Contractor facility, there shall be strict housekeeping practice.

The waste Contractor shall implement an environmental monitoring program which shall include groundwater, effluent and air quality monitoring, to ensure that waste storage, treatment, recycling/reuse and disposal activities do not impact on the environment or result in public health concerns.

Waste facility shall be designed, constructed, operated and maintained to prevent explosion/fire, and control the release of dangerous waste into the air, soil or groundwater. The facility shall have an internal communication system or alarm system for emergency. The waste facility operator shall develop a Contingency plan to be activated in emergency situation such as medical emergency, fire, security emergency and combating spilled waste. The Contingency plan shall be for on-site and off-site emergency. Off-site emergency shall put into consideration the community.

There shall be personnel responsible for Emergency Co-ordination (Emergency Co-coordinator). The responsible person shall have the authority of the owner of the facility to commit the resources needed to implement the Contingency plan. The waste facility shall have fire extinguisher, spill containment, decontamination equipment, and adequate water volume and pressure to supply water to foam producing system, automatic sprinklers and water spray system.

The waste facility shall possess a system to keep waste secured by preventing unauthorized entry and exit. Such security system shall include perimeter fencing and 24-hour surveillance. There shall also be a vehicle entry and exit documentation system or register.

It is required of the waste Contractor to respect the host community’s culture.

7.21. Waste Treatment Certificate Issuance

The waste Contractor shall issue to the Company a Waste Treatment Certificate within 30 days of receiving waste from the Company. Such Waste Treatment Certificate shall include the waste type, quantity, method of treatment, point of temporary storage and point of final disposal.

7.22. Audit, Inspection and Performance Evaluation

Periodic audit of the cradle to grave waste management shall be carried out, to ensure compliance to regulatory and Company requirements. Regular inspection of onsite practices is required for continuous improvement. Contractor shall send to the Company reports of their internal and external audits and Inspections. The Company shall audit her Waste Management Service Contractor at least once every year.

8. Appendices

8.1. Appendix A- Waste Register & Plan

Site :
Month of:

Notes :

Column A : Type. **Column B** : Source (where from). **Column C**: Unit of measurement (number, basket etc.)

Column D: Calculated quantity based

Column E : Treatment (if any) & Disposal method

Column F: Any additional information/remarks.

Description of Waste (A)	Source (B)	Unit (C)	Quantity (D)	Treatment/Disposal (E)	Remarks (F)
Empty Metal drum	All Locations	Kg		Crush & Recycle	
Empty Plastic drum	All locations	Kg		Crush & Recycle	
Maintenance waste: Transformer Bulbs	All locations All locations	Kg Kg		- Extraction of PCB for incineration - Decontamination of metal parts for recycling - Mercury recovery - Recycling of other parts	
Spent Fluorescent tubes	All locations	Kg		- Mercury recovery - Recycling of other parts	
Batteries	All locations	Kg		Decontamination via neutralisation Recycling	
Filters	All locations	Kg		Incineration	
Asbestos	All locations	Tons		Package & Stockpile	Await disposal at engineered landfill.
Medical Waste:	All locations	Tons		Incineration	
Contaminated soil	Onshore facilities	Tons		Incineration / Bio- treatment	
Tank bottom/oily sludge	All locations	Tons		Incineration	
Pigging sludge	All locations	Tons		Incineration	
Scrap metal:	All Locations	Tons		Recycling	
Wood	All Locations	Tons		Incineration /Recycling	
Cardboard	All Locations	Tons		Recycling	

Description of Waste (A)	Source (B)	Unit (C)	Quantity (D)	Treatment/Disposal (E)	Remarks (F)
Paper	All Locations	tons		Recycling	
Plastics	All Locations	tons		Recycling	
Tins & Cans	All Locations	tons		Recycling	
Glass	All Locations	tons		Recycling	
Bio-deg. domestic waste:	Offshore & Onshore	tons		- Macerate & Dispose to sea (Offshore) - Dispose in a dumpsite (Onshore)/Compost	
Computer Scraps	All locations	tons		Return to manufacturer's Representative	
Construction Debris	All locations	tons		Government approved dumpsite	
Dis-used furniture	All locations	tons		Disposed based on component parts	
Sewage & Kitchen waste water	All locations	litres		Bio-treatment in a sewage treatment facility	
Oily rags	All locations	tons		Incineration	
Production water	Onshore & Offshore	litres		- Oil-in-water separation and re-injection in Onshore facility. - Oil - in-water separation and discharge in an offshore discharge zones	
Printer cartridges & Toner	All locations	tons		Return to manufacturer for recycling	
Sewage	All locations	litres		Biological treatment via sewage treatment plants	
Smoke detector	All locations	tons		Incineration/ E-waste management	
Used absorbent	Onshore & Offshore	tons		Incineration	
WBM	Onshore & Offshore	tons		Treatment to acceptable limits and discharge (Deep offshore)	
WBM cuttings	Onshore & Offshore	tons		Incineration/Stabilisation, Land farming (Onshore & Near shore)	
SBM	Onshore & Offshore	tons		TDU treatment and reuse (Deep Offshore, Onshore & Near shore)	
SBM cuttings	Onshore & Offshore	tons		Treatment to acceptable limits and discharge (Deep offshore). Incineration/Stabilisation (Deep Offshore, Onshore & Near shore)	
Work over completion fluids	Onshore & Offshore	tons		Treatment and discharge (Deep offshore), TDU treatment (Onshore & Near shore)	

8.2. Appendix B- Waste Manifest

TOTAL UPSTREAM COMPANIES IN NIGERIA
WASTE TRACKING MANIFEST/WAYBILL

S/N	WASTE DESCRIPTION	QTY/UNITS (Kg/Litres/tons)	REMARKS/COMMENTS
	NON-HAZARDOUS RECYCLABLES		
	Recyclable Paper		
	Recyclable Plastics		
	Recyclable Glass		
	Recyclable Metal scraps		
	Empty metallic Drum		
	Empty Plastic Drum		
	HAZARDOUS RECYCLABLES		
	Ink-Jet/Toner Cartridges		
	Fluorescent tube/Electric bulbs		
	Batteries (Wet & Dry cell)		
	Spent Lube oil		
	HAZARDOUS BURNABLES		
	Absorbents/Oily rags		
	Air Filters/Oil Filters/Fuel Filters		
	Contaminated Soil		
	Oily sludge/tank bottom		
	Obsolete Chemical		
	Pigging waste		
	Medical waste		
	Combustible trash		
	Drill Cuttings/Mud		
	NON HAZARDOUS & NON RECYCLABLE		
	Food/Biodegradable		
	OTHERS		
	Sewage		
	Construction Debris		
	Asbestos		
	Woods/Furniture		
	Other (specify)		

ORIGINATOR/GENERATOR	TRANSPORTER(VESSEL/VEHICLE)	WASTE RECIEVER/DISPOSAL FACILITY
Name:	Driver Name:	Name:
Site/Dept:	Company:	Facility/Site:
Phone:	Vehicle No/Vessel Name:	Phone No:
Loading Point:	Phone No:	Receipt Address:
Date:	Date:	Date:
Time:	Time:	Time:
Signature:	Signature:	Signature:

Distribution

White copy: Waste Mgt Officer (Tracking Copy), **Green Copy:** Originator/Book copy, **Blue copy:** Security Control,

Yellow Copy : Waste receiver/facility, **Pink Copy** Transporters.

8.3. Appendix C-Review of FMENV and DPR Guidelines on Hazardous Waste Management

Guideline	Section	Regulation/law	Implication
FEPA Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991	Part II –*Guidelines for the Management of Solid and Hazardous Wastes* Chapter One - *Dangerous Waste List, Characteristics and Criteria*. Subsection 1.1 - *Discarded chemical products* Article 1.1.1 (d)	Any residue or contaminated soil, water, or other debris resulting from the clean up of a spill of a commercial chemical or manufacturing chemical intermediate which has, or an off specification commercial chemical product or manufacturing chemical intermediate which if it has met specification would have, the generic name listed in the discarded chemical product list FAC-000-000-9903 (Part II, Chapter One, pages 156-172)	This definition suits waste crude (as residue/chemical) and contaminated soils. The following could be listed under this class: • Waste crude • Obsolete chemicals • Chemical containers • Waste chemicals • Contaminated soil • Oily sludge • Oil-based mud cuttings • Waste oil-based mud • Pigging waste • Paints (except water-based) • Solvents

Appendix C continuation-- Review of FMENV and DPR Guidelines on Hazardous Waste Management

Guideline	Section	Regulation/law	Implication
FEPA Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991	Part II –*Guidelines for the Management of Solid and Hazardous Wastes* Chapter One - *Dangerous Waste List, Characteristics and Criteria*. Subsection 1.2 – *Dangerous Sources*	The dangerous waste sources list appears in FAC-000-000-9904 (Part II Chapter Three, page 181). Any waste which is listed or which is a from the management of waste listed on the dangerous waste sources list shall be designated a dangerous waste and shall be identified as DW (Dangerous Waste), except the FAC –000-000-9904 includes several footnotes describing circumstances under which it is designated EHW (Extremely Hazardous Waste) rather than DW. **FAC-000-000-9904** FEW001 - Wastes generated from the salvaging, rebuilding, or discarding of transformers or capacitors which contain polychlorinated biphenyl (PCB).	This definition suits: • Transformer & capacitor oils
	Part II –*Guidelines for the Management of Solid and Hazardous Wastes* Chapter One - *Dangerous Waste List, Characteristics and Criteria*. Subsection 1.3– *Infectious Dangerous Waste*	Infectious dangerous waste shall include, but need not be limited to, the following types of solid waste: • culture and stock of infectious agents • pathological wastes • waste human blood and products of blood sharp instruments that have been used in patient care or in medical, research, or industrial laboratories etc	This definition suits: • Clinical wastes • Sewage sludge

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Appendix C continuation-- Review of FMENV and DPR Guidelines on Hazardous Waste Management

Guideline	Section	Regulation/law	Implication
FEPA S.I. 15 Management of Solid & Hazardous Wastes Regulations. 1991	S.I. 15 Part II Section 6. (1)	A waste shall be regarded as hazardous/dangerous if the waste appears in the list of dangerous waste in FAC-000-000-9903 as listed in Schedule 12 of the FEPA S.I. 15. Such waste shall be designated exclusively Hazardous waste (EHW).	
	S.I. 15 Part II Section 6. (2b)	A waste shall be regarded as hazardous/dangerous if it is a residue from the management of a waste listed in the dangerous waste in FAC-000-000-9903 as listed in Schedule 12 of the FEPA S.I. 15.	Including Incineration Ash
	S.I. 15 Part II Section 7	An infectious waste shall include but not limited to infectious waste specified in Schedule 5 of the FEPA S.I. 15.	This include clinical waste, sewage, rotten biodegradable food waste such as rotten meat etc
	S.I. 15 Part II Section 8.3	Any person who has a dangerous waste material shall use data available to him to determine the extent of toxicity in the waste. Where the data available to such person is inadequate to determine toxicity, the person concerned shall apply to the Agency to determine if the waste is contained in the Exclusive List of Registered Dangerous Substances, in the register with the Agency	Involve use of MSDS
	S.I. 15 Part II Section 11	Waste which contains Halogenated Hydrocarbons and Polycyclic Aromatic Hydrocarbons with more than three rings and less than seven rings (PAH) shall be determined to establish the concentration of these compounds.	Include spent/used Lube oil
	S.I. 15 Part II Section 11	A substance is regarded as carcinogenic if it is listed as International Agency for Research on Cancer (IARC) human or animal positive or suspected carcinogen.	NORM, Drilling Cutting and Radioactive Source
	S.I. 15 Part II Section 12	A Waste that contains a carcinogen is regarded as Exclusively Hazardous Waste, if the monthly or batch waste quantity exceeds 100Kg or the concentration of any positive (human or animal) carcinogen exceeds 1.0 percent of the waste quantity.	Formation sand/ drilling Cutting containing high level of NORM
	S.I. 15 Part II Section 13	Provides the characteristics to determine a solid waste has a dangerous waste.	

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Appendix C continuation-- Review of FMENV and DPR Guidelines on Hazardous Waste Management

Guideline	Section	Regulation/law	Implication
			This definition suits:
FEPA Guidelines and	Part II –*Guidelines for the*	A substance which is listed as an IARC (International Agency for Research	• Lead cells (batteries)
Standards for Environmental	*Management of Solid and*	on Cancer) human or animal positive or suspected carcinogen, shall be	Ni-Cd ·cells
Pollution Control in Nigeria, 1991	*Hazardous Wastes* Chapter One - *Dangerous Waste List, Characteristics and Criteria*.	carcinogenic substance which is an inorganic, respiratory carcinogen shall be a carcinogenic substance only if it occurs in a friable format (i.e. if it is in a waste which easily crumbles and forms dust which can be inhaled).	• Asbestos
	Subsection 1.7 – *Carcinogenic*		
	Dangerous Waste.		
	Article 1.7.1		

Appendix C continuation-- Review of FMENV and DPR Guidelines on Hazardous Waste Management

Guideline	Section	Regulation/law	Implication
DPR Environmental Guidelines and Standards for the Petroleum Industry In Nigeria, Revised edition 2018.	Part C – *Hazardous Waste Management* Section 2.0 – *Waste Management* Subsection 2.1 – *Identification* Article 2.1.2 Part II –*Guidelines for the Management of Solid and Hazardous Wastes* Chapter One - *Dangerous Waste List, Characteristics and Criteria*. Subsection 1.3– *Infectious Dangerous Waste*	Hazardous substances shall include but not limited to any element, compound, mixture, solution which because of its quantity and/or concentration, or physical, chemical or infectious characteristics, may: (i) cause or significantly contribute to an increase in mortality or an increase or (ii) pose substantial hazards to human health or the environment when managed and; (iii) hazardous substance shall satisfy the following criteria/characteristics: (a) Ignitability – liquid and/or liquid waste other than an aqueous solution containing less than 24% alcohol, that has a flash point of less than 60ºc; Waste (not a liquid), which is capable under standard temperature and pressure, of causing fire through friction, adsorption of moisture, or spontaneous chemical charge and, when ignited, burns so vigorously and persistently as to create a hazard; An oxidizer; An ignitable compressed gas; (b) Corrosivity – aqueous substance with a pH 2.0 or less or 12.0 or more; Liquid that corrodes steel at a rate greater than 5mm/year. (c) Reactivity – forms toxic gases, vapors, fumes, or explosive mixture with water when exposed to pH conditions between 2.0 and 12.5; Normally unstable and capable of explosion if subjected to a strong igniting/heat source; And explosive capable of detonation or explosion at standard temperature and pressure. (d) (i) Toxicity – that the level of concentration using Toxicity Characteristic Leaching Procedure (TCLP), is above the regulatory levels. Table VIII – (1).(ii) Listed toxicity (capable through chemical action of killing, injuring or impairing an organism; fatal to human in low doses. Table VIII-C2	Waste meeting conditions (iii) as the limiting criteria would be confirmed after analyses. However, the may fall into this group: • Waste crude • Obsolete chemicals • Chemical containers • Spent chemicals • Mercury wastes • Batteries • Paints (except water-based) • Solvents • Incinerator ash

8.4. Appendix D- Hazardous Waste Fact Sheet

Waste Name: Description: Category:	Hazard_ID_No. Revision number Date	TOTAL

Physical data			Composition
Boiling point	:	°C	Chemical Component
Melting point	:	°C	
Flash point	:	°C	
Density	:	kg/m3	
Solubility in water	:		
pH	:		
Dry matter	:	wt%	
Caloric value (1)	:		
Vapour pressure	:	mbar	Radioactivty
Smell (2)	:		Radium :
Colour	:		
Aggregation (3)	:		
Nature (4)	:		

(1) Caloric value	(2) Smell	(3) Aggregation		(4) Nature
1 = <17,000 kJ/kg	1 = no	1 = powder	5 = thick liquid	1 = explosive
2 = 17,000 - 30,000 kJ/kg	2 = slight	2 = solid matter	6 = thin liquid	2 = corrosive
3 = >30,000 kJ/kg	3 = strong	3 = shoveable/paste	7 = (liquified) gas	3 = aggressive
		4 = slurry		4 = poisonous

Handling Requirements	Risk Indicators
Packing :	Permissible Level of Exposure (PLE) :
Labelling :	Threshold Limit Value (TLV) :
Storage :	Lower Flammability Limit (LFL) :
Transport :	Upper Flammability Limit (UFL) :
Disposal :	Immediate Danger to Life & Health (IDHL) :

Hazard Evaluation	
Personnel Protection & Sanitation	**First Aid**
Exposure & Effects	**Remark**

Recorded by: