ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND MANAGEMENT PLAN FOR INTERVENTIONS IN NORTHERN BUSHROD ISLAND

Liberia Urban Resilience Project (LURP)
Northern Bushrod Island and Southeastern Paynesville Areas (Phase One)

Prepared for

Ministry of Public Works

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR INTERVENTIONS IN NORTHERN BUSHROD ISLAND

Volume I: Executive Summary

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Abbreviations and Acronyms

CH_4	Methane
CO_2	Carbon Dioxide
EHSG	Environmental Health and Safety Guideline
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency

EPML	Environmental Protection and Management Law of Liberia
ESF	Environmental and Social Framework
ESCP	Environmental and Social Commitment Plan
ESIA	Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
FGDs	Focus Group Discussions
GBV	Gender-Based Violence
GHG	Greenhouse Gases
GIIP	Good International Industry Practice
GoL	Government of the Republic of Liberia
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HFCs	Hydrofluorocarbons
ILO	International Labor Organization
km	Kilometer
LARP	Local Area Resilience Plan
LLA	Liberia Land Authority
LURP	Liberia Urban Resilience Project
LWSC	Liberia Water and Sewer Corporation
m	Meter
m^3	Cubic meter
MCA	Multi Criteria Analysis
MCC	Monrovia City Corporation
MPW	Ministry of Public Works
msl	Mean Sea Level
N_2O	Nitrous Oxide
NaFAA	National Fisheries and Aquaculture Authority
NF_3	Nitrogen Trifluoride
NGOs	Non-Governmental Organizations
O_3	Ozone
OHS	Occupational Health and Safety
PAP	Project-Affected Person

PFCs	Perfluorocarbons
PMU	Project Management Unit
POCs	Parameters of Concern
RAP	Resettlement Action Plan
s	Second
SEA/SH	Sexual Exploitation and Abuse and Sexual Harassment
SEP	Stakeholder Engagement Plan
SF_6	Sulfur Hexafluoride
S-WMP	Solid Waste Management Plan

Glossary

ARREST Agenda for Inclusive Development (2025–2029)	The ARREST Agenda is the country's fourth post-conflict National Development Plan, launched in January 2025 under President Joseph Boakai. It is designed to accelerate socio-economic transformation and move Liberia from a low-income to a lower-middle-income status by focusing on inclusiveness, sustainability, accountability, and resilience. The agenda addresses systemic challenges such as poverty, unemployment, and weak infrastructure while leveraging Liberia's youthful population and natural resources. Its framework revolves around six strategic pillars - Agriculture, Roads, Rule of Law, Education, Sanitation, and Tourism - which aim to modernize infrastructure, foster good governance, revitalize the economy, and empower citizens through improved education and healthcare.
Borrower	The party that receives financing from the World Bank to implement a project. The Borrower is responsible for ensuring compliance with the Bank's requirements throughout the project life cycle. For LURP, the Borrower is the Republic of Liberia, represented by the Ministry of Public Works (MPW).

Executive Summary

Introduction

This document is the Environmental and Social Impact Assessment (ESIA) Report for the Liberia Urban Resilience Project (LURP): Interventions in Northern Bushrod Island ("the Project"), located in Monrovia, Montserrado County, Liberia. The ESIA was prepared by Earthtime Inc. ("Earthtime") on behalf of the Ministry of Public Works (MPW), through its Project Management Unit (PMU, "the Client"), for submission to the Environmental Protection Agency of Liberia (EPA). This ESIA is accompanied by a stand-alone Environmental and Social Management Plan (ESMP) which must be read alongside this report.

Background and Overview

Greater Monrovia faces increasing flood risks due to its low-lying coastal setting, aging and insufficient drainage infrastructure, rapid unplanned urban growth, inadequate solid waste management, and the effects of climate change. Northern Bushrod Island is among the most vulnerable areas, experiencing recurrent flooding that affects communities, infrastructure and public helath and safety. In response, the Government of Liberia, with support from the World Bank, is implementing the LURP to enhance flood resilience and urban living conditions. Proposed interventions include flood risk management measures, drainage rehabilitation, environmental management actions, and community upgrading works. Key intervention areas include New Kru Town and the St. Paul River estuary and associated wetlands, which play a critical role in flood conveyance and attenuation.

Objectives, Scope of Work and Methodology

The main objective of this ESIA is to identify and assess the potential environmental and social impacts associated with the Project to define measures to avoid, minimize, mitigate, or compensate for adverse impacts while enhancing positive outcomes.

The ESIA covers the construction and operation phases of the Project. Project activities includes cleaning, rehabilitation, and realignment of existing drainage channels and culverts, construction of new drainage sections where required, localized community upgrading infrastructure in flood-prone areas, and implementation of complementary non-structural measures.

The preparation of the ESIA involved desktop and literature review, field surveys to collect data on the physical, biological, and socio-economic environments, laboratory analysis, and expert consultation. Public consultations were held with stakeholders, communities of the project area, and relevant government agencies. Impact identification and evaluation were carried out using a standardized and systematic approach.

Legal and Institutional Framework

The ESIA has been prepared in compliance with the Liberian regulations, the World Bank requirements and GIIP. Specifically, it has been prepared in accordance with Sections 13 and 14 of the Liberian Environmental Protection and Management Law (EPML) of 2003, the EPA's

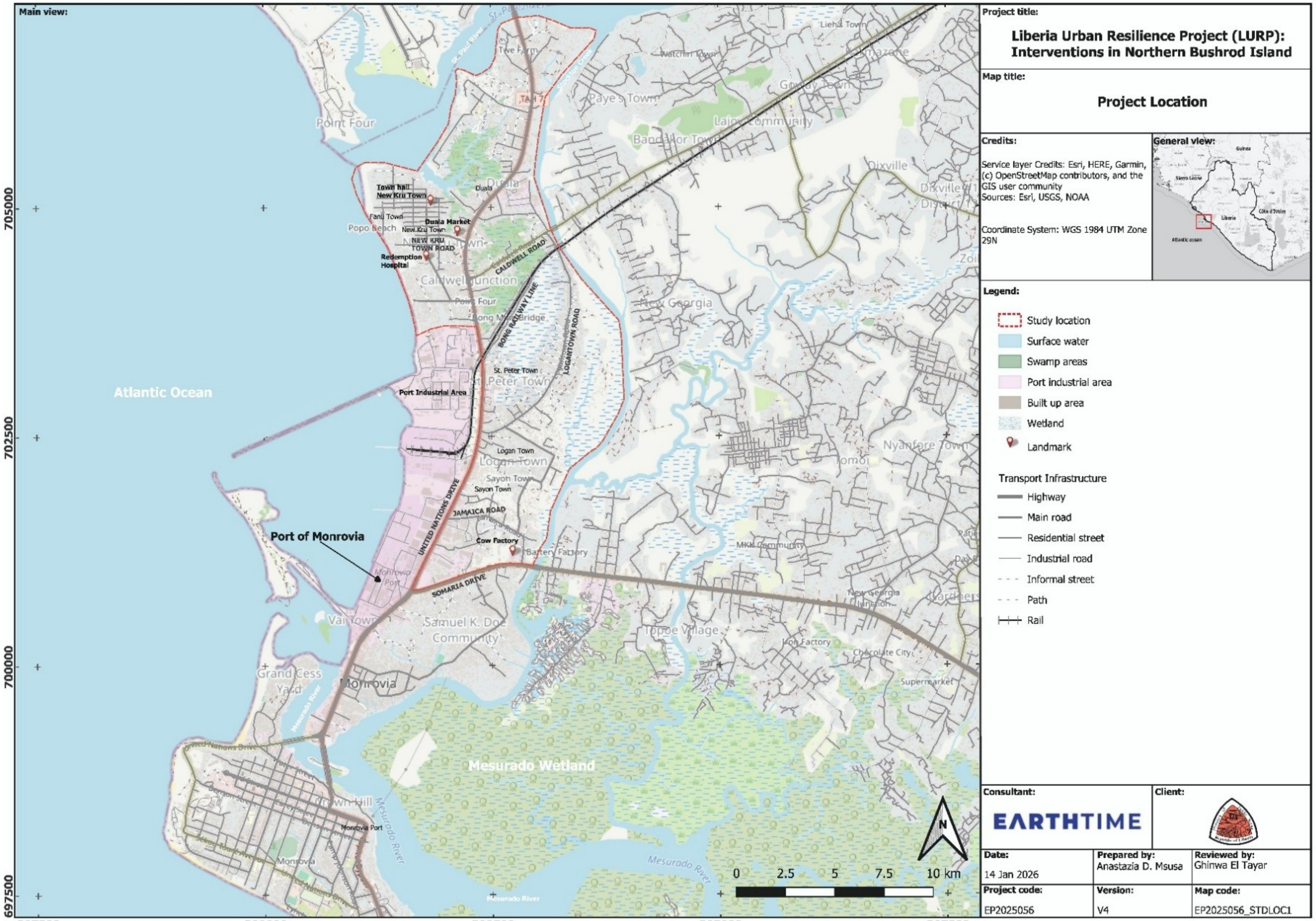
ESIA Procedural Guidelines of 2022, relevant EPA Parameters of Concern (POCs) of 2024 and the World Bank's Environmental and Social Framework (ESF) and its Environmental and Social Standards (ESS). A gap analysis between Liberia's national environmental and social regulatory framework and the World Bank ESSs was undertaken as part of this ESIA. The latter applies the higher standard where there is overlap between Liberian legislation and World Bank requirements. Where national regulations are less comprehensive or less stringent than the relevant ESS provisions, the ESIA adopts the requirements of the World Bank ESF to ensure alignment with international good practice.

Project Description

The Project's summary sheet is presented in the box below, while the figure that follows shows the Project's general location.

Project summary sheet

Summary sheet of the LURP Interventions in Northern Bushrod Island
• **Project proponent**: Ministry of Public Works (MPW) - Project Management Unit (PMU) • **Project location**: Northern Bushrod Island, Monrovia, Montserrado County, Liberia • **Project type**: Integrated flood risk management and community upgrading works • **Estimated design life**: 25-50 years • **Project phases**: Construction and operation • **Project duration**: **Construction phase:** Approximately 9 months **- Operation phase**: 25-50 years • **Activities** ○ **Construction phase:** ▪ Clearing of existing drainage infrastructure ▪ Earthworks for the excavation and rehabilitation of existing drainage channels and drains. ▪ Replacement of existing culverts and bridges with improved structures ▪ Construction of new drainage channels and drainage outlet structures ▪ Construction of footbridges, landscaping along the channels, construction of maintenance facilities ○ **Operation phase** ▪ Routine operation and maintenance of drainage channels, culverts, outlets, and pathways ▪ Regular inspection, cleaning, and desilting of drainage infrastructure ▪ Monitoring of water levels, drainage performance, and flood behavior ▪ Implementation of flood zoning , community awareness measures capacity-building activities • **Equipment:** Construction equipment including excavators, loaders, trucks, concrete mixers, compaction equipment, lifting equipment, pumps, and small tools • **Materials**: Cconcrete, cement, steel, rock, gravel, aggregates, geotextile, sand, fuel and water • **Expected waste**: Organic waste, solid waste, sediment, demolition and construction waste, hazardous waste • **Employment**: Approximately 100 workers • **Land ownership**: Public and private land



Project location mapxi

Analysis of Alternatives

As part of this ESIA, a structured analysis of alternatives was undertaken to identify the most feasible and sustainable approach for reducing flood risk in Northern Bushrod Island while minimizing environmental and social impacts. The assessment considered a no-project scenario, as well as alternatives related to location, design, construction methods, and operational approaches. The analysis of alternatives confirms that the selected project configuration in Northern Bushrod Island is the most feasible and sustainable option for reducing flood risks in the target areas. Environmental and social impacts have been avoided or minimized where possible, with unavoidable impacts justified by significant long-term resilience and health and safety benefits and managed through the ESMP and RAPs.

Analysis of alternatives

Alternative Category	Options Considered	Selected Approach and Rationale
No-Project Alternative	• No implementation of flood management interventions	Rejected because it would not address chronic flooding, inadequate drainage, solid waste accumulation, and associated environmental, social, public health, and safety risks in Northern Bushrod Island.
Location Alternatives	• Different intervention areas within Greater Monrovia	The Atlantic (New Kru Town) and St. Paul Wetlands sub-locations were selected as they provide the highest flood risk reduction benefits within the available budget. Other areas were excluded due to lower benefit-to-cost ratios, higher environmental sensitivity, and greater resettlement risks.
Routing and Alignment Alternatives	• Different drainage alignments and channel locations	Alignments were optimized to avoid densely occupied residential areas and reduce land acquisition and resettlement impacts. Existing roads and drainage corridors were prioritized, and new channels were introduced only where no viable alternatives existed. Remaining impacts will be managed through the RAP.
Design Alternatives	• Rehabilitation vs. replacement of channels; different lining materials; culvert options; solid waste control measures	Rehabilitation of existing drainage channels was prioritized where technically feasible to minimize land take and resettlement. Vegetated and mortared stone-lined channels were preferred over concrete structures where possible to reduce environmental impacts and improve landscape integration. Culverts will be replaced to improve hydraulic capacity and reduce blockages. Localized trash racks were selected as the most practical and effective solid waste control measure.
Construction Alternatives	• In-situ vs. prefabricated construction; mechanized vs. manual construction methods	Construction methods will be selected site-specifically. In-situ construction is generally preferred in dense urban areas due to greater flexibility and lower transport and lifting impacts, while prefabricated elements may be used selectively where impacts can be effectively managed. Manual methods will be prioritized in sensitive or confined areas to reduce noise, vibration, access disruption, and safety risks.
Operation and Maintenance Alternatives	• Reactive maintenance vs. routine inspection and cleaning	The selected approach emphasizes routine inspection and regular maintenance throughout the infrastructure design life to improve long-term performance and resilience. Waste and vegetation management will rely primarily on regular manual cleaning where feasible, reducing emissions and pollution risks.

Public Participation and Stakeholder Engagement

A **stakeholder identification and analysis** were conducted to inform this ESIA. Stakeholders were identified and classified into affected parties and interested parties.The stakeholder engagement activities were conducted to provide information on the Project and ESIA process, gather stakeholder feedback, concerns, and expectations, understand community and social dynamics, identify ecosystem service use, and capture anticipated project outcomes and potential impacts from affected groups and communities. Stakeholder engagement was carried out during the undertaking of the ESIA as shown in the table below. **ESIA stakeholder engagement details**

Engagement type	No.	Participants	Key discussions
High-level stakeholder consultation	1	• Government entities • NGOs • Local officials • Key stakeholders	Stakeholder feedback, concerns, inquiries, and recommendations
Community consultation	18	• Residents of surveyed communities	Community concerns, expectations, inquiries and recommendations
Focus group discussion	11	• Women	Gender-specific issues, social and economic impacts, and expectations
	8	• Youth	Youth's concerns and expectations
	10	• Chiefs and elders	Leaders' and elders' concerns and expectations
	8	• Fishermen • Fishmongers • Wetland Users	Resource use, livelihoods, concerns and expectations
	4	• Landowners	Community concerns and expectations
	2	• Civil society • Drivers union	Concerns and expectations
Key informant interview	27	• Elders • Chairpersons • Religious leaders • Administrative members • Community members	Concerns and expectations

Outcome of Consultations

Stakeholders raised several **positive expectations and concern**. In terms of **positive expectations**, stakeholders expect the Project to reduce flooding, improve public health and safety, strengthen drainage and infrastructure, improve sanitation and access to services, enhance mobility and access to livelihoods, create employment opportunities for local communities, and provide fair resettlement where required. Communities emphasized the need for long-term and sustainable flood management solutions.

A summary of the **key concerns** raised by the stakeholders is listed in the table below. **Key stakeholder concerns**

Engagement type	Key concerns articulated
High-level stakeholder consultation	• Risk of community opposition and need for continued consultation with local authorities and communities • Potential loss of habitats and biodiversity • Need to consider sensitive sites (e.g., Redemption Hospital) • Need to ensure alignment with national laws, policies, and environmental regulations • Need to include a health assessment in the ESIA • Need for detailed mitigation measures and long-term monitoring and maintenance • Need for clarity on the ESIA timeline and overall project implementation schedule
Community consultation	• Fear of project-induced resettlement without compensation, land tenure uncertainties, past unmet promises, weak coordination, and demand for meaningful community engagement • Existing concerns related to flooding, poor waste management and sanitation, limited access to safe drinking water, lack of roads and emergency access during flooding events, high exposure to disease, unsafe living conditions, coastal erosion, sand mining, and risks to children's livelihoods
Focus group discussion	• Concerns about project delays, incomplete works, poor construction quality, weak supervision, and failure to complete the project on time before the rainy season • Fear of corruption, mismanagement, lack of transparency, poor communication, and repetition of past failed or unfulfilled projects • Concerns about weak stakeholder engagement, exclusion from decision-making and employment, unfair recruitment, and hiring of external workers instead of local youth • Fear of increased crime, drug abuse, sexual violence and harassment, child safety risks, accidents, conflicts, and general insecurity linked to the influx of workers • Anxieties around demolition, relocation, loss of homes and services, social dislocation, higher rents, and lack of fair and timely compensation • Concerns about disruption to fishing, wetland use, market access, beach and road access, waste management, maintenance, and long-term project sustainability

Key informant interviews	• Project may not be implemented as promised, leading to continued flooding, waste issues, and poor health • Demolition of homes, shops, or churches in drainage paths and uncertainty about compensation • Construction disruptions and nuisance including noise, access difficulties, and safety risks for children • Fear of increase in crime/drug use by youth • Tensions arising from unfair selection and hiring process • Loss of trust due to previous projects that never returned

Information Dissemination and ESIA Disclosure

Information dissemination and stakeholder engagement were conducted throughout the ESIA process as described above. The various engagement activities ensured that project information was communicated to communities and relevant stakeholders, while also providing opportunities to gather feedback on potential environmental and social considerations. The ESIA findings will be disclosed in accordance with national requirements and the World Bank Environmental and Social Framework. The ESIA report will be made publicly available, including publication on the World Bank's website and the MPW's website, to ensure that affected communities and interested parties have access to project information and the opportunity to review and provide feedback.

Baseline Conditions: The Physical Environment

Baseline physical conditions were assessed to understand the existing environmental context and provide a reference point for evaluating potential project impacts. The project area has already been significantly affected by rapid urbanization, wetland encroachment, inadequate land-use planning, and poor waste management, resulting in obstructed drainage, degraded water quality, elevated air and noise levels, and increased flood and erosion risks. Baseline conditions were established through a review of available data and targeted field surveys.

Topography, Geology, Soils and Sediments

The project area lies within Liberia's low-lying coastal plain, with elevations generally between 0 and 6 m asl (above sea level), and is strongly influenced by tidal processes from the Atlantic Ocean and fluvial inputs from the St. Paul River, the Mesurado River and associated creeks, estuarine and wetland system, making it highly prone to flooding. The geological setting is dominated by recent Quaternary coastal, lagoonal, and fluvial sediments overlying the Guinea Shield, resulting in unconsolidated sandy, silty, and clay-rich deposits typical of wetland and estuarine environments. Soils in the project area consist mainly of regosols and alluvial soils with high moisture content, low strength, and variable organic matter. Baseline soil sampling indicate soil conditions generally compliant with applicable international guideline values, with localized nutrient enrichment linked to organic-rich and waterlogged environments and a localized petroleum hydrocarbon contamination consistent with domestic wastewater inputs, solid waste disposal, and stagnant hydrological conditions.

Meteorology and Climate Change

Baseline conditions for the project area were established using historical climatological data and site-specific records confirming pronounced wet and dry seasons with peak rainfall between June and September (period of highest flood risk) and strong maritime influence. The Project will not significantly contribute to greenhouse gas emissions and integrates climate considerations into its design, implementation, and long-term management, in line with sustainable development principles and Liberia's Nationally Determined Contributions.

Water Resources

The project area is influenced by a complex system of rivers, tidal creeks, wetlands, and coastal waters, where intense rainfall, tidal backflow, and limited drainage capacity contribute to recurrent flooding. Baseline surface water sampling was conducted as part of this ESIA at five locations: the wetland area south-east of the project area, the outfall of drainage into Stockton Creek near Bong Mines Railway Bridge, the wetland area near the St. Paul River , the outfall of the drainage from New Kru Town beach into the ocean, and the mouth of the St. Paul River. Baseline water quality in the project area reflects a combination of natural conditions and human activities. Inland surface water show signs of organic pollution, nutrient enrichment and localized hydrocarbon contamination, reflecting wastewater inputs, solid waste disposal, and stagnant conditions. Meanwhile, estuarine and coastal waters display marine influence, higher salinity, and generally better oxygenation due to tidal mixing. Baseline groundwater sampling was conducted during the ESIA field activities at two locations: the hand pump near Bong Mines Railway area, and the hand pump in New Kru Town. Groundwater quality was generally within applicable standards; however, localized exceedances of nutrients and suspended solids indicate impacts from sewage infiltration and organic-rich wetland conditions, while salinity indicators suggest seawater intrusion.

Air Quality and Noise

The project area is a densely populated and highly urbanized environment influenced by heavy vehicular traffic, port activities, power generation, small industries, commercial and market activities, informal waste burning, and fugitive dust, with dispersion conditions affected by high humidity and generally low wind speeds. Baseline air quality conditions were established through short-term monitoring at representative locations near residential areas, sensitive receptors, and major road corridors. Results indicate moderate particulate matter levels typical of dense urban and commercial settings, largely driven by traffic, road dust resuspension, and market activities. Gaseous pollutants such as nitrogen dioxide, carbon monoxide, and sulfur dioxide were generally within applicable national and international guideline values. Elevated methane concentrations and volatile organic compounds concentrations at selected locations reflect organic waste decomposition, wastewater stagnation, and localized fuel- and solvent-related activities. Noise monitoring was conducted at a residential area along Bong Mines Railway Road, near Redemption Hospital, and at the intersection zone between UN Drive and Logan Town Road. Results indicate that daytime noise levels already exceed national and World Bank Group Environmental, Health and Safety Guidelines limits, reflecting a high background noise environment driven by traffic peaks, commercial activity, and dense residential settlements.

Visual Amenity

The project area is characterized by a dense, highly urbanized visual environment comprising mixed residential and commercial areas, transport corridors, industrial facilities, and fragmented wetland and coastal features. Overall visual quality is reduced by informal development, encroachment into wetlands, unregulated roadside activities, and the accumulation of solid waste. Artificial lighting levels are moderate to high due to urban and port-related activities. Visual receptors include surrounding communities, schools, health facilities, and small businesses located near intervention sites.

Baseline Conditions: The Biological Environment

Natural habitats within and around the project footprint are fragmented and modified; however, coastal and wetland ecosystems remain present. The Mesurado Wetland, located a few kilometerts south of the project area, is nationally recognized and designated as a Ramsar site. However, this wetland system, and associated habitats, are subject to long-standing pressures from urban expansion, land reclamation, pollution, waste disposal, altered hydrology, and resource extraction.

The biodiversity assessment combined desk-based review with field investigations, including habitat mapping, rapid flora and fauna surveys, aquatic sampling, and environmental DNA (eDNA) analysis, supplemented by community engagement and local ecological knowledge.

Ecological Context and Habitat Condition

The habitat mapping identified a heterogeneous but heavily modified landscape comprising twelve habitat types, including fragmented mangrove stands, brackish marsh wetlands, drainage-associated aquatic habitats, disturbed grasslands, shrub mosaics, sandy beach areas, and urban coastal waters. Most habitats fall within the World Bank ESS6 “modified habitat” category, reflecting extensive anthropogenic alteration, although some degraded natural habitats remain, particularly wetlands and mangroves. Dense mangrove stands occupy a very small proportion of the Project’s Biodiversity Area of Influence (less than 0.5%) while fragmented mangrove stands account for approximately 6.5% of the Biodiversity Area of Influence, reflecting historical disturbance.

Flora and Invasive Species

A total of 142 plant species representing 111 genera and 58 families were recorded within the Biodiversity Area of Influence. Vegetation structure is strongly skewed toward herbs (39%), grasses (12%), and sedges and dominated by disturbance-tolerant species typical of urban wetlands and degraded coastal environments. No species classified as Threatened or Near Threatened under the IUCN Red List were recorded, and no endemic or restricted-range species were identified. All taxa are widespread across West Africa or the broader tropics. Mangrove relics (*Avicennia germinans, Rhizophora mangle, Rhizophora racemosa, and Laguncularia racemosa*) and fern- and sedge-dominated wetlands represent the most ecologically significant vegetation remaining. A high prevalence of invasive and potentially invasive plant species was recorded, particularly in wetlands and drainage-associated habitats, reflecting long-term anthropogenic disturbance and indicating an already degraded baseline condition.

Fauna and Aquatic Ecology

Field surveys recorded 53 bird species, five herpetofauna species, 27 fish species, and five aquatic macroinvertebrate taxa within the Biodiversity Area of Influence. Faunal assemblages were dominated by disturbance-tolerant and urban-adapted species typical of modified coastal and wetland environments. No Critically Endangered or Endangered species were confirmed during field surveys. One Vulnerable migratory bird species, the Grey Plover, was recorded, and seven Palearctic migratory species were documented, confirming the continued seasonal use of the coastal–wetland mosaic as a stopover habitat despite extensive urbanization. Aquatic surveys confirmed a diverse assemblage of estuarine and marine fish, including commercially important species. Most fish species recorded are classified as Least Concern; however, the Vulnerable Madeiran Sardinella and the Near Threatened Bigeye Grunt were detected in low abundance, indicating the importance of the wider coastal zone for regional fisheries resources. Aquatic macroinvertebrate assemblages were dominated by disturbance-tolerant estuarine crustaceans and molluscs, with no globally threatened taxa recorded. eDNA analysis further strengthened the baseline. Recorded mammal DNA was dominated by rodents and bats typical of urban environments. The Near Threatened Strawcoloured Fruit Bat was recorded. The Vulnerable Madeiran Sardinella and one invasive fish species (Redbelly Tilapia) were also detected through eDNA. Community interviews reported the occasional presence and killing of several reptile species in the wider area, snakes, crocodiles and turtles, which is relevant for occupational health and safety planning. Overall, the fauna assemblage reflects a highly modified urban–wetland system dominated by generalist and disturbance-tolerant taxa, while retaining functional connectivity to the wider Mesurado estuarine and coastal ecosystem.

Ecosystem Services and Community Dependence

Ecosystem services were assessed through an integrated approach combining literature review, household surveys results, focus group discussions with fishers and wetland users, and ecological field surveys. Provisioning services are primarily associated with aquatic and coastal ecosystems. Artisanal river and marine fisheries constitute the most significant ecosystem-dependent livelihoods. Access to landing sites, beaches, rivers and nearshore waters is critical to income generation and food security. Localized clay extraction and river sand mining were documented and contribute to habitat modification. Remaining wetland vegetation and mangrove relics continue to provide regulating services such as buffering and filtration functions; however, field evidence and community feedback confirm that these services are already compromised by solid waste accumulation, polluted drainage discharge, vegetation clearing, and hydrological alteration. Cultural services remain important, with fishing forming a core component of some affected communities' identity and social cohesion.

Overall Baseline Characterization and ESS6 Critical Habitat Screening

Baseline biodiversity assessments, including habitat mapping and targeted flora and fauna surveys, indicate a highly modified urban–coastal environment with degraded but still ecologically and socially important wetland and aquatic systems. While modified and natural habitats, such as wetlands and mangrove stands, are present within the project area, these habitats are highly degraded and do not meet the criteria for critical habitat as defined under World Bank Environmental and Social Standard 6 (ESS6). Accordingly, the Project is not expected to result in significant adverse impacts on critical habitats, and biodiversity impacts should be assessed and managed in line with ESS6 requirements applicable to modified and natural habitats. Finally, although no intact or critical habitats were identified within the project footprint, residual ecological sensitivity remains, particularly in relation to mangroves, wetlands, aquatic habitats, and fisheries-dependent livelihoods. This baseline underscores the need for carefully designed mitigation measures to avoid exacerbating existing pressures, manage invasive species risks and protect ecosystem services.

Baseline Conditions: The Socio-Economic Environment

The socio-economic baseline was developed using a mixed-methods approach combining quantitative household surveys with qualitative tools, such as Key Informant Interviews (KIIs), Focus Group Discussions (FGDs) alongside broader community consultations within the defined Project's Social Area of Influence (SAI). The household survey captured demographic characteristics, tenure and housing conditions, livelihood patterns, income sources, food security, service access, vulnerability factors, and community priorities. Qualitative engagement explored governance structures, fisheries and wetland-based livelihood dependencies, gender roles and division of labor, social networks, vulnerability patterns, and perceptions of flood risk and infrastructure needs. Secondary data was also consulted as needed.

Population and Household Characteristics

The population surveyed within the social area of influence is predominantly young, with 85.5% of individuals under the age of 45. The sex ratio is approximately 0.85 males for every female, and the average household size is 5.2 persons. Most households are male-headed (about 70%) while the rest are female-headed (about 30%).

Access to Services and Infrastructure

Basic services such as education, health, water supply, sanitation, and markets are present across communities; however, the number and capacity of facilities vary and are often insufficient to meet community needs. While households generally report access to available services, accessibility differs depending on the location of facilities and population distribution within and across communities. The condition of existing infrastructure is widely reported as inadequate, with limited maintenance, insufficient sanitation coverage, and constrained water supply affecting service quality and reliability.

Socio-economic Conditions and Livelihoods

Households rely on a combination of informal trade, small businesses, wage labor, with some individuals engaged in private and government employment. Some are involved in small scale agriculture or fishing. 19% of the surveyed population reported business ownership as their primary occupation, with women representing nearly three-quarters of this group. Formal and structured employment opportunities are more limited and predominantly male dominated. Fishing as a primary occupation represents less than 1% of respondents and is exclusively male. Meanwhile, 5% reported being unemployed and actively seeking work. Community land use is primarily residential, with limited small-scale cultivation and natural resource-based activities, though security of land ownership and tenure varies. Land tenure reflects Liberia's hybrid customary–statutory system, but in practice land access is limited, with few households holding small, predominantly formally titled parcels. Women's access to land is primarily exercised through household and community structures rather than formal ownership. In this context, women are commonly involved in managing household assets and livelihoods. Income and expenditure patterns reveal low and uneven cash flow, supplemented in some cases by passive income sources such as remittances or pensions. Asset ownership remains modest for many households.

Health and Education

Health services across the SAI are primarily provided through public health centers, district hospitals, and local clinics, with households showing a strong reliance on the formal public health system. Availability varies by location, with some facilities located within communities and others requiring travel outside the town. Average travel time to health facilities is relatively high. Gender-specific health access indicators highlight high utilization of maternal health services. However, preventive health outreach remains limited, with coverage varying across locations. Conditions of health services present challenges related to quality of care, cost of services, and poor medical supplies. Educational infrastructure is present across surveyed communities, with nearly all communities reporting access to at least one elementary school, and approximately half reporting access to secondary schools. Vocational schools are limited, and no universities were reported within the SAI. Sixteen percent of surveyed individuals had never attended school, with a higher proportion among women (10%) than men (6%). Enrollment at nursery and primary levels is relatively balanced between boys and girls; however, participation declines sharply at higher levels. Only 1% of women and 3% of men reported reaching undergraduate education. In terms of access conditions, households reported a strong reliance on private schools (46%), compared to government schools (8%).

Water, Sanitation and Waste Management

Approximately 44% of surveyed households reported access to a water source, with an average travel time of just over 4 minutes, indicating physical proximity; however, reported challenges include salinity intrusion, seasonal supply interruptions, and concerns regarding water quality. Sanitation infrastructure is limited and uneven, with many households relying on shared or unimproved facilities, and only a small proportion having private household sanitation. Practices such as open dumping and waste burial remain common. Solid waste management is particularly weak: only 1 out of 16 surveyed communities reported access to a formal waste disposal system. Most households rely on communal pits or dumpsites, alongside continued open dumping and private pits.

Poverty and Vulnerability

Households in the project area experience notable economic constraints, including income shortages (>50% of surveyed households), seasonal food insecurity (about 60% of surveyed households), and limited access to formal financial services (4% of surveyed households). Livelihoods are primarily oriented toward meeting basic needs, as reflected in borrowing for education, food, and medical expenses, occasional asset sales for essential expenditures, and the prioritization of employment, education, water, health services, and drainage improvements as the most urgent community needs. Vulnerability in the project area was assessed using a set of socio-economic and demographic indicators embedded in the ESIA analysis, including income stability, food security, disability status, access to basic services, educational attainment, and households' ability to cope with economic shocks. Based on these indicators, vulnerable groups were identified as households with limited or unstable incomes, women-headed households, households with elderly or disabled members, and households with limited education.

Gender and Social Inclusion

Women in the SAI play a central role in sustaining household welfare and community life, yet they face multiple structural challenges that limit their socio-economic participation and heighten their vulnerability. While many women are active in informal income-generating activities, caregiving, and community networks, their opportunities are constrained by limited access to formal employment, lower educational attainment, and heavy unpaid care responsibilities. Women are involved in leadership roles and play a role in community. Participation often remains consultative rather than decision-making in nature. Women also face heightened exposure to risks such as unsafe living conditions, inadequate sanitation, and gender-based violence. Incidents of domestic violence and sexual and gender-based violence, including verbal, physical, and sexual abuse, are reported across communities, often resolved informally without legal recourse. Approximately 31% of households reported cases of gender-based violence within their communities. Support mechanisms were reported by 79% of households, primarily through police or legal services and community leaders.

Environmental and Social Impacts, Mitigation, Management and Monitoring

Summary of Impacts

The Project's impact assessment considered potential effects across the physical, biological, and socio-economic environments throughout all phases of project development. Using a precautionary and risk-based approach, the assessment applied criteria consistent with World Bank ESSs to evaluate the scale, duration, and significance of both direct and indirect project impacts. Each impact was assessed and assigned a significance rating (negligible, minor, moderate, or major). For each impact, mitigation strategies are identified in the ESIA and detailed mitigation measures are set out in the ESMP, with the objective of avoiding or minimizing adverse impacts and reducing their residual significance to acceptable levels. Following the implementation of these measures, a residual significance was determined for each impact. The table below summarizes the positive impacts expected from the Project, as well as the negative impacts that retain a minor or moderate residual significance after mitigation.

Overall, the assessment indicates that while the Project will generate a wide range of environmental and social impacts during construction and operation, most adverse impacts can be effectively avoided or minimized through the mitigation measures set out in the ESMP. The majority of environmental impacts are expected to have negligible or minor residual significance after mitigation, reflecting their localized and temporary nature. However, some moderate residual impacts remain in the social domain, particularly those related to physical and economic displacement, livelihood disruption, and social tensions associated with workforce influx.

List of environmental and social impacts iof the Project outling the residual signifcances after mitigation

Potential impact and cause	Significance	Residual significance after mitigation
POSITIVE IMPACTS		
Economic benefits and increased investment opportunities due to infrastructure development, improved accessibility and reduced flood related losses.	Moderate	N/A
Rehabilitation and upgrading of drainage and urban infrastructure, improving flood resilience and reducing flood risk and property damage.	Major	N/A
Improved soil and water quality through reduced stagnation and waste accumulation.	Moderate	N/A
Improved soil stability and reduced waterlogging in rehabilitated drainage corridors.	Moderate	N/A

Potential impact and cause	Significance	Residual significance after mitigation
Reduction in methane emissions from stagnant drains and flooded areas.	Moderate	N/A
Improved visual amenity due to drainage rehabilitation and reduced waste accumulation.	Moderate	N/A
Reduced solid waste accumulation and pollutant inflow into receiving aquatic, wetland and marine environments, supporting healthier ecosystems and enhancing provisioning ecosystem services (fishing).	Minor	N/A
Improved hydrological functioning of wetlands and strengthened longterm flood regulation capacity resulting in enhancing and regulating ecosystem services.	Moderate	N/A
Protection of remaining mangrove and marshy wetlands from further fragmentation from encroachment and land reclamation and pollution from ongoing solid waste dumping, through wetland zoning.	Moderate	N/A
Temporary employment opportunities for local communities during the construction phase.	Moderate	N/A
Improved access and mobility for community members due to reduced flooding, facilitating access to schools, health facilities, and markets.	Moderate	N/A
Improved road conditions as a result of reduced flood occurrence and improved drainage infrastructure.	Moderate	N/A
Increased demand for local goods and services during construction, supporting small businesses and informal economic activities.	Minor	N/A
Improved public health conditions due to reduced stagnant water and lower exposure to flood-related health risks.	Moderate	N/A
Reduction in vector-borne disease risks due to flood control measures that minimize standing and stagnant water.	Major	N/A

NEGATIVE IMPACTS		
Impacts on the general environment		
General environmental damage due to inadequate compliance and supervision.	Moderate	Minor
Potential non-compliance with national environmental regulations, permit conditions, and World Bank ESF/ESS requirements during project planning, construction, and operation.	Moderate	Minor
Long-term environmental degradation in absence of proper operation and maintenance.	Major	Minor
Impacts on soil and land resources		
Soil erosion and degradation from excavation, earthworks, construction and operation activities.	Moderate	Minor
Degradation of soil structure and permeability in wetlands and low-lying areas due to drainage construction.	Moderate	Minor
Impacts on water resources		
Water pollution from poor drainage systems and sediment-laden runoff entering watercourses and wetlands.	Moderate to Major	Minor
Contamination of surface and groundwater from spills, leaks and contaminated runoff.	Moderate to Major	Minor
Alteration of natural drainage patterns, hydrological connectivity and wetland water retention characteristics resulting from construction of new channels, drain rehabilitation and Long-term improvement of drainage efficiency	Major	Minor

Potential impact and cause	Significance	Residual significance after mitigation
Impacts on air quality		
Dust emissions from land clearing, excavation, construction activities and vehicle movement.	Moderate	Minor
Exhaust emissions from machinery, generators, and transport vehicles.	Moderate	Minor
Impacts from noise and vibration		
Noise and vibration from construction activities, blasting, operation of heavy equipment, and transport.	Moderate	Minor
Impacts related to climate change		
Greenhouse gas emissions from vehicles, heavy machinery, generators and from routine operation and maintenance activities.	Moderate	Minor
Failure of Project infrastructure due to improper operation and maintenance or to extreme climate-related events (e.g., flooding, storms, sea-level rise) leading to increased vulnerability.	Major	Minor
Impacts from waste generation		
Pollution of soil and water from improper waste handling and disposal.	Moderate	Minor

Impacts from traffic and transport		
Traffic congestion, dust, and accidents from project vehicle movement on public roads.	Major	Minor
Temporary safety hazards, dust, noise, land access conflicts, local traffic and community mobility disruption due to road diversions.	Major	Minor
Impacts from drainage and stormwater runoff		
Increased surface runoff and localized flooding due to poor drainage design and increase of impermeable surfaces.	Moderate	Minor
Impacts from construction materials		
Land damage (degradation, loss of soil and cover, reduced productivity) and environmental disturbance (noise, vibration, dust, water pollution) from borrow pits and quarries.	Moderate	Minor
Impacts on biodiversity		
Loss of modified or natural (degraded) habitats due to vegetation clearing and infrastructure development.	Moderate	Minor
Direct loss of flora and fauna from vegetation clearing or removal by workers.	Moderate	Minor
Impacts on ecosystem services		
Disruption of artisanal fishing activities and related cultural habits near active construction zones due to construction works and potential associated increased turbidity and sediment mobilization.	Moderate	Minor
Impacts on community relations		
Damage to land, yards, access paths, and communal spaces due to construction activities, material storage, and movement of machinery.	Major	Minor
Nuisance impacts from construction activities (including dust, noise, and vibration) disrupt daily life, affect community well-being, and affect sensitive receptors such as places of worship, schools, and health centers.	Moderate	Minor
Safety risks to community members from increased road traffic.	Moderate	Minor
Damage to or contamination of drinking water supplies from project activities.	Moderate	Minor
Conflicts or tension due to inadequate consultation or exclusion from benefits.	Moderate	Minor

Potential impact and cause	Significance	Residual significance after mitigation
Disruption of social networks, community ties, and informal support systems for households relocated to new areas or new communities, with associated pressure on housing, services, and livelihood opportunities in host communities.	Major	Moderate
Impacts on livelihoods		

Temporary or permanent economic displacement due to loss or restriction of access to livelihood spaces and resources as a result of construction activities and access controls.	Major	Moderate
Physical displacement of households due to permanent land acquisition, resulting in loss of housing, relocation, and disruption of established social and economic systems.	Major	Moderate
Impacts from influx of people		
Influx of people seeking employment puts pressure on local resources and services, leading to social tensions with host communities.	Moderate	Minor
Social tension — including frustration, feelings of exclusion, and decreased local support for the project — arising from unequal employment opportunities and the failure to prioritize affected communities in hiring.	Major	Moderate
Risk of child labor, sexual exploitation and abuse/sexual harassment (SEA/SH), and other forms of labor-related misconduct associated with excessive need for job opportunities and poor labor management.	Moderate	Minor
SEA/SH and gender-based violence (GBV) increase in the affected communities due to the influx of temporary laborers.	Moderate	Minor
Pressure on housing, services, and livelihood opportunities due to the presence of workers, leading to tension with host communities.	Moderate	Minor
Improved living conditions in project areas may attract immigration, increase population density hence placing additional pressure on housing, services, infrastructure, and livelihood opportunities, thus leading to increased social stress within host communities.	Moderate	Minor
Impacts on cultural heritage		
Loss, disturbance, or restricted access to cultural sites — disturbs or damages sites of historical, spiritual, or cultural significance and limits communities' ability to perform traditional and spiritual practices.	Moderate	Minor
Impacts on public health and safety		
Increased road accidents during construction and operation.	Moderate	Minor
Higher risk of communicable diseases (e.g., sexually transmitted diseases) linked to workforce influx and limited health awareness.	Moderate	Minor
Community exposure to hazards from open trenches, inadequate fencing, and unsafe work sites, particularly affecting children.	Moderate	Minor
Impacts on labor and working conditions		
Local communities are excluded from employment if project opportunities are preferentially given to outsiders.	Moderate	Minor
Increase in vulnerable groups being excluded from employment.	Moderate	Minor
Gender inequality and exclusion of women from employment.	Moderate	Minor
Employees face exploitation due to low pay, long hours, and inadequate contracts.	Moderate	Minor
Impacts on occupational health and safety		
Fire, explosion, and electrical hazards caused by poor facility design, inadequate maintenance, or unsafe handling of flammable and reactive materials.	Major	Minor

Potential impact and cause	**Significance**	**Residual significance after mitigation**
Traffic and machinery-related injuries due to inadequate segregation of work zones, poor traffic management, and untrained vehicle or equipment operators.	Major	Minor
Health risks and disease transmission from poor hygiene, inadequate potable water, lack of clean eating areas, or unsanitary living conditions.	Moderate	Minor
Injuries are exacerbated due to inadequate emergency response.	Major	Minor
Increased OHS hazards for workers operating on or near water bodies including drowning, slips and falls on wet or unstable surfaces, and risks associated with vessel or pontoon instability.	Major	Minor
Risk of serious injury from encounters with venomous or constrictor snakes and crocodiles, including snakebite envenomation, crushing injuries, severe trauma, or drowning.	Major	Minor

Cumulative Impacts

The Project will interact with existing environmental and social pressures in Northern Bushrod Island and surrounding areas. While many project impacts are localized and manageable on their own, their interaction with past, ongoing, and planned developments may contribute to cumulative effects in a dense and already stressed urban environment. Key cumulative impacts identified include cumulative degradation of soil and water quality, disturbance, nuisance, and traffic-related impacts, pressure on waste management systems, habitat loss and degradation, socio-economic and livelihood vulnerability and pressure on urban services and infrastructure.

Impact Mitigation

A standalone ESMP has been prepared to ensure implementation of mitigation measures in line with EPA requirements, World Bank ESSs, and GIIP. The ESMP consolidates environmental, social, health and safety, biodiversity, labor, and community-related mitigation measures into a single integrated framework. Impacts are grouped under thematic categories including impacts on the general environment, water, air, waste, biodiversity, ecosystem services, livelihoods, community health and safety, labor and working conditions, and occupational health and safety.

The mitigation approach follows the mitigation hierarchy of avoidance, minimization, mitigation, and compensation. Measures for the physical environment focus on pollution prevention, erosion and sediment control, protection of water resources, management of noise, dust, emissions, hazardous materials, and rehabilitation of disturbed areas. Biodiversity mitigation prioritizes avoidance of sensitive habitats, minimization of disturbance footprints, protection of flora and fauna, invasive species control, and ecological restoration. Social mitigation includes compensation and RAP implementation, livelihood restoration, stakeholder engagement, grievance management, protection of vulnerable groups, and management of labor-related risks including SEA/SH, GBV, and child labor. Occupational health and safety measures are based on GIIP and include worker training, PPE, traffic and site safety measures, emergency preparedness, and controls for high-risk activities.

Crosscutting impacts are managed through integrated waste management, pollution prevention, land restoration, and environmental and social monitoring measures.

Monitoring

Monitoring is an essential component of the Project's ESMP and ensures that mitigation measures are implemented effectively and deliver the intended outcomes. The ESMP includes a comprehensive Monitoring Plan specifying parameters, frequency, responsibilities, methods, and reporting requirements for both environmental and social aspects.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR INTERVENTIONS IN NORTHERN BUSHROD ISLAND

1. Introduction

This document is the Environmental and Social Impact Assessment (ESIA) Report for the Liberia Urban Resilience Project (LURP): Interventions in Northern Bushrod Island ("the Project"). The Project is located in Monrovia, Montserrado County, Liberia.

The ESIA has been prepared by Earthtime Inc. ("Earthtime" or "the Consultant") on behalf of the Ministry of Public Works (MPW), through its Project Management Unit (PMU, "the Client"), for submission to the Environmental Protection Agency of Liberia (EPA).

This ESIA is accompanied by a stand-alone Environmental and Social Management Plan (ESMP) which must be read in conjunction with it.

1.1. Background

Liberia, and particularly Greater Monrovia, faces increasing risks from flooding due to its lowlying geography, inadequate, aging and lack of maintenance of drainage infrastructure, and rapid, unplanned urban growth especially around the Mesurado Wetland area in the last 4050 years. Historical events have demonstrated the severe human and economic impacts of pluvial and fluvial flooding, which are expected to worsen under future climate scenarios. On average, almost 15% of the inhabitants of Monrovia are directly affected by flooding every year (Deltares, 2021). Key contributing factors include poor solid waste management, lack of urban zoning, aging or insufficient drainage systems, and climate change impacts such as heavy rainfall events and rising sea levels which increase the severity of floods (CDR International & Earthtime Inc., 2025b).

The Government of the Republic of Liberia (GoL), through the MPW and its PMU, with financial support from the World Bank, is developing and implementing the Liberian Urban Resilience Project. The LURP seeks to enhance flood resilience and urban infrastructure in Greater Monrovia, through interventions such as drainage rehabilitation, construction of flood risk management infrastructure and community facilities to reduce vulnerability to flooding and improve living conditions.

The LURP focuses on four flood-prone areas in greater Monrovia (Figure 1-1):

- Location 1: Northern Bushrod Island (subject of this ESIA)
- Location 2: Central Business District, Soniwein
- Location 3: Omega Market
- Location 4: South-eastern Paynesville

Earthtime was commissioned by the MPW-PMU to prepare the ESIA Report for the LURP inteventions proposed for Northern Bushrod Island.

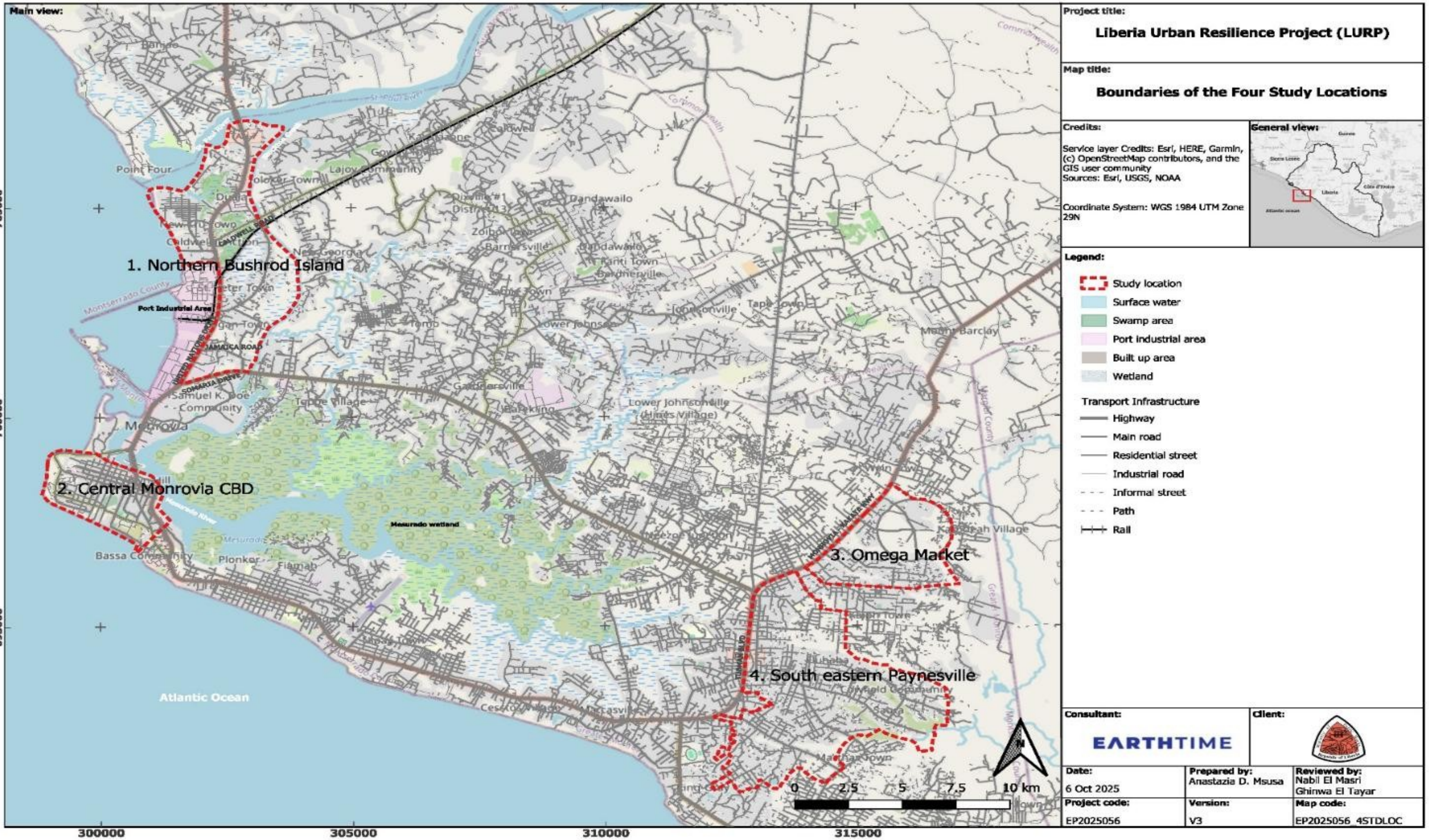


Figure 1-1 Boundaries of the four study locations as part of LURP[15]

1.2. Project Overview

This ESIA focuses on the LURP inteventions proposed for Northern Bushrod Island ("the Project"), one of the most flood-prone and densely populated areas of Monrovia.

The ESIA assesses potential environmental and social impacts associated with the design, construction, and operation of the proposed interventions. A standalone Environmental and Social Management Plan (ESMP) will be prepared for the Project to ensure compliance with the Environmental Protection and Management Law of Liberia (EPML), the EPA Revised ESIA Procedural Guidelines, and the World Bank Environmental and Social Framework (ESF) (see Section 2).

The Project prioritizes selected zones within Northern Bushrod Island for rapid improvements in flood resilience, community safety and environmental management under its scope, while esnsuring feasibility within the available financial considerations. The selection process was guided by a scoring and prioritization process conducted as part of a LARP which integrated hydrological modeling, flood hazard mapping, and extensive community consultation. The following criteria were considered:

- Flood risk reduction
- Environmental and safety impacts
- Community benefits
- Financial considerations
- Procurement feasibility
- Implementability

Based on this assessment and on effectiveness of the flood risk reduction inteventions, the selected zones for structural and soft interventions and community upgrading were as follows (CDR International & Earthtime Inc., 2025a):

- **New Kru Town**, with drainages outfalls into the Atlantic Ocean and St. Paul Estuary. This area was prioritized due to severe and recurrent pluvial flooding, constrained drainage capacity, and high exposure of vulnerable communities.
- **St. Paul River** including the estuary and the associated wetlands located south of the St. Paul River and north of the Duala Market and wetlands areas around Caldwell Road and the Bong Mines Railway. These zones were prioritized due to their key hydraulic function, their role in conveying and attenuating floodwaters from upstream areas, and their feasibility for implementation within acceptable environmental and social risk levels.

The project includes the construction and operation of two main categories of interventions as follows:

- **Flood risk management infrastructure**, including drainage channels, culverts, bridges and drainage outlet structures
- **Community upgrading infrastructure**, including footbridges providing safe pedestrian routes for communities, drain maintenance facilities

Project structural interventions will be supported by selected soft measures such as zoning in wetland areas to prevent encroachment. A detailed project description including design, activities and resource requirements is provided in Section 3.

1.3. Objectives

This ESIA Report has been prepared in accordance with Liberian regulations, World Bank ESF requirements and good international industry practice (GIIP) (see Section 2). More specifically, the ESIA Report has been prepared in accordance with:

- Sections 13 and 14 of the Liberian EPML of 2003
- EPA's ESIA Procedural Guidelines of 2022
- Relevant EPA Parameters of Concern (POCs) of 2024
- The World Bank's ESF and its Environmental and Social Standards (ESS)
- GIIP

The ESIA's main objective is to ensure that the potential impacts associated with Project activities are identified, their significance is assessed, and appropriate mitigation measures are proposed to eliminate or minimize such impacts during a reasonable timeframe.

1.4. Scope

The ESIA covers the construction and operation phases of the Project as defined in Section 1.2 (see Section 3 for further detail).

1.5. Structure of the Report

The ESIA Report has been organized to cover all the items listed in the Liberia ESIA Procedural Guidelines (Environmental Protection Agency of Liberia, 2022), as well as the various pertinent World Bank requirements.

The overall ESIA Report structure is summarized in Table 1-1.

Table 1-1 ESIA report structure

Section	Title	Contents
Volume I: Extended Executive Summary		

	Extended Executive Summary	Presents a summary of the ESIA, showcasing key findings in non-technical terms.
Volume II: Context		
1	**Introduction**	Presents a brief background of the Project, and the objective, scope, and structure of the report.
2	**Legal and Institutional Framework**	Describes the legal and policy requirements as well as the administrative structure relevant to the Project.
3	**Project Description**	Describes the project's location, components, duration, design, and activities.
4	**Project Alternatives**	Analyzes the various alternatives that were assessed for the Project.
5	**Stakeholder Engagement and Grievance Redress**	Presents stakeholder engagement activities and findings.
	References (Volume II)	Cites all sources referred to in Volume I.
	Appendices (Volume II)	Includes supporting materials relevant to Volume I.
Volume III: Baseline Conditions		
6	**Baseline Conditions: The Physical Environment**	Provides a detailed baseline assessment of the receiving physical environment.
7	**Baseline Conditions: The Biological Environment**	Provides a detailed baseline assessment of the receiving biological environment.
8	**Baseline Conditions: The Socioeconomic Environment**	Provides a detailed baseline assessment of the receiving socio-economic environment.
	References (Volume III)	Cites all sources referred to in Volume II.
	Appendices (Volume III)	Includes supporting materials relevant to Volume II.
Volume IV: Impact Analysis and Management		
9	**Environmental and Social Impact Assessment**	Presents: • the standardized approach to impact assessment in order to make the findings, conclusions, and recommendations more objective and transparent. • the actual assessment of the Project's impacts to the physical, biological, and socio-economic environments.
10	**Environmental and Social Mitigation**	Describes the approach followed to set mitigation measures that must be put in place for each potential impact.
11	**Environmental and Social Management Overview**	Provides an overview of what the Environmental and Social Management Plan includes. The latter is a separate standalone document that accompanies this ESIA report.

2. Legal and Institutional Framework

This section sets out the relevant policy, legal and administrative context in Liberia. It documents the environmental and social standards with which the Project will achieve compliance, as well as the international standards that the Project will be guided by.

Specifically, this section summarizes the following:

- Environmental and social administrative framework in Liberia
- Liberian environmental and social laws and regulations applicable to the Project
- Applicable multilateral agreements to which Liberia is a signatory
- World Bank requirements
- Good International Industry Practice (GIIP)

2.1. National Environmental and Social Administrative Framework

This section summarizes the overall legal structure and governance related to environmental management in Liberia. It describes the government organization and institutional framework related to environmental and social management in the country.

2.1.1. Environmental and Social Institutional Framework

The environmental and social governance in Liberia is divided between the EPA and some other ministries and national authorities, at the national level, and the Environmental and Social Committees, at the local level.

2.1.1.1. National Institutions

The EPA is the main agency and principal authority in Liberia for environmental management. Table 2-1 summarizes the key functions of the EPA and other institutions relevant to environmental and social governance related to the Project.

Table 2-1 Summary of key national institutions and their environmental and social functions relavant to the Project

Institution	Key project-relevant functions
Environmental Protection Agency (EPA)	• Responsible for issuing environmental impact assessment licenses • Responsible for compliance monitoring relating to environmental regulations and standards
Forestry Development Authority (FDA)	• Oversees the protection and management of forests, wildlife, and protected areas. • Provides guidance on biodiversity conservation and wildlife-related matters.
Ministry of Agriculture (MoA)	• Provides oversight on agriculture- and soil-related matters relevant to the Project, including soil conservation and agricultural land use.
Ministry of Public Works (MPW)	• Leads implementation of the Project through the PMU. • Oversees public works, drainage and related infrastructure • Supervises RAP implementation and compliance with applicable requirements.
Liberia Water and Sewer Corporation (LWSC)	• Coordinates on water supply, sewerage, and sanitation matters where the Project interfaces with existing or planned services.
National Disaster Management Agency (NDMA)	• Supports disaster preparedness, risk reduction, and emergency response coordination.
Ministry of Health and Social Welfare (MHSW)	• Oversees public health, sanitation, and environmental health matters relevant to the Project. • Supports hygiene promotion and sanitary oversight where required.
Ministry of Gender, Children and Social Protection (MGCSP)	• Provides policy oversight on gender, vulnerable groups, and social protection issues. • Supports measures related to gender equality and GBV risk management.
Ministry of Justice, Sexual and Gender-Based Violence Unit (SGBVU)	• Supports referral, coordination, and prosecution processes related to sexual and gender-based violence cases.
Ministry of Labor (MOL)	• Enforces labor standards and workplace requirements, including occupational health and safety provisions applicable to Project workers.

National Social Security and Welfare Corporation (NASSCORP)	• Administers social security and employment injury schemes for eligible workers and oversees employer compliance with applicable requirements.
Liberia Land Authority (LLA)	• Oversees land administration, land rights, land valuation, survey and mapping, and land-related dispute resolution relevant to Project land acquisition and resettlement.
National Housing Authority (NHA)	• Provides oversight on housing matters and may support government-led housing planning or resettlementrelated coordination where relevant.
National Fisheries and Aquaculture Authority (NAFAA)	• Regulates fisheries and aquaculture and may provide guidance on potential impacts to aquatic resources and fishing activities where relevant.
Liberia Wildlife Task Force (LWTF)	• Regulates fisheries and aquaculture and may provide guidance on potential impacts to aquatic resources and fishing activities where relevant.
Liberia National Police (LNP)	• Supports law enforcement, public order, and enforcement actions where required in relation to Project activities, including wildlife protection and community safety matters.

2.1.1.2. Management at the Local Level

To decentralize environmental management, the Environment Protection Agency Act authorizes the establishment of County and District Environmental Committees. County Committees are composed of county and district officials, traditional leaders, private citizens, and legislattors, supported by a County Environment Officer, hired by the EPA. District Environment Committees are established by and report to the relevant County Environment Committee. They are charged with promoting environmental awareness and supporting local monitoring of activities to prevent adverse environmental impacts. The District Committees are composed of district officials, mayors, chiefs, and private citizens and are staffed by a District Environment Officer hired by the EPA.

County and District Environment Officers support these committees by facilitating environmental awareness, coordinating public consultations (including EIA-related hearings), and reporting to the EPA.

In practice, formal County Environmental Committees remain limited; however, the EPA maintains decentralized presence through county-level offices staffed by Environmental Inspectors, who perform monitoring and enforcement functions.

In Monrovia, environmental management functions are also carried out by the Monrovia City Corporation (MCC). Through its Environmental Health and Sanitation Directorate, MCC oversees solid waste management, sanitation enforcement, and environmental health inspections, . MCC also leads pest control programs, health emergency responses, and public awareness campaigns on hygiene and environmental stewardship. MCC also plays a role in urban management, guiding land use, enforcing zoning regulations, and supervising infrastructure projects like drainage systems and public spaces.

2.1.2. Environmental Inspectors and Courts

The Environmental Protection Agency Act provides for the appointment of Environmental Inspectors and the establishment of an Environmental Court system.

The EPA may designate Environmental Inspectors at county and district levels, including EPA staff and other qualified public officers. Inspectors are empowered to enter sites, conduct inspections, take samples, review records, and issue Restoration Orders to address noncompliance, in accordance with the EPML.

Inspectors are currently deployed nationwide and form the primary mechanism for environmental monitoring and enforcement.

The EPA Act establishes a two-tier system comprising an Environmental Administrative Court and an Environmental Appeals Court to address environmental disputes and appeals.

However, this court system has not yet been operationalized.

2.2. National Environmental and Social Policy and Legislation

A brief summary of the Liberian legislation relevant to the Project is presented in Table 2-2 while a more detailed description of these legislations and the relevant national policies, strategies, guidelines, codes and plans is provided in Appendix A (A.1 and A.2).

Table 2-2 Relevant national legislation

Category	Title	Year	Key provisions relevant to the Project
General	Constitution of the Republic of Liberia	1986	Establishes fundamental rights, including equality, nondiscrimination, and protection of citizens.
Environment	The Environment Protection Agency (EPA) Act	2003	Establishes EPA authority and requires ESIA for projects with potential environmental impacts.
	The Environment Protection and Management Law (EPML)	2003	Defines ESIA procedures, environmental standards, permitting, and pollution control requirements.
Wetlands and biodiversity conservation	Protected Forest Areas Network Law	2003	Establishes protected areas and supports conservation of forest ecosystems.
	Act to Establish the Community Rights Law with respect to Forest Lands	2009	Recognizes community rights in the management and use of forest resources.
	National Wildlife Conservation and Protected Areas Management Law	2016	Provides for wildlife protection and management of protected areas and ecosystems.
	Wetland Regulations of Liberia	2024	Classifies wetlands and requires permits for activities within wetland areas.
	Executive Order No. 143	2025	Strengthens protection of wetlands, waterways, and coastal areas and addresses encroachment and pollution.
Water resources	Water Resources (Wetlands, Rivers, Lakes, Groundwater and Sea Shore) Management Regulations	2009	Regulates use and protection of water resources, including wetlands and coastal zones.
	Water Quality Regulations of Liberia (Draft)	2024	Establishes water quality standards and requires permits for abstraction and effluent discharge.
Chemicals and hazardous substances	Asbestos Regulation of Liberia	2017	Prohibits production, import, and use of asbestos and regulates its disposal.
	Liberia Plant Pesticide Regulatory Services Bureau Act	2019	Regulates registration, importation, and safe use of pesticides.
	Guidelines for the Importation, Handling, transportation and storage of Chemicals in Liberia	2022	Establish safe handling, transport, and storage of chemicals.
Category	**Title**	**Year**	**Key provisions relevant to the Project**
Waste	Liberia Waste Management and Standards Regulations	2009	Regulates management of all waste types and requires licensing and compliance monitoring.

Land rights	Property Law	1976	Governs land ownership, transfer, and registration.
	Land Rights Act	2018	Defines land ownership categories and governs land acquisition, use, and compensation.
Zoning and urban planning	Liberian Code of Laws (Zoning Law Title)	1958	Provides basic land-use classifications and development controls.
	New Zoning Law (Draft)	2024	Introduces updated land use planning and climateresponsive urban development measures.
Labor and occupational health and safety	Decent Work Act	2015	Establishes labor standards, OHS requirements, and prohibits forced and child labor.
	Social Security Act	2017	Provides social security and employment injury benefits for workers.
Public health and safety	Public Health Law, Revised	2022	Regulates sanitation, hygiene, disease control, and environmental health.
Children rights	Children's Law	2011	Provides for the rights, welfare, and protection of children, including safeguards against exploitation, abuse, and hazardous labor.

2.2.1. Legal Dispositions for the Project

The main legal dispositions most relevant to the Project are the Constitution, the EPA act, the EPML, the Wetland Regulations of Liberia (2024), and Liberia Waste Management and Standards Regulations (2009). These are described in the subsections that follow below.

2.2.1.1. Constitution of the Republic of Liberia (1986)

The 1986 Constitution is the main legal framework which provides for the rights, equal treatment, and protection of all Liberian citizens and those residing within the borders of Liberia. It ensures that no citizen is discriminated against on the basis of sex, age, ethnic background, religious belief, political affiliation, social and economic status.

Article 7 of the Constitution sets the fundamental basis for the constitutional, legislative, and institutional frameworks for the protection and management of the environment. It encourages public participation in the protection and management of the environment and the natural resources in Liberia.

Article 8 of the Constitution states that the Republic shall direct its policy toward ensuring equal opportunities for employment and livelihood under just humane conditions for all citizens, and towards promoting safety, health, and welfare facilities in employment.

Article 22 (a) provides that every person shall have the right to own property alone as well as in association with others; only Liberian citizens have the right to own real property.

2.2.1.2. The Environmental Protection Agency Act (2003)

The EPA was created by the Act creating the Environment Protection Agency of the Republic of Liberia, known as the EPA Act. Section 5 of the Act designates the EPA as the principal Liberian authority for environmental management which shall co-ordinate, monitor, supervise, and consult with relevant stakeholders on all the activities for environmental protection and the sustainable use of natural resources.

2.2.1.3. Act Adopting the Environment Protection and Management Law of the Republic of Liberia (2003)

The EPML is the principal piece of legislation covering environmental protection and management in Liberia in parallel to the EPA Act.

The EPML (Ministry of Foreign Affairs, 2003b) defines the specific requirements for performing an ESIA and other measures required to protect the environment in Liberia. Further details of the ESIA process are included in Section 2.3 of this chapter.

A summary of the key sections of the EPML are presented in Table 2-3.

Table 2-3 Key sections of the Environment Protection and Management Law

Section	Description
6	Requires an ESIA license or permit for the commencement of projects that have the potential to impact the environment. An ESIA is required for some specific types of projects (defined in Annex I of the EPML), while the need for an ESIA for other projects may be determined on a case-by-case basis.
12	Requires environmental review for projects or activities that may have significant impact on the environment. Project proponent shall submit their plans to the EPA for improving environmental performance, including: • Identification of the major environmental effects • A comprehensive mitigation plan in accordance with Section 15 of this law
13	Requires the preparation of an environmental impact study.
15	Investors should present an environmental mitigation plan to the EPA, which should include the following sections: • Objectives • Description of activities to be carried out by the project to mitigate any adverse effects on the environment • Period within which the mitigation measures shall be implemented • Proven effectiveness of the mitigation measures by indicating their experimental nature
24	The EPA should ensure that projects comply with their environmental mitigation plans through monitoring of their operations. Where evidence of non-compliance occurs, the EPA shall impose remedial measures and may bring action before the Environmental Court or through the Ministry of Justice to enforce compliance.
25	The EPA is responsible for carrying out periodic environmental audits of activities or projects likely to have adverse effects on the environment.
58	An "Effluent Discharge License" must be obtained from the EPA for any type of effluence discharge into the sewage system, also in case of operation of a sewage system. This license does not exceed one year.
64	Requires project proponents to acquire a "Solid and Hazardous Waste Disposal License" in case of generation, storage, handling, transport or disposal of hazardous waste, or else ownership or operation of a waste disposal site. The EPA provides this license for a period of not more than one
Section	Description
	year. This license entails the party who is generating waste to take up waste management measures such as treatment, determination or recycling and remediation.

71	Requires a "Pollution Emission License" for any project or activity which is likely to pollute the environment in excess of any standards or guidelines issued under this Law (the EPML). The EPA provides this license for a period of not more than one year.
74	The EPA may prescribe general or specific guidelines for the management of rivers, lakes or wetlands. Those of specific relevance to the project include: • Measures for the prevention or control of soil erosion • The conservation of any vegetation growing in and around a river, lake or wetland • The contingency plan for the prevention and control of any deliberate or accidental discharge which is likely to pollute the river, wetland or lake
75	Prohibits the activities below in relation with any river, lake or wetland declared as protected areas by the EPA. These activities include: • Using, erecting, constructing, placing, altering, extending, removing or demolishing any structure in, on, under, or over the bed • Excavating, drilling, tunneling or disturbing the bed otherwise • Introducing or planting any part of a plant, plant specimen or organism whether alien or indigenous, dead or alive in a river, lake or wetland • Introducing any animal or microorganism whether alien or indigenous, dead or alive in a river, lake or wetland • Depositing any substance in a river, lake, or wetland or in or under its bed, which is likely to have adverse environmental effects on the river, lake or wetland • Directing or blocking a river, lake or wetland from its natural and normal course • Draining any river, lake or wetland
80	Provides an outline framework for the Protection of Wild Animals and Birds and includes conservation areas. It differentiates wildlife protected areas in section 80 (4) – national park, wildlife reserve, and nature reserve – from wildlife management areas in section 80 (5) – wildlife sanctuary, and community wildlife area – while also stating that the Line Ministry can designate any other area as either as it sees fit.
83-85	Provide for the enabling environment for the conservation of biodiversity, charging the EPA with responsibility for a wide range of measures from preparing national conservation strategies to selecting and managing buffer zones to protected areas, to issuing guidelines for botanical gardens.
91	The EPA may impose on the party that has caused or is likely to cause harm to the environment an "Environmental Restoration Order," requiring it to remedy/prevent the harm within 21 days of the service of the order.
92	Allows the party to request the Agency to reconsider that order (Section 91) by giving reasons in writing within the same period.
107	States that non-compliance with the restoration order convicts the responsible party to imprisonment and/or a fine.

2.2.1.4. Wetland Regulations of Liberia (2024)

- The Wetland Regulations of Liberia (2024):Prohibit activities that could degrade wetland ecosystems, including backfilling, construction, drainage alteration, and the introduction of alien species, without prior EPA approval.
- Require permits for any proposed development within wetland zones, ensuring that such activities are subject to environmental assessment and compliance monitoring.

- Mandate the conservation of vegetation around wetlands, the prevention of soil erosion, and the implementation of contingency plans for accidental discharges that may pollute water bodies.
- Outline restoration strategies and promote sustainable land use of wetland areas.

2.2.1.5. Liberia Waste Management and Standards Regulations (2009)

The Liberia Waste Management and Standards Regulations (2009) apply to household, industrial, biomedical, hazardous, and radioactive waste, and aim to prevent environmental degradation and protect public health.

The Regulations:

- Require project proponents and operators to obtain specific licenses from the EPA for activities involving waste generation, storage, transportation, and disposal. These include the Solid and Hazardous Waste Disposal License, the Effluent Discharge License, and the Pollution Emission License, each valid for a period not exceeding one year.
- Mandate periodic environmental audits of waste facilities and impose strict penalties for non-compliance.
- Require project developers to implement waste minimization strategies, including segregation, recycling, and safe treatment of hazardous materials.

For the Solid and Hazardous Waste Disposal License, the project proponent must submit a detailed waste management plan to the EPA, along with proof of qualified personnel and contingency measures for emergencies. The EPA reviews the application, conducts site inspections, and issues the license for one year, renewable annually. The cost of obtaining this license typically ranges between USD 2,000 and USD 5,000, depending on the scale and complexity of operations (Environmental Protection Agency of Liberia, 2009, 2021).

2.2.1.6. Human Rights and Gender Equality

Liberia has ratified or acceded to the core international human rights treaties. It is a party to the major regional human rights instrument which obliged states to respect, protect and fulfil human rights of all persons within the territory and subject to the jurisdiction of the state, without discrimination. As a state party to the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (the "Maputo Protocol"), Liberia has made legally binding commitments to exercise due diligence to combat gender-based violence and discrimination. National safeguard provisions such as the National Human Rights Action Plan of Liberia (2024-2028), the Liberia Gender Strategy (2022–2025), the SGBV Accountability Framework (2024) are in place to address this issue. More details about the human rights and gender equality governance framework in Liberia are included in Appendix A (A.3).

2.2.2. ESIA Process in Liberia (2022)

An ESIA Process Flow Chart has been illustrated in Figure 2-1. This process is applied prior to issuance of an environment permit.

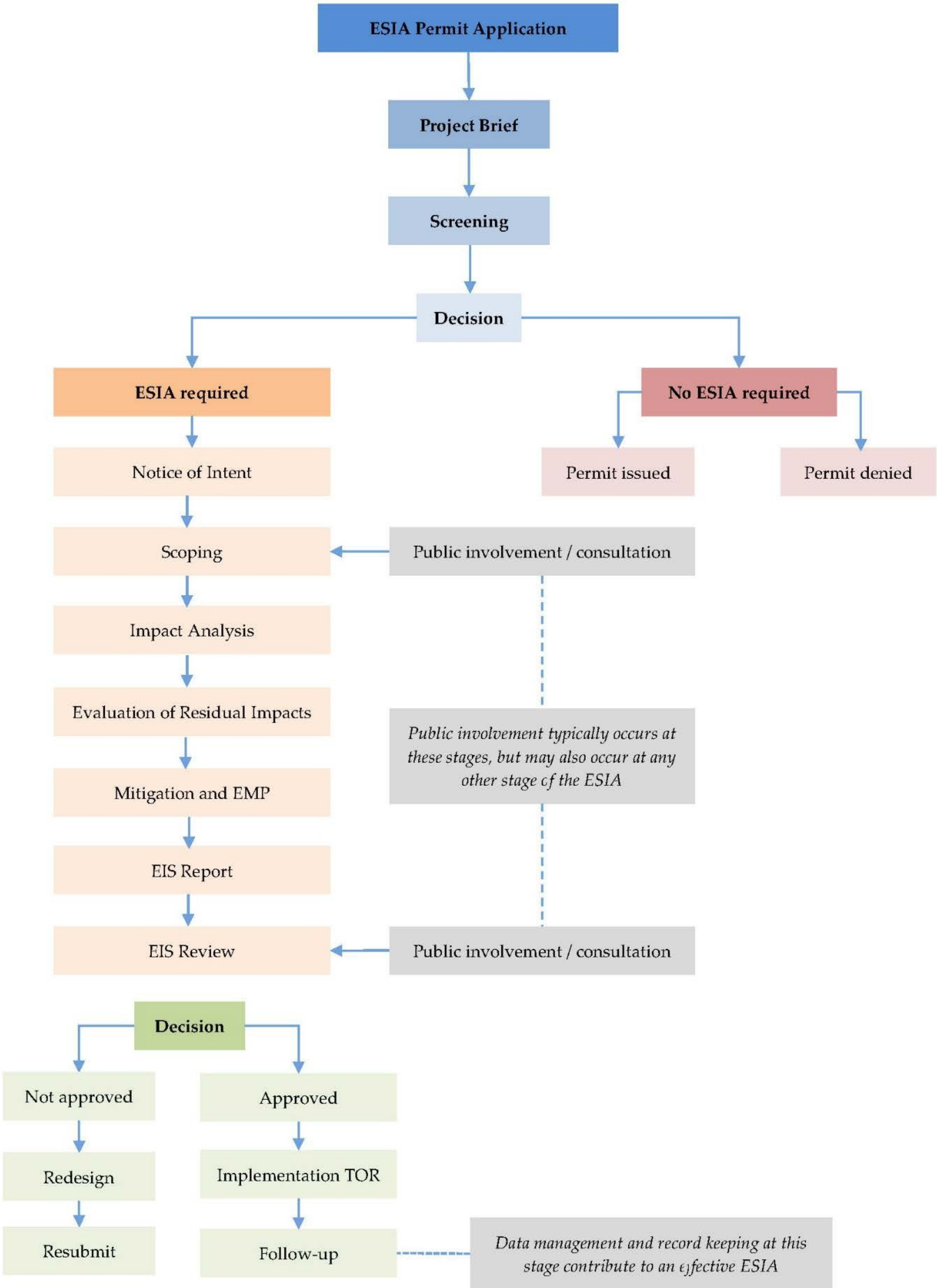


Figure 2-1 ESIA process in Liberia

2.2.3. Public Consultation Requirements of the ESIA Process

Involvement of the public in the ESIA commences with the launch of the ESIA process and continues throughout its course. The different requirements of the public involvement throughout the ESIA process are presented in Table 2-4.

Table 2-4 Public consultation requirements under the ESIA process

ESIA stage	Requirement	Purpose	Key activities
After application for environmental impact assessment permit	Notice of intent	Inform stakeholders and identify interest	• Publication of notice of intent • Includes project nature, activities, timeframe, location, and area of impact
ESIA Scoping stage	Public consultation	Define issues, impacts, and alternatives with stakeholders	• Inform stakeholders of project and potential impacts • Collect stakeholder inputs and concerns • Identify impacts, mitigation measures, and alternatives • Public meetings and media publication • Scoping report with stakeholder inputs
ESIA review stage	Public review of ESIA report	Enable stakeholder input into the EPA's ESIA decision-making	• Public consultation meetings • Stakeholder review of ESIA findings • Inputs considered by EPA in approval decision
Special cases (EPA discretion)	Public hearing	Strengthen participation in complex or contested cases	• Held if requested by public, if project is controversial, or if comment period expires without closure

2.3. Multilateral Environmental and Social Agreements

Relevant international treaties, conventions and protocols to which Liberia is a signatory are presented in Table 2-5.

Table 2-5 Relevant environmental and social multi-lateral agreements

Category	Convention	Liberia year of ratification / accession	Relevance to Project
Air quality	Convention for the Protection of the Ozone Layer (Vienna Convention) (UN, 1985)	1996	Project activities are expected to produce emissions that deplete the ozone layer.
	Montreal Protocol on Substances that Deplete the Ozone Layer	1996	
	Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	2004	
Biodiversity conservation	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Switzerland, 1973)	1981	CITES species might occur in or around the project location.
	Convention on Biological Diversity (CBD) (UN, 1992)	2000	The Project takes place near areas with biodiversity importance.
	Cartagena Protocol on Biosafety (UN, 2000)	2002	
	Convention on the Conservation of Migratory Species of Wild Animals (CMS/Bonn Convention) (Germany, 1979)	2004	Migratory species may occur in or around the project location.
	Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Côte d'Ivoire, 1981)	2005	The Project takes place in the coastal zone and might affect the marine environment.
	Protocol concerning Co-operation in combating Pollution in cases of Emergency (Côte d'Ivoire, 1981)	2005	
	Memorandum of Understanding concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa (CMS/UNEP, 2000)	2005	
	Memorandum of Understanding concerning the Conservation of the Manatee and small Cetaceans of Western Africa and Macaronesia (CMS, 2008)	2008	
	Memorandum of Understanding on the Conservation of Migratory Sharks (CMS, 2010)	2010	
	International Convention for the Conservation of Atlantic Tunas (FAO, 1966)	2014	
	Revised African Convention on the Conservation of Nature and Natural Resources (Maputo Convention) (AU, 2003)	2014	The Project will take place near parts of Liberia with conservation value.
	The Ramsar Convention on Wetlands of International Importance (UNESCO, 1971)	2003	The Project will take place near a designated RAMSAR site (i.e. Mesurado Wetland).

Category	Convention	Liberia year of ratification / accession	Relevance to Project
Climate change	United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1992)	2002	The Project will result in increased greenhouse gas emissions.
	Kyoto Protocol (UN, 1997)	2002	
	Doha Amendment to the Kyoto Protocol (UN, 2012)	2015	
	Paris Agreement (UN, 2018)	2018	
	United Nations Convention to Combat Desertification (UN, 1996)	1998	Vegetation clearing is anticipated for the Project.
Chemicals and hazardous substances	Stockholm Convention on Persistent Organic Pollutants (UNEP, 2001)	2002	Potential use of insecticides and pesticides during the project activities.
Waste transport	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (UN, 1989)	2004	The Project might involve the generation and disposal of hazardous waste (fuels, lubricants, solvents, etc.)
	Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (UN, 1995)	2005	
	Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal (UN, 1999)	2005	
	Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (AU, 1991)	2013	
Maritime	Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN, 1995)	2005	Some project tasks will be implemented in Liberia's coastal areas and marine environment.
	United Nations Convention on the Law of the Sea (UNCLOS) (UN, 1982)	2008	
	International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) (IMO, 1990)	1995	
	Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances	2008	

Ministry of Public Works
2026

	Convention for Co-operation in the Protection and Development of the Marine and Coastal environment of the West and Central African Region	2005	
Socio-economic and cultural	Convention Concerning the Protection of the World's Cultural and Natural Heritage (UNESCO, 1972)	2002	Potential occurrence/presence of culturally important resources in the project area of influence.
	International Covenant on Economic, Social and Cultural Rights (ICESCR) (UN, 1976)	2004	The Project is affecting the livelihoods of local communities and of some local labor force.
Labor	Minimum Age Convention (ILO, 1973)	2006	The project is employing a workforce

Category	Convention	Liberia year of ratification / accession	Relevance to Project
	Forced Labor Convention (ILO,1930)	2005	
	Abolition of Forced Labor Convention (ILO,1957)	2005	
	Discrimination (Employment and Occupation) Convention (ILO, 1958)	2005	
Human rights and gender equality	African Charter on Human and Peoples' Rights (1981)	1982	The project is employing a workforce and is affecting the livelihoods of local communities, including women, children and, potentially, vulnerable groups.
	Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (the "Maputo Protocol") (2003)	2007	
	African Charter on the Rights and Welfare of the Child (1990)	2007	
	International Covenant on Civil and Political Rights (1966)	2004	
	International Covenant on Economic, Social and Cultural Rights (1966)	2004	
	Convention on the Elimination of All Form of Discrimination against Women (1979)	1984	
	Convention on the Rights of the Child (1989)	1993	
	Convention on the Rights of Persons with Disabilities (2006)	2012	

2.4. World Bank Requirements

In addition to its compliance with the national legislations and policies, and international agreements to which Liberia is a signatory, this ESIA is written in accordance with the World Bank Environmental and Social Framework (ESF) which requires compliance with ten Environmental and Social Standards (ESS).

Eight of the ESSs are preliminary assessed to be relevant to the Project. These ESSs are summarized in Table 2-6. A detailed description of the ESS requirements is provided in Appendix A (A.4).

Table 2-6Summary of Applicable World Bank Environmental and Social Standards (World Bank Group, 2017)

ESS	Key relevant requirements	Relevance to the Project
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	• Conduct ESIA and implement ESMP • Apply mitigation hierarchy • Monitor and report performance	ESS1 applies to all projects funded by the World Bank.
ESS2: Labor and Working Conditions	• Develop Labor Management Procedures • Ensure fair treatment and non-discrimination • Implement OHS measures and worker GRM	The Project is anticipated to employ a workforce, directly and through contractors.
ESS3: Resource Efficiency and Pollution Prevention and Management	• Manage air, water, and soil pollution • Ensure efficient use of resources • Implement waste management measures	The Project will require the use of water and energy, as well as construction materials. It is also expected to consume fuel, oils, and lubricants that could potentially contaminate the surrounding environment. In addition, the Project is likely to generate air pollutants and greenhouse gas emissions. Both hazardous and non-hazardous waste will be generated by the Project.
ESS4: Community Health and Safety	• Assess risks to communities • Manage traffic, safety, and hazardous materials • Implement emergency preparedness measures	The Project may affect the health and safety of local communities within the project area.
ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	• Avoid/minimize displacement • Provide compensation at replacement cost • Prepare and implement RAP	The Project will involve physical and economic displacement.
ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	• Avoid/minimize impacts on habitats • Apply mitigation hierarchy • Develop Biodiversity Management measures where needed	The Project may lead to the direct, indirect and/or cumulative loss or degradation of habitats. It may also affect ecosystem services in the project area.
ESS8: Cultural Heritage	• Avoid impacts on cultural heritage • Implement chance finds procedure	The project might affect cultural tangible and/or intangible cultural heritage and/or reveal undiscovered archeological elements.

ESS10: Stakeholder Engagement and Information Disclosure	• Conduct meaningful consultations • Disclose information • Establish and implement GRM	ESS10 applies to all projects funded by the World Bank.

2.5. Comparative Analysis of National and World Bank Requirements

The objective of this section is to identify and analyze the key differences between Liberia's national environmental and social management framework and the World Bank ESF, which governs the preparation and implementation of this project. While Liberia has established a solid foundation for environmental and social regulation through the EPML, the EPA Act, the Land Rights Act, and other sectoral instruments, certain provisions do not yet fully align with the requirements of the World Bank's ESSs. The gap analysis in Table 2-7 highlights the main areas of convergence and divergence between the two systems and proposes specific gapfilling measures to ensure that the ESIA meet both national regulatory obligations and World Bank ESS requirements.

2.6. Good International Industry Practice

In addition to the national and World Bank ESS requirements, this ESIA is guided by GIIP, including the following guidelines:

- General Environmental, Health and Safety Guidelines (EHSGs) (World Bank Group, 2007a)
    - EHSGs for Construction Materials Extraction (World Bank Group, 2007b)

Table 2-7 Gap Analysis between National Framework and World Bank ESSs

ESS	National equivalent(s)	Main gaps identified	Proposed gap-filling measures
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	• EPML (2003) • EPA Liberia Act (2003) • ESIA Revised Procedural Guidelines (2022) • EPA Strategic Plan (2025–2029) The EPA's EIA process permits the application of higher standards where necessary. According to the national requirements, no project requiring an environmental impact assessment may proceed until the assessment is completed and relevant regulations are in place.	• Social risks are referenced in the national framework but are not comprehensively defined or systematically assessed. • National requirements do not explicitly require cumulative impact assessment, climate change risk screening, or climate resilience considerations. • Limited provisions for environmental and social risk classification, proportionality, and management of associated facilities. • Disclosure, adaptive management, and structured grievance redress mechanisms in the national framework are not prescribed to the level required under ESS1.	• Where gaps exist in national requirements, provisions under ESS 1 will be adopted. • The ESIA assesses environmental and social risks and impacts, including cumulative effects and climate-related risks. • An ESMP will be prepared and implemented. • The Project is supported by a Stakeholder Engagement Plan, and a Grievance Redress Mechanism. • Monitoring, reporting, and adaptive management measures consistent with ESS1 are incorporated throughout the project lifecycle. • The feasibility phase prioritized flood risk assessment through hydrologic and hydraulic modeling, infrastructure data analysis, and community needs mapping. • The design phase has included all environmental and social risks reduction measures feasible while maintaining the project's objectives.

ESS2: Labor and Working Conditions	• Labor Law of Liberia • Decent Work Act (2015) • National Occupational Health and Safety (OHS) Guidelines (2023) The national laws align with the International Labor Organization conventions, United Nations standards, and international human rights laws.	• Existing laws align with ESS2 to a certain extent. • No requirement for detailed labor provisions such as Labor Management Procedures or Grievance Redress Mechanism (GRM) for workers • Limited provisions regarding contractor obligations and worker grievance mechanisms. • Limited enforcement of health and safety standards.	• The project applies existing laws which align with ESS2 requirements. • Contractors will be required, through contractual provisions, to comply with national laws and ESS2 requirements, including Codes of Conduct, occupational health and safety procedures, and a dedicated worker GRM. • Labor and working condition risks are assessed in the ESIA and mitigation measures included in the ESMP.

ESS	National equivalent(s)	Main gaps identified	Proposed gap-filling measures
ESS3: Resource Efficiency and Pollution Prevention	• EPML (2003) • EPA Liberia Act (2003) • ESIA Revised Procedural Guidelines (2022) • Draft Water Resources Regulations of Liberia (2024) • Liberia Waste Management and Standards Regulations (2009) • Wetland Regulations	• While national regulations address pollution control and resource use in general terms, they do not fully meet ESS3 requirements. • No explicit requirement for greenhouse gas accounting or resource efficiency monitoring. • Absence of GIIP references, as required under World Bank ESS3. • Limited technical standards for pollution prevention, waste management, and resource efficiency. • Weak monitoring and reporting requirements for emissions, waste, and resource use.	• The Project applies GIIP, including the World Bank Group Environmental, Health and Safety Guidelines (EHSG). • The ESIA and ESMP include measures for efficient use of energy, water, and materials; waste and hazardous materials management; spill prevention; pollution control; and monitoring. • Where relevant, greenhouse gas emissions will be estimated and monitored during construction and operation. • The Project will prepare and implement a Site-specific Waste Management Plan (S-WMP).

	(2024)		
ESS4: Community Health and Safety	• EPA Liberia Act (2003) • EPML (2003) • ESIA Revised Procedural Guidelines (2022) • New Public Health Law of Liberia (revised - 2022) • National Disaster Management Agency (NDMA) Act (2022)	• Limited guidance on emergency preparedness and traffic safety • Insufficient provisions for managing risks from hazardous materials and construction impacts on communities • Lack of mandatory community health and safety plans.	• ESS4 requirements are applied. • The ESIA assesses risks to community health and safety, including traffic, emergency response, and constructionrelated hazards. • Community health and safety protection measures will be implemented as part of the project ESMP. • The Project will implement emergency preparedness and response procedures, traffic management measures, and monitoring provisions consistent with ESS4.
ESS5: Land Acquisition and Involuntary Resettlement	• Land Rights Act (2018) • Liberia Land Authority (LLA) Act and Guidelines • EPML (2003) • ESIA Revised Procedural Guidelines (2022) • Executive Order No. 144 (2025) • New Zoning Law (2024)	• Lack of detailed guidelines for managing resettlement during project activities beyond the Environmental Protection and Management Law and the 2018 Land Rights Act in Liberia. • No livelihood restoration or compensation for informal land use • Limited prescriptive guidance on conducting resettlement during project implementation. • Weak integration of zoning and land-use planning considerations into resettlement processes.	• ESS5 requirements will be adopted. • The project avoided causing resettlement wherever feasible. • Where resettlement is unavoidable, a Resettlement Action Plan (RAP) is being developed and implemented to meet ESS5 standards. • The RAP includes measures to assist affected persons in relocating and restoring their livelihoods, ensuring fair compensation and support for vulnerable groups.
ESS	**National equivalent(s)**	**Main gaps identified**	**Proposed gap-filling measures**

ESS6: Biodiversity Conservation and Sustainable Management	• Forestry Development Authority Act • National Biodiversity Strategy and Action Plan (2025-2030) • Wetland Regulations of Liberia (2024) • Executive Order No. 144 (2025)	• National framework focuses on protected areas; with limited provisions for biodiversity management outside protected areas. • No explicit requirement for application of the mitigation hierarchy described in ESS6. • National Biodiversity Action Plan addresses conservation but lacks provisions for sustainable use of living natural resources.	• ESS6 is applied to address these gaps. • The ESIA assesses impacts on biodiversity and ecosystem services and applies the mitigation hierarchy (avoid, minimize, restore, offset). • The Project seeks to avoid significant conversion or degradation of natural habitats and, where critical habitat is present, achieve net biodiversity gains. • Depending on impact significance, a Biodiversity Management Plan (BMP) may be prepared and implemented, including monitoring and adaptive management measures.
ESS8: Cultural Heritage	• National Museum Act (1989) • Monuments and Relics Ordinance (1949) • EPML (2003)	• Limited provisions for cultural heritage protection; no chance-find procedures.	• ESS8 is applied regardless of confirmed presence of cultural heritage. • Cultural heritage screening and chance-find procedures will be applied to ensure that any heritage resources encountered during project implementation are properly managed.

ESS10: Stakeholder Engagement and Information Disclosure	• EPML (2003) • ESIA Revised Procedural Guidelines (2022)	• National legislation requires public consultation during ESIA preparation but does not mandate continuous stakeholder engagement throughout the project lifecycle. • There is no requirement for preparation of a standalone Stakeholder Engagement Plan (SEP). • Documentation, monitoring, and reporting of stakeholder engagement activities beyond the ESIA phase are not required. • No explicit requirement for a project-level Grievance Redress Mechanism accessible throughout construction and operation.	• In alignment with the requirements of ESS10, the project has developed and adopted a comprehensive SEP and a Community Engagement Strategy, which are presented in Appendix B and Appendix C. • The Project has a GRM in place (Appendix D). Consultations have been initiated and are ongoing at various stages of the project, including during the preparation of this ESIA. • The Client will keep a register of all stakeholder engagement activities, feedback and grievances. • The project places particular emphasis on inclusivity, ensuring that vulnerable groups—such as women's associations and elderly community members—are actively engaged and their concerns duly considered in decisionmaking processes.

3. Project Description

This section presents the project description for the LURP interventions in Northern Bushrod Island, for which this ESIA Report is developed.

3.1. Project Location

The Project is located in Northern Bushrod Island, within Greater Monrovia, Montserrado County, Liberia. Bushrod Island is bounded by the Atlantic Ocean to the west, the St. Paul River to the north, Stockton Creek to the east, and the Mesurado River to the south (Figure 3-1).

The project will implement interventions within the following designated areas in Northern Bushrod Island:

- New Kru Town with drainages outfalls into the Atlantic Ocean which remains the main outflow point and into the St. Paul Estuary to the north. This project's sublocation is referred to as **Sub-location Atlantic**.
- The area to the northeast of Bushrod Island comprising of communities around the three marshy wetland areas separated by Caldwell Road and Bong Mines Railway, the Duala culvert area along UN Drive and the Island Clinic community area to the north of Duala. The existing drainage infrastructure in this area has its main outfall draining to the St. Paul River Estuary with additional outfalls following the Caldwell Road and Bong Mine Railway into Stockton Creek to the east. This project's sub-location is referred to as **Sub-location St. Paul Wetlands**.

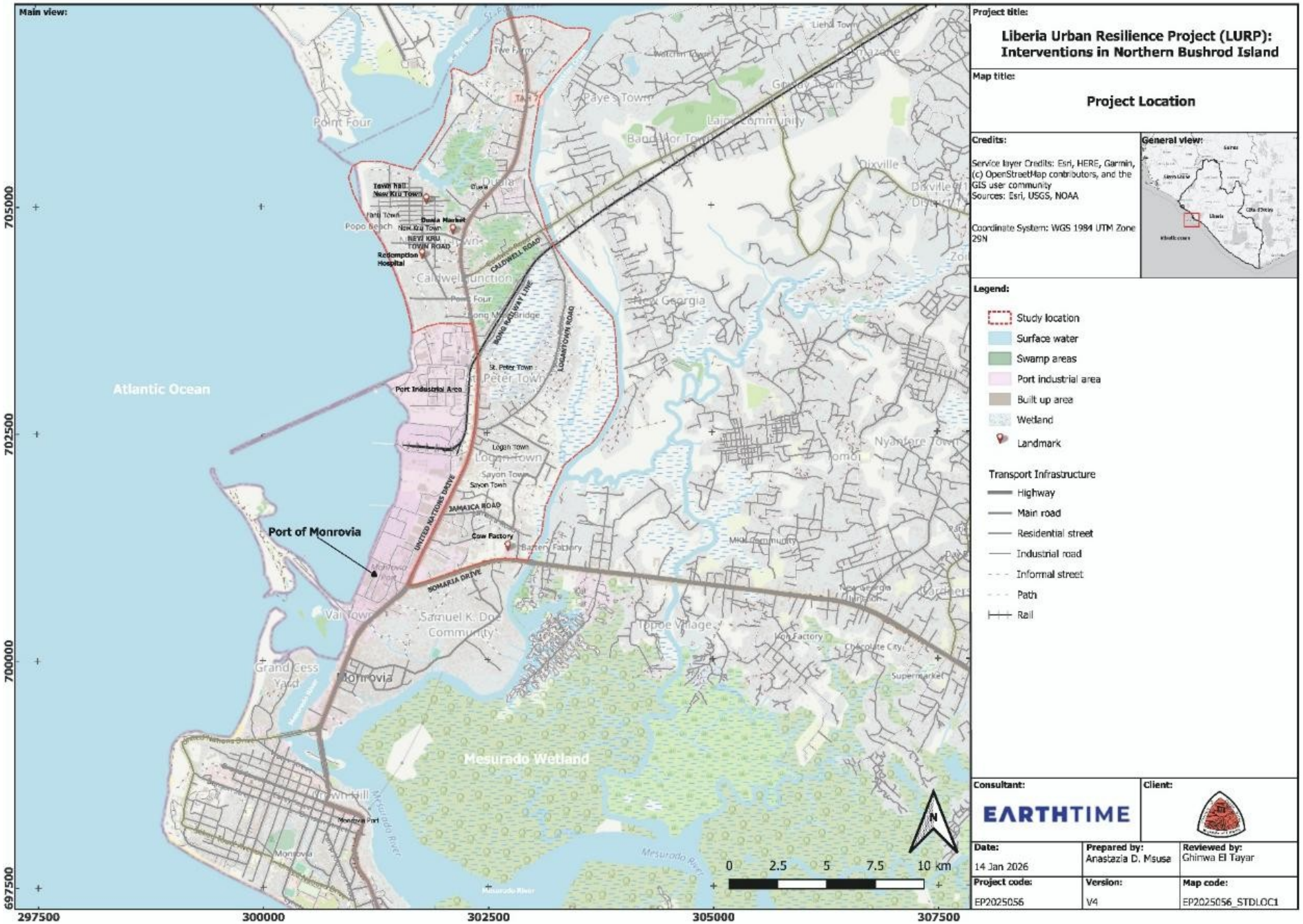


Figure 3-1 Project location map 0

3.2. Project Duration

The project's construction phase is scheduled to take place about 9 months. The operation phase will commence following completion of construction and will continue throughout the functional lifespan of the infrastructure. The design life of the various interventions is planned to be between 25 and 50 years (CDR International & Earthtime Inc., 2025b).

3.3. Project Design

The design described in this section is based on draft preliminary design documentation and necessary information provided by the engineering consultant at the time of preparing the ESIA. As such, the design details presented herein may be subject to refinement during subsequent detailed design stages. Any such refinements are expected to remain within the scope and intent of the assessed design and are not anticipated to materially alter the nature or significance of the environmental and social impacts identified in subsequent sections of this ESIA. Where future detailed design modifications result in changes in how impacts may occur, such that different mitigation measures are required, the ESMP will need to be updated by the Client, as necessary, to ensure continued compliance with applicable national regulations and World Bank requirements (refer to section on adaptive management in the ESMP).

The general design criteria focus on reducing flood depth, duration, and extent for a 1-in-10year rainfall event, ensuring that interventions have a minimum design life of 25 years and take into account future climate projections (SSP5-8.5 for 2050). All proposed solutions are required to remain within an indicative budget range of USD 10–12 million, prioritize costeffective and nature-based approaches where feasible, promote reuse of materials, and minimize environmental and social impacts, with a preference for options that require lower long-term maintenance.

The project includes two main categories of interventions:

- **Flood risk management infrastructure**, including:
  - **Drainage channels**, designed to effectively drain rainwater from the surrounding area towards either the Atlantic Ocean or the St. Paul River estuary.
  - **Culverts or bridges**, where drainage channels cross main road or rail infrastructure, to facilitate the flow of water underneath existing rail and road infrastructure and to facilitate safe crossing of persons and vehicles over the culvert/bridge
  - **Drainage outlet structures**, to stabilize drainage channel outlets by preventing excessive movement of sediment around and into the channel, ensure a smooth connection between the channel and the receiving water body, and to accommodate a trash rack to trap waste from the drainage channels before it flows into the receiving water body.
- **Community upgrading infrastructure supported by selected soft measures**, including:
  - **Footbridges**, to provide safe pedestrian routes for residents and improve connectivity between residential areas and main roads
  - **Drain maintenance facilities**, to support proper waste collection and maintenance of drainage systems, to be upgraded into community hubs (safe havens for social

interaction and sheltering during flood events) during future project phases. ○ **Zoning measures** in wetland areas to stop encroachment into the wetlands.

3.3.1. Preliminary Design

The project will be implemented in two sub-locations, each divided into several zones as follows (Figure 3-2):

- **Sub-location Atlantic (New Kru Town)** ○ **Zone A1**: the main direction of the runoff is toward to the north, where the runoff is directed through a narrow flow path along the road leading to the beach from New Kru Town Elementary School ○ **Zone A3**: the main direction of the runoff in Zone A3 is toward the south.
- **Sub-location St. Paul Wetlands** ○ **Zone P.W1**: northern wetland zone acting as final discharge area to the St. Paul River ○ **Zone P.W2**: northward flow direction, between upstream drainage inputs and downstream discharge toward the river ○ **Zone P.W3**: wetland storage zone, receiving runoff from adjacent urban drainage systems and upstream wetland areas ○ **Zone P.W4**: southern wetland zone, convoying flows northward through the wetland system.

The delineation of the sub-locations and zones is indicated Figure 3-2**.** The types of interventions per sub-location and zone are described in Sections 3.3.1.1 and 3.3.1.2. Photos showning the types of structural interventions are given in Appendix E (E.1).

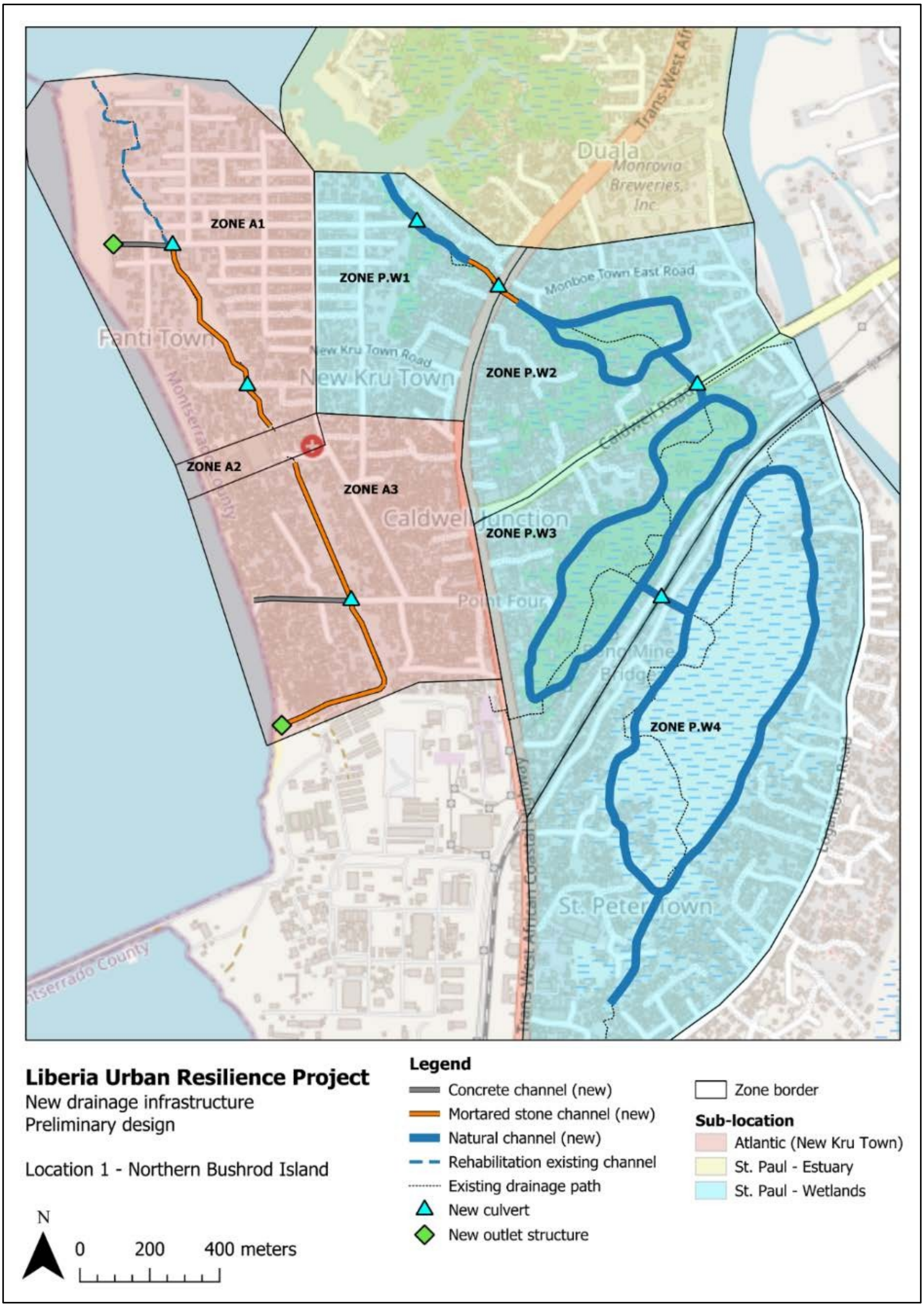


Figure 3-2 Overview of the new drainage infrastructure for Northern Bushrod Island (CDR International & Earthtime Inc., 2025a)

3.3.1.1. Sub-location Atlantic (New Kru Town Area)

Zones A1 and A3 form part of the Atlantic drainage system in New Kru Town are characterized by dense urban development, low-lying terrain, and drainage corridors that discharge primarily toward the Atlantic Ocean through an existing green corridor. Flooding in these zones is mainly driven by pluvial rainfall, exacerbated by limited drainage capacity, sediment and solid-waste accumulation, and localized tidal influence at the outlets.

The selected interventions for this sub-location are described in Table 3-1, Figure 3-3 and Figure 3-4. Designs and drawings are presented in Appendix E (E.2).

Table 3-1 Design interventions in Sub-Location Atlantic

Zone	Design element	Intervention description
A1	**New drainage connection (A1-DC.2)**	Construction of a new U-shaped concrete box drainage connection across the road
	Channel rehabilitation A1-DC.3 and A1-DC.4	Use of mortared stone masonry lining within the existing green corridor
	Outlet structure A1-OUT.1	The outlet of the channel A1-DC.2 is designed to stabilize the concrete channel outlet.
	Drainage channel rehabilitation A1-DC.1	Cleaning and clearing of the existing drainage channel
	Culvert replacement A1-CU.1 and A1-CU.2	Replacement of existing undersized pipe culvert with a single box culvert to improve flow capacity and reduce blockage risk.
A3	**Channel rehabilitation A3-DC.1**	Construction of mortared stone masonry drainage channels within the existing green corridor
	New concrete channel A3-DC2	New small road U-shaped concrete box drainage channel to drain
	Culvert replacement A3-CU.1	Single box culvert under the New Kru Town main road, replacing the existing pipe culvert.
	Outlet structure A3-OUT.2	Stabilized drainage outlet discharging to the Atlantic Ocean

Figure 3-3 Overview of the new drainage infrastructure for Sub-location Atlantic, zone A1 (CDR International & Earthtime Inc., 2025a)

Figure 3-4 Overview of the new drainage infrastructure for Sub-location Atlantic, zone A3 (CDR International & Earthtime Inc., 2025a)

3.3.1.2. Sub-location St. Paul - Wetlands

The St. Paul River wetlands sub-location comprises low-lying wetland and estuarine areas, including Zones P.W1, P.W2, P.W3 and P.W4, that function as a natural flood storage and attenuation system for Northern Bushrod Island. This area is influenced by pluvial runoff from upstream catchments, fluvial backwater effects from the St. Paul River, and tidal conditions. Given its high ecological sensitivity, the design approach avoids extensive hard engineering works and instead prioritizes nature-based and low-impact drainage interventions.

The selected interventions for this sub-location are described in Table 3-2, Figure 3-5, and Figure 3-6. Drawings and designs are presented in Appendix E (E.3). **Table 3-2 Design interventions in sub location St. Paul Wetlands**

Zone	Design element	Intervention description
P.W1	**Culvert replacement P.W1CU.1 and P.W1-CU.2 (Duala Market culvert)**	Replacement of existing culverts with new double box culverts (3.0 m × 1.5 m) designed to convey a design discharge of 5.3 m^3/s.
	Channel rehabilitation P.W1-DC.1, and P.W1-DC.2	Channels are designed as natural channels of 10 m bottom width, as in this region there is sufficient space.
	Channel rehabilitation P.W1-DC.3	Construction of a new mortared stone channel of 6 m bottom width, downstream of the Duala Market culvert.
	Trash racks	Installation of trash rack structure near the wetland–river interface to intercept floating solid waste before discharge into the St. Paul River.
P.W2	**Natural perimeter channel PW.2-DC2, PW.2-DC3 and PW.2-DC4**	Implemenation of natural, wide perimeter canals (bottom width: 10 m). These channels both improve drainage capacity of the surrounding neighbourhoods, as well as serve as a physical boundary to stop further encroachment.
	Channel rehabilitation PW2. DC.1	Construction of a mortared stone channel in section upstream of the Duala Market culvert (bottom width: 6 m).
	Trash racks	Installation of trash rack structure next to the maintenance depot to intercept floating solid waste before discharge into the St. Paul River.
P.W3	**New natural perimeter channel PW.3-DC1, PW.3DC2 and PW.3-DC3**	Implementation of new perimeter canals, connected to adjacent zones through culverts to improve overall drainage capacity. The perimeter canals have a bottom width of approximately 10 m, with bed levels set at -0.5 m msl*.
	Culvert replacement P.W3CU.1 (Caldwell Road culvert)	Replacement of the Caldwell Road culvert with a double-box culvert (2.2 m × 1.1 m) designed for an expected discharge of 1.0 m^3/s.
P.W4	**Culvert replacement P.W4-CU.1 (Bong Railway culvert)**	Replacement of the Bong Railway culvert with a double-box culvert (2.2 m × 1.1 m) designed for an expected discharge of 1.0 m^3/s.
	Natural perimeter channel PW.4-DC1. PW.4-DC2	Implementation of new perimeter canals in Zone P.W4, forming the upstream section of the St. Paul sub-location drainage system and connecting to downstream zones through culverts. The perimeter canals have a bottom width of approximately 10 m, with bed levels set at -0.5 m msl*.
	Natural channel P.W4-DC.3	Channel is designed as a narrow, 2 m wide natural channel, which connects the southern urban areas with the main drainage network.
** Note: bed levels might be changed during detailed design phase depending on the results of topographic survey and modelling activities, to ensure that that they are higher than the lowest water level in the wetlands and avoid drying out the wetlands*		


Monrovia Breweries, Inc.
P.W1-DC.1
P.W1-CU.1
P.W1-DC.2
Kuwait-Monboe East Road
Fulani United Community School
P.W1-DC.3
P.W1-CU.1 (Duala Market Culvert)
Monboe Town East Road
Lucky Pharmacy
P.W2-DC.1
P.W2-DC.2
Tropical Clinic Annex
Kru Town Road
P.W2-DC.3
P.W2-DC.4
Last Hope Clinic
Trans-West African Coastal Highway
P.W3-DC.2
Caldwell Road
Liberia Urban Resilience Project
New drainage infrastructure zone P.W1 and P.W2
Preliminary design
Location 1 - Northern Bushrod Island
Legend
Concrete channel (new)
Mortared stone channel (new)
Natural channel (new)
Rehabilitation existing channel
Existing drainage path
New culvert
New outlet structure
Zone border
N
0 50 100 meters

Figure 3-5 Overview of the new drainage infrastructure for Northern Bushrod Island, zone P.W1 and P.W2 (CDR International & Earthtime Inc., 2025a)

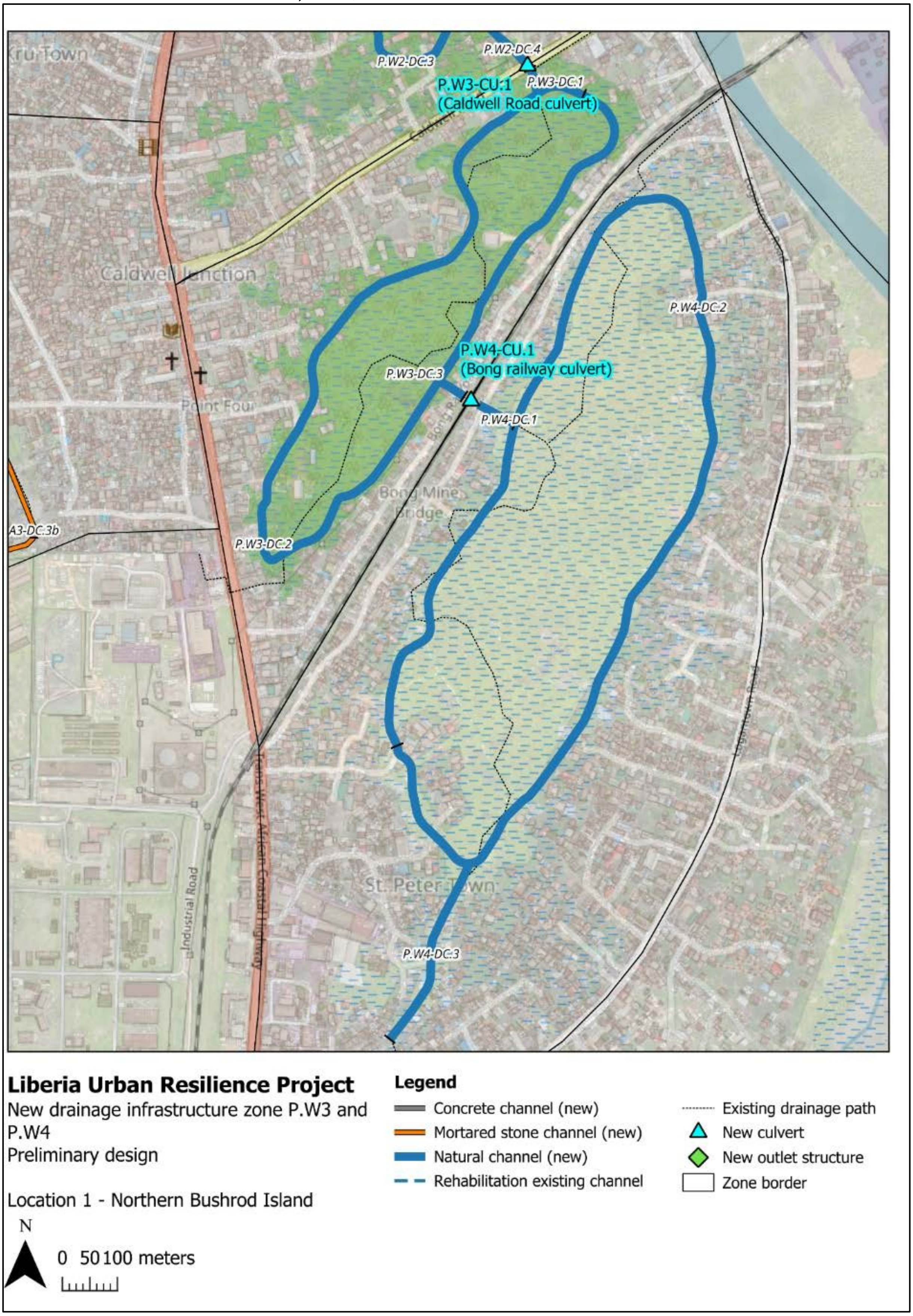


Figure 3-6 Overview of the new drainage infrastructure for Northern Bushrod Island, zone P.W3 and P.W4 (CDR International & Earthtime Inc., 2025a)

3.4. Land Ownership and Resettlement

The Project interventions in Northern Bushrod Island will be implemented on a combination of public and private land, including areas currently occupied by drainage corridors, roads, wetlands, and adjacent built-up zones. Land tenure in the Project area is complex and includes formally owned plots, informally occupied land, and areas used for residential, commercial, and livelihood activities.

At the time of preparation of this ESIA, the exact number of affected land parcels, structures, households, and businesses has not yet been determined. Project-affected persons (PAPs) have not been relocated yet and there is no information on the number of PAPs who will need to be relocated. Detailed identification and quantification of land acquisition requirements and potential physical and economic displacement will be undertaken as part of the Resettlement Action Plan (RAP).

3.5. Project Activities

The Project activities consist of a range of operations required to prepare, construct, and operate the flood-resilience interventions planned for Northern Bushrod Island under LURP. These activities are grouped into two phases: construction and operation phases, as shown in Table 3-3.

Table 3-3 Project activities by phase

Activity group	Key activities
Construction phase	
Site preparation and clearing	• Demarcation of works areas • Site establishment and access • Vegetation clearing and grubbing • Topsoil stripping and stockpiling • Timber handling • No burning (unless approved)
Demolition and removal	• Removal of structures and obstructions • Salvage and material storage • Removal of bridges/culverts (with flow/traffic control) • Substructure excavation
Utilities management	• Identification and coordination • Relocation/removal of utilities (pipes, poles, telecoms)
Excavation works	• Channel and structure excavation • Mechanical/manual excavation • Rock breaking (if required) • Excavation support (slopes, shoring) • Spoil handling and disposal

Drainage construction	• Subgrade preparation • Geotextile installation • Rock placement (scour protection) • Channel construction (precast / in-situ / masonry) • Cover slabs installation
Activity group	**Key activities**
Slope stabilization	• Surface grading and topsoil placement • Seeding (local species) • Fertilizing (if needed) • Watering and re-seeding
Culverts and outlet works	• Bedding and placement of culverts • Jointing and sealing • Backfilling and compaction • Headwalls, wing walls, catchpits • Outlet protection (geotextile + rock) • Trash racks installation
Bridges and access structures	• Footbridge construction • Road/pavement reinstatement
Materials and logistics	• Material transport and handling • Quality control/testing • Laydown and storage areas
Traffic and access management	• Partial/temporary road closures • Alternative routes for vehicles/pedestrians
Operation phase	
Inspection and maintenance	• Routine inspection of drainage, culverts, outlets • Periodic cleaning • Maintain hydraulic performance of structures • Maintain green corridors and wetlands • Maintain footbridges
Waste and debris management	• Removal of solid waste and debris
Capacity building / soft measures	• Drainage maintenance training • Flood awareness • Zoning-related activities

3.6. Resource Requirements

3.6.1. Materials

The main materials to be used during the Project , along with their source, are presented in Table 3-4.

Table 3-4 Sumary of construction materials and sourcing

Material group	Key materials / use	Source
Concrete and structural materials	• Concrete (channels, culverts, outlets, foundations and bridges) • Reinforcement steel • Precast elements	• Local or regional certified suppliers • Ready-mix or mobile batching (Engineer-approved)
Masonry and paving	• Mortared stone masonry (erosion protection) • Asphalt (road paving)	• Local or regional suppliers
Aggregates and fill	• Aggregate, sand, cement • Rock and armour rock • Backfill (selected and reused excavated material)	• Licensed quarries or borrow pits • On-site reuse of excavated material as much as possible
Geotechnical and erosion control	• Geotextiles (stabilization, lining) • Light erosion control materials	• Approved suppliers meeting technical specifications
Material group	**Key materials / use**	**Source**
Hydraulic components	• Trash racks (solid waste control)	• Fabricated or sourced locally or regionally
Vegetation materials	• Topsoil, grass seeds, native plants (slope stabilization)	• Locally sourced; native or adapted species
Construction materials (temporary)	• Timber, protective coverings	• Local suppliers
Fuel and consumables	• Fuel and lubricants (equipment operation)	• Licensed suppliers; compliant storage and handling

3.6.2. Equipment

The main equipment to be used during the Project activities are presented in Table 3-4.

Table 3-5 Construction equipment

Equipment type	Use
Excavators	Channel and site excavation
Loaders (front-end)	Material and soil handling
Breakers	Rock breaking (no blasting anticipated)
Dump trucks	Transport of materials and waste
Low-bed lorries	Transport of equipment and reinforcement
Concrete mixers	Concrete works (drains, culverts)
Compaction equipment	Rollers and plate compactors
Water trucks	Dust suppression and watering

Levelling equipment	Placement of culverts and prefabricated elements
Manual tools	Shovels, wheelbarrows (restricted areas)
Specialized equipment	Amphibious excavators, pontoons or small barges (wetlands)

3.6.3. Power Supply

During the construction phase, the Project will rely on equipment engines for equipment operation. Additionaly, the Project already has access to the national electricity grid, which may be used where available and reliable.

During the operation and maintenance phase, power demand will be minimal, limited to routine inspections and maintenance activities, and will continue to rely on generators. Where feasible, conncection to local electricity network may be used.

3.6.4. Fuel and Water Needs

The anticipated fuel and water requirements of the Project are provided in Table 3-6, including purpose of use, indicative consumption levels and proposed supply and management arrangements.

Table 3-6 Fuel and water requirements

Resource	Phase	Key use	Estimated demand	Supply and management
Fuel	Construction	• Heavy equipment (excavators, loaders, trucks, mixers, generators)	• ~1,000–2,000 L/day (peak) • ~100–150 L/day per excavator	• Licensed local suppliers • Temporary on-site storage • Containment and spill prevention • Controlled refuelling
	Operation	• Maintenance (cleaning, inspections, minor repairs)	• Low	• Light vehicles and portable equipment
Water	Construction	• Concrete mixing and curing • Dust suppression • Equipment cleaning • Worker use	• ~5–10 m³/day (peak)	• Boreholes/wells (limited) • Water trucks • Hybrid supply approach • Engineer-approved sources
	Operation	• Minor maintenance	• Minimal	• Portable supply
Water (drinking)	Construction	• Workforce consumption	• Not quantified	• Water dispensers preferred (reduce plastic waste)

3.6.5. Workforce and Temporary Accommodation

Employment opportunities will be available during the construction phase and for extended periods during operation. It is expected that approximately 25 to 75 workers (including foremen, skilled construction workers, equipment operators, and support staff) will be engaged per sub-location during peak construction activities.

Construction activities are expected to be carried out primarily during daytime hours, with shifts of up to 12 hours per day, preferably between 7:00 a.m. and 6:00 p.m., including breaks. Alternatively, 8-hour shifts may be adopted.

Night-time construction works are not anticipated under normal circumstances, due to supervision, safety, and security constraints. Limited night works may only be considered in exceptional cases, such as works on busy roads or where required to meet specific deadlines.

The workforce will be primarily recruited from local communities within Northern Bushrod Island, with workers commuting daily to site. The establishment of temporary worker camps within or near the Project area is possible, particularly in locations where several intervention locations are in close proximity.

3.7. Management of Pollution

This section outlines the main sources of pollution associated with project activities during construction and operation, including solid waste, liquid waste, and greenhouse gas emissions. The key pollution sources are summarized in Table 3-7.

A Site-specific Solid Waste Management Plan (S-WMP) will be developed Project and will guide all aspects of solid waste handling during project implementation. The S-WMP will include waste characterization for waste resulting from the cleaning of the existing drainages, consultations with relevant stakeholders, and recommended measures for solid waste handling, transport, stockpiling, and final disposal, in line with EPA and World Bank requirements.

Table 3-7 Pollution sources

Pollution type	Source	Key waste / emission
Solid waste	• Drainage rehabilitation, channel cleaning, community upgrading works, construction activities • Demolition activities • Construction activities • Operation and maintenance activities • Workforce activities	• Vegetation waste • Municipal solid waste • Sediments from drains, canals, culverts, wetlands • Construction and demolition waste • Excavated material • Packaging waste • Recyclable materials • Hazardous waste (used oil, lubricants, filters, bitumen, paint containers, contaminated rags) • Domestic waste • Sanitary waste
Liquid waste	• Temporary site facilities • Equipment cleaning • Fuel and oil handling • Drain cleaning, dredging, excavation • Flooded or blocked drains	• Greywater and sewage • Oil-contaminated water • Sediment- and organic matter–laden water • Potentially contaminated pumped water

Greenhouse gas emissions	• Construction phase equipment and vehicles • Operation and maintenance activities • Organic waste (if unmanaged)	• CO_2 from fuel combustion • CH_4 from organic waste (if unmanaged)

3.8. Development Projects Nearby

A number of developments proposed and in progress near the project area have been identified and raised by stakeholders. These projects along with their relative potential interaction with the LURP are presented in Table 3-8.

Table 3-8 Development project nearby and potential interactions

Project	Location	Key components	Status	Potential interaction with LURP
Liberia Sustainable Management of Fisheries Project – Mesurado Industrial Fishing Port, Artisanal Fish Landing Site and Access Road (National Fisheries and Aquaculture Authority (NaFAA) / World Bank-funded)	• Mesurado Pier / Coast Guard Base, Freeport of Monrovia	• Industrial fishing port • Artisanal landing site • Fish market • Processing and cold-chain facilities • Utilities • ~1.2 km asphalt access road	Under implementation	• Temporary cumulative impacts related to dredging and turbidity, fisheries-related wastewater and solid waste, traffic impacts • Cumulative effects on coastal use and fisheries • The project also includes resettlement along the access road
UN Drive Road Expansion Project (MPW / GoL)	• Located along UN drive in Bushrod Island	• UN Drive Road widening and upgrading to improve traffic flow and road safety and stimulate trade.	Underway in Duala market area	• Temporary increases in traffic, dust, noise, water pollution and construction activity and potential added resettlement in the Duala market area
Port of Monrovia Operations	• Liberia's primary commercial port located Eastern edge of Bushrod Island	• Cargo handling • Container operation • Fuel storage • Vessel movement	Ongoing	• Continuous noise, air emissions, wastewater discharge, and heavy vehicle traffic contributes to cumulative urban and coastal pressure.

Industrial Facilities	Several medium-to-large scale industrial operations are active across the island, including: • Breweries • Cement manufacturing plants • Grain mills and food-processing units • Metal workshops and fabrication yards • The Liberia Electricity Corporation Heavy Fuel Oil power generation facility and fuel tank farm	• Manufacturing • Processing • Power generation • Fuel storage	Operational	• Industrial emissions wastewater, air and noise pollution contributing to cumulative environmental baseline conditions

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4. Analysis of Alternatives

The analysis of alternatives is a critical component of the ESIA process, as it evaluates different project options to determine the most sustainable and least impactful approach. This alternatives analysis considers technical, environmental, social, and economic factors in line with GIIP and World Bank requirements. An in-depth analysis of all considered alternatives is given in Appendix F while a summary detail is provided in the subsections below.

4.1. No-Project Alternative

The no-project alternative assumes that the proposed Project is not implemented. Under this scenario, exsiting environmental and socio-economic conditions within the project location would largely remain unchanged. A summary of the advantages and disadvantages of this alternative is given in Table 4-1.

Table 4-1 Summary of advantages and disadvantages of the No-Project alternative

Aspect	Pros (No-Project alternative)	Cons (No-Project alternative)
Constructionrelated impacts	Avoids temporary impacts (noise, air emissions, water pollution, traffic disruption)	—
Land acquisition and resettlement	Avoids land take, displacement, and access restrictions	—
Flood risk and infrastructure	—	Continued chronic flooding causing damage to assets and infrastructure
Access and mobility	Avoids temporary access disruption in specific areas	Ongoing disruption to access to services, employment, and emergency response
Biodiversity and wetlands	Avoids vegetation clearance and shortterm disturbance	Continued encroachment and degradation of wetlands and mangroves
Public health	—	Increased exposure to stagnant water, waste accumulation, and disease vectors
Water	Avoids potential temporary disruption	Continued pollution of St. Paul River, Stockton Creek, and coastal waters
Waste management	—	Ongoing uncontrolled dumping and reduced drainage capacity
Economic impacts	Avoids immediate project costs	Long-term costs from flood damage, repairs, and productivity losses
Long-term management	—	No improvement in drainage maintenance or flood management systems
Socio-economic benefits	—	Loss of benefits (flood resilience, employment, local economic opportunities)

Overall, while the No-Project Alternative avoids short-term construction impacts and resettlemnt-related impacts, it fails to address existing environmental degradation, public health risks, and chronic flooding challenges in Northern Bushrod Island. The ”No-Project” alternative is therefore not a supportable or sustainable proposition.

4.2. Location Alternatives

Potential sub-locations across Northern Bushrod Island were assessed for flood risk management interventions, including Atlantic/New Kru Town, St. Paul Wetlands, Duala Market, and areas draining toward Stockton Creek. These were assessed against the criterias listed in Section 1.2, including flood risk reduction effectiveness, technical feasibility, environmental and social risks, and cost, based on technical assessments and stakeholder consultations.

The results of this assessment are summarized in Table 4-2.

Table 4-2 Summary of location alternatives assessment

Sub-location	Description	Key considerations	Selection status
Atlantic / New Kru Town	Coastal drainage system discharging to the Atlantic Ocean	• Highest flood depths and extent; Strong system-level hydraulic benefits • High population exposure	**Selected**
St. Paul – Wetlands	Marshy wetlands and drainage system toward St. Paul River Estuary (incl. Caldwell Rd and Bong Mines Railway)	• Significant flood risk reduction potential • System-level drainage improvement • Manageable E&S risks	**Selected**
Stockton Creek areas (e.g., Cow Factory, Crab Hole)	Drainage areas discharging toward Stockton Creek	• Lower benefit-to-cost ratio • Potential cumulative impacts on Mesurado Wetland (Ramsar site)	Not selected
Duala Market area	Highly urbanized commercial area	• High social risks, including resettlement and livelihood impacts	Not selected
St. Paul estuarine wetlands (direct interventions)	Sensitive estuarine wetland environments	• High environmental sensitivity • High technical complexity and cost	Not selected

Overall, the selected locations represent the most feasible and balanced option in terms of flood risk reduction effectiveness, technical feasibility, cost efficiency, community benefits, and management of environmental and social impacts under the current phase of LURP.

4.3. Routing Alternatives

Within the selected sub-locations, alternative drainage alignments and routing options were assessed during the preliminary design stage with the objective of avoiding and minimizing land acquisition and resettlement impacts, while maintaining drainage functionality. This process was undertaken through iterative consultations between the Engineering team, the Environmental and Social consultant team, and the Client, supported by site reconnaissance and information collected during baseline surveys and community engagement. The routing alternatives assessment is summarized in Table 4-3.

Table 4-3 Summary of routing alternatives assessment

Location / zone	Area description	Initial option	Optimized design / selected approach	Key considerations
New Kru Town – North (Zone A1DC.1 - see Section 3.3.1.1**)**	Northern section of New Kru Town, around New Kru Town Elementary School extending toward the beachfront	Extend drainage works northward toward the beach through residential areas	• Reduced intervention; alignment shifted along the existing road connecting the school to the beach	Avoids dense residential clusters and physical displacement while maintaining drainage conveyance to the outfall
New Kru Town – Central ("Green Corridor")	Corridor between New Kru Town Elementary School and Redemption Hospital	Use of existing open corridor for drainage improvement	• Retained as primary drainage corridor with localized improvements	Some physical and economic displacement and access constraints remain unavoidable due to existing settlement patterns
New Kru Town – South (Zone A3DC.2 - see Section 3.3.1.2**)**	Southern New Kru Town, where drainage discharges to the Atlantic through densely built residential areas	Widen and deepen existing open channel between closely spaced houses	• Route drainage beneath the existing roadway (culverted alignment)	Avoids major displacement in high-density housing areas while maintaining hydraulic connectivity to the ocean outfall
South of Redemption Hospital / Culvert locations	Localized areas along the southern corridor and key crossing points (culverts)	N/A (localized design constraints)	• Minor alignment and footprint adjustments	Limited residual resettlement may be required at specific structures and culvert locations
St. Paul – Wetlands (Perimeter channels & Duala culvert)	Marshy wetland areas north-east of Bushrod Island, including communities around Caldwell Road, Bong Mines Railway, and Duala culvert area	Multiple alignment options within wetlands and adjacent settlements	• Optimized perimeter channel alignments to direct flow toward St. Paul River	Avoidance not fully feasible due to hydraulic requirements; impacts minimized through alignment refinement, footprint reduction, and avoidance of key community features where possible

Overall, the routing and design alternatives assessed demonstrate a deliberate effort to apply the mitigation hierarchy—prioritizing avoidance and minimization of resettlement impacts—while maintaining the technical effectiveness and flood risk reduction objectives of the Project. All residual impacts from land acquisition and physical and economic resettlement are addressed separately through the preparation of a RAP in accordance with World Bank ESS5 and local requirements.

4.4. Design Alternatives

A range of design alternatives was assessed to identify drainage solutions that achieve the required hydraulic performance while minimizing environmental and social impacts, ensuring constructability within dense urban areas, and supporting long-term operation and maintenance. The assessment considered hydraulic effectiveness, environmental and social risk, constructability, maintenance requirements, lifecycle costs, and climate resilience. The key design alternatives and selected approaches are summarized inTable 4-4.

It is worth noting that several non-prioritized interventions, primarily related to solid waste management and community upgrading, were deferred from the current LURP phase and may be considered in later stages of the Project, subject to funding availability and environmental and social considerations.

Table 4-4 Summary of design alternatives assessment

Design aspect	Alternatives considered	Selected approach	Key considerations
Drainage channels (rehabilitation vs new construction)	• Rehabilitation of existing channels • Construction of new channels	Combination: rehabilitation prioritized, with new perimeter channels where required (e.g., St. Paul Wetlands margins)	• Rehabilitation reduces land take and resettlement • New channels required where no continuous drainage exists to ensure system-level flood conveyance
Channel lining	• Concrete-lined channels • Mortared stonelined channels • Vegetated/natur al channels	Predominantly vegetated and stone-lined channels; limited concrete/box structures where necessary	• Reduces environmental impact, erosion, and runoff velocity • Improves integration with surroundings and supports maintenance
Culverts	• Retain existing culverts • Replace with upgraded structures (e.g., box culverts)	Replacement of existing culverts with highercapacity structures	• Existing culverts are undersized and frequently blocked • Replacement improves hydraulic capacity, reduces flooding, and supports maintenance

Solid waste control	• No debris control • Trash racks • Floating booms	Installation of trash racks at key upstream and outlet locations	• Prevents blockage of culverts and outlets • Booms not suitable for tidal/estuarine conditions • Supports maintenance efficiency

Overall, the selected design reflects the application of the mitigation hierarchy, prioritizing the use of existing infrastructure, minimizing environmental and social impacts, and adopting nature-based and low-impact solutions where feasible. Where higher-impact interventions are required to achieve hydraulic performance, these have been limited to essential locations and optimized through design refinement.

4.5. Construction Alternative

Construction alternatives were assessed with the objective of identifying approaches that meet the Project's technical requirements while avoiding or minimizing environmental and social impacts, occupational health and safety risks, and disruption to surrounding communities.

The key construction alternatives and selected approaches are summarized in Table 4-5.

Table 4-5 Summary of construction alternatives assessment

Construction aspect	Alternatives considered	Selected approach	Key considerations
Construction method (culverts and drainage structures)	• Prefabricated elements • In-situ construction	Site-specific selection; predominantly in-situ for larger structures	• Prefabrication reduces construction time but increases transport, lifting, and traffic risks • In-situ offers flexibility in constrained urban areas and reduces handling impacts
Culvert installation	• Prefabricated single-cell culverts • In-situ construction (single and double cell)	Combination approach: prefabricated where feasible; in-situ for larger/double-cell culverts	• Larger structures require insitu construction due to scale and integration constraints
Construction techniques	• Fully mechanized methods • Combination of mechanized and manual methods	Combination approach with manual methods prioritized in sensitive or confined areas	• Reduces noise, vibration, access disruption, and safety risks • Allows adaptation to local conditions

4.6. Operation Alternative

Operational alternatives were considered with respect to maintenance frequency, waste management practices, emission control, and long-term sustainability of tdrainage system. The key operational alternatives and selected approach are summarized in Table 4-6.

Table 4-6 Summary of operational alternatives assessment

Operational aspect	Alternatives considered	Selected approach	Key considerations

Maintenance strategy	• Reactive/ emergency maintenance • Routine and preventive maintenance	Routine inspection and periodic cleaning throughout design life	Reduces flood risk, prevents blockage, and avoids costly emergency interventions
Waste management	• Irregular clearance • Systematic waste and sediment removal	Regular removal of solid waste, sediments, and debris	Prevents accumulation, reduces pollution and methane generation, and maintains drainage capacity
Operational aspect	**Alternatives considered**	**Selected approach**	**Key considerations**
Vegetation management	• Mechanized clearing • Manual and selective clearing	Manual vegetation management where feasible	Minimizes fuel use, protects ecological functions, and reduces disturbance
Resource use and emissions	• High-intensity equipment use • Targeted low-intensity interventions	Use of small-scale equipment and targeted interventions	Reduces fuel consumption, emissions, and water use while maintaining system performance

4.7. Conclusion

The analysis of alternatives demonstrates that the selected project configuration represents the most feasible and balanced option for addressing chronic flooding and associated environmental and social risks in Northern Bushrod Island. Across all levels of analysis—including the no-project, location, routing, design, construction, and operation alternatives—the Project has prioritized avoidance and minimization of environmental and social impacts while maintaining technical effectiveness and long-term resilience.

While certain interventions, particularly new perimeter drainage channels and culvert replacements, involve unavoidable environmental and social impacts, these have been limited to locations where no viable lower-impact alternatives exist and are justified by the substantial and sustained reduction in flood risk, improved public safety, and enhanced resilience of affected communities. Residual impacts are addressed through targeted mitigation measures in the project's ESMP and the preparation of a RAP.

5. Public Participation and Stakeholder Engagement

Stakeholder engagement serves as a means to keep project stakeholders informed about project activities, potential project impacts, and strategies to minimize these impacts during the ESIA stage. It enables stakeholders to express their concerns about project activities and offer feedback. This feedback is carefully considered when planning project activities and devising measures to address and alleviate any issues.

This section offers an outline of the stakeholder engagement efforts conducted for the Project. Additionally, it summarizes the key aspects of stakeholder engagement and the procedures followed for addressing grievances.

5.1. Notice of Intent

In accordance with the ESIA Procedural Guidelines (Environmental Protection Agency of Liberia, 2022), a Notice of Intent was published in three newspapers for three days, as follows (see Appendix G).

- Oracle newspaper, on October 17, 20 and 21, 2025
- Hot Pepper newspaper, on October 17, 20 and 22, 2025
- The New Republic newspaper, on October 20, 22 and 24, 2025

The Notice of Intent included information on the nature of the project, its location, activities, and the project proponent. At the time of preparation of this document, no input had been received from the public following the publishing of the Notice of Intent.

5.2. Review of Prior Project Reports and Activities on Stakeholder Engagement

A range of stakeholder engagement activities studies were reviewed to inform the project, including a Multi-Criteria Analysis (MCA) workshop, activities held by previous consultants reports, and activities undertaken under the the project's Environmental and Social Management Framework (ESMF) and Resettlment Policy Framework (RPF). These consistently highlight key challenges in the project area, notably inadequate drainage and recurrent flooding, poor waste management and sanitation, limited access to basic services (including healthcare and water), and exposure to climate-related risks such as sea level rise. Social vulnerabilities, including displacement risks and the needs of vulnerable groups, were also emphasized. Across all sources, there is strong alignment on the need for improved infrastructure, strengthened environmental and social safeguards, and sustained stakeholder engagement to ensure inclusive and effective project implementation.

A detailed review of these activities is given in Appendix H.

5.3. ESIA Stakeholder Engagement and Public Participation

5.3.1. Stakeholder Identification and Mapping

During the undertaking of the ESIA, project stakeholders were identified and mapped. Stakeholders were categorized into affected parties and interested parties, and each was assigned a level of influence (high, medium, or low). Affected parties are individuals, groups, or communities that are directly or indirectly affected by the projects, whether positively or negatively. Interested parties are stakeholders who are not directly affected by project impacts but have an interest in the project or can influence or be involved in its outcomes. Based on this assessment, appropriate engagement approaches were defined, with stakeholders either engaged closely or informed and consulted as needed. Further details are presented in Table 5-1.

5.3.2. Stakeholder Engagement Methodology

During the undertaking of the ESIA, engaging stakeholders was done through various channels as follows:

- **High-level stakeholder consultation**, during which key stakeholders were consulted. Details and findings of the key stakeholder consultations are presented in Section 5.3.3.
- **Community consultations**, during which all communities in the social area of influence and expected to be directly affected by the Project were consulted. Details and findings of the community consultations are presented in Section 5.3.4.
- **Focus Group Discussions** (FGDs), including women groups, chiefs and elders, landowners, youth, fishermen, fishmongers, transportation union, wetland and mangrove users, and civil society in the project area. Details and findings of FGDs are presented in Section 5.3.5.
- **Key Informant Interviews**, during which key stakeholders were consulted. Details and findings are in Section 8 (ESIA Volume III).

Table 5-1 Stakeholder identification and mapping

No.	Stakeholder	Description	Influence	Engagement level
1.	**Communities in the project area of influence**	Affected party	Medium	Engage closely
2.	**Structure owners and landowners**	Affected party	High	Engage closely
3.	**Fishermen, fishmongers and wetland users**	Affected party	Medium	Engage closely
4.	**Women's groups**	Affected party	Medium	Engage closely
5.	**Transport unions**	Affected party	Medium	Engage closely
6.	**Community-based organizations**	Interested Party	Medium	Inform and consult
7.	**Local authorities** (governors, elders, community leaders, block leaders, chairperson)	Interested party	Medium	Inform and consult
8.	**County/district authorities** (Superintendent and Commissioner)	Interested party	Medium	Inform and consult
9.	**Ministry of Internal Affairs**	Interested party	High	Inform and consult
10.	**Ministry of Public Works**	Interested party	High	Inform and consult

11.	**Ministry of Gender and Social Development**	Interested party	High	Inform and consult
12.	**Ministry of Labor**	Interested party	High	Inform and consult
13.	**Ministry of Transport**	Interested party	High	Inform and consult
14.	**Ministry of Agriculture**	Interested party	Medium	Inform and consult
15.	**Ministry of Finance Development Planning**	Interested party	High	Inform and consult
16.	**Liberia Land Authority**	Interested party	High	Inform and consult
17.	**Environmental Protection Agency**	Interested party	High	Inform and consult
18.	**Non-Governmental Agencies**	Interested party	Medium	Inform and consult
19.	**National Disaster Risk Management Agency**	Interested party	High	Inform and consult
20.	**Liberia Water and Sewer Corporation**	Interested party	High	Inform and consult
21.	**Monrovia City Corporations**	Interested party	High	Inform and consult
22.	**Liberian Artisanal Fishermen Associations**	Interested party	High	Inform and consult
23.	**World Bank**	Interested party	High	Engage closely

5.3.3. High-Level Stakeholder Consultation

A high-level stakeholder consultation meeting was with stakeholders from various ministries, agencies and other entities at the head office of the MPW in Monrovia, on October 24, 2025. The aim of this consultation was to brief stakeholders on the Project's design, activities, and potential impacts, in order to gather their feedback, address questions, and deliberate on their suggestions and concerns.

The meeting began with Earthtime's representative introducing the Project, offering a concise historical context, and outlining the project's location, description, and potential effects. Subsequently, the discussion centered on key stakeholders' perspectives and apprehensions regarding the Project. The presentation, the minutes of meeting and the attendance sheet are available in Appendix I.

A summary of concerns raised during the meetings is presented in Box 5-1, while photographs are presented in Figure 5-1.

Box 5-1 Summary of high-level stakeholder consultation held

High level stakeholder consultation

- **Location**: Ministry of Public Works, Monrovia
- **Date**: October 24, 2025
- **Attendees:**
  - Earthtime (Environmental and Social Consultant)
  - Liberia National Police
  - Borough of New Kru Town
  - Ministry of Public Works
  - Monrovia City Corporation
  - Project Management Unit
  - Paynesville City Corporation
  - Environmental Protection Agency
  - Redemption Hospital
  - Ministry of Transport
  - Forestry Development Authority
  - Ministry of Mines and Energy
  - Society for the Conservation of Nature of Liberia
  - National Public Health Institute of Liberia
  - Ministry of Internal Affairs
  - Liberia Water and Sewer corporation
  - Ministry of Gender Children and Social Protection
  - United Nations Development Program
  - National Disaster Management Agency
- **Main concerns raised**
  - Clarification requested on the timeline and duration of both the ESIA process and of the overall LURP implementation
  - Concerns about possible community opposition
  - Potential loss of habitat and biodiversity due to project activities
  - Suggestion to actively involve local authorities and residents in data collection and monitoring efforts
  - Questions raised regarding the alignment of project interventions with the National Zoning Law, Solid Waste Management Policy and environmental regulations to avoid legal and operational challenges
  - Recommendation to include Health Impact Assessment as part of the ESIA to address public health risks
  - Concerns about ensuring long-term monitoring and maintenance of flood control infrastructure to sustain functionality
  - Concerns related to emphasizing the need for detailed mitigation plans once the design is finalized
  - Recommendation to consider the proximity of Redemption Hospital in impact assessments and mitigation planning
  - Recommendation to conduct follow-up stakeholder consultations and community meetings once draft designs become available

Figure 5-1 Photographs of high-level stakeholder consultation held on October 24, 2025

5.3.4. Community Consultations

Eighteen communities in Northern Bushrod Island were consulted between Novemver 13, 2025 and November 24, 2025 as presented as described in Table 5-2. Photographs form the various consultation meetings are shown in Appendix J.

The community consultation meetings shared the same agenda, which included:

1. Prayer
2. Introduction of Earthtime consultants and attendees
3. Debriefing about the LURP project
4. Remarks
5. Questions and concerns from community members

The meetings offered an opportunity for communities to express their concerns, emphasize noteworthy social, environmental, and economic project-related matters, and establish a shared understanding of how to tackle these significant concerns moving forward. They also offerered communities an opportunities to raise inquires and make recommendations.

The communities made numerous inquiries regarding the project, the drainage, affected persons, and resettlement and compensations.

Concerning the drainage, communities inquired about:

- The areas where the drainages will be constructed
- Whether the drainages will be closed
- If concrete will be used in the construction of the new drainage
- Whether the new drainage will put an end to flooding and rising water levels in swamps,
- The drainage management
- Whether security officers will be present to maintain it.
- Whether existing drainages will be cleared
- Whether MPW will inform people present in the of the drainage construction.

Concerning the project, the communities inquired about:

- The start and end date of the project
- Who is implementing it
- Whether it will be completed on time
- Whether safety measures will be taken during its implementation
- If the project will affect houses
- If it will manage waste disposal sites

- If the project material will remain with the community.

Concerning affected persons, communities inquired about:

- The fate of people with houses in the project area
- About the role of their members during project implementation.

Concerning resettelement, communities inquired about:

- Whether affected persons (such as people with houses built over drainage or house owners) will be compensated
- Whether the resettlement plan will be implemented before the start of the project.

Other inquiries included:

- If women and vulnerable groups will be prioritized
- Whether local community members will receive employment opportunities
- Whether retaining walls will be built.

Some of the key recommendations included:

- Building more public toilets, concrete drainages, bridges, roads, retaining walls, hand pumps, safe wells, as well as infrastructures such as schools, hospitals, and clinics.
- Incorporating a proper waste management system for the community
- Establishing a community-based enterprise for waste collection
- Dumping waste in specific dump sites.

Recommendations concerning resettlement included:

- Carrying out the resettlement prior to project implementation
- Relocating all individuals instead of conducting development projects in the area.

Other recommendation included:

- Opening blocked alleys
- Checking water channels
- Closing drainages
- Demolishing the houses of people who have built in alleys
- Removing buildings built over drainage lines
- Youth participation in the project
- Establishing a memorandum of understanding between the parties.

Table 5-2 Schedule of the public consultations and number of participants

No.	Location	Name of Community	Date	No. attendees

				Male	Female	Total
1.	**New Kru Town**	Central New Kru Town Community	November 15, 2025	42	88	130
2.		Duala Market Community	November 17, 2025	10	16	26
3.		Fundaye Community	November 14, 2025	19	29	48
4.		Lagoon Community	November 14, 2025	15	32	47
5.		Supermarket Community	November 21, 2025	10	11	21
6.		Popo Beach Community	November 17, 2025	29	39	68
7.		Trowin Community	November 13, 2025	46	42	88
8.	**St. Paul River**	Bong Mines Bridge Community	November 15, 2025	14	6	20
9.		Caldwell Road Community	November 18, 2025	37	77	114
10.		Crab Hole Community	November 19, 2025	38	37	75
11.		Island Clinic Community	November 24, 2025	47	81	128
12.		King Peter Town	November 20, 2025	19	12	31
13.		Momboe Town	November 18, 2025	20	17	37
14.		Whea Town Community	November 19, 2025	5	17	22
15.		Zuma Town Community	November 24, 2025	20	23	43
16.	**Stockton Creek**	Cow Factory Community	November 21, 2025	21	19	40
17.		Central Jamaica Road Community	November 22, 2025	10	5	15
18.		Zondo Town Community	November 20, 2025	9	1	10
Total				**411**	**552**	**963**

The main concerns and questions raised during the community consultations, are summarized in Table 5-3.

Table 5-3 Summary of concerns articulated during community consultations

No.	Location	Community	Main concerns raised
1.	**New Kru Town**	Central New Kru Town	• Flooding, lack of access to safe drinking water, public toilets, and waste disposal sites • Blocked drainages • Lack of safe drinking water
2.	**New Kru Town**	Duala Market	• Waste disposal and scattered dump sites • Drainage • Flooding • Lack of public toilets • Lack of household toilets • Lack of safe drinking water

No.	Location	Community	Main concerns raised
3.	**New Kru Town**	Fundaye	• Flooding • Waste disposal in drainages • Lack of household toilets • People building over drainages • Sea flooding destroying houses • Malaria cases • Waste disposal on beaches, causing difficulty for fishermen
4.	**New Kru Town**	Lagoon	• Flooding during rainy season • Waste disposal in drainages • Poor waste management system • Lack of public toilets
5.	**New Kru Town**	Supermarket Community	• Flooding and its impact on households • Project implementation • Unfulfilled promises from previous experiences • Community role • Fear of resettlement and losing structure with no compensation or engagement
6.	**New Kru Town**	Popo Beach	• Waste disposal in new drainages to build and lack of public toilets • Fate of landowners without land deeds • Community members claiming public toilets and handpumps built on government property • Sea erosion • Lack of toilets and safe drinking water • Flooding during rainy season
7.	**New Kru Town**	Trowin	• Construction over drainages • Lack of toilets in the community and the dysfunctionality of some of the present ones • Elderly people's inability to pump water using a hand pump • Waste disposal in drainages, blocking water flow/poor waste management system • Flooding houses during rainy season • Project implementation • Poor sewage management system

8.	**St. Paul River**	Bong Mines Bridge	• Lack of roads in the community • Construction over drainage • Road rehabilitation affecting people • Flooding and the lack of help from the disaster management team • Fear of resettlement and losing structure with no compensation or engagement • Waste management problem
9.	**St. Paul River**	Caldwell	• Grievance about how they never benefitted from previous projects • Lack of vocational school and training center for women • Broken water and sewage pipe, leading to water overflow into people's properties
10.	**St. Paul River**	Crab Hole	• Lack of access to the main road • Sand mining as a major issue in the community • Flooding • Lack of a clinic and water taps in the community • Lack of roads
11.	**St. Paul River**	Island Clinic	• Flooded households and blocked drainages • Waste causing hygiene and health issues • Flooding in wells
12.	**St. Paul River**	King Peter Town	• Constant flooding during rainy days • Lack of garbage disposal sites • Snakes entering houses during rainy days • Alleys blocked by newly constructed buildings • Flooding because of living next to drainages • Living nearby properties where dirt is dumped • Sloping of King Peter Town causing people living in swamps to suffer during rainy season • Child safety nearby open wells • Narrow drainages
No.	**Location**	**Community**	**Main concerns raised**
13.	**St. Paul River**	Mombo Town	• Lack of waste disposal sites • Blocked drainages due to waste • Construction over drainages, leading to flooding • Requested further sewage water collection points
14.	**St. Paul River**	Whea Town	• Flooding from rising sea water • Lack of safe drinking water in the community • Lack of toilets and schools

15.	**St. Paul Bridge**	Zuma Town	• Drainage blockage which leads to flooding • Lack of roads leading into the community • Inability of trucks to reach burning houses • Scattered dumpsites • Floods limiting their ability to reach work and schools
16.	**Stockton Creek**	Cow Factory	• Filling the area with waste • Waste in the community • Waste disposal in drainages • Flooding • Animals entering houses as well as lack of cooking and playing areas during rainy seasons • Construction of houses on alleys and restricting water flow to drainages
17.	**Stockton Creek**	Jamaica Road	• Seeing tangible results
18.	**Stockton Creek**	Zondo Town	• Community people claiming NGO wells • Construction over drainages • Waste management issue • Lack of collaboration from other communities on similar projects

5.3.5. Focus Group Discussions

FGDs were conducted with various groups in the social area of influence in November 2025. These included FGDs with women, youth, chiefs and elders, ecosystem services users (including fish mongers, fishermen, and wetland users) landowners, civil society, and drivers union. Details on each FGD are presented in the sections below. FGD photographsand questionnaires are available in Appendix J and Appendix K, respectively.

Table 5-4 Summary of focus group discussions held

Type of FGD	No. FGDs conducted	No. participants
Women	11	118
Youth groups	8	83
Chiefs and elderly	10	100
Ecosystem services	8	67
Landowners	4	32
Other groups	2	12
Total	**43**	**412**

5.3.5.1. Women Focus Groups

Women FGDs were held after community consultations in November 2025. A total of 11 discussions were held with women from different ages and backgrounds. Each discussion was attended by 8 to 11 women and a total of 118 women were involved. The FGD schedule and number of participants in each group are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-5. The breakdown of issues articulated per community is given in Appendix M.

FGDs with women offered a safe environment for them to voice their worries and anticipated outcomes related to the Project. Insights from these discussions supplemented and broadened the feedback and concerns articulated by the communities during previous consultations. Moreover, it furnished a broader understanding of the circumstances surrounding women in the project area, contributing to the social baseline. The issues mentioned in the consultations were recorded and taken into consideration in which several measures were suggested to minimize these challenges in the mitigation measures.

Table 5-5 Summary of concerns articulated during focus group discussions with women

Area	Concerns	Expectations
New Kru Town	• Concerns about project implementation • Fear of resettlement without compensation or engagement • Concerns about hiring from outside the community • Potential marginalization of certain locations • Concerns about biased employment and exclusion • Mismanagement of materials and leftover waste • Fear of lack of cooperation from property owners (e.g., for toilets/hand pumps)	• Employment opportunities (including for women and youth) • Women's empowerment (vocational training, income activities) • Provision of safe drinking water and sanitation (toilets, hand pumps, sewers) • Improved drainage systems • Safe relocation conditions (schools, clinics, safety checks) • Security during construction • Compensation and suitable housing for affected people • Improved business and livelihoods • Flood reduction and safer schooling conditions
St Paul Wetlands	• Concerns about full and effective project implementation • Concerns about stakeholder engagement • Fear of resettlement without compensation • Concerns about hiring practices (local vs outsiders) • Concerns about influx of external workers (social risks) • Uncertainty about project completion • Concerns about relocation distance and adequacy of new sites	• Compensation, financial aid, and improved housing • Safe relocation with access to schools, clinics, and markets • Transportation support for relocation (people and assets) • Employment opportunities (especially for youth and women) • Women empowerment (training, loans, grants) • Access to education (schools, scholarships, vocational training) • Improved mobility and community development • Business recovery and growth • Social infrastructure (clinics, libraries, public toilets) • Counseling and support services for relocated people

Stockton Creek	• Concerns about resettlement without compensation or engagement	• Adequate compensation and housing • Transportation and food support during relocation • Proper engagement with host communities • Facilities such as public toilets and meeting spaces for women

5.3.5.2. Youth Focus Groups

Youth FGDs were held after each community consultation in November 2025. A total of eight discussions were held with youth from different ages and backgrounds along the alignment. A total of 56 young men and 27 young women attended these dicussions. The FGD schedule and breakdown of participants in each group are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-6. The breakdown of issues articulated per community is given in Appendix M.

Table 5-6 Summary of issues articulated during focus group discussions with youth

Area	Concerns	Expectations
New Kru Town	• Concerns about project implementation and work safety • Continued waste disposal into drainage systems after project completion • Safety of affected persons at project sites • Increase in criminal activities, drug use, and sexual harassment • Risks to women's safety • Mismanagement of project materials	• Employment opportunities (including permanent roles where possible) • Involvement of local communities in project implementation • Skills development and vocational training (including waste management skills) • Increased literacy and awareness among youth and businesspeople
St Paul Wetlands	• Fear of resettlement without compensation or adequate engagement • Concerns about transparency (e.g., payments) • Mismanagement or theft of project materials • Noise and construction disturbances • Influx of workers and associated social risks (conflicts, behavior, GBV/SEA risks) • Child safety concerns • Risk of halting construction or incomplete implementation • Concerns about relocation of key infrastructure (schools, churches, shops)	• Employment and income-generating opportunities (especially for youth and women) • Youth empowerment and involvement in the project • Skills development, capacity building, and training • Public awareness and communication about the project • Improved mobility and safer housing • Protection of assets and prevention of property damage • Scholarships and literacy improvements • Dedicated spaces for youth engagement and community interaction
Stockton Creek	• Fear of resettlement without compensation or engagement • Insufficient project communication • Increase in drug abuse and sexual harassment	• Short-term employment opportunities • Skills development • Increased public awareness about the project

5.3.5.3. Chiefs and Elders Focus Groups

Chiefs and Elders FGDs were held after community consultations in November 2025. FGDs were not conducted in the Bong Rail side Communities as impacts are employment related and environmental rather than differentiated by community subgroups. In total, ten discussions were held with both men and women from the Chiefs and Elders groups.). Each discussion was attended by 9 to 11 people and a total of 100 people were involved (25% women). The FGD schedule and the breakdown of participants are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-7. The breakdown of issues articulated per community is given in Appendix M.

FGDs with Chiefs and Elders provided a chance for them to share their worries, immediate concerns, and expectations about the project. These discussions added to and expanded on the feedback raised by communities during the Town Hall meetings. They also gave a clearer understanding of the traditional community management systems in the project area, helping build the social baseline and document specific information from each community.

The concerns raised during the consultations were recorded and considered, and several measures were proposed to reduce these challenges in the ESMP.

Table 5-7 Summary of issues articulated during chiefs and elders focus group discussions

Area	Concerns	Expectations
New Kru Town	• Concerns about project implementation, completion, and monitoring • Fear of resettlement without compensation or engagement • Poor quality of construction materials and works • Increase in social risks due to influx of workers (violence, theft, sexual harassment, prostitution, drug abuse) • Concerns about incomplete or delayed project delivery	• Flood reduction through improved drainage • Improved public health (reduced malaria, diarrhea, skin diseases) • Safe drinking water and improved sanitation facilities • Employment opportunities, especially for youth • Youth empowerment • Safer environment for children • Improved mobility • Regular community engagement and collaboration with local leaders • Regulated and improved waste management systems
St Paul Wetlands	• Concerns about project completion, quality, and timely implementation • Fear of resettlement without compensation or engagement • Exclusion from employment opportunities • Concerns about lack of tangible results and false promises from past projects • Need for better supervision and long-term maintenance (especially drainage systems) • Weak enforcement of waste management policies • Community resistance risks • Need for stronger community inclusion in project processes	• Flood reduction and functioning drainage systems • Improved waste management and regular waste collection • Reduced health risks and illnesses (e.g., malaria, typhoid) • Access to safe drinking water • Employment and livelihood opportunities • Public sanitation facilities and enhanced sanitation services • Community development (clinics, trade schools, recreational centers) • Improved emergency access (fire trucks, ambulances) • Clean and well-maintained environment

Stockton Creek	• Concerns about project initiation and delivery • Poor quality construction/work • Lack of community involvement in decisionmaking • Accountability, transparency, and corruption risks • Theft of materials	• Flood reduction and erosion control • Reduced illnesses • Employment opportunities • Improved community economy • Cleaner community

5.3.5.4. Ecosystem Services Users Focus Groups

FGDs on ecosystem services were conducted in November 2025 to understand how communities use and depend on natural resources in the Project area. The discussions helped identify which ecosystem services are important for livelihoods, daily activities, and wellbeing, and how project activities may affect access to these resources. The FGDs also supported the identification of key concerns and appropriate mitigation measures through direct community input.

5.3.5.4.1. Fishmongers

Fishmongers FGDs were held after community consultations in November 2025. A total of four discussions were held with fishmongers). Each discussion was attended by 8 to 10 women and a total of 38 fishmongers (all females) were involved. The FGD schedule and breakdown of participants are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-8. The breakdown of issues articulated per community is given in Appendix M.

Table 5-8 Summary of issues articulated during focus group discussions with fishmongers

No.	Location	Main concerns raised	Expectations
1.	**New Kru Town**	• Restrictions on access to the beach • Safety risks	• Compensation • Healthier environment
2.	**St. Paul River**	• Physical and economic resettlement • Harder logistics • Impact on livelihoods • Impacts on fish landing sites • Loss of direct access to beach and fish resources • Fear of not receiving cash compensation • Loss of family connections and support in case of relocation	• Healthier environment • Cash compensations • Grants • Loans • Help in logistics and transportation in case of relocation or restriction on access • System in place to organize the resettlement and activities through the government • Improved roads and infrastructure in the community • Protection against flooding

5.3.5.4.2. Fishermen

Two discussions were held with fishermen from different ages and backgrounds in November 2025 along the alignment). One of the discussions was attended by seven men, while the other was attended by nine men. The FGD schedule and breakdown of participants are given in Appendix L.

During these meetings, no concerns or expectations were raised but the participants shared insights on their livelihood. Any restriction on access to the beach will have an impact on their livelihoods. More discussion is outlined in Section 8 (ESIA Volume III).

5.3.5.4.3. Wetland Users

Two discussions were held with wetland users from different ages and backgrounds in November 2025 along the alignment). One discussion was attended by seven men and one woman while another discussion was attended by five men. A total of 13 people were involved. The FGD schedule and breakdown of participants are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-9. The breakdown of issues articulated per community is given in Appendix M.

Table 5-9 Summary of concerns articulated during focus group discussions with wetland users

No.	Location	Communities represented	Main concerns raised	Expectations
1.	**St. Paul Wetlands**	Whea Town Community	• Building drainages in areas that will lead to house demolition • Not finding new areas for hunting	• Flood reduction • Community Development
2.	**Stockton Creek**	Cow Factory	• Seizing wetland areas for drainage construction • Project impact on people who depend on wetland areas for fishing, and hunting	• Government regulation of wetland and mangrove policies • Proper waste management approach • Flood reduction in the areas

5.3.5.5. Landowners Focus Groups

Four discussions were held with landowners from different ages and backgrounds in November 2025 along the alignment). In total, the discussions were attended by 19 men and 13 women and a total of 32 people were involved. The FGD schedule and breakdown of participants are given in Appendix L.

The issues articulated during the FGDs are summarized in Table 5-10. The breakdown of issues articulated per community is given in Appendix M.

Table 5-10 Summary of main concerns articulated during focus group discussions with landowners

No.	Location	Main concerns raised	Expectations
1.	**New Kru Town**	• Fear of resettlement and losing structure with no compensation or engagement	• Compensation for resettlement • Community benefits and development • Positive outcomes from drainage construction • Safer structures houses
2.	**St. Paul Wetlands**	• Tension between landowners and implementing agencies • Fear of resettlement and losing structure with no compensation or engagement	• Adequate and timely compensation • Prompt relocation • Solution to flooding • Added value to properties and rent increase • Cleaner community • Community development

			• Road pavement (Zuma town) • WASH facilities
No.	**Location**	**Main concerns raised**	**Expectations**
3.	**Stockton Creek**	• Fear of resettlement and losing structure with no compensation or engagement • Increased rents	• Compensation for affected properties • Proper compensation • Reduction in floods • Business development in the area and • Increase in property values and rent increase • Solution to flooding

5.3.5.6. Other Focus Groups

One civil society FGD and one drivers union FGD were held in New Kru Town on November 20 and November 25, 2025 respectively. A discussions was held with individuls from different ages and backgrounds along the alignment. Each discussion was attended by 6 people from each group. Attendees raised concerns regarding worksite acidents, damage to properties, relocation, health risks and crimes, in addition to restriction on access to parking areas, potential loss of structures, and marketer operating in disorganized ways along roads and junctions. Attendees also shared their expectations regarding the project. These included an enhanced drainage system, flood reduction, a cleaner evironment, a proper waste management system, and not restricting access to parking and essential areas.

5.3.6. Standardized Responses to Stakeholder Concerns

To ensure consistency and accuracy in communication during stakeholder engagement activities, the Project team developed and applied a standardized Frequently Asked Questions (FAQ) sheet.

The FAQ sheet was used by all consultation team members as a reference tool to provide clear, consistent, and transparent responses to commonly raised questions and concerns from stakeholders, including communities, local leaders, and other interested parties. The consultation team was trained in its application to ensure that information was conveyed uniformly and that expectations were appropriately managed, particularly in relation to the scope and limitations of the Project.

The FAQ sheet reflects the key topics raised during consultations and the corresponding responses provided by the Project team. It also serves to clarify issues that may fall outside the Project's mandate, thereby helping to avoid misunderstandings and unrealistic expectations among stakeholders.

The FAQ sheet is presented in Appendix N.

5.4. How Stakeholder Feedback Influenced Project Design, Impact Assessment and Mitigation

Stakeholder engagement conducted during the ESIA process played an important role in informing the refinement of the project design and mitigation measures. Consultations with affected communities, local authorities, traditional leaders, and other stakeholders provided valuable insights into local concerns related to resettlement, access to livelihoods, flooding, community safety, and the protection of cultural and social assets.

Feedback received through public meetings, FGDs, KIIs, and community consultations was reviewed by the project team and communicated to the design team where relevant. In several cases, stakeholder concerns resulted in adjustments to project design elements, the incorporation of additional mitigation measures, or the strengthening of social safeguards and management plans.

In particular, community concerns regarding potential displacement, encroachment risks, and disruption to livelihoods contributed to the refinement of project components and the development of mitigation measures aimed at reducing adverse impacts on households and community resources. Similarly, concerns raised regarding access to community facilities, and traffic safety, informed the inclusion of additional safeguards within the project's ESMP and the preparation of the RAP.

Table 5-11 provides examples of how stakeholder feedback was considered during project development and how it influenced project design and management measures.

Table 5-11 Examples of stakeholder feedback influencing project design

Stakeholder concern raised during consultation	Project response / design adjustment	Reference
Fear of resettlement and loss of structures and homes due to project interventions	Refinement of project footprint and integration of resettlement planning through the preparation of a RAP in accordance with ESS5, including compensation and livelihood restoration measures. More details are presented in Section 4.	• ESIA Volume IV: o Section 9.2, Table 9-5, Impact category no.16 o Section 9.4.3.2 (Impacts on livelihoods) o Section 10.3.3 • ESMP, Section 4, Table 4-1, Mitigation category no. 16 • RAP
Concerns about encroachment and flooding in wetland areas	Inclusion of perimeter drainage channels and improved drainage design to control water flow and reduce encroachment into protected areas.	• Project Preliminary Design Documents
Concerns about disruption to informal livelihood activities (e.g., vending, fishing, fish drying areas)	Identification of livelihood impacts and development of livelihood restoration measures under the RAP.	• ESIA Volume IV: o Section 9.2, Table 9-5, Impact category no.16 o Section 9.4.3.2 (Impacts on livelihoods) o Section 10.3.3 • ESMP, Section 4, Table 4-1, Mitigation category no. 16 • RAP

Concerns regarding community safety and traffic risks during construction	Inclusion of traffic management measures and community safety provisions within the ESMP.	• ESIA Volume IV, Section 9.2, Table 9-5, Impact categories no. 9 and 19. • ESMP, Section 4, Table 4-1, Mitigation categories no. 9 and 19.

5.5. Grievance Redress Mechanism

A Grievance Redress Mehcanism (GRM) was developed for this project by the PMU. It is presented in Appendix D.

The GRM follows a clear, step-by-step procedure for handling complaints from lodging to close-out and appeals for unresolved cases. .

The GRM operates through two levels, with Community-Level GRCs as the first point of contact for local intake and resolution and the PMU-Level GRC handling escalated or complex complaints and reporting, while the Project Steering Committee serves as the final internal escalation point.Grievances are tracked through a central register and regularly monitored The GRM provides for key monitoring indicators.

6. Baseline Conditions: The Physical Environment

This section provides a detailed description of the baseline conditions of the physical environment within the project area. It covers key aspects such as topography, geology, climate and meteorology, water resources, soil, sediment, air quality, ambient noise levels, and visual amenity. The baseline conditions for each of these components are detailed in the following subsections.

Establishing a clear understanding of the existing physical environment is critical for accurately assessing the potential environmental impacts associated with the development of the Project. This baseline serves as a reference point for identifying and evaluating changes that may result from project activities.

6.1. Source of Baseline Data

The assessment of the physical environment's existing conditions is based on a comprehensive review of available data, including aerial photography, topographic maps, public databases, published literature, and previous studies conducted in the project area. This initial review is supplemented by field surveys, sampling, and monitoring activities that are then analyzed to support the preperation of a complete ESIA Report ensuring that the baseline conditions are thoroughly documented and understood, and providing a solid foundation for assessing potential environmental impacts.

A field survey was conducted between November 29 and 31, 2025. The survey included sampling of surface water, groundwater and soil and sediments and monitoring of air quality and noise levels. The environmental data collection locations, presented in Figure 6-1 and further described in the following sub-sections, covered the wetlands, exisitng drains, rivers and ocean sides as well as exisiting roads and sensitve receptors.

Additional data sets were used for the assessment of the baseline conditions of the physical environment of the project; these include:

- Data collected during the Project Brief phase of the Project in October 2025, for water quality, air quality and noise levels.
- Data collected from the Monrovia Breweries Inc. (MBI) meteorological station between 2019 and 2025.

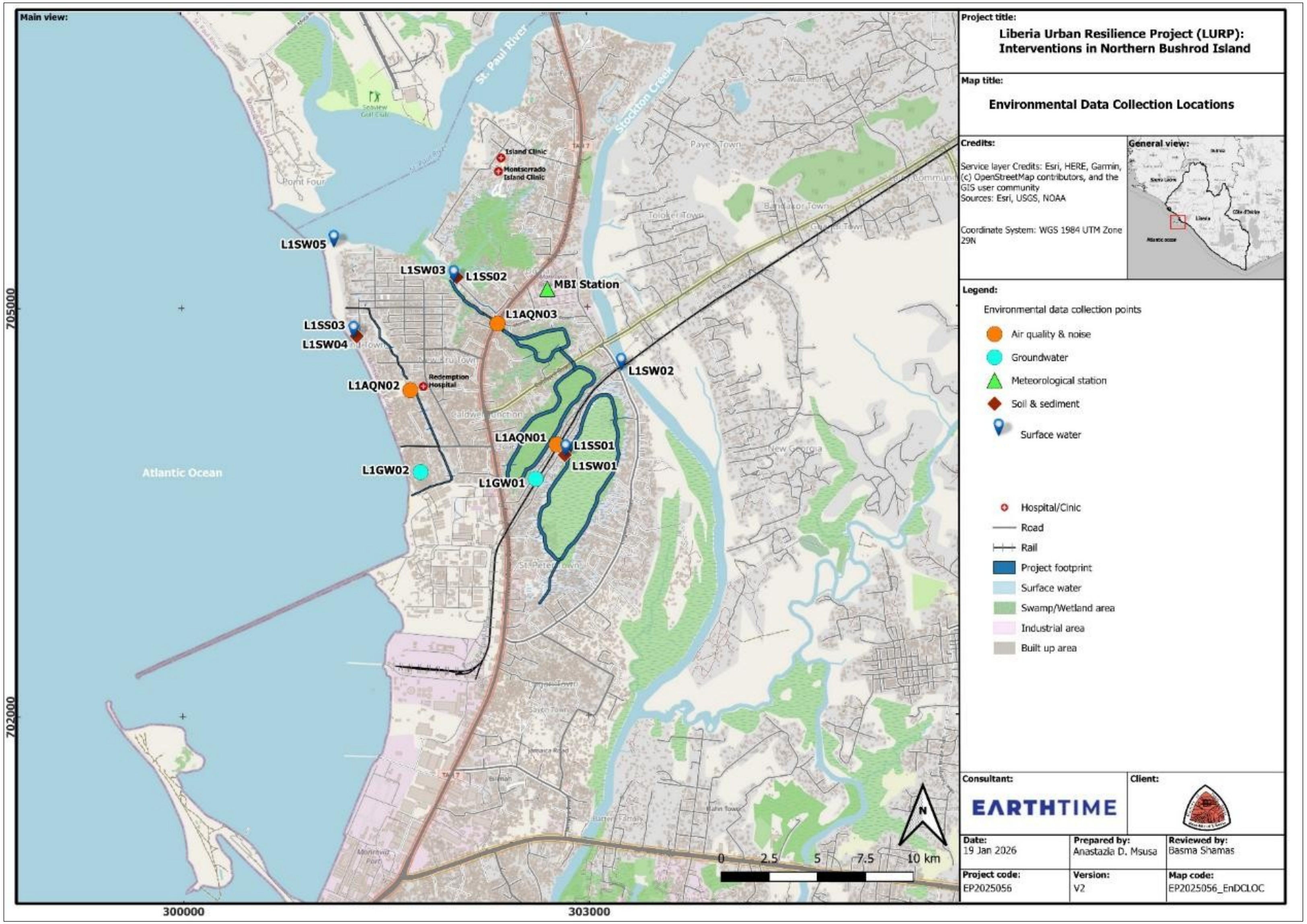

Figure 6-1

Environnemental data collection locations18

6.2. Topography

Liberia can be divided into three distinct topographical areas. First, a flat coastal plain which extends up to 80 kilometers (km) inland, with creeks, lagoons, and mangrove swamps; second, an area of broken, forested hills with altitudes from 180–370 meters (m), which covers most of the country; and third, an area of mountains in the northern highlands, with elevations reaching 1,384 m.

The Project site is located within the coastal plain zone. It is one of the flattest and lowest lying regions of Liberia, dominated by tidal influences from the Atlantic Ocean, and fluvial discharges from the St. Paul River, Mesurado River, and Stockton Creek network, making it the most flood prone areas in Greater Monrovia. The elevation on site ranges between 0 and 6 m above sealevel (asl). The landscape is a mix of flat reclaimed land, natural low wetland areas and small elevated reliefs, mainly towards the center of the site around New Kru town and Duala Market areas. The eastern and north eastern side of the Project area includes patched wetlands that form natural stormwater retention zones, however, urban encroachment, unplanned expansions and wastre accumulation have altered drainage patterns, reduced storage capacity and impeded natural flow.

6.3. Geology

Geological investigations in Liberia have shown that nearly all of the terrain is underlain by Precambrian crystalline metamorphic rocks which form part of the West Africa shield known as the Guinea Shield. The rocks forming this crystalline shield consist of granite, gneiss, and schist beds which have resulted from metamorphism by tectonic forces acting on a regional scale. The structural features of the rocks in this region are uniform over relatively large areas. Gneissic structure and schistosity dip at high angles in most places and are often vertical.

Generally, geologic information is limited and mostly available from the 1:250,000 geological maps of Liberia. The Liberian coastline that has been shaped by processes dating back to the Pan-African orogeny (550 million years ago), which influenced the rifting of the West African margin during the Mesozoic era. This geological history has influenced the formation of various coastal features, including swash-aligned barrier beaches, enclosed lagoons, prograded beach ridge plains, and rocky headlands (Anthony, 1991; Bird, 2010).

The project site lies within Liberia's coastal sedimentary basins (Appendix A). This coastal zone is composed of Quaternary sediments including beach sands, lagoonal deposits, fluvial silts, clay-rich mangrove soils, and deltaic materials. The Monrovian coastline is predominantly straight, sandy and wave-dominated with a steep beach profile and coarse sediments typical of a reflective shoreline. It is mainly subject to long period swell waves which induce an alongshore sediment transport along the coast. Further inland and along the coast, fluvial and deltaic deposits of buff silt and sand, including beach sands, overlay a landscape of very low relief. Lagoonal and deltaic zones contain finer silts and clays, often capped by recent sand layers, indicating ongoing sedimentation processes that shape the island's geomorphology.

6.4. Seismicity and Landslides

Earthquake hazard in Liberia is classified as very low by the Global Facility for Disaster Reduction and Recovery. This means that the chance of potentially damaging earthquakes in the Project area is less than two percent in the coming 50 years (Global Facility for Disaster Reduction and Recovery, 2020). The last inland earthquake in Liberia occurred in 1995. It had a 4.5 magnitude on the short period body wave type (mb) and a 10 km depth, and the epicenter was located around 16 km south-east of Tubmanburg, Bomi County (United States Geological Survey, 2025). The closest seismic active zone to Liberia is the Mid-Atlantic ridge, but it poses no major threat because of its distance from the Liberian shore.

Landslide potential across the project area is classified as low by the Global Facility for Disaster Reduction and Recovery. This means that the combination of rainfall patterns, geology and soil types, landcover, topography and seismic risk in the area make the landslide risk an uncommon hazard phenomenon. However, it is difficult to predict the impact of climate change on the parameters affecting the potential for landslides, especially alteration in slop and bedrock stability due to changes in rainfall and temperature patterns. Thus, it is important to plan project activities, designs, and construction methods by considering the potential for landslides (Global Facility for Disaster Reduction and Recovery, 2020).

6.5. Meteorological Conditions

Meteorological parameters including rain, temperature, humidity and wind direction and speed, are directly related to different aspects of the Project as they can influence factors like construction schedules, environmental management and design efficiency. Thus, obtaining meteorological data is necessary for understanding the environmental conditions in the project area and to adequately and comprehensively assess environmental impacts.

The baseline meteorological conditions for the project site will be assessed using general historical climatological conditions of Liberia obtained from public literature, as well as meteorological data obtained from the MBI weather station (Figure 6-1); a Vantage Pro2 Plus meteorological station installed at MBI on the northeastern side of Bushrod Island (UTM 29 N 705132 m; E 302704 m).

6.5.1. Liberia's Climate

Liberia has a predominantly tropical climate influenced by its equatorial position and the distribution of low and high-pressure belts along the African continent and the Atlantic Ocean (Food and Agriculture Organization of the United Nations, 2005). The coastal regions feature equatorial characteristics with high humidity and consistent rainfall throughout the year, while the inland areas experience a tropical monsoon climate with distinct wet and dry seasons (Peel et al., 2007). A heavy rainy season occurs between April and October, while the period from November to March is relatively dry. Rainfall patterns are influenced by the movement of the Inter-Tropical Convergence Zone, which changes location on an annual cycle. Precipitation is not homogeneous across counties or seasons. Furthermore, variation in topography affects rainfall distribution, contributing to localized differences.

6.5.2. Meteorological Conditions in the Project Area

The most recent and available data for the project area was collected between January 2019 and October 2025 at the MBI meteorological station in Bushrod Island (Figure 6-1) .The data collected is based on 30-minute average recording intervals.

6.5.2.1. Rain

The MBI station provided a full set of rainfall data for the period between May 2019 and December 2022 and then from January to October 2025. Rain data between January 2023 and July 2024 were not recorded and thus are not reflected in the assessment.

Average annual rainfall recorded at the MBI Station is approximately 3,407 mm (Figure 6-2), reflecting the high-rainfall tropical coastal climate typical of the Liberian coast and Monrovia.

The highest rainfall is recorded in the months between June and September and the lowest rainfall months are December to March which typically represents the season fluctations (Figure 6-3).

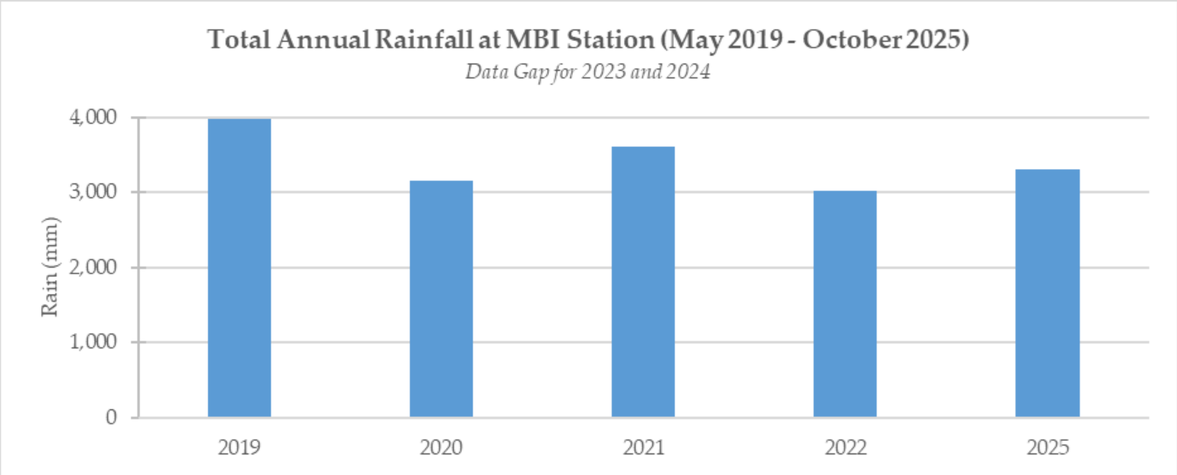

Figure 6-2 Total annual rainfall at MBI Weather Station between May 2019 and October 2025

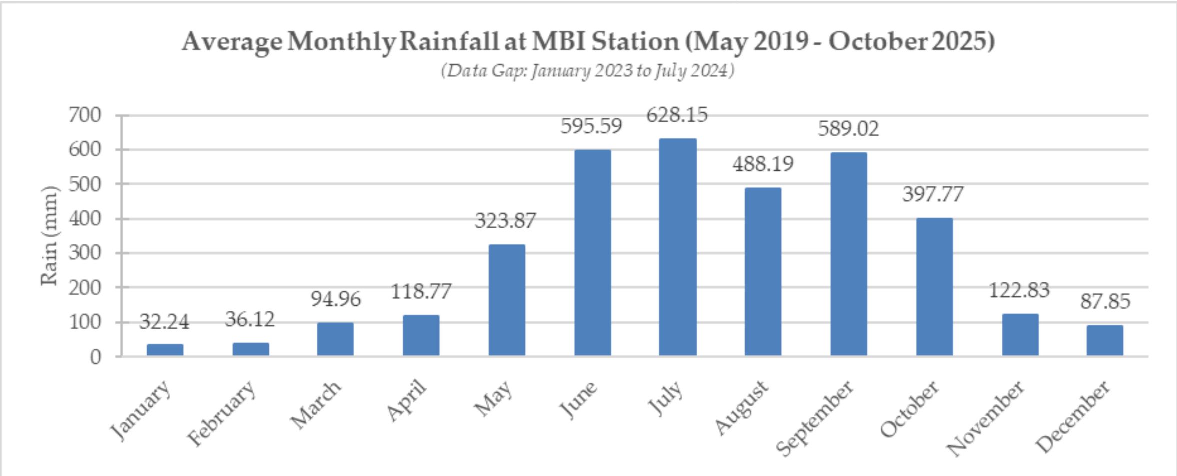

Figure 6-3 Average monthly rainfall at MBI Weather Station between May 2019 and October 2025

6.5.2.2. Temperature

The temperature data collected between May 2019 and October 2025 (Figure 6-4) indicate typical tropical climate patterns, with warm temperatures year-round and slight seasonal variation. Average monthly temperatures ranged betrween 25 and 28°C. Minimum temperatures remain relatively stable between 22 and 23°C, while maximum temperatures vary between 30 and 33°C, peaking in December and January. The warmest period corresponds to the dry season, when reduced cloud cover increases solar radiation, potentially enhancing the formation and dispersion of atmospheric pollutants from traffic and urban activitis. Lower temperatures are observed between June and August, coinciding with the rainy season and higher humidity, which generally suppress dust emissions but may limit pollutant dispersion.

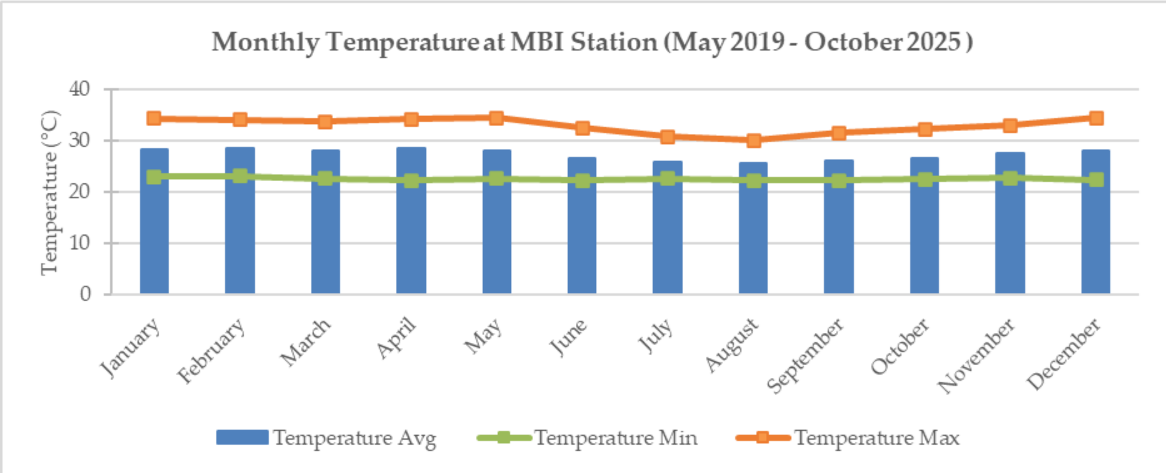

Figure 6-4 Monthly temperature collected at MBI station from May 2019 to October 2025

6.5.2.3. Humidity

Monitoring data (Figure 6-5) indicate high relative humidity throughout the year, with average monthly values ranging from approximately 75% during the drier months (JanuaryFebruary) to over 90% during the peak rainy season (July-September). Maximum humidity frequently approaches 98-99%, reflecting the strong maritime influence and proximity to wetlands and coastal waters.

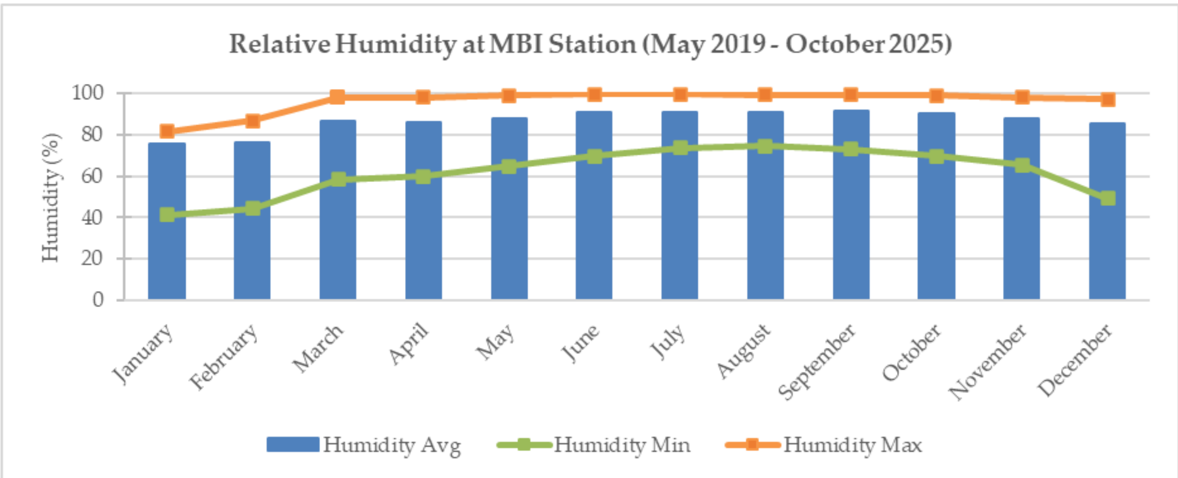

Figure 6-5 Monthly humidity collected at MBI station from May 2019 to October 2025

6.5.2.4. Wind

6.5.2.4.1. Wind Speed

Average wind speed recorded at MBI station (Figure 6-6) ranges between 1.28 m/s and 1.9 m/s with average peaks reaching 4.32 m/s (Figure 6-7). Wind conditions are relatively calm and show limited seasonal variability throughout the year. Slightly higher average wind speeds are observed during the late dry to early wet season (March to April), coinciding with increased atmospheric instability and transitional weather conditions.

Although extreme wind events are infrequent, short-duration higher wind speeds may increase the dispersion of air pollutants and contribute to localized dust resuspension, particularly along open drainage corridors and construction areas.

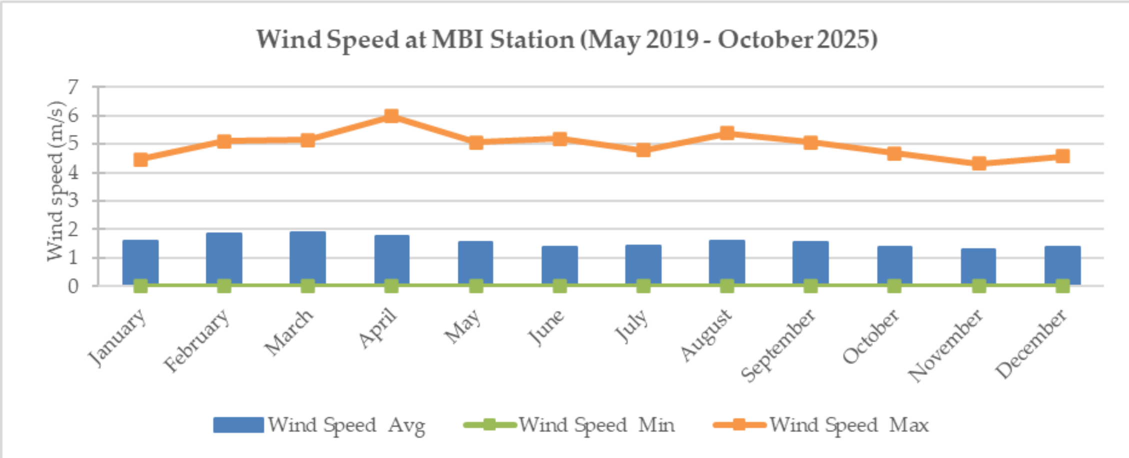

Figure 6-6 Average wind speed collected at MBI station 2019-2025

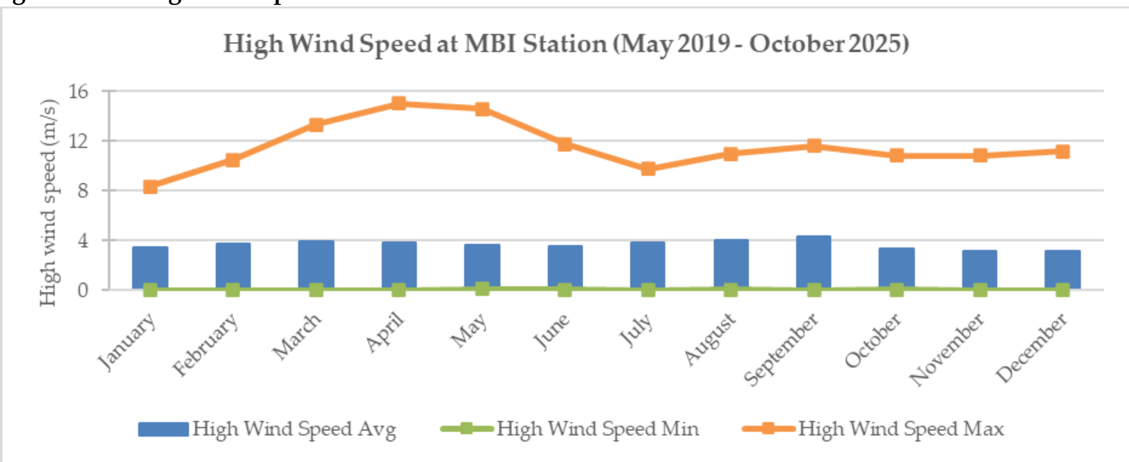

Figure 6-7 Average high wind speed collected at MBI station 2019-2025

6.5.2.4.2. Wind Direction

The dominant wind direction recorded at MBI station generally corresponds to winds blowing from the west-south-west zone throughout the year reflecting the prevailing ocean influence from Atlantic Ocean.

A secondary dominant wind direction coming from thesouth-south-east is observed mainly between July and September, corresponding to the wet season when moist monsoonal flows prevail. In contrast, winds blowing from the north-east are more frequent between November and January, associated with the Harmattan period characterized by drier continental air masses (Appendix B).

6.6. Water Resources

6.6.1. Overview

Liberia has abundant water resources, with one of the highest per capita water availabilities in Sub-Saharan Africa. Surface water is distributed across 600,000 hectares of wetlands and 15 principal river basins, most of which flow in a northeast-to-southwest direction into the Atlantic Ocean. Despite the abundant rainfall and dense network of rivers, water infrastructure remains underdeveloped, and hydrological data is limited (United States Agency for International Development, 2021). Groundwater is considered the primary source of water for drinking, cooking, cleaning and sanitary use. Communities largely rely on wells with hand pumps or shallow, hand-dug wells, many of which are vulnerable to contamination from rural runoff and pose significant health risks. Moreover, local communities use local creeks for livelihood activities such as fishing as well as washing and bathing and sometimes also drinking.

6.6.2. Hydrological and Hydrogeological Settings

The project area lies within a complex hydrological system including a network of rivers, tidal creeks, wetlands and estuarines that shape the physical and environmental conditions of Bushrod Island. The island is positioned between three major water bodies:

- **The Atlantic Ocean to the west**, influencing Bushrod Island through tidal movements and salt-water intrusions and exerting backflow pressure during high tides and storm surges.
- **The St. Paul River to the north**, which is one of Liberia’s major rivers, originating in southeastern Guinea. The river enters Liberia about 50 km north of Gbarnga and crosses Liberia in a southwesterly direction, before discharging into the Atlantic Ocean at Cap Mesurado north of Bushrod Island, where it forms a tidal estuary affected by daily saline intrusion.
- **The Mesurado River and wetland system to the south**, locally known as Du-River. It has a total length of about 25 km and flows through the capital city of Monrovia, into the Atlantic Ocean, south of Bushrod Island. It is considered to be Liberia's most polluted river, with pollution sources including waste dumping, sewage discharge, and blast fishing, which introduces nitrates and alkaline compounds.

The Mesurado River and Estuary is linked to the St. Paul River through Stockton Creek, which defines the eastern border of Bushrod Island. It is approximately 1.5 km long and generally extends in a north-to-south direction.

The hydrological regime is dominated by tidal fluctuations, intense rainfall, and restricted drainage capacity, which together contribute to recurrent flooding. Wetlands, low-lying depressions, and man-made channels form the primary pathways for stormwater movement across the island. During high tides and storm surges, oceanic pressure blocks drainage outfalls, forcing seawater inland and prolonging inundation (CDR International & Earthtime Inc., 2025; Earthtime Inc. & CDR International, 2019).

The hydrogeological setting of Northern Bushrod Island is shaped by its coastal geomorphology, young unconsolidated sediments, and extensive wetland systems associated with both the Atlantic Ocean and the St. Paul River and Mesurado River estuaries.

Quaternary deposits in the area, including beach, lagoonal, fluvial, and deltaic deposits, can serve as good aquifers for shallow wells. Groundwater depth in Monrovia ranges from 1.5 m in the rainy season to 2.5 m in the dry season, with heavy rainfall being the main source of recharge for the unconsolidated sediments. During the peak of the wet season, aquifer discharge can reach up to 30-40 mm per day, and many people use shallow wells to access this water (Earthtime Inc., 2015).

Hydrological behavior is the project area is also affected by tidal variations and saltwater intrusion from its proximity to the Atlantic Ocean and to brackish systems such as the St. Paul estuary and the Mesurado River and Estuary. Groundwater quality is further affected by the high organic content of surrounding wetlands. Groundwater can also be contaminated by infiltration from open drains, solid-waste dumpsites, and poorly managed pit latrines, resulting in deterioration of water quality.

6.6.3. Field Baseline Data Collection

Two rounds of water sampling were conducted for this Project, one preliminary round on 2 October, 2025 and another more extensive round between October 29 and 31, 2025.

6.6.3.1. Sampling Methodology

Water samples were collected using sterile bottles, following standard operating procedures to prevent contamination. Samples were stored in cool, dark conditions and transported to the laboratory under a strict chain of custody. The detailed sampling methodology and photographic documentation of sampling activities are presented in Appendix C.1 and C.2.

6.6.3.2. Sampling Locations

Water sampling locations (Figure 6-1 and Table 6-1) were selected to ensure comprehensive coverage of the study area, including sampling the wetlands areas, exisitng drains, rivers and ocean sides, and groundwater (Figure 6-8). This approach helps capture variations in water quality across different hydrological conditions and potential sources of contamination.

Table 6-1 Water sampling details

Site ID	Sampling Date	Coordinates (WGS84 UTM29N)		Sample Type	Description of Location
		Northing	Easting		
L1SW01	30/10/2025	703909	302839	Surface Water - Swampy Area	Wetland area south-east of the project area
L1SW02	30/10/2025	704542	303253	Surface Water - Stockton Creek	Outfall of drainage into Stockton Creek near Bong Mines Railway bridge
L1SW03	29/10/2025	705191	302017	Surface Water - St. Paul wetland area	Wetland area receiving drainage outfall near Saint Paul River

L1SW04	29/10/2025	704784	301275	Surface water - Atlantic Ocean	Outfall of drainage from New Kru town beach into the ocean
L1SW05	29/10/2025	705452	301131	Surface Water – St. Paul estuary	Mouth of St. Paul River
L1GW01	30/10/2025	703737	302613	Groundwater	Hand pump near Bon Mine railway area and Swampy area – Not used for drinking
L1GW02	30/10/2025	703790	301763	Groundwater	Hand pump in New Kru Town – used for drinking, last chlorinated in 2024


L1SW03 L1GW01

Figure 6-8 Photographs of water sample collection

6.6.4. Sampling Results

Surface water quality results and groundwater quality results, along with standard values, are presented in Appendices C.3 and C.4. The laboratory report is included in Appendix D.

The surface water tested in the project area includes drainge discharges, swampy areas, rivers and ocean waters which are not used for drinking, Thus test results for surface water samples are compared to the following three local water quality standards:

- Liberian primary water quality standards for Class-II waters (Environmental Protection Agency of Liberia, 2009b).
- Standards for effluent discharged into the environment (Environmental Protection Agency of Liberia, 2024).
- Liberian Water Quality Standards Class II: Natural and cultivated fisheries, public bathing places, recreational water sports (Ministry of Health and Social Welfare, 1987).

Test results for groundwater samples are compared to two drinking and domestic local water quality standards and one international drinking water guidelines; these are:

- Liberian water quality standards for domestic water (Environmental Protection Agency of Liberia, 2018).

- Liberian water quality standards Class I: Drinking water; water supply for industry requiring drinking water (Ministry of Health and Social Welfare, 1987).
- The World Health Organization Guidelines for Drinking Water quality (World Health Organization, 2022).

In surface water samples, several exceedances of the relevant standards were recorded across multiple sampled locations and parameters (Appendix C.3). Key observations are presented and discussed as follows:

- **Dissolved Oxygen (DO):** DO concentrations at L1SW01–L1SW03 were very low and below the Environmental Protection Agency (EPA) Class II standards, indicating oxygen-depleted conditions that are not conducive to sustaining aquatic biodiversity. These low values are consistent with stagnant waters and high organic loading from surrounding settlements and drainage discharges. In contrast, estuarine/coastal sites (L1SW04 and L1SW05) showed high DO levels, which reflect tidal flushing and stronger river mixing that maintain suitable oxygen conditions despite evidence of organic inputs.
- **Phosphate**: Similar to DO, phosphate concentrations at L1SW01–L1SW03 exceeded Ministry of Health (MoH) guidelines, indicating elevated nutrient and organic matter inputs likely associated with wastewater and drainage discharges.
- **Biological oxygen demand (BOD) and chemical oxygen demand (COD)**: BOD at L1SW04 slightly exceeded the EPA effluent guideline standard. COD values at L1SW01 and L1SW04 exceeded the EPA effluent standard. These results confirm a high organic, and chemical contaminants load consistent with wastewater inputs, decomposing vegetation, solid waste leachate and urban runoff.
- **Salinity-related parameters**: Elevated chloride, sulphate, hardness and salinity values were recorded at L1SW04, consistent with marine influence and reflecting ocean water characteristics rather than anthropogenic pollution sources.
- **Turbidity and solids**: Higher turbidity, total suspended solids (TSS) and total dissolved solids (TDS) values were recorded at L1SW01, reflecting the swampy and stagnant nature of the wetland system, decomposing vegetation and organic loading from wastewater and waste discharges.
- **Metals**: Iron and manganese exceeded the MoH standards at L1SW01. Other metals (chromium, cobalt, copper, lead and zinc) were below standards but showed higher concentrations at L1SW01 compared to other sites, indicating potential contamination from wastewater discharge, runoff or localized fuel and oil sources (such as generators and vehicles). Boron showed higher concentrations at L1SW04, which is typical of ocean water.
- **Hydrocarbons**: Although no national standards exist for benzene, toluene, ethylbenzene, and xylenes (BTEX), extractable petroleum hydrocarbons (EPH, C6–C40), toluene and gasoline range organics (GRO), their detection at L1SW01 exceeds levels expected in uncontaminated surface waters. These compounds are clear indicators of petroleum and oil contamination from waste dumping, vehicle washing,

and discharge of oily residues to drainage networks. Their detection at L1SW01 only could suggest a localized contamination source and is also consistent with stagnant conditions where contaminants accumulate rather than disperse or dilute.

In groundwater, the majority of parameter concentrations were within the above-mentioned relevant standards (Appendix C.4), with the following notable exceedances and observations:

- **Iron** concentrations were elevated, likely reflecting the naturally iron-rich soils and bedrock characteristic of the Liberian geology.
- **Nitrate** concentrations at L1GW02 exceeded all guideline values, indicating contamination from sewage or domestic wastewater infiltration into shallow groundwater. Elevated nitrite and phosphate concentrations at this same location further support ongoing microbial breakdown of nitrogen-rich waste and confirm contamination from sanitation sources.
- **TSS** exceed applicable limits at L1GW01 which aligns with field observations of swampy contamination conditions. The elevated TSS is likely driven by limited water circulation, decaying vegetation, and organic waste accumulation within nearby wetland areas.
- **Cyanide** concentrations slightly exceeded MoH guideline at L1GW02. Cyanide might occur in drinking water at concentrations well below those of health concern (World Health Organization, 2022), and could be due to localized anthropogenic contamination such as improper waste disposal.
- **Aluminum** exceeded the EPA standards at L1GW01, which may reflect both natural and anthropogenic influences. Aluminum is known to mobilize under organic-rich, low-oxygen wetland conditions due to prolonged water–sediment interactions.
- **Sodium** exceeded EPA limits at L1GW01, which may showcase the influence of saline groundwater inputs from coastal processes.

Overall, the surface water and groundwater sampling results indicate that water quality in the project area is strongly influenced by both natural processes and anthropogenic activities. Surface waters at inland swamp and drainage-influenced locations (L1SW01–L1SW03) show clear evidence of organic pollution, nutrient enrichment, low oxygen conditions, and localized petroleum hydrocarbon contamination consistent with domestic wastewater inputs, solid waste disposal, and stagnant hydrological conditions. Estuarine/coastal sites (L1SW04–L1SW05) exhibited marine signature, such as elevated salinity parameters and boron, and generally more favorable oxygen conditions driven by tidal mixing and flushing. Groundwater quality was comparatively better, with most parameters within applicable standards; however, exceedances of nitrates, nitrites, phosphates, ammoniacal nitrogen, and TSS at select locations indicate localized contamination from sewage infiltration and wetland organic loading. Elevated iron and aluminium likely reflect natural geochemical conditions, while sodium exceedances suggest possible saline intrusion. These combined results highlight the influence of inadequate wastewater management, waste disposal practices, and coastal processes on local water resources, underscoring the need for improved sanitation infrastructure, waste management, and groundwater protection measures in the surrounding area.

6.7. Soil and Sediment Quality

6.7.1. Overview

Liberia features three main soil groups, ferralsols or latosols, lithosols or leptosols, and regosols (coastal and alluvial sands), with occasional local variations (Table 6-2) (Ministry of Agriculture Liberia, 2007).

Soils in Liberia were largely formed through extensive mechanical and chemical weathering of the underlying geological formations. The humid tropical climate and the severe erosion and weathering processes, including frequent flooding and tidal influence, have caused extensive leaching of the soil profiles, leading to generally infertile soils with clay-rich compositions that hold minimal nutrients and strong interaction with surface water and groundwater systems. In some locations, prolonged waterlogging creates reducing conditions, which can mobilize naturally occurring metals such as iron and manganese from soils into pore water and adjacent surface.

In the Project area, soils, mainly regosols and alluvial soils, are predominantly composed of young unconsolidated alluvial, marine, and lagoonal sediments, including sands, silts, clays, and organic-rich materials associated with wetlands and tidal flats. These deposits are characterized by high moisture content, low structural strength, and variable organic matter, particularly in swampy and poorly drained zones.

Urbanization and human activities in Northern Bushrod Island further influence soil quality. Urban encroachement, unplanned expansions, unlined drains, poor sanitation infrastructure, and limited solid waste management contribute to localized soil and sediment contamination, particularly near drainage channels, wetlands, and coastal margins.

Table 6-2 Type of soils in Liberia (adapted from Ministry of Agriculture Liberia, 2007)

Soil type	Liberian classification	Area	Properties
Lateritic soils or latosols	Kakata, Suakoko and Voinjama Series	75%	Reddish brown, leached 10 cm topsoil, 4–6 % organic matter , acidic, well-drained, productive agricultural soils
Regosols or coastal sandy soils	Claratown, Sinkor and Freeport Series	20%	Well-drained, 60% coarse sand, very low water holding capacity, low humus and few mineral nutrients, not productive agricultural soil
Alluvial soils or swamp soils	Gbelle, Ballam, Grayzohn and Cuttington Series	5%	Waterlogged, gray hydromorphic soils, poorly draining, thick dark layer of loamy-peaty organic material with relatively high humus content

6.7.2. Field Baseline Data Collection

6.7.2.1. Sampling Methodology

Soil samples were collected using an auger or shovel, with topsoil removed to obtain material from below 20 centimeters (cm) depth. Multiple cores were combined for homogeneity where needed, and all samples were placed in pre-labeled sterile containers. Samples were immediately stored in a cool, dark environment and transported under chain-of-custody protocols to maintain sample integrity. The detailed sampling methodology is presented in Appendix E.1. Sampling photos are provided in Appendix E.2.

6.7.2.2. Sampling Locations

To establish a baseline for soil conditions in the project area, soil sampling was carried out at three locations as detailed in Table 6-3. The sample locations (Figure 6-1, Figure 6-9) were selected to cover several types of environment in the project area, including wetlands, coastal and estuarine environments.

Table 6-3 Details of soil and sediment sampling locations

Sample ID	Date	Coordinates (WGS84 UTM29N)		Sample Type	Description of Location
		Northing	Easting		
L1SS01	30/10/2025	703913	302829	Soil	Swampy area, from the wetlands south-east of the project area, near Bong Mines Railway bridge
L1SS02	30/10/2025	705221	302034	Soil	At the bank of the St. Paul Wetland area
L1SS03	29/10/2025	704790	301294	Beach sediment	Beach sand, near drainage exiting New Kru Town into the ocean

L1SS01

Figure 6-9 Photographs of soil and sediment sample collection

6.7.3. Sampling Results

Soil and sediment samples were tested for parameters covering both general quality indicators, such as color, moisture content, pH, and mineral composition, as well as potential contaminants, including heavy metals and petroleum hydrocarbons. The full list of tested parameters and the results are presented in Appendix E.3. The original laboratory report is presented in Appendix D.

In the absence of a definitive Liberian standard for soil and sediment quality, the test results were interpreted using the following reference guidelines.

- The Dutch Intervention Values for Soil (Ministerie van Volkshuisvesting - Ruimtelijke Ordening en Milieu (VROM), 2013).
- The United States EPA (US EPA) regional screening levels (United States Environmental Protection Agency, 2024)

It is important to note that guidelines and standards in any country are based on a number of factors regarding both ecological and human health risks in that country, and that they do not necessarily apply equally well elsewhere. In addition, the testing methodology can give varying results on account of the ways in which different chemical tests extract different fractions of elements and compounds within the soil. For these reasons it is necessary to use professional judgement in interpreting soil analyses.

The soil sample results (Appendix E.3) were all in compliance with the above-mentioned standards with the exception of phosphorus, which exceeded the US EPA regional screening levels at all tested locations. These exceedances can be attributed to multiple factors, including the discharge and dumping of wastewater and solid waste in the surrounding areas, as well as the swampy and organic-rich nature of the terrain, which promotes the generation and accumulation of phosphorus., and the decomposition of organic waste and vegetation that releases phosphorus into the soil profile.

It is worth noting that soil chemical characteristics varied across locations. L1SS01, collected from a swampy wetland area, showed the highest moisture content (44%), organic matter (8.91%), and cation exchange capacity (CEC) confirming waterlogged conditions and organic accumulation. The site also exhibited higher alkalinity and the highest phosphorous concentrations, which are consistent with stagnant wetland environments receiving organic inputs. In contrast, L1SS02 and L1SS03 displayed lower organic matter, lower moisture, and reduced CEC (CEC <2 meq/100g), indicating poor nutrient retention and limited soil fertility typical of sandy or disturbed urban soil.

The heavy metals such as iron, aluminium, and magnesium were detected in the samples, but their concentrations were within acceptable limits. These levels are likely due to the natural composition of the area's rocks.

Additionally, and although below the standard levels, zinc and volatile organic compounds (VOCs) were detected in higher concentrations at L1SS01, which in line with the water quality results confirms a more localized petroleum hydrocarbon contamination consistent with domestic wastewater inputs, solid waste disposal, and stagnant hydrological conditions.

6.8. Air Quality

6.8.1. Overview

Northern Bushrod Island is a densely populated urban area characterized by intense commercial activity, industrial operations, and continuous vehicle movement. The flat coastal terrain and high humidity further influence pollutant dispersion. Air emissions levels in the project area are therefore influenced by a combination of mobile, stationary, and communitygenerated sources.

The primary sources of air emissions in and around the site include:

- **Vehicular traffic**: including dust and exhaust emissions from roads. Vehicle exhaust contains VOCs, nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO) released from tailpipes during vehicle operation. Roads such as UN Drive, Jamaica Road, Logan Town Road, and Somalia Drive experience heavy traffic from cars, minibuses, motorcycles, and trucks transporting goods to and from the Freeport of Monrovia. Traffic congestion, especially around Duala Market and New Kru Town, contributes to localized pollution hotspots.

- **Fugitive dust**: Resuspension of fine particles due to vehicle movement, particularly along bad road conditions, markets, densely populated areas and nearby construction.

- **Port-related activities at the Freeport of Monrovia**, including ship operations and vehicle movements, contribute to local air pollution. Emissions arise from vessel engines and trucks transporting goods to and from the port, releasing NO_x, sulfur dioxide (SO_2), CO, VOCs, and particulates.

- The **Liberia Electricity Corporation power generation facility**, located on Bushrod Island, represents a major stationary source of emissions in the wider area. The combustion of heavy fuel oil for electricity production releases NO_x, sulfur oxides (SO_x), PM, and CO, which can disperse over nearby communities, particularly under low wind conditions.

- **Occasional open burning of municipal solid waste** also releases gaseous pollutants such as NO_x, CO_2, SO_x, PM, methane (CH_4), ammonia, dioxins/furans, VOCs, and polycyclic aromatic hydrocarbons (PAHs).

- **Combustion from industries** such as cement factories, welding and paint workshops, grain processing mills, and others, release pollutants such as SO_2 and NO_x from fuel combustion, particulate matter from cement and grain processing, and VOCs from industrial solvents, paints, and oils.

- **Natural and seasonal factors** such as the Harmattan wind originating from the Sahara Desert during the dry season contribute additional fine dust particles, while high humidity during the wet season helps to suppress dust levels but can prolong the atmospheric persistence of gaseous pollutants.

6.8.2. Field Baseline Data Collection

6.8.2.1. Monitoring Methodology

Air quality data was collected using an Aeroqual S500 portable multi-sensor gas monitor using the methodology described in Appendix F.1. The monitored parameters included nitrogen dioxide (NO_2), SO_2, CO, carbon dioxide (CO_2), VOCs, and CH_4, as well as particulate matter (PM_{10} and $PM_{2.5}$). Photographs of air quality monitoring activities are provided in Appendix F.2.

6.8.2.2. Monitoring Locations

To establish baseline air quality conditions before project initiation, air quality data was collected from three monitoring locations across Northern Bushrod Island (Figure 6-1, Table 6-4). These locations were selected to represent a range of environemental settings relevant to the project such as road corridor with heavy traffic and dust generation (intersection between UN drive road and Logantown road), sensitive receptors such as schools (D Tweh memorial High School) and health facilities (Redemption Hospital), high density market and commercial and residential areas.

Table 6-4 Air quality monitoring locations

Site ID	Coordinates (WGS84 UTM29N)		Description of Location	Activities During Monitoring Time	Weather Conditions
	Northing	Easting			
L1AQN01	703988	302770	Residential area along Bong Railway Road, close to the edge of wetland area, and to drainage line where intervention activities will occur	• Pedestrian movement • Children playing nearby • Women washing near drainage • Vehicles movement	• Cloudy and light rain • Wind speed: 3.0 m/s • Wind direction: NE to SW • Temperature: 29.8°C
L1AQN02	704391	301689	Near Redemption Hospital and D Tweh Memorial High school zone	• Student moving within D Tweh Campus • Market women nearby • High movement of motorbikes	• Sunny • Wind speed: 1.2 m/s • Wind direction: N to S • Temperature: 29.7°C
Site ID	**Coordinates (WGS84 UTM29N)**		**Description of Location**	**Activities During Monitoring Time**	**Weather Conditions**
	Northing	**Easting**			
L1AQN03	704879	302335	Intersection zone between UN Drive and Logan Town Road. Busy commercial and market area, near major drainage where intervention activities will occur.	• Presence of an economic center • Heavy traffic of motorcycles, buses, vehicles and trucks movement	• Cloudy and light rain • Wind speed: 1.6 m/s • Wind direction: N to S • Temperature: 32.8°C

				• Vendors and commercial activities	

6.8.3. Monitoring Results

Air quality monitoring resutls are presented in Appendix F.3 and are compared to the following guideline values used for interpretation of results

- The Liberian Ambient Air Quality tolerance limit (Environmental Protection Agency of Liberia, 2009a)
- The World Health Organization (WHO) Air Quality Guidelines (World Health Organization, 2021) adopted by the World Bank Environmental, Health and Safety Guidelines (EHSG).

6.8.3.1. Particulate Matter

Baseline particulate matter levels reflect the environmental pressures typical of a dense, highly urbanized, and commercially active area such as Northern Bushrod Island. PM_{10} concentrations ranged from 0.024 to 0.077 mg/m^3, while $PM_{2.5}$ ranged from 0.009 to 0.025 mg/m^3 across the three monitoring sites. Although these short-duration measurements cannot be directly compared to 24-hour WHO guideline values, the results illustrate the influence of road dust resuspension, heavy vehicular traffic, roadside commercial activity, deteriorated pavement surfaces, and informal waste burning particularly around New Kru Town, Duala Market, and Jamaica Road. Higher readings at L1AQN03 are consistent with observations of increased traffic density. The presence of informal dump sites, open drains, and unpaved road shoulders further contributes to fine particulate generation. It is worth noting that the particulate matter concentrations at L1AQN02 have increased from its previous values recorded during the Project Brief phase on October 2, 2025. This increase could indicate the effect of seasonal variations, moving from the end of the rainy season towards the dry season, which typically results in higher ambient dust levels due to reduced soil moisture and stronger resuspension of particles.

Overall, the particulate matter baseline indicates moderate dust loading consistent with the project area's urban and coastal conditions, serving as an important reference for assessing construction-related dust impacts and informing mitigation measures.

6.8.3.2. Gasesous Emissions

Baseline measurements of gaseous pollutants across the three monitoring locatoion indicate that ambient concentrations of combustion-related gases in Northern Bushrod Island remain within acceptable international health-based limits.

- **NO_2** levels ranged from 0.018 to 0.083 mg/m^3 which is way below both national and international guideline limits.

- **CO** concentrations were low (0.000–0.065 mg/m³), indicating minimal accumulation of incomplete combustion emissions.
- **SO_2** was undetectable at all sites.
- **CO_2** ranged between 583 and 752 mg/m³, consistent with typical urban background levels influenced by vehicular activity, commercial operations, and the use of small generators.
- **CH_4** concentrations (9.0–22.273 mg/m³) were noticeably elevated, even though relevant air quality standard are not available, particularly at L1AQN03, reflecting active decomposition of organic waste and stagnant wastewater, a known characteristic of the New Kru Town and Stockton Creek environments.
- **VOC** concentrations (1.482–1.845 mg/m³), although not comparable to any relevant air quality standard, also indicate the influence of local activities such as fuel handling, welding, paint shops, generator exhaust, and market operations.

6.9. Noise

6.9.1. Overview

Northern Bushrod Island is a densely populated urban area characterized by intense commercial and industrial activities and continuous vehicular traffic. Key contributors to exsting noise levels include:

- **Vehicular traffic**: Motorbikes, cars, trucks, and tankers, with higher traffic volumes in urban centers especially along UN drive, Jamaica road and Duala Market.
- **Local community activities**: local shops or small businesses, generators etc. contribute to periodic noise.
- **Urban noise**: Commercial and market activities particularly in New Kru Town and Duala Market where vendors, generators and crowd movement create continuous daytime noise.
- **Industrial facilities**: cement grinding, milling operations, welding workshops, paint shops etc. contribute to mechanical and operational noise.
- **Port operations at the Freeport of Monrovia**: including truck movements for cargo transport and mechanical noise generated by ships.

Given this, the project's baseline noise assessment aims to quantify ambient noise levels and evaluate potential project-related impacts.

6.9.2. Field Baseline Data Collection

6.9.2.1. Monitoring Methodology

Noise monitoring was perforemed using a Casella 63X digital sound level meter as per the methodology described in Appendix G.1. Photographs of noise monitoring activities are provided in Appendix G.2.

The recorded parameters used for the assessment of baseline noise included A-weighted equivalent continuous sound pressure level (LAeq), C-weighted peak sound level (LCpeak), and A-weighed statistical noise levels (LA10, LA50 and LA90).

6.9.2.2. Monitoring Locations

To establish current baseline conditions noise monitoring was conducted at three locations (Figure 6-1, Table 6-5) on November 29 and 30, 2025. The selected locations represent conditions within the project area, including dense residential zones, busy commercial corridors, and areas adjacent to drainage channels. The locations are strategically selected to represent different environmental settings and sensitive receptors such as hospitals, and schools.

Table 6-5 Noise monitoring locations, site descipritons, and activities during measurment period

Site ID	Coordinates (WGS84 UTM29N)		Description of Location	Activities During Monitoring Time	Weather Conditions
	Northing	Easting			
L1AQN01	703988	302770	Residential area along Bong Railway Road, close to the edge of wetland area, and to drainage line where intervention activities will occur.	• Pedestrian movement • Children playing nearby • Women washing near drainage • Vehicles movement	• Cloudy and light rain • Wind speed: 3.0 m/s • Wind direction: NE to SW • Temperature: 29.8°C
L1AQN02	704391	301689	Near Redemption Hospital and D Tweh Memorial High school zone.	• Student moving within D Tweh Campus • Market women nearby • High movement of motorbikes	• Sunny • Wind speed: 1.2 m/s • Wind direction: N to S • Temperature: 29.7°C
Site ID	**Coordinates (WGS84 UTM29N)**		**Description of Location**	**Activities During Monitoring Time**	**Weather Conditions**
	Northing	**Easting**			
L1AQN03	704879	302335	Intersection zone between UN Drive and Logan Town Road. Busy commercial and market area, near major drainage where intervention activities will occur.	• Presence of an economic center • Heavy traffic of motorcycles, buses, vehicles and trucks movement	• Cloudy and light rain • Wind speed: 1.6 m/s • Wind direction: N to S

				• Vendors and commercial activities	• Temperature: 32.8°C

6.9.3. Monitoring Results

Measured noise levels were assessed against the following standards:

- EPA Noise Pollution Control & Standards Regulation (Environmental Protection Agency of Liberia, 2017).
- World Bank Environmental, Health, and Safety Guidelines (EHSG) (World Health Organization, 1999)

These guidelines define maximum permissible noise limits based on the type of human activity (e.g., residential, industrial) and time of day (daytime vs. nighttime). The noise monitoring locations where categorized based on these definitions.

The recorded noise levels for each monitoring location along with the relevant EPA and World Bank EHSG limits are presented in Appendix G.3.

At all three locations, the LAeq values exceeded both the EPA daytime limits and the corresponding World Bank EHSG values, which shows that the general noise levels in the Project area during day time is elevated.

The analysis of statistical noise indicators (LA10, LA50, LA90) provides important insight into the noise environment:

- At L1AQN01, the recorded background noise (LA90) and median noise (LA50) were lower then the standards, while the LA10 value was higher then the standards, which indicates that elevated noise levels are primarily by intermittent traffic peaks caused by heavy vehicular traffic and not by general background noise and major human activities.
- At L1AQN02 and L1AQN03, all statistical noise indicators exceeded the standards, indicating that background noise, human activities and vehicular traffic are all actively contributing to the high noise levels in the area.

Overall, the elevated noise levels recorded across all locations reflect the combined influence of heavy vehicular traffic along UN Drive, Logantown Road, and market access routes, intense commercial activity around Duala Market and New Kru Town, the frequent use of megaphones and loudspeakers by street vendors, and dense residential settlements where households, street activities, and continuous community movement generate constant background noise. Baseline measurements indicate that Northern Bushrod Island functions as a high-noise urban environment, with ambient levels already exceeding applicable healthbased guideline thresholds prior to the commencement of any project-related construction activities. This reflects existing cumulative sources such as traffic, commercial activity, and dense settlement patterns.

6.10. Visual Amenity

6.10.1. Overview and Existing Visual Character

The project area is characterized by a dense and highly urbanized landscape shaped by mixed formal and informal residential settlements, comercial road corridors and light to medium industrial facilities.The land use primarily consists residential areas, roadside markets, industrial zones, community facilities, and transport infrastructure such as UN Drive and Jamaica Road. Wetland patches remain scattered across the island, most notably along the north eastern zone, forming part of the wider estuarine system. Key non-human natural features include the St. Paul River, Stockton Creek, tidal channels, mangroves, and coastal wetlands which together shape the island's low-lying topography and drainage patterns.

The existing visual character is defined by a combination of crowded street activity and congested built enviroment.The dominant colors and textures in the landscape include dark grey from buildings, paved surfaces, and port infrastructure; green vegetation associated with wetland and mangrove patches; and blue tones from water bodies along the St. Paul River mouth to the north, the Atlantic coastal fringe to the west, and Stockton Creek to the east, as well as smaller swampy depressions around the central corridor near Caldwell Road and the Bong Mines Railway.

Despite these natural visual elements, overall visual quality is reduced by multiple detractors including open waste dumps along drainage lines, informal housing encroaching into wetland and mangrove areas, unregulated roadside activities, and industrial facilities. Accumulated solid waste in drains and public spaces, limited vegetative buffers, and the density of informal settlements contribute to visual clutter and deterioration of the landscape. This has resulted in a visually degraded urban environment with low aesthetic value and limited opportunities for scenic vistas.

New Kru Town coastal view

Vegetation zone in New Kru Town

	
Logan Town	St. Paul River
	
Stockton Creek	Bong Mines Railway

Figure 6-10 General landscape of the project area in Northern Bushrod Island

6.10.2. Artificial Lighting

Artificial lighting at night, commonly referred to as light pollution, can result in a variety of environmental and social impacts. These include disruption of nocturnal ecosystems, interference with wildlife behavior, negative effects on human circadian rhythms, and a reduction in the visibility of the night sky.

Artificial lighting in the project area is largely provided by urban streetlights, residential lighting, and illumination from industrial facilities. Light pollution levels are moderate to high, reflecting the concentration of informal and formal settlements, and the presence of coastal and port-related activities. Areas with significant night-time illumination include town centers, major roads, community hubs, commercial zones.

The proposed interventions are not expected to result in any significant increase in artificial lighting. Construction activities are planned to occur during daytime hours, and no nighttime works are foreseen; therefore, no temporary construction lighting will be required. As such, the project will not contribute to short-term increases in illumination levels nor is it expected to cause disturbance to nearby communities or sensitive receptors.

6.10.3. Potential Visual Receptors

The communities most likely to be affected by visual changes include New Kru Town, Duala Market area, Logan Town and other residential cluster across Northern Bushrod Island. These are dense urban settlements where residents have direct views toward drainage channels, road corridors, shoreline areas, and zones designated for infrastructure upgrades.

Visual impacts will be influenced by localized vegetation clearing, temporary material storage, and the presence of machinery during construction. Works will occur during daytime only, and no night-time artificial lighting is planned, minimizing potential light-related disturbance. The most noticeable changes will occur in areas where construction activities and stockpiling are concentrated.

Other potential visual receptors include schools, health centers, religious institutions and small businesses situated near the intervention sites. While Northern Bushrod Island does not contain protected areas, it includes visually sensitive coastal and wetland zones, particularly along the Atlantic shoreline and the Mesurado wetland system, where localized changes in landform or vegetation cover could occur.

Overall, impacts are expected to remain limited and short-term, and no major visual impacts on receptors are anticipated due to the already highly urbanized and visually modified character of the area.

6.11. Climate Change

6.11.1. Overview

Climate change is increasingly recognized as a significant factor influencing environmental conditions and developmental outcomes. Liberia is highly vulnerable to the adverse effects of climate change due to its dependence on climate-sensitive sectors such as agriculture, forestry, fisheries, and energy (Environmental Protection Agency of Liberia, 2021b; World Bank Group, 2024a).

Climate projections indicate that the country will experience increased temperatures, erratic rainfall patterns, and a heightened frequency of natural disasters, including heavy rains and flooding. These climatic changes pose significant risks to Liberia's infrastructure, water resources, and food security (World Bank Group, 2024b).

6.11.2. Greenhouse Gas Emissions

Liberia's contribution to global greenhouse gas (GHG) emissions is minimal; however, the country has committed to ambitious reduction targets. In its revised Nationally Determined Contributions, Liberia pledges to reduce economy-wide GHG emissions by 64% below projected business-as-usual levels by 2030. This includes an unconditional reduction of 10% and an additional 54% conditional upon international support. The primary sources of GHG emissions in Liberia are land-use change and forestry, agriculture, and energy production (Environmental Protection Agency of Liberia, 2021a).

In the project area, baseline air quality data indicate a low to moderate contribution to GHG emissions. Existing emission sources include:

- **Small-scale generators**, particularly those using heavy fuel oil to provide electricity to mine sites, camps, and nearby communities. Heavy fuel oil is a known source of high CO_2 and particulate matter emissions
- **Vehicle traffic and machinery use**, which further contribute to GHGs and associated pollutants.
- **Informal waste disposal and open waste burning,** which contribute to CO_2, CH_4, and black carbon emissions.
- **Port operations**, including cargo handling equipment, ship berthing activities, and fuel combustion from support vessels and machinery, which contribute to localized CO_2 and NO_x emissions.

These activities contribute to the observed ambient levels of combustion-related pollutants and suggest that the GHG emission profile in the area is already on the rise.

The proposed project activities, including drainage rehabilitation, channel cleaning, and improved solid waste management are not high GHG emitting activities. However, temporary GHG emissions will be generated during construction due to:

- Operation of construction machinery and trucks
- Short-term use of generators and support equipment.

Compared to existing urban emission sources, the project contribution to GHG emissions is expected to be minor, localized, and temporary. On a long term, the Liberia Urban Resilience Project (LURP) is anticipated to benefit the climate by :

- Improving drainage efficiency and reducing flood-related stagnation
- Limiting methane generation from accumulated organic waste in blocked drains

With the application of appropriate mitigation measures, the project is unlikely to significantly affect urban's overall GHG emissions profile in Northern Bushrod Island.

6.11.3. Vulnerability and Adaptation

The impacts of climate change could significantly affect Liberia's economy and population. Without intervention, climate change could reduce Liberia's GDP by 15% and push 1.3 million people into poverty by 2050 (World Bank Group, 2024b).

To address these challenges, Liberia has developed key policy frameworks such as the National Policy and Response Strategy on Climate Change and the National Adaptation Plan framework to guide climate resilience efforts. These policies focus on enhancing early warning systems, improving water resource management, and strengthening climate-smart agriculture practices (Environmental Protection Agency of Liberia, 2021a).

On the project level, due to the Island low-lying coastal setting, dense urbanization, poor drainage network and proximity to water bodies, the project area is exposed to several climate risks, including increased rainfall intensity, flooding, droughts, extreme heat, and sea level rise in coastal areas. These changes can affect the durability and functionality of infrastructure, disrupt operations, and increase environmental risks such as erosion or water scarcity, and public health risk.

To enhance the project's resilience to climate change, the following adaptation measures will be incorporated:

- Design of infrastructure to withstand heavy rainfall and flooding, including improved drainage systems, elevated platforms, and slope stabilization.
- Design and implement erosion control measures.
- Improved solid waste management practices to prevent drain blockage and reduce flood risk during extreme rainfall events.

By addressing both its potential contribution to climate change and its vulnerability to future climate impacts, the project aims to align with sustainable development principles and Liberia's Nationally Determined Contributions, ensuring that climate considerations are fully integrated into its design, execution, and long-term management.

7. Baseline Conditions: The Biological Environment

This section provides a detailed description of the baseline conditions of the biological environment within the project area. It covers key aspects such as conservation areas, habitats, flora, fauna and ecosytem services. The baseline conditions for each of these components are detailed in the following subsections.

Establishing a clear understanding of the existing biological environment is critical for accurately assessing the potential impacts on biodiversity and ecosystem services associated with the development of the Project. This baseline serves as a reference point for identifying and evaluating changes that may result from project activities.

7.1. Source of Baseline Data

The assessment of biological conditions is based on a combination of desk-based research and field investigations. Initial data sources include public databases, available mapping data, and relevant published literature. This initial review is supplemented by mapping and field survey efforts including habitat mapping, a biodiversity field survey, an environmental DNA (eDNA) survey. The data collected through these efforts are analyzed to provide a comprehensive understanding of the biological environment. Information about ecosystem services was gathered through the social survey, including consultations, discussions and household surveys, as well as through engagement with community members during the biodiversity field survey.

7.2. Context

Liberia's coastal environment consists of sandy beaches, estuaries, tidal creeks, wetlands, and mangrove systems that support aquatic and terrestrial biodiversity and provide ecosystem services of local and national importance. The coastline extends for approximately 560 km along the Atlantic Ocean and includes river mouths and estuarine systems where freshwater inflows mix with marine waters. These transitional environments support fish and invertebrate species that use estuaries as nursery and feeding areas and are important for local fisheries.

Mangrove vegetation is a key habitat type along the Liberian coast, particularly in estuarine and sheltered areas. Mangroves contribute to shoreline stabilization, sediment retention, and nutrient cycling and provide habitat for fish, crustaceans, birds, and other wildlife. Liberia's coastal wetlands also include swamp forests, marshy areas, and tidal flats that are influenced by seasonal rainfall and tidal processes.

Available information on coastal biodiversity in Liberia is limited, and baseline data are uneven across habitat types. There is limited published evidence confirming the presence of extensive coral reefs or seagrass beds along the Liberian coastline. Their occurrence, if present, is likely to be localized and patchy. As a result, site-specific field surveys and local ecological knowledge are important sources of baseline information for project-level assessments.

The project area is located within the urban coastal zone of Monrovia. Stockton Creek forms the eastern boundary of the project area and connects the St. Paul River Estuary in the north with the Mesurado Estuary in the south, creating a hydrologically connected estuarine system influenced by tidal exchange with the Atlantic Ocean. This system represents a transitional environment between freshwater and marine ecosystems and supports mangroves and estuarine aquatic species adapted to variable salinity conditions. Estuaries play a vital role in nutrient cycling and sediment transport, which maintain coastal water quality and biodiversity (Augustine et al., 2024).

The project site is adjacent to the Freeport of Monrovia and lies within a densely populated and industrialized urban setting. Land use in the surrounding area includes residential settlements, port and shipping activities, commercial operations, and transport infrastructure. Natural habitats in the immediate project vicinity are therefore fragmented and modified, although mangroves, wetlands, and tidal creeks remain present in nearby areas, including the Mesurado Wetlands.

The Mesurado Wetlands are recognized at the national level for their ecological importance and are designated as a Ramsar site. These wetlands support mangrove vegetation, fish and crustacean populations, and waterbird species, including migratory birds. However, they are subject to ongoing pressures from urban expansion, pollution, waste disposal, and hydrological modification.

Key pressures on biodiversity in the coastal and estuarine environments of Monrovia include shoreline erosion, solid waste accumulation, discharge of untreated or partially treated effluents, habitat loss associated with urban development, fishing pressure, and vessel traffic related to port operations. These pressures have resulted in degraded environmental conditions in many parts of the coastal zone. The biodiversity baseline for the project therefore focuses on describing existing habitat conditions, species presence, and ecological sensitivities within an urbanized and modified environment.

7.2.1. Habitats

The various coastal habitats in Liberia are presented in Sections 7.2.1.1 through 7.2.1.5 below. Information on Monrovia's coastal habitats and Northern Bushrod Island area is presented where available.

7.2.1.1. Beaches

The coast of Liberia is dominated by narrow sandy beaches, intercepted with lagoons, estuaries, bays and brackish wetlands (United States Agency for International Development (USAID), 2008). Sandy beaches are difficult habitats for marine organisms as they are unstable and constantly change with the movements of waves, tides and currents. Coconut trees usually grow on these beaches, along with plant and grass species that are tolerant to salt and sand. These beaches are inhabited by few species of crabs, molluscs, and insects, in addition to sea birds that feed on these organisms. Sea turtles are reported to nest along the beaches in Liberia, but no mass nesting sites were identified.

Monrovia's coast is not an exception. Sandy beaches are found all along the coast of Monrovia and are only interrupted by minor rocky areas such as the Mamba Point area known as the Cape of Monrovia, some lagoon areas and two main estuaries: the St. Paul River Estuary and the Mesurado River Estuary. In Monrovia, the sandy beaches are under pressure by the impacts of sand mining, climate change and erosion, solid waste pollution, sewage pollution, human traffic and the expansion of the city among other causes. Sea turtles do not nest on beaches of Monrovia due to increased human traffic (day and night) and pollution on these beaches.

To the west of the project location in Northern Bushrod Island lies a stretch of sandy beach separating the New Kru Town settlement from the ocean. Field observations along this beach revealed considerable pollution by solid waste and open defecation from nearby communities (Figure 7-1).

Figure 7-1 Solid waste pollution along the New Kru Town Beach (October 2025)

7.2.1.2. Coastal Savannah

Usually, nestled behind the beaches, is a stretch of coastal savannah, which consists of low grasses with scattered low trees. It also contains palm and coconut trees along with mangrove and Raphia palms (Wiles, 2005). It provides a refuge for a variety of birds as well as some species of small mammals and reptiles.

The propagation of the city of Monrovia towards its coast prevented stretches of coastal savannah to grow. Rapid urban expansion has resulted in significant habitat loss in several areas.

In New Kru Town, housing structures directly fringe the beach. Figure 7-2 illustrates what remains of the coastal savannah at Wongah Beach, located northwest of New Kru Town.

Figure 7-2 Photograph showing what remains of the coastal savannah at Wongah Beach, northwest of New Kru Town (October 2025)

7.2.1.3. Coastal Wetlands and Mangrove Forests

Coastal wetlands in Liberia mostly consist of mangrove forests which are either lagoonal, occurring in lagoons behind barrier islands that extend parallel to the beach, or deltaic, located in estuaries, such as the Mesurado Wetland in Monrovia.

The Mesurado Wetland lies south of the project area in the Mesurado River estuary. More information about the Mesurado Wetland is available in Section 7.2.2.1. In addition, small patches of wetlands, including mangrove forests, remain scattered around Northern Bushrod Island, more specifically in the St. Paul River Estuary (Figure 7-3) and along Stockton Creek. Mangroves are vital coastal forests that thrive at the intersection of ocean, freshwater, and land, offering significant environmental benefits, particularly in their ability to protect against storms and sea level rise. In Liberia, much of the primary mangrove forest has been replaced by secondary stands due to widespread destruction, particularly in major coastal cities like Monrovia.

The mangroves around Monrovia face severe threats from urban expansion and landfills, a situation exacerbated by the civil conflict when many displaced individuals established settlements by landfilling in the Mesurado and Marshall Mangrove wetlands. This has led to the degradation of extensive mangrove areas, which are also exploited for charcoal production and for meat consumption. Overall, the health of Monrovia's mangroves is crucial for maintaining local biodiversity and combating climate change, but they are increasingly at risk from human activities

Figure 7-3 St. Paul River Estuary with mangrove vegetation and palm trees along the bank

7.2.1.4. Shelf Habitats

The shelf habitats of Liberia are largely understudied and dominated by soft sediments, primarily mud and sand, which form parallel strips along the coast. Between depths of 80 and 200 meters, fossil coral banks from the Holocene age are present, while rocky areas are minimal (Martos et al., 1991; Villegas & Garcia, 1983). The soft-bottom habitats lack significant vegetation like seaweeds and seagrasses (Castro & Huber, 2005), making them unvegetated communities where phytoplankton is the primary producer. Nutrients are mainly sourced from land, including estuaries and mangroves, as well as marine detritus. Faunal communities consist mainly of infauna, such as worms, snails, and clams, which burrow into the sediment, and epifauna like anemones, shrimps, and crabs that live on the surface. Fish species like skates, rays, and soles are also common over these soft sediments.

In contrast, Liberia's limited rocky areas support a greater diversity of marine life, providing stable surfaces for seaweeds, barnacles, anemones, sponges, and other sessile organisms. These rocky habitats offer shelter and food for various fish and invertebrate species and their juveniles. Seabed rocks are important fishing grounds for commercially valuable species like snappers and groupers.

7.2.1.5. Estuaries

Estuarine habitats in Liberia occur at the mouths of major rivers where freshwater mixes with marine waters of the Atlantic Ocean. These environments are influenced by tidal exchange, seasonal river flows, and sediment transport, resulting in variable salinity conditions. Estuaries in Liberia typically include river mouths, tidal creeks, lagoons, and associated wetlands.

Liberian estuaries are commonly bordered by mangrove vegetation, swamp forests, and marshy wetlands. These habitats support fish, crustaceans, and mollusks, many of which use estuaries as nursery and feeding areas. Estuarine wetlands also provide habitat for waterbirds, including migratory species.

Estuarine systems, particularly in urban and peri-urban areas, are subject to pressures such as pollution, solid waste accumulation, fishing pressure, hydrological modification, and land encroachment.

The project area is influenced by a connected estuarine system formed by the St. Paul River Estuary to the north, the Mesurado Estuary to the south, and Stockton Creek, which links these two water bodies along the eastern boundary of Northern Bushrod Island. Together, they form a dynamic coastal–estuarine complex shaped by the tidal exchanges of the Atlantic Ocean. This hydrological connectivity creates a single, highly productive mosaic of habitats where freshwater inflows mix with saline tidal waters creating productive ecosystems that support fisheries, mangroves, and diverse wildlife (The Food and Agriculture Organization, 2024). These areas serve as nursery and feeding grounds for many species of commercial and subsistence importance.

The St. Paul River Estuary is located to the north of the project area, where the St. Paul River discharges into the Atlantic Ocean. The river exhibits substantial seasonal variability, with daily discharge ranging from 25 m^3/s to 1,950 m^3/s (World Bank, 2021). Dominated by mangroves, primarily *Rhizophora racemosa*, it provides nursery grounds for fish and shrimp. St. Paul River Estuary is important for demersal finfish and shrimp fisheries (The Food and Agriculture Organization, 2024).

The Mesurado Estuary, located south of the project area, is a mangrove-dominated habitat supporting aquatic species and migratory birds (BirdLife International, 2025). It provides ecosystem services such as shoreline protection and water filtration (Barbier et al., 2011).

Stockton Creek is a tidal creek connecting the St. Paul River and the Mesurado River and Wetland. Its banks support some mangrove stands that serve as breeding and feeding grounds for fish and invertebrates.

These estuaries provide important spawning and nursery habitats for marine species, support local fisheries, and offer ecosystem services such as flood mitigation and water quality improvement. However, they face threats from urbanization, pollution, and climate change, requiring effective management strategies (UN Environment, 2019).

7.2.2. Conservation Areas and Internationally Recognized Areas

There is no nationally or internationally designated protected area within the project area. However, the Mesurado Wetland, one of five RAMSAR sites in Liberia, is situated along the Mesurado River mouth, extending approximately eight kilometres and beginning about three kilometres south of the nearest project intervention (Figure 7-4).

7.2.2.1. Mesurado Wetland

The Mesurado Wetland is situated in the heart of the city of Monrovia (Figure 7-4). This estuarine wetland of 6,670 hectares is one of the five designated Wetlands of International Importance in Liberia. This site has a high ecological value, mainly due to three mangrove species (*Rhizophora harrisonii, R. mangle* and *Avicennia africana*) which are threatened by intense charcoal burning and fuel wood collection (Ramsar Convention Secretariat, 2006). As per its

Ramsar information sheet, the site provides a favorable habitat and feeding ground for several species of birds such as the African Spoonbill (*Platalea alba)*, the Common Pratincole (*Glareola nuchaltis)* and the Curlew (*Numenius arquata)*. The site hosts three reptile species: the African Dwarf Crocodile (*Osteolaemus tetraspis*) which is currently classified as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the African Sharp-Nosed Crocodile (*Crocodylus cataphractus* - Critically Endangered), and the Nile Crocodile[1] (*Crocodylus niloticus*) which is included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I for protection against over-exploitation through international trade. The Red Colobus Monkey (*Procolobus badius*) - Endangered and protected in Liberia (Appendix H) and the Water Chevrotain (*Hyemoschus aquaticus*), which is classified as Least Concern globally but still protected under Liberian wildlife regulations, occur at the Mesurado Wetland, according to the Ramsar designation documents. Although not mentioned in the Ramsar sheets, the West African Manatee (*Trichechus senegalensis* - Vulnerable) may also be present in the Mesurado Wetland (Earthtime Inc. & CDR International, 2019). Other mammals that are expected to occur in the coastal wetland areas of Monrovia are rats, mice, bats, duikers and antelope species. Detailed information on the diversity, structure and species abundance of these assemblages in the Mesurado Wetland is not available.

[1] The African Nile Crocodile is currently recognized as two distinct species: one occupying eastern Africa, the Nile valley and southern Africa and retaining the name *Crocodylus niloticus* Laurenti, 1768; and the other occupying west and central Africa, and assigned to the existing name *Crocodylus suchus* Geoffroy, 1807. Red List assessments now treat these two taxa independently. Therefore, *Crocodylus suchus* is the species for Liberia. As of 2025, the West African crocodile (*Crocodylus suchus*) has not yet been formally assigned an individual status on the IUCN Red List.

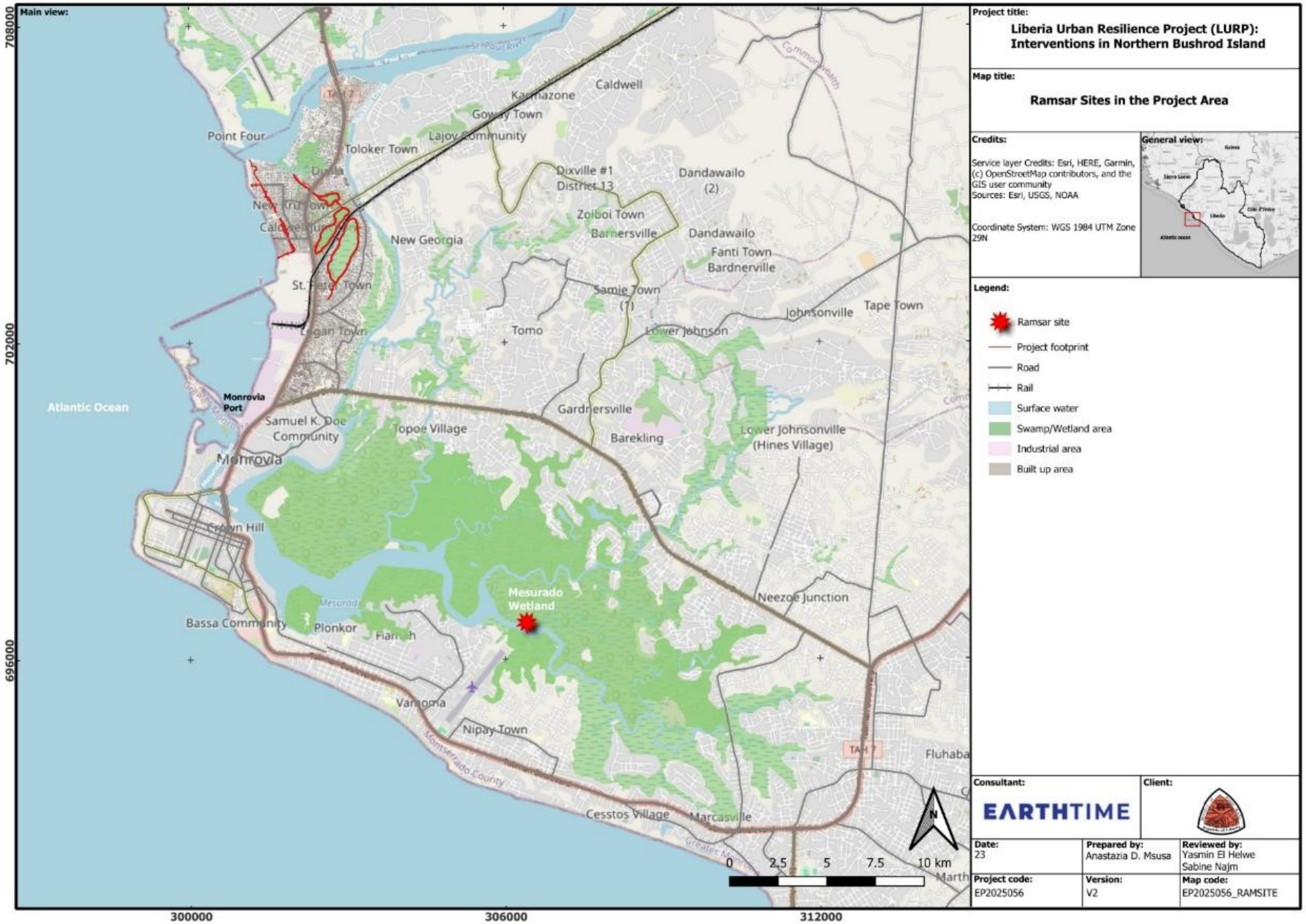

Figure 7-4 Map showing the Mesurado Wetland, a Ramsar site near the project location

The Mesurado Wetland has been under pressure due to the following main reasons:

- Cutting of mangrove trees for fuel wood, construction material, medicinal use, etc.
- Disposal of solid waste and trapping of solid debris carried by the Mesurado River and the Stockton Creek (Figure 7-5a)
- Industrial pollution (fuel and oil storage, refinery, paint factories)
- Urban encroachment and construction of infrastructure in the wetland (Figure 7-5b)
- Erosion due to climate change and seal level rise

(a) (b)

Figure 7-5 (a) Mangrove trees trapping solid waste at the Mesurado Wetland; (b) Expansion of the city at the expense of the Mesurado Wetland (Earthtime and CDR, 2019)

7.3. Biodiversity Baseline Data Collection Methodology

The biodiversity assessment was structured around three complementary components designed to capture a representative and integrated understanding of ecological conditions within the study area. These components included:

- Habitat mapping (Section 7.3.2)
- Flora and fauna field surveys (Section 7.3.3)
- eDNA sampling (Section 7.3.4)

7.3.1. Study Area

The biodiversity baseline data collection focused on the project's defined Biodiversity Area of Influence (AoI), representing the geographic extent within which project activities may directly or indirectly affect ecological receptors. The AoI includes zones of physical land take, construction activity, operational disturbance, and areas potentially influenced by secondary or induced project-related impacts such as, air, water, noise, and light pollution, as well as potential changes in hydrology and human access.

Accordingly, the study area incorporated:

- **Direct impact zones***:* areas subject to physical disturbance from construction works and permanent land take, including site preparation, vegetation clearing, excavation of drainage channels, culvert and bridge installation, demolition of existing structures, and construction of outlets.

- **Indirect influence zones***:* habitats and ecological features within buffer areas where project activities may cause disturbance or functional impacts on biodiversity through mechanisms such as noise and vibration, dust generation and air emissions, water pollution, increased human presence, and movement of machinery and materials.

To adequately capture these potential pathways of impact, the AoI was defined as follows:

- A 50-meter buffer on land surrounding the Project footprint to capture indirect terrestrial and wetland impacts;
- A 500-meter marine buffer extending seaward from the coastline to account for potential dispersion of runoff, sediment, and pollutants at coastal outfalls;
- The full extent of Stockton Creek to the east, despite no direct physical interventions being planned within the creek itself. Stockton Creek was included as part of the AoI as a precautionary measure, given that it is connected to and influenced by the St. Paul River.

The resulting AoI is presented in Figure 7-6.

Habitat classification was undertaken within the defined Biodiversity Area of Influence (AoI), to identify habitat types and map ecological variation (see Section 7.3.2).

Flora and fauna field surveys were also carried out, with transects and observation points positioned to maximize habitat representativeness and accessibility (see Section 7.3.3).

eDNA sampling targeted key freshwater bodies around the project area i.e Stockton Creek and the St. Paul River, the coastal and marine environment near Popo Beach and the New Kru Town revetment, to detect aquatic and semi-aquatic animal groups not captured through conventional field surveys, particularly elusive or cryptic species (see Section 7.3.4). The eDNA survey also covered areas of the Mesurado Wetland system to establish baseline reference conditions in the wider area, following the precautionary approach described above rather then implying an expectation of impacts on the Mesurado Wetland.

7.3.2. Habitat Mapping

The habitat mapping process combined remote sensing, GIS-based spatial analysis, and field validation to accurately classify and delineate habitat types within the study area. The steps included are described in Appendix I.1. The resulting habitat map and classification is presented in Section 7.4.

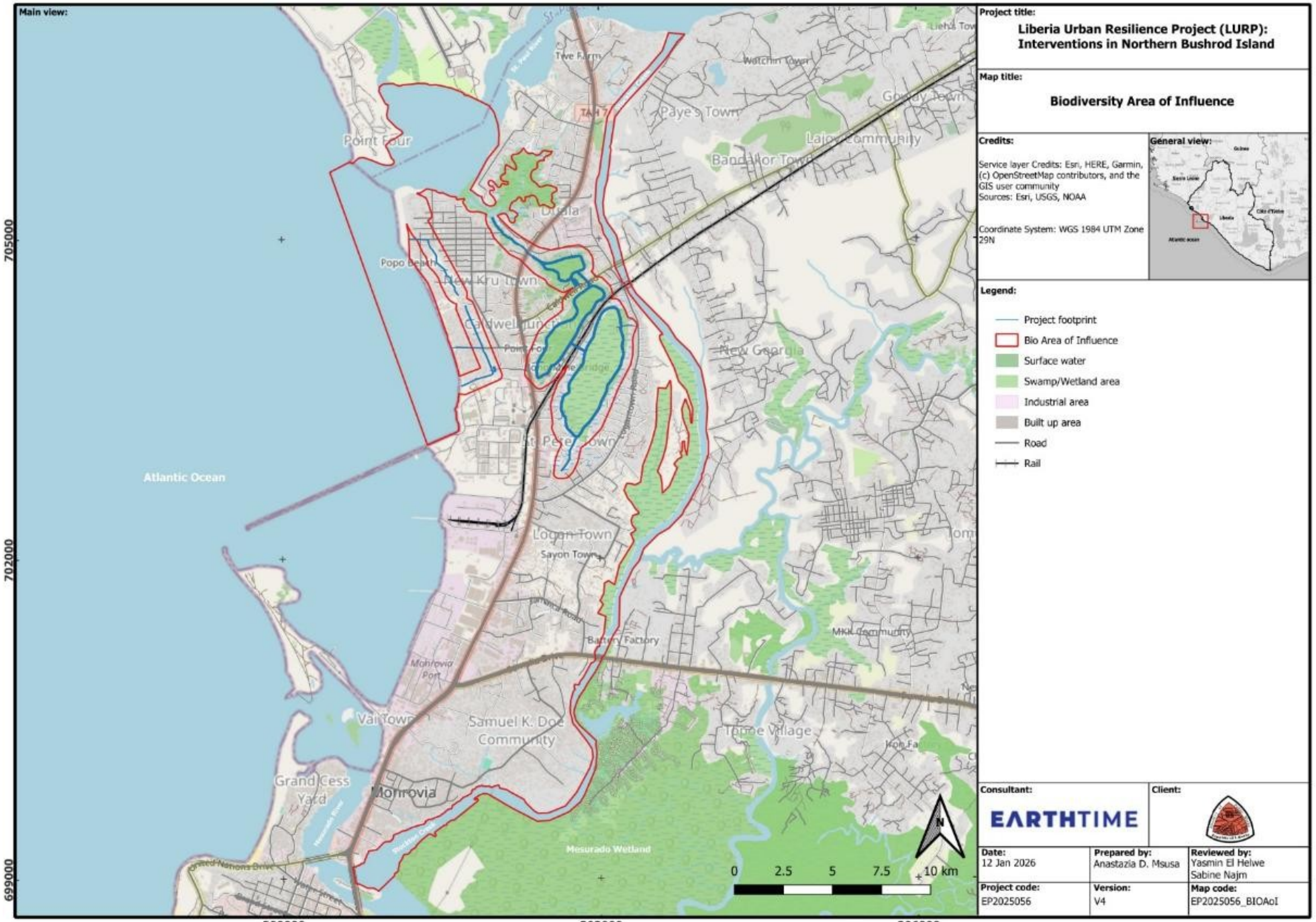

Figure 7-6 Map showing the Biodiversity Area of Influence 54

7.3.3. Flora and Fauna Field Survey

The flora and fauna surveys utilized the Rapid Biodiversity Assessment Protocol (Royal Society for Protection of Nature, 2022) bringing together specialists focused on four core taxonomic groups: aquatic fauna, birds, plants, and herpetofauna, across the study area. Fieldwork was concentrated in the Biodiversity AoI defined in Section 7.3.1. Fieldwork was primarily conducted during the shoulder season (the end of the rainy season, the beginning of the dry season), between November 10 and 15, 2025. Additional datasets were collected between December 11 and December 18 for habitats and plants, herpetofauna, and aquafauna. The timing aimed at allowing the survey teams to capture species active in both seasons of the year, given the short timeframe within which the ESIA had to be conducted.

Geographic data, including GPS coordinates and photographs of observations were recorded. Community members were engaged where possible to provide local knowledge and sightings of species and gather insights on ecosystem services. Opportunistic encounters of fauna and flora species were recorded and photographed where possible by each team.

Field survey locations for flora an fauna are presented in Figure 7-7 and Figure 7-8, respectively.

Detailed survey methodologies for each surveyed taxonomic group are provided in Appendix I.2.

Ministry of Public Works
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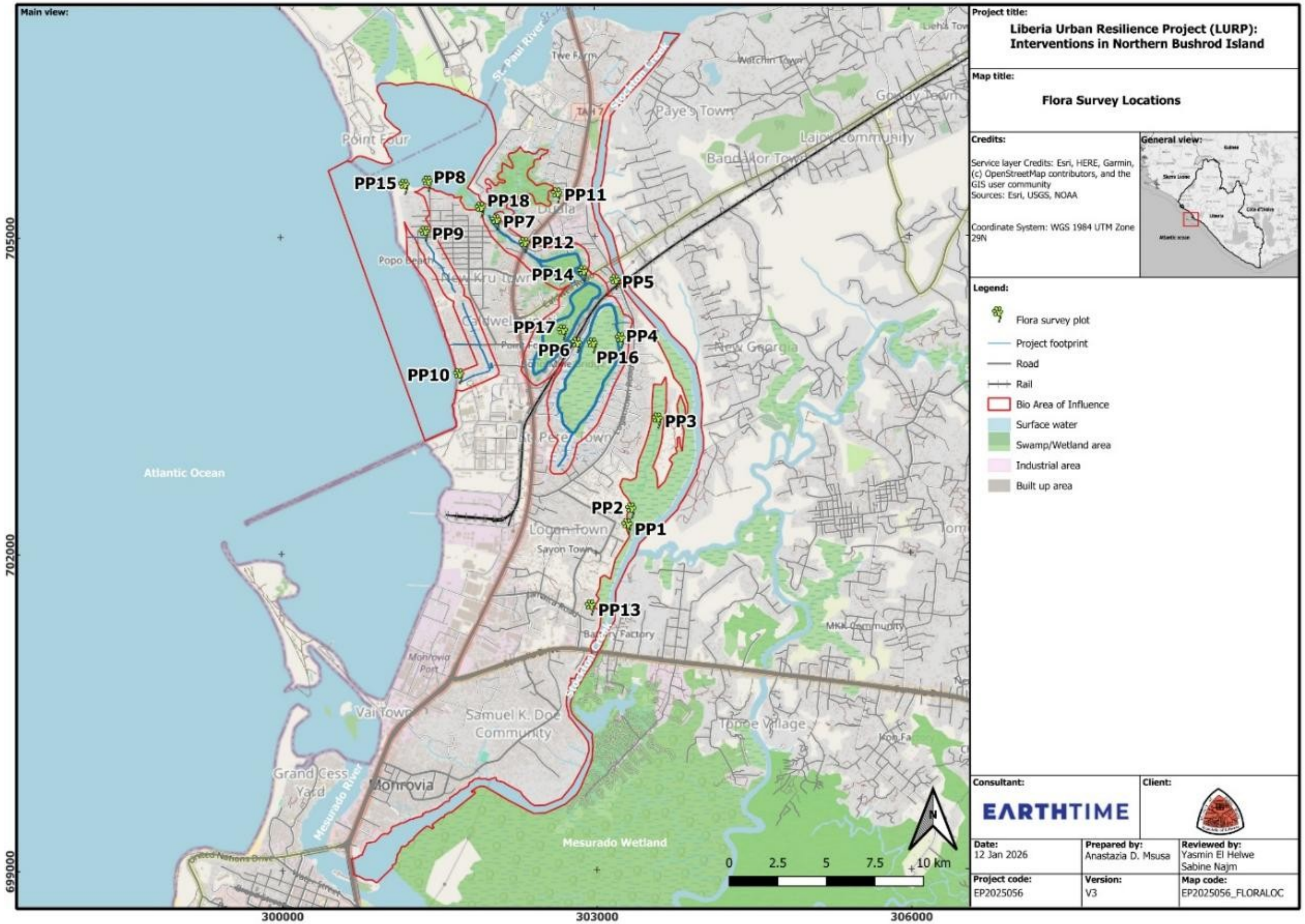


Figure 7-7 Flora field survey locations

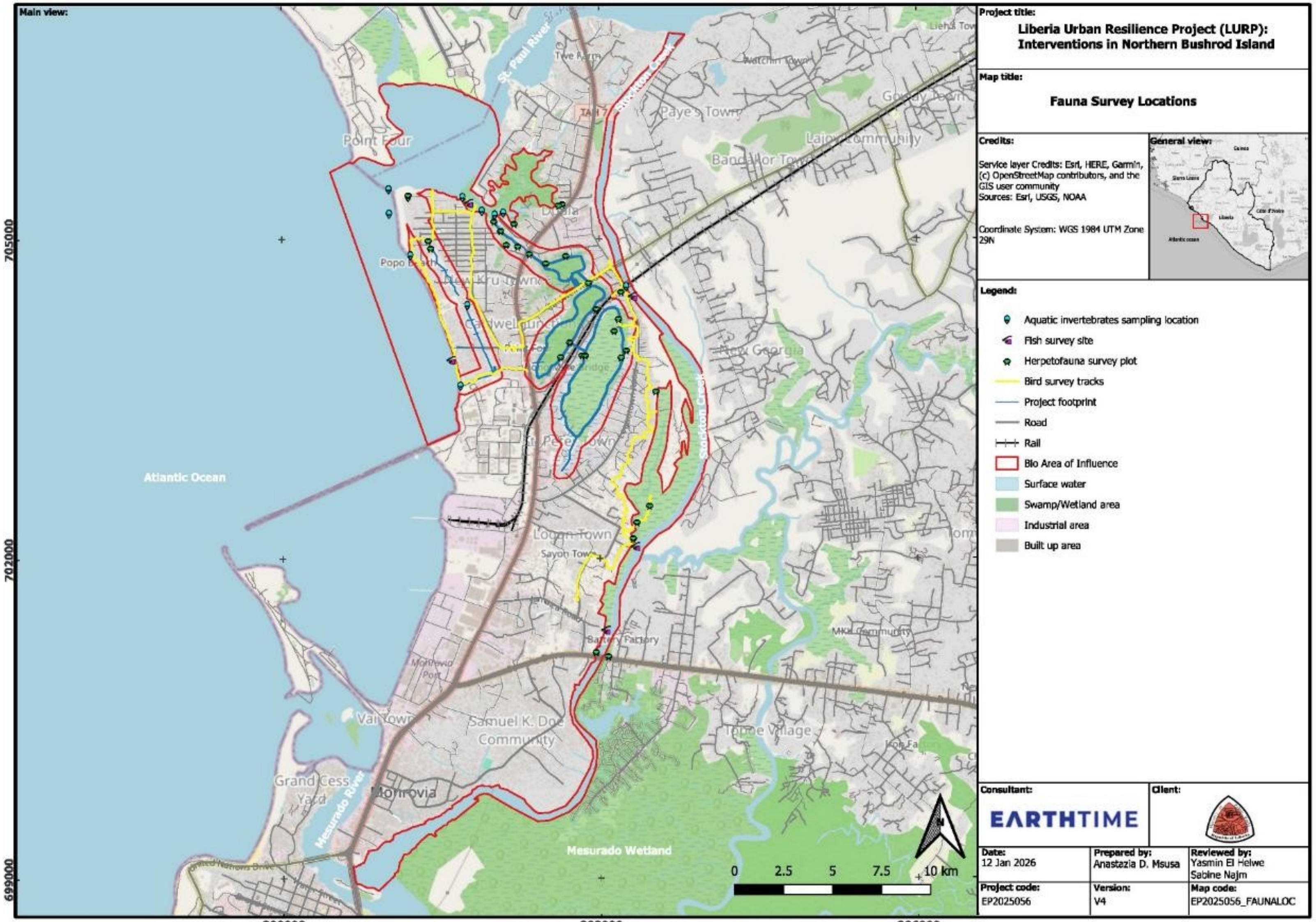


Figure 7-8 Fauna field survey locations

7.3.4. eDNA Sampling

In addition to the flora and fauna field survey which used traditional biodiversity survey methods within the time allowed for biodiversity baseline data collection, a relatively new tool was used to detect the presence of fauna species in the project area. It relies on the collection of eDNA, which is trace DNA left behind by various species in the environment. eDNA is deposited in the environment through excretion, shedding, mucous secretions, saliva, etc. It can be collected in environmental samples such as water or sediment and used to identify the organisms that it originated from (NatureMetrics, 2023).

Once environmental samples are received at the laboratory, eDNA is extracted and then amplified through polymerase chain reaction (PCR). DNA sequences obtained from the samples are matched to DNA sequences in reference databases, allowing species identification.

The objective of the sampling exercise was to identify broad vertebrate community, detect any protected vertebrates and map the presence of fish and mammals in the project area.

Based on the above, the sampling design was established.

Sampling of eDNA samples was undertaken between October 29 and 31, 2025. The detailed protocol is available in Appendix I.3.

- Collection of water
- Filtration of water
- Preservation of DNA
- Shipping samples to the laboratory

Samples were shipped to NatureMetrics, a nature intelligence technology company based in the United Kingdom, for analysis.

A total of ten water samples were collected for eDNA testing. Sampling targeted rivers, tidal creeks, wetlands, and swampy areas within the study area, including samples from the St. Paul River Estuary, Stockton Creek and the Mesurado Estuary, based on the assumption that eDNA can be transported up to approximately two kilometers. Two samples were collected from nearshore coastal waters, including one taken adjacent to the mouth of the Saint Paul Estuary.

The eDNA sampling locations are provided in Figure 7-9. Details on the sampling design and photos of sampling are provided in Appendix I.3.

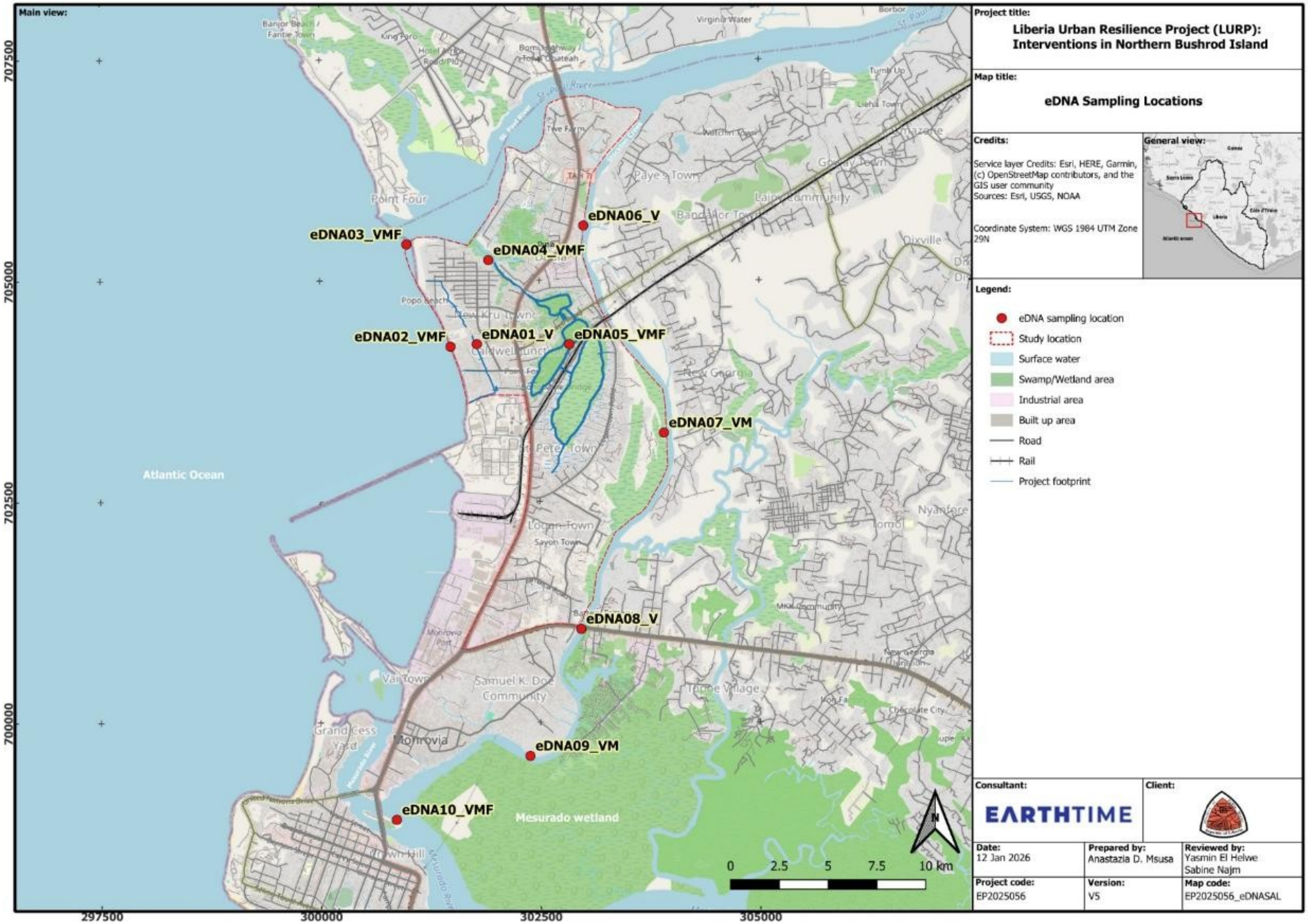


Figure 7-9 eDNA sampling locations

7.4. Habitat Mapping

Habitats within the AoI were mapped to support ecological baseline assessment and impact evaluation using the methodology described in Section 7.3.2. The resulting habitat map is presented in Figure 7-10.

The habitat mapping reveals a heterogeneous landscape shaped by both natural wetland systems and extensive urban influence. Twelve distinct habitat types were identified, ranging from dense mangrove stands and brackish wetlands to intertidal zones, grasslands, and urban coastal waters (Table 7-1).

As shown in Figure 7-10, dense mangrove stands (H1) are limited in extent, covering less than one percent of the area, but retain structural complexity with shrubs, small trees, herbs, sedges, and vines. Despite urban modification and altered hydrology, they qualify as degraded natural habitat with moderate-to-high sensitivity, reflecting their ecological importance for biodiversity and coastal protection. Fragmented mangroves (H2) are more extensive (about 6% cover) but occur as small, scattered patches intermixed with crops and grasses. These fragments are modified habitats with moderate sensitivity, highlighting the impact of urban encroachment on once-continuous mangrove areas.

Brackish marsh wetlands (H3) and lagoon-adjacent wetlands (H8) are relatively small in area (about 4% and 2% respectively) but continue to provide key wetland functions despite altered hydrology, waste dumping, and encroachment. Both are considered degraded natural habitats with moderate sensitivity. Similarly, intertidal zones (H10) and urban-influenced estuarine habitats (H11)[2], covering roughly 9% each, show signs of disturbance and hydrological modification but maintain ecological function, supporting a moderate to moderate–high sensitivity rating.

Heavily modified habitats dominate large portions of the landscape. Drainage- or channelassociated wetlands (H4, about 12%), grasslands and disturbed open habitats (H5, about 4%), bush thickets/shrub–herb mosaics (H6, about 4%), and scattered trees/crops mosaics (H7, about 9%) exhibit significant human alteration from settlement, cultivation, and drainage engineering. These are classified as modified habitats with low to moderate sensitivity, retaining limited ecological function. Sandy urban beaches (H9, about two percent) are similarly disturbed but continue to play a minor ecological role in the estuarine system.

The largest single habitat type is nearshore marine waters (H12), covering approximately 39% of the study area. Although influenced by urban runoff, fishing, and drainage inputs, these waters remain a functioning coastal ecosystem and are assigned a moderate–high sensitivity rating.

[2] The small estuarine patches shown as occurring within nearshore waters in the habitat map reflect the moderate resolution of Sentinel-2 imagery and the GIS suitability model, which identifies low-elevation, water-proximal coastal cells as exhibiting estuarine characteristics.

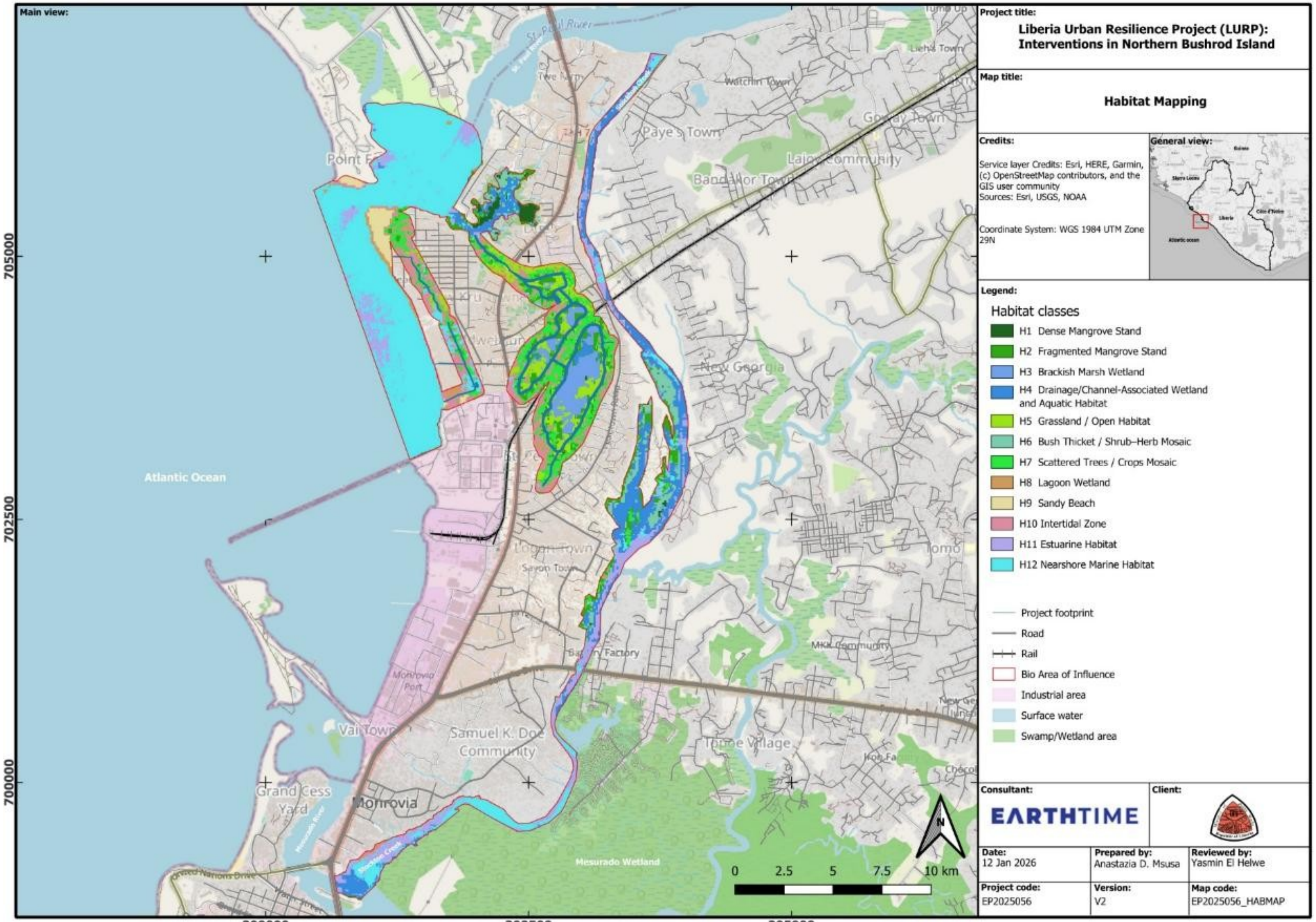


Figure 7-10 Habitat map within the Biodiversity Area of Influence

Table 7-1 Habitat classification within the Biodiversity Area of Influence

Code	Habitat type	Description	Cover percentage	Condition / modification level	World Bank ESS6 habitat category	Precautionary sensitivity rating
H1	**Dense mangrove stand**	Dense patches of mangroves occurring along the estuarine margin. No intact systems remain; all are surrounded by settlements, altered drainage, and waste.	0.4%	Dense but urbanmodified; hydrological flow altered	Natural habitat (degraded but still meets definition of natural ecosystem)	Moderate-High
H2	**Fragmented mangrove stand**	Scattered, degraded mangrove trees mixed with grasses, sedges, herbs, and creeping vines. Occurring in isolated pockets, structurally fragmented.	6.5%	Highly modified, small, disconnected patches	Modified habitat	Moderate
H3	**Brackish marsh wetland**	Internal wetlands within Bushrod Island. Dominated by ferns, sedges, and invasive floating plants. Brackish due to tidal influence and groundwater salt intrusion.	4.1%	Hydrology altered by settlement, blocked drainage, invasive plant dominance	Natural habitat (degraded)	Moderate
H4	**Drainage / channelassociated wetland and aquatic habitat**	Wetland vegetation and aquatic habitat along drainage channels with aquatic weeds and fauna and solid waste.	11.6%	Heavily modified, hydrology engineered or redirected	Modified habitat	Low-Moderate
H5	**Grassland / Open Habitat (Disturbed)**	Dominated by grasses, sedges, herbs; present on cleared plots, abandoned land, and disturbed areas.	4.1%	Strongly influenced by human clearing and settlement patterns	Modified habitat	Low
H6	**Bush thicket / shrub-herb mosaic**	Secondary vegetation composed of shrubs, small trees, herbs, sedges, and vines. Often on abandoned land or railway edges.	3.7%	Heavily altered	Modified habitat	Low
H7	**Scattered Trees / Crops Mosaic**	Scattered or planted trees mixed with crops, grasses, and herbs. Semi-managed plots along settlement edges.	8.8%	Highly modified by cultivation and settlement	Modified habitat	Low

H8	**Lagoon wetland (near beach)**	Wetland adjacent to the coastal lagoon; subject to runoff inputs, encroachment, disturbed hydrology.	2.4%	Moderately degraded but retains wetland function	Natural habitat (degraded)	Moderate
H9	**Sandy beach (urban / periurban)**	Sandy shoreline affected by human activity, waste, and erosion.	1.6%	Disturbed and human impacted	Modified habitat	Low-Moderate

Code	Habitat type	Description	Cover percentage	Condition / modification level	World Bank ESS6 habitat category	Precautionary sensitivity rating
H10	**Intertidal zone (urbaninfluenced)**	Tidal zone affected by waste deposition and altered shoreline processes.	9.0%	Moderately disturbed	Natural habitat (degraded)	Moderate
H11	**Estuarine habitat (urbaninfluenced)**	Brackish mixing zone of the estuary influenced by drainage, runoff, urban activities and fishing.	9.3%	Hydrology and salinity modified but ecological function persists	Natural habitat (degraded)	Moderate-High
H12	**Nearshore marine habitat (urban coastal waters)**	Coastal marine waters receiving runoff and sediment from urban shoreline and exploited for fishing.	38.6%	Modified but functioning marine system	Natural habitat (degraded)	Moderate-High

7.5. Vegetation

7.5.1. Available Data

Available information on flora within the project area is derived primarily from published literature, national and international databases, and previous environmental and social impact assessments conducted in the Monrovia coastal zone. Detailed site-specific botanical surveys are limited, and much of the existing information reflects regional or habitat-level patterns.

Despite heavy urbanization in the project area, several distinct vegetation types occur, reflecting a mosaic of managed, semi-natural, and remnant natural habitats. These include terrestrial and coastal vegetation as well as tidal, brackish, and aquatic vegetation, such as riparian and swamp vegetation, mangrove communities and limited aquatic vegetation.

7.5.1.1. Terrestrial and Coastal Vegetation

7.5.1.1.1. Urban and Terrestrial Vegetation

Urbanization has fragmented natural vegetation, leading to dominance by grasses, weeds, and small shrubs commonly associated with open spaces, roadside verges, abandoned plots, and informal settlements.

Common grasses and herbaceous species include *Panicum maximum* and *Urochloa mutica* in open spaces and roadside verge (Republic of Liberia, 2017). Invasive species like *Chromolaena odorata* and *Lantana camara* are common in abandoned lots and unmanaged areas (Akin-Fajiye & Akomolafe, 2021). Tree cover is largely composed of planted species including *Mangifera indica* (mango) and *Elaeis guineensis (*african oil palm*)* providing shade and aesthetic value but limited ecological value in the highly urbanized setting.

7.5.1.1.2. Coastal Vegetation

The coastal fringe of Northern Bushrod Island supports vegetation adapted to sandy substrates and saline conditions, playing a critical role in dune stabilization and shoreline protection. Species that may occur include *Ipomoea pes-caprae* (beach morning glory) and *Canavalia rosea* (bay bean), both recognized as pioneer species that stabilize foredunes and reduce erosion through extensive creeping stems and root systems (Martinez et al., 2016). Occasional stands *of Hibiscus tiliaceus* (sea hibiscus) could be present near more stabilized dunes (Della Bella et al., 2024). The tidal and brackish zones are characterized by vegetation adapted to saline and periodically inundated conditions.

7.5.1.1.3. Mangrove Communities

Mangrove forests are the most important vegetation in the coastal area of Liberia. They are present in fragmented patches within the Mesurado Wetland system and associated tidal channels near the project area. The most common mangrove species in Liberia is *Rhizophora racemosa*, but three other species are abundant in the country. These are *Rhizophora harrisonii*, *Rhizophora mangle* and *Avicennia germinans*, which are believed to occur in the Mesurado Wetland in Monrovia (Ramsar Convention Secretariat, 2006).

These species form dense stands along tidal creeks and estuarine margins, contributing to sediment retention and reducing coastal erosion. Mangrove patches also serve as breeding and nursery grounds for fish, crustaceans, and mollusks (Ramsar Convention Secretariat, 2006).

7.5.1.1.4. Riparian and Swamp Vegetation

Riparian and swamp zones occurs along creeks, lowlying wetlands and drainage channels. These habitats are commonly dominated by *Raphia hookeri* (Raffia Palm) and sedges (*Cyperus spp*.) These plants thrive in waterlogged soils and play a role in water filtration and flood regulation. In some locations, small mangrove stands are interspersed within these zones (Lenssen et al., 2000).

7.5.1.1.5. Aquatic Vegetation and Seagrasses

Aquatic vegetation within the project area is limited and poorly documented. Sheltered lagoons, tidal pools, and wetland areas may support submerged or emergent aquatic plants; however, confirmed records are scarce. Liberia has three recorded seagrass species: *Cymodocea nodosa*, *Ruppia maritima*, and *Halodule wrightii*, with the latter being most common in West African coastal waters. Although seagrass beds are not well-documented in Monrovia, minor growth may occur in sheltered lagoons and estuarine wetlands. These habitats support primary productivity and provide feeding grounds for aquatic invertebrates and fish (Cheikh et al., 2022; Earthtime Inc. & CDR International, 2019).

7.5.1.2. Marine Flora

West Africa's algal species diversity is low compared to that of other marine regions. This is due to many contributing factors such as the seasonal upwelling, the seasonal inflow of turbid, silt-laden water, the seasonally lowered inshore salinity, the absence of suitable shallow water substrata, as well as the low habitat diversity and heterogeneity (Bolton et al., 2003).

Published information on seaweed species diversity in Liberia revealed about 90 different algal species. This number may be underestimated because Liberia's seaweed diversity is under-investigated. Some of the listed, and other unidentified, seaweed species are expected to occur on rocky areas in the inter-tidal and subtidal zones of Monrovia's shore.

7.5.2. Field Survey Results

7.5.2.1.1. Habitats

The habitats and vegetation assessment across the 18 survey plots revealed a highly modified coastal–urban landscape, dominated by wetlands, mangrove habitats, and disturbed herbaceous/grasslands. Human pressures, such as settlement expansion, waste dumping, altered drainage, and agricultural use, shape nearly all habitat units.

Approximately 35% of surveyed sites (PP1, PP2, PP3, PP7, PPN11, PP13, PP18) fall within mangrove habitat types (Table 7-2). Of these:

- Most habitats (PP1, PP2, PP3, PP7, PP11, PP13) are highly fragmented or degraded patches of mangroves. Mangrove trees persist only as scattered individuals or small clusters interspersed with sedges, grasses, and floating weeds (e.g. *Cyperus sp.*, *Schoenoplectus corymbosus*, *Ipomoea sp., Paspalum sp.*, *Commelina diffusa*, *Pistia stratiotes, Eichhornia sp.).*

- Only one surveyed site (PP18) has dense mangrove stands dominated by *Avicennia germinans*.

Approximately 25%, e.g., PP4, PP6, PP16, PP17) are dominated by brackish wetland vegetation, ranging from marshes to drainage-associated wetlands (Table 7-2).

- Brackish marsh wetlands were recorded at PP4, PP16 and PP17, where communities were dominated by ferns (*Thelyteris cf. kunthii),* grasss *(Pragmites karka)*, creeping vines (*Convolvulus arvensis)*, and floating plants (*Pistia stratiotes*). These wetlands occur in low-lying depressions with seasonally or permanently saturated soils and are strongly influenced by altered drainage patterns.
- Drainage -associated wetland was evident at PP6, where *Pistia stratiotes, Lemna minuta*, and tall grasses (*Urochloa mutica, Saccharum officinarum*) dominated. Vegetation indicates nutrient enrichment and stagnant-water conditions resulting from blocked drainage and runoff inputs.

These wetlands collectively illustrate advanced modification and invasive plant proliferation.

PP8, PP9, PP10, PP12, PP14 (approximately 25–30%) represent highly disturbed grass–sedgelands and herbaceous open habitats, typically occurring on reclaimed plots, abandoned lots, or heavily disturbed margins of wetland basins.

Vegetation includes:

- widespread grasses (*Paspalum sp., Chloris gayana, Eleusine indica, Digitaria ciliaris*)
- creeping species (Ipomoea sp.)
- ruderal herbs (*Phyllanthus urinaria, Physalis peruviana, Ageratum conyzoides*)
- patches of *Colocasia esculenta*

Shrub/herb mosaics were observed in a few inland plots (e.g., PP11 and parts of PP13), where shrubs (*Machaerium lunatum*) and young trees are mixed with extensive herbs and sedges.
These represent transitional zones between mangroves or wetlands and built-up areas.

Scattered trees / crops mosaic was identified at PP5, where managed and semi-managed crops, scattered fruit trees (e.g. *Mangifera indica, Carica papaya and Elaeis guineensis*), and mixed herbs occur along the shoulder of the abandoned railway, forming a disturbed agro-mosaic transitioning toward wetland margins.

PP15 recorded sandy shoreline conditions, coupled with herbs, sedges, creeping vines, including invasive plants (e.g. *Paspalum distichum* and *Digitaria ciliaris*) reflecting anthropogenic disturbance, and active modification.

Details of the site visited, including locations, habitat types and species recorded are presented in Appendix J.1 Photographs of various sites visited are shown in Appendix J.2. The field observations revealed highly modified mosaic of natural and semi-natural habitats, with only small remnants of intact mangrove forest remaining.

Table 7-2 Summary of habitat types observed during the field survey

Habitat type	No. sites	Notes
Dense mangrove stand	1	Dense patches of mangroves occurring along the margins pf the St. Paul River Estuary. No intact systems remain; all are surrounded by settlements, altered drainage, and waste.
Highly fragmented mangrove patches	6	Varies in condition—under brushed, disturbed, degraded, or fair; mostly subject to past human use.
Brackish wetland vegetation	3	Internal wetlands within Bushrod Island. Dominated by ferns, sedges, and invasive floating plants. Brackish due to tidal influence and groundwater salt intrusion.
Drainage-associated wetland	1	Wetland vegetation and aquatic habitat along drainage channels with aquatic weeds and fauna and solid waste.
Open habitat (disturbed)	5	Dominated by grasses, sedges, herbs; present on cleared plots, abandoned land, and disturbed areas.
Shrub–herb mosaic	2	Secondary vegetation composed of shrubs, small trees, herbs, sedges, and vines. Often on abandoned land or railway edges.
Scattered trees / crops mosaic	1	Scattered or planted trees mixed with crops, grasses, and herbs. Semimanaged plots along settlement edges.
Sandy beach (urban / peri-urban)	1	Sandy shoreline affected by human activity, waste, and erosion

7.5.2.1.2. Flora

A total of 142 plant species from 111 genera and 58 families, were recorded in the survey plots established in the project area (Appendix J.3). The recorded species were predominantly herbs (39%), followed by trees (13%) and grasses (12%). Grasses and sedges were particularly dominant in seasonally flooded areas and along the margins of drainage lines. The flora composition included a mix of wild native species and common domesticated plants, such as Mango (*Mangifera indica*), Cassava (*Manihot esculenta*), and Sweet Potato (*Ipomoea batatas*). The dominant plant families observed were Poaceae (about 18%), followed by Cyperaceae (about 14%), Fabaceae (about 12%), and Asteraceae (about 10%).

Mangrove- species recorded inlude *Avicennia germinans* (Acanthaceae), *Laguncularia racemosa* (Combretaceae), *Rhizophora mangle* and Rhizophora racemosa (Rhizophoraceae).

No species classified as Threatened or Near Threatened under the IUCN Red List were recorded within the surveyed sites. No species found are endemic to Liberia, and none qualify as restricted-range species. All species recorded in the survey are widespread across West Africa, Africa, or the tropics.

The dominance of herbs (39%) and grasses (12%) is a classic indicator of of a disturbed landscape. The current structural composition heavily weighted toward the Poaceae and Asteraceae families reflects a habitat that is frequently cleared, burned, or trampled.

The presence of mangrove relics and fern-dominated wetlands remains the most significant ecological feature of the project area. Despite high levels of firewood harvesting and land reclamation, these patches provide the only complex structural habitat available. The ferns

(Cyclosorus and Pteridium) and sedges (Cyperaceae) identified are not only resilient to seasonal flooding but also serve as the final biological filter for urban runoff before it enters the Stockton Creek.

The survey confirmed the presence of several invasive and potentially invasive plant species, especially in disturbed areas and wetlands. These include *Bryophyllum pinnatum, Chromolaena odorata, Digitaria ciliaris, Pistia stratiotes*, *Eichhornia crassipes*, *Ipomoea aquatica*, *Lemna minuta*, *Paspalum distichum*, *Paspalum notatum*, *Physalis peruviana, Salvinia molesta* and *Urochloa mutica*. Many of these were abundant in certain plots, reflecting strong human disturbance and altered hydrology. *Chromolaena odorata and Eichhornia crassipes* are confirmed invasives in Liberia. *Salvinia molesta* is an alien invasive confirmed globally. It forms dense mats that deoxygenate water and represents a high risk for Liberia wetlands. The presence of Giant Salvinia (*Salvinia molesta*) and Water Hyacinth (*Eichhornia crassipes*) is particularly concerning. These species ranked among the world's 100 most invasive species and thrive in nutrient-rich (eutrophic) waters typical of urban areas with poor waste management (Tabassum-Abbasi et al., 2022). The other species listed above are either alien or native but have invasive potential in Liberia. Overall, the dominance of invasive and potentially invasive species in the surveyed plots is consistent with the highly disturbed, urban–wetland setting of the project area, where altered hydrology, nutrient enrichment, and repeated vegetation clearance favor opportunistic and aggressive taxa. The abundance of *Chromolaena odorata* and floating aquatic invasives such as *Eichhornia crassipes* and *Salvinia molesta* indicates long-standing anthropogenic pressure and disrupted water regimes, and highlights a heightened risk of further spread during construction if disturbance pathways are not carefully managed. This assemblage reflects a degraded baseline rather than intact natural vegetation, but nonetheless requires targeted preventive and control measures to avoid exacerbating impacts on surrounding wetlands and drainage systems.

Detailed results of plant survey are provided in Appendix J.1. The species checklist is presented in Appendix J.3. Photographs of select species identified are shown below in Appendix J.4.

7.6. Fauna

7.6.1. Available Data

Available information on fauna within the project area is derived primarily from secondary sources, including previous relevant environmental and social impact assessments (one of which is recent and including and eDNA survey conducted in the West Point / Mesurado coastal–estuarine system), as well as Ramsar Site documentation for the Mesurado Wetland system.

The project area is located within a highly urbanized and modified landscape characterized by dense human settlement, infrastructure development, and long-term habitat disturbance. As a result, terrestrial faunal diversity within the project footprint is expected to be low and dominated by species tolerant of human activity. Records of higher biodiversity value species from the wider Mesurado Wetland system are therefore considered representative of regional ecological context rather than confirmed presence within the project area.

7.6.1.1. Mammals

Mammals likely to occur within or near the project area are expected to be largely limited to small, disturbance-tolerant species commonly associated with urban environments. Previous assessments in Monrovia report synanthropic rodents and bats as the most frequently encountered mammal groups in urban settings (Earthtime Inc., 2013).

Results from an eDNA survey conducted during the undertaking of an ESIA in the West Point/Mesurado Estuary area detected common invasive commensal rodents (*Mus musculus* and *Rattus norvegicus*), which is consistent with expectations for densely populated coastal urban areas (Earthtime Inc., 2025).

The Mesurado Wetlands Ramsar documentation indicates that the wider wetland system has historically supported wetland-associated mammals such as the Water Chevrotain (*Hyemoschus aquaticus*, IUCN: Least Concern) and the Red Colobus (*Piliocolobus badius*[3], IUCN: Endangered)). These Ramsar listings are treated here as regional context and do not confirm current presence within the project footprint or heavily urbanized wetland margins.

In addition, prior environmental assessment work in the Mesurado Wetland complex has reported the West African manatee (*Trichechus senegalensis*, IUCN: Vulnerable). This record

indicates the potential for manatee use of the broader estuarine system, but does not confirm presence or reliance within the heavily urbanized project footprint.

7.6.1.2. Birds

Bird assemblages expected within the project area are likely to be dominated by urban generalists and species tolerant of human presence, with many observations consisting of flyovers or opportunistic use of open spaces and shoreline edges. Commonly reported species include the Red-Eyed Dove (*Streptopelia semitorquata*), Laughing Dove (*Stigmatopelia senegalensis*), Pied Crow (*Corvus albus*), African Palm-Swift (*Cypsiurus parvus*), and Palm-Nut Vulture (*Gypohierax angolensis*) (Earthtime Inc., 2013).

Ramsar documentation for the Mesurado Wetlands indicates that the wider system supports a range of wetland and coastal birds (including herons, plovers, sandpipers and terns), as documented in Ramsar Site Information Service records (2006) and regional ornithological literature (Borrow & Demey, 2014; Gatter, 1997). Some of these species may occur within the project area. These species are typically associated with less disturbed wetland, estuarine, and shoreline habitats and are considered unlikely to depend on the highly modified habitats. Bird use of the project area is therefore expected to be limited to opportunistic foraging or resting.

7.6.1.3. Herpetofauna

[3] Note: older literature may use *Procolobus badius*

Available information on reptiles and amphibians within the immediate project area is limited. In urban environments across Monrovia, herpetofauna is generally represented by a small number of disturbance-tolerant species associated with wetlands, drains, and vacant plots.

At the regional scale, the Mesurado Wetland system has historically supported several reptile species, including crocodiles such as the African dwarf crocodile (*Osteolaemus tetraspis* - Vulnerable), Nile Crocodile[4] (*Crocodylus niloticus*), and African slender-snouted crocodile (*Crocodylus cataphractus*, IUCN: Critically Endangered), as well as water snakes, lizards, skinks, and turtles (International Union for Conservation of Nature, 2025; Ramsar Convention Secretariat, 2006). However, no recent or site-specific records of reptiles or amphibians are available for the project area, and their occurrence within the project footprint is expected to be low due to long-term habitat disturbance and continuous human presence.

7.6.1.4. Beach Fauna

Faunal diversity along sandy beaches within the urban coastal zone of Monrovia is generally low and limited to a small number of crabs, molluscs, insects, lizards, and birds. Birds commonly observed resting or feeding on sandy beaches in Liberia include terns, herons, and waders (Gatter, 1997).

Previous environmental assessments and community consultations conducted among fishing communities in Monrovia, including West Point's fishing communities, indicate that sea turtles do not nest on the city's beaches. This absence is attributed primarily to high levels of human activity, artificial lighting, and continuous disturbance. In contrast, turtle nesting has been documented along less disturbed beaches in southeastern Liberia and up to Grand Bassa County (Earthtime Inc. & CDR International, 2019).

7.6.1.5. Marine and Estuarine Fauna

7.6.1.5.1. Invertebrates

Published, site-specific studies of marine and estuarine invertebrates in the Monrovia area are limited. Available literature indicates that Liberia's nearshore and estuarine waters support crustaceans and molluscs, including crabs, shrimps and bivalves, some of which are of local commercial and subsistence importance. National biodiversity planning documents (e.g. Liberia's first National Biodiversity Strategy and Action Plan) present indicative lists of marine invertebrates for coastal locations including West Point in Bushrod Island; however, these sources generally do not describe sampling methods or effort and include taxa from a range of habitats. Le Loeuff and von Cosel (1998) sampled sedimentary macrofauna of northwestern

[4] The African Nile Crocodile is currently recognized as two distinct species: one occupying eastern Africa, the Nile valley and southern Africa and retaining the name *Crocodylus niloticus* Laurenti, 1768; and the other occupying west and central Africa, and assigned to the existing name *Crocodylus suchus* Geoffroy, 1807. Red List assessments now treat these two taxa independently. Therefore, *Crocodylus suchus* is the species for Liberia. As of 2025, the West African crocodile (*Crocodylus suchus*) has not yet been formally assigned an individual status on the IUCN Red List.

Africa on the shelf, to a depth of 200 m. The dominant fauna at all depths sampled were Polychaete worms. The study found that the Liberian fauna was reduced in numbers. This was explained to be due to a diminished effect of nutrient upwelling and primary productivity compared with the Guinea coast to the north and Ivory Coast, inside the Gulf of Guinea, to the south (Le Lœuff & Von Cosel, 1998). As a result, the literature provides a broad indication of invertebrate groups that may occur in the wider coastal– estuarine environment, rather than a verified species inventory for the urban shoreline.

Results from an eDNA survey conducted during the undertaking of an ESIA in the West Point Coast/Mesurado Estuary in 2025 detected multiple invertebrate taxa, supporting the interpretation from the literature that estuarine mixing zones may support relatively higher invertebrate diversity compared to more exposed coastal waters. The survey detected 14 taxons of Annelids, with 6 identified to species level (e.g. *Bimastos rubidus, Dendrobaena octaedra, Nais communis, Pontoscolex corethrurus, Arctonoe vittata, Megadrilus hochbergi*), about 30 taxa of Arthropods dominated by zooplancton and insect taxa in addition to two taxa of crabs including a Portunid crab (e.g. *Callinectes sapidus*) and one unidentified species of Ocypode. The surey also detected five taxons of Molluscs, but none identified to species level (Earthtime Inc., 2025). These findings are interpreted as indicative of recent presence and do not provide information on abundance or habitat dependency.

7.6.1.5.2. Fish

Compared with other faunal groups, fish diversity and occurrence in Liberian waters are relatively better documented, largely due to the importance of fisheries. Identification guides and fisheries literature describe a diverse assemblage of coastal and estuarine fish species, including clupeids (e.g. sardinellas), sciaenids (croakers), threadfins, snappers, groupers and other demersal and pelagic species commonly exploited by artisanal fisheries.

An environmental assessment conducted by Earthtime for the MCCRP in Monrovia in 2019 revealed that Cassava Croakers, West African Ilisha, Sardine and Barracuda are the most abundant in the coastal waters of Monrovia, up to 6 Nautical Miles.

The 2025 eDNA survey undertaken for the Monrovia Metropolitan Climate Resilience Project provides additional, recent evidence supporting these conclusions, having detected multiple fish taxa and indicating higher species-level diversity in estuarine samples compared with coastal and riverine samples. Notable detections included species assessed as Near Threatened or Vulnerable on the IUCN Red List, such as Angola Dentex (*Dentex angolensis*) and Royal Threadfin (*Pentanemus quinquarius*). These detections are interpreted as evidence of recent presence within the wider estuarine and coastal system.

7.6.1.5.3. Marine Mammals

Information on marine mammal occurrence in Liberian waters is limited and largely derived from targeted literature reviews undertaken for offshore and coastal ESIAs. These reviews indicate that a number of cetacean species may occur within Liberia's Exclusive Economic Zone, with some species using nearshore and coastal waters.

Of particular relevance to the coastal and estuarine context described in the literature are the Atlantic Humpback Dolphin (*Sousa teuszii*), which is restricted to shallow coastal and estuarine waters of West Africa and is assessed as Critically Endangered by the IUCN, and the West

African Manatee (*Trichechus senegalensis* –Vulnerable), which utilises nearshore marine, estuarine and freshwater habitats. Although confirmed, site-specific records in urban Monrovia are not available, the literature identifies these species as potentially occurring within suitable coastal and estuarine habitats along the Liberian coast.

7.6.1.5.4. Marine Birds

Marine and coastal birds such as terns, waders and herons are documented in the literature as occurring in Liberian nearshore and offshore waters. Global bird databases and regional ornithological literature list several intertidal, neritic and oceanic seabird species for Liberia. Within urban coastal settings such as Monrovia, some of these species are expected to be transient or opportunistic users of coastal waters and shorelines rather than as dependent on local breeding or roosting habitat. Representative species include terns (e.g. Little Tern *Sternula albifrons* and Common Tern *Sterna hirundo*), plovers and sandpipers, and herons (BirdLife International, 2024).

7.6.1.5.5. Sea Turtles

Four species of sea turtles are known to occur in Liberian waters, including the hawksbill, green, olive ridley and leatherback turtles, based on national and regional literature. However, previous environmental assessments and community consultations in Monrovia consistently indicate that sea turtles do not nest on the urban beaches of Monrovia, including within the project area, due to high levels of human activity, artificial lighting and disturbance.

7.6.2. Field Survey Results and Discussion

7.6.2.1. Birds

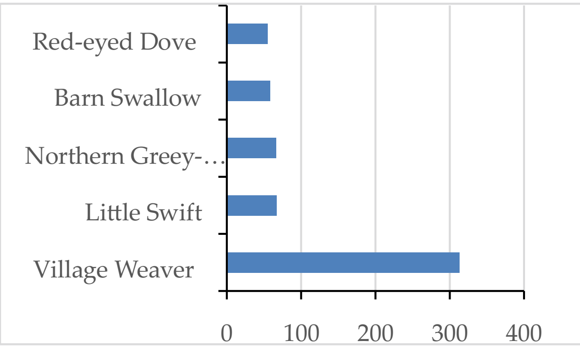
The bird survey conducted in documented a total of 53 species. All bird species recorded in the survey are classified as Least Concern (LC) under the IUCN Red List, except for the Grey Plover (*Pluvialis squatarola*) wich is assessed as Vulnerable and two species that are not yet evaluated under the Red List.

The top five most abundant species recorded during the field survey were Village Weaver (*Ploceus cucullatus*, 313 individuals), Little Swift (*Apus affinis*, 67 individuals), Northern Greyheaded Sparrow (*Passer griseus*, 66 individuals), Barn Swallow (*Hirundo rustica*, 58 individuals), and Red-eyed Dove (*Streptopelia semitorquata*. 55 individuals) (Figure 7-11a).

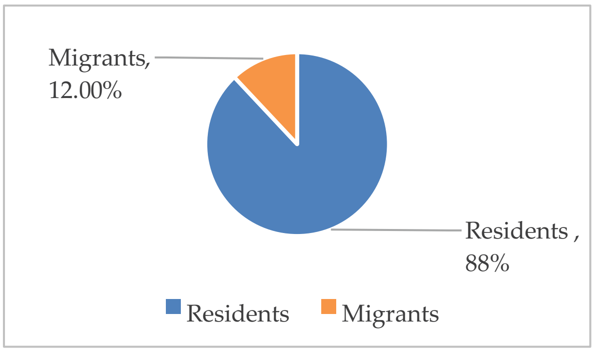
The bird community included both resident and migratory species. Resident birds dominated the survey results, with about 90% of records (Figure 7-11b). Seven long-distance Palearctic migrant species were recorded (Table 7-3). The most abundant among migrant species was the Barn Swallow, with 58 individuals recorded. Among them, the Grey Plover is assessed as Vulnerable in the IUCN Red List.

While other threatened migratory species such as Leach's Storm-petrel (*Hydrobates leucorhous*, Vulnerable) and Curlew Sandpiper (*Calidris ferruginea*, Vulnerable) were not directly sighted during this study, the coastal habitats extending from the New Kru Town Lagoon Community to Popo Beach remain suitable for them.

Furthermore, while the rare Rufous Fishing-owl (*Scotopelia ussheri*, Vulnerable) was not recorded, historical reports (Gatter, 1997) indicate its presence within the larger Mesurado Wetland. It is important to note, however, that the Rufous Fishing-owl is highly dependent on undisturbed mangrove and riverine forests. Given the highly disturbed nature of the current landscape, any conservation initiatives should prioritize the protection of the remaining good patches of mangroves along Stockton Creek and St. Paul River to maintain any potential habitat for this species.



(a)



(b)

Figure 7-11 (a)Abundance of the most frequently recorded bird species (n>50) during the field survey; (b) Migrant vs. resident bird species recorded during the field survey

Table 7-3 Migratory bird species recorded during the field survey

English name	Scientific name	Abundance	Habitat preference	IUCN Red List category*
Grey Plover	*Pluvialis squatarola*	1	Seashore	**VU**
Arctic Tern	*Sterna paradisaea*	6	Seashore	LC
Barn Swallow	*Hirundo rustica*	58	Open area	LC
Common Sandpiper	*Actitis hypoleucos*	14	Wetland	LC
Arctic Tern	*Sterna paradisaea*	6	Seashore	LC
Eurasian Whimbrel	*Numenius phaeopus*	3	Wetland	LC
Wood Sandpiper	*Tringa glareola*	3	Wetland	LC
**LC= Least Concern; VU= Vulnerable*				

The vast majority of bird species recorded (54%) are typically associated with grasslands and open habitats, home to seed-eating birds such as the African Palm Swift (*Cypsiurus parvus*), Bronze Mannikin (*Lonchura cucullata*), Laughing Dove (*Spilopelia senegalensis*), Common Bulbul (Pycnonotus barbatus) and Barn Swallow (*Hirundo rustica*). However, the survey also documented species associated with a variety of other habitat types, including (Appendix J.5):

- Wetlands (21%), which support specialist species such as the Common Moorhen (*Gallinula chloropus*), the Common Sandpiper *(Actitis hypoleucos)* and Reed Cormorant (*Microcarbo africanus*)

- Bush thicket (23%), which provides cover and foraging opportunities for species like the Tawny-flanked Prinia (*Prinia subflava)*, the Northern Puffback (*Dryoscopus gambensis*) and Grey-backed Camaroptera (*Camaroptera brevicaudata*).
- Fewer species (2%) associated with seashores (e.g. Arctic Tern, Grey Plover), rivers (e.g. White-bibbed Swallow), and grassland (e.g. Splendid Starling)

Despite urban pressures, the presence of seven Palearctic migratory species, including the IUCN Red Listed Grey Plover, confirms that the area is an seasonal stopover. Although the survey took place early in the migration season, the presence of these species suggests that the study area and the broader Mesurado Wetland provide essential resources for migratory birds.

The birds data summary is shown in Appendix J.5 and the species checklist is presented in Appendix J.6 and photographs are presented in Appendix J.7.

7.6.2.1.1. Community Perceptions and Threats

Informal community interviews conducted during the bird survey reported absence of bird hunting and trapping. In many coastal Liberian communities, shorebirds are frequently targeted for subsistence; however, the communities surveyed in Northern Bushrod Island indicated a shift away from these practices.

However, birds face a systemic threat from habitat degradation. The heavy accumulation of garbage and plastic waste in the wetland areas is a critical concern. Foraging shorebirds and wetland specialists are particularly vulnerable to the ingestion of or entanglement in plastic debris. Furthermore, the use of drains and wetlands as dumpsites alters the hydrology and water quality, potentially reducing the abundance of aquatic invertebrates that serve as a primary food source. Ultimately, the contamination of nesting sites with non-biodegradable waste poses a direct threat to the reproductive success of resident species.

7.6.2.2. Herpetofauna

A total of 111 herpetofauna records were documented, including 103 direct sightings and eight acoustic recordings of mating frogs and toads' calls, were recorded across the 32 survey plots established along the project area.

Five herpetofauna species were recorded, including 4 amphibian species and one reptile species, representing fie herpetofauna families and reflecting low taxonomic diversity within the sampling effort and temporal window).

The herpetofaunal survey revealed a dominance of Agama lizards *Agama agama*, recorded 31 times across grassland, swamp, and drainage-associated habitats, particularly within urban and peri-urban settings. Its population ranged from isolated individuals to concentrations exceeding ten per plot, underscoring its high tolerance to human disturbance and widespread distribution across modified landscape.

Amphibian diversity was represented primarily by the Mascarene Grass Frog (*Ptychadena mascareniensis*), Hallowell's Toad (*Amietophrynus maculatus*), Brown Banana Frog (*Afrixalus dorsalis*), and the less frequently detected Crowned Bullfrog (*Hoplobatrachus occipitalis*), all classified as Least Concern by the IUCN Red List. These species were most frequently recorded in mixed grassland–swamp mosaics, drainage channels, and the rail-track corridor, with several detections associated with anthropogenically altered wetlands, garbage-affected areas, and defecation sites. Their presence within degraded aquatic habitats suggests tolerance to pollution and habitat modification.

Several plots yielded no herpetofaunal detections, particularly those dominated by garbage accumulation, hardened drainage channels, or severe habitat alteration, indicating localized unsuitability for amphibians and reptiles.

On the other hand, informal interviews with community members revealed four additional reptile species that were not detected during field surveys but were reported from areas immediately surrounding the project footprint, particularly along drainage channels, mangrove fringes, and urban settlements near St. Paul estuary and Logan Town). Reported species include:

- Black Tree Cobra (*Pseudohaje nigra*)
- Common Night Adder (*Causus maculatus*)
- African Rock Python (*Python sebae*)
- West African Crocodile (*Crocodylus suchus*), commonly called Nile Crocodile (see Section 7.6.1.3)
- West African Mud Turtle (*Pelusios castaneus*)

Several interviewees reported recent sightings, while others described intentional killings, notably of the African Rock Python and West African Crocodile.

Among all species recorded, the Central African Rock Python (*Python sebae*), classified as Near Threatened (NT) by the IUCN Red List, is the only species of elevated global conservation concern. Although it was not detected during the present survey, it is known for its distribution in West Africa and potential presence in less disturbed swamp areas. Together with the "Nile" corocodile, the Rock Phyton is also protected in Liberia (Appendix H).

While most recorded species pose no direct threat to surveyors or workers, potentially dangerous reptile species included in the broader species inventory warrant attention although not encountered during the assessment:

- Black Tree Cobra (*Pseudohaje nigra*) – venomous: this elapid species is medically significant. It can deliver neurotoxic venom and may present a risk if present in less work areas.
- Spotted Night Adder (*Causus maculatus*) – Venomous (Viperidae): this viper is mildly venomous but capable of inflicting painful bites. Bites are rarely fatal but may impair workers if encountered.
- While not venomous, *Python sebae* is capable of defensive biting and is a potentially dangerous constrictor.
- The West African crocodile (*Crocodylus suchus*), is a potentially dangerous species

Detailed results of the herpetofauna survey are presented in Appendix J.8. The checklist of recorded species is presented in Appendix J.9, while some photographic documentation of herpetofauna recorded are provided in Appendix J.10.

7.6.2.2.1. Community Perceptions and Threats

A significant finding of community reports recorded during the herpetofauna survey is the high level of direct threat to reptiles. Unlike the bird populations, which were reported to be largely unharvested, reptiles in the project area face intense pressure from both subsistence hunting and persecution. The killing of African Rock Pythons and the consumption of West African Mud Turtles and crocodiles highlight a conflict between urban expansion and wildlife survival. The presence of venomous species like the Black Tree Cobra in residential areas poses a public health risk that often results in the pre-emptive killing of all snake species, regardless of their ecological value or venom status.

For amphibians, the primary threat is habitat contamination. The use of ponds and swamps as communal dumpsites and defecation areas have severely degraded the microhabitats necessary for larval development and skin-moistening. Plastic waste and liquid effluent change the chemical composition of these water bodies, which likely explains the low diversity of amphibian species recorded. Furthermore, sand and clay mining has altered the natural topography in some areas, creating artificial trenches that, while holding water, may act as ecological traps due to high pollution levels.

7.6.2.3. Aquatic Fauna

7.6.2.3.1. Fish

A total of 27 fish species were recorded among 351 individuals captured from water bodies in the AoI, including the St. Paul River, Stockton Creek and the Atlantic Ocean. Of these, 25 were identified to species level and two to genus level. Recorded fish are marine, estuarine, and freshwater-associated species, reflecting the nature of the project area. Species composition was dominated by coastal and estuarine generalists, with several taxa known to tolerate variable salinity, turbidity, and anthropogenic disturbance.

The most abundant species were disturbance-tolerant estuarine generalists such as Silver Catfish (*Chrysichthys nigrodigitatus*, 83 individuals), Flagfin Mojarra (*Eucinostomus melanopterus*, 63 individuals) and Blackchin Tilapia (*Sarotherodon melanotheron*, 55 individuals).

Most recorded species are classified as Least Concern in the IUCN Red List, indicating low overall conservation sensitivity. However, the detection of *Sardinella maderensis* (Vulnerable) and *Brachydeuterus auritus* (Near Threatened), albeit in low numbers, highlights the importance of the wider coastal zone as part of regional fisheries resources. According to the IUCN Red List, the primary threat to both species is overexploitation through commercial and artisanal fisheries. Population declines in these taxa are driven mainly by high fishing pressure across their broader distribution range, particularly in West African coastal waters, where industrial and small-scale fisheries overlap.

None of the fish species recorded are considered invasive in Liberia, and no endemic species were identified.

Detailed results of the aquatic survey in the project area are presented in Appendix J.11. The checklist of fish species recorded is presented in Appendix J.12. Some photographic documentation of aquatic species and taxa recorded are provided in Appendix J.13.

7.6.2.3.2. Macroinvertebrates

A total of five macroinvertebrate taxa were recorded among 282 individuals captured from 16 sampled locations, including water bodies, existing draining channels, drainage outlets, beaches and riverbanks. Identified taxaincluded four crustaceans:

- the West African Blue Crab (*Callinectes amnicola,* 36 individuals*)*
- the Atlantic Ghost Crab (*Ocypode cursor*, 25 individuals)
- the African River Prawn (*Macrobrachium vollenhoveni,* 48 individuals)
- *Sesarma spp.* (four individuals)

These taxa are characteristic of estuarine, intertidal, and shallow coastal environments and are generally recognized as disturbance-tolerant species. No IUCN Red List threatened species were recorded.

One species of mollusk, the West African Mud Creeper (*Tympanotonos fuscatus,* 169 individuals), was highly abundant, which is commonly associated with brackish mudflats and mangrove systems and are widely consumed in the project area.

In addition, various bivalve shells were recorded along the beach to the west of the project area; however, they could not be identified to species level. The shells were documented as scattered accumulations of bleached and highly weathered material observed along sections of the sandy shoreline. Due to their degraded condition, reliable species identification was not possible. These observations indicate a general presence of intertidal bivalves in the wider coastal environment.

None of the recorded invertebrate taxa are listed as globally threatened under the IUCN Red List. The West African Blue Crab and the Atlantic Ghost Crab are currently not evaluated by the Red List, reflecting gaps in global assessment rather than known conservation risk.

Detailed results of the aquatic survey in the project area are presented in Appendix J.11. Some photographic documentation of invertebrate species and taxa recorded are provided in Appendix J.14.

7.6.2.3.3. Community Perceptions and Threats

Direct engagement with residents across study sites during the aquatic revealed a high degree of community dependency on aquatic resources for both food security and income. This reliance creates significant anthropogenic pressure on the diverse, yet fragile, ecosystems of Bushrod Island. The key livelihood activities included artisanal fisheries and river sand mining.

Fishing was a primary livelihood activity in waterfront communities. Both subsistence and small-scale commercial fishing occur across the Stockton Creek, St. Paul River, and the Atlantic coast.

Active river sand mining was observed along Stockton Creek, from Jamaica Road Bridge to Caldwell Bridge. This activity directly alters benthic habitats, increasing turbidity and disrupting the spawning grounds of fish and crustaceans. More information on these aspects is given in Section 0 on ecosystem services.

7.6.2.4. Additional survey results

While the primary focus of the survey was on aquafauna, avifauna, and herpetofauna, community engagement recorded the potential presence of two mammal species within the project area. Residents in the Logan Town community reported sightings of the Green Monkey (*Chlorocebus sabaeus*) and the Common Mongoose (*Herpestes ichneumon*) in the wetland areas along Stockton Creek. Both species are well-adapted to disturbed environments and are classified as Least Concern in the IUCN Red List of Threatened Species. Community members noted that a single large Green Monkey, likely a remnant of a formerly larger troop, frequently visits a specific patch of mangrove within the area.

7.6.3. eDNA Survey Results and Discussion

7.6.3.1. Vertebrate Assay

The eDNA sampling exercise identified 79 Operational Taxonomic Units[5] (OTU) or DNA sequences of vertebrates, suggesting a total vertebrate species richness of 79 among the seven samples reported. The average species richness per sample was 26.

It should be noted that three out of the ten samples initially collected and sent to the laboratory for analyis did not pass the laboratory's quality-control checks. These are eDNA01_V, eDNA04_VMF, and eDNA05_VMF, which were collected respectively from a drainage channel, a drainage outlet, and a marshy wetland. The most likely cause is PCR inhibition by compounds naturally present in these samples (e.g. humic/fulvic acids, organic debris, sediments) or pollutants (e.g.chemical pollutants). PCR inhibition occurs when compounds present in the sample interfere with the PCR reaction, preventing or reducing target DNA amplification and subsequent detection.

Species richness varied among the samples. Samples eDNA02_VMF, eDNA03_VMF, and eDNA06_V and eDNA08_V had a relatively higher species richness (52, 37, 27 and 28, respectively), indicating a relatively healthier and functioning ecosystem at these locations.

Samples eDNA09_VM and eDNA10_VMF had the lowest species richness of 10 and 12, respectively (Figure 7-12a).

Evolutionary diversity also differed among samples, with samples eDNA09_VM, and eDNA10_VMF having the lowest evolutionary diversity (less than 1.5), indicating a relatively lower vertebrate resilience at these locations (Figure 7-12b). Samples eDNA03_VMF, and eDNA02_VMF showed relatively higher evolutionary diversity (greater than 3) showing an increased resilience of the community.

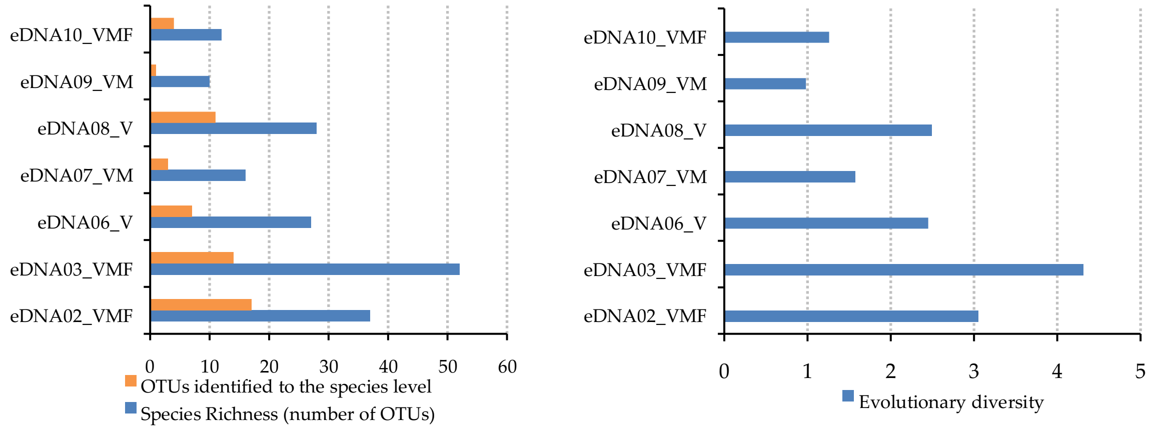
It should be noted that about 35% of the OTUs could be identified to the species level. The remaining OTUs were identified to the genus, family or order level. This could be due to the

[5] An OTU is a DNA sequence found in a sample and, in most cases, is broadly equivalent to a species.

lack of a matching sequence reference in the reference database, due to current gaps in the database[6].

The majority of the OTUs detected were fish (91%), followed by birds (5%) and mammals (4%) (Figure 7-13). However, these fractions do not reflect the relative abundance of the various classes of vertebrates at the time of sampling. They rather represent the distribution of the DNA sequences that were present in the water samples among the various classes of vertebrates. For instance, the dominance of fish DNA sequences is attributed to the fact that fish are fully aquatic and consistently release DNA into the water.

No reptiles were detected in the samples. This absence may be attributed to several factors, including the typically low DNA shedding rates of reptiles (Adams et al., 2019; Nordstrom et al., 2022), their predominantly terrestrial habitats, and limited interaction with aquatic environments, except in the case of aquatic species.



a) Species richness

b) Evolutionary diversity

Figure 7-12 Vertebrate species richness and evolutionary diversity

Similarly, no amphibians were detected. This absence may be due to several factors. Amphibians are primarily freshwater or terrestrial organisms with limited tolerance for saline conditions, which reduces their likelihood of detection in the brakish samples Marine primers also tend to show lower amplification efficiency for amphibian DNA (Harper et al., 2019; Valentini et al., 2016). Amphibians generally shed low amounts of eDNA, especially when they are not directly interacting with the sampled environment (Harper et al., 2019). In addition, local amphibian abundance may be reduced due to habitat degradation caused by solid waste pollution and contamination from defecation, further decreasing the probability of detection.

[6] Depending on completeness of reference databases for the region where the sample is taken, some OTUs may not match to a reference at species level. Global DNA reference databases contain millions of barcodes, but gaps remain, particularly in regions and taxonomic groups that are more diverse and less studied. Coverage is expected to improve over time and data tables can be updated to include new information gained. Other factors may include DNA degradation, the limited ability of short barcode regions to distinguish closely related species, and the use of conservative taxonomic assignment thresholds.

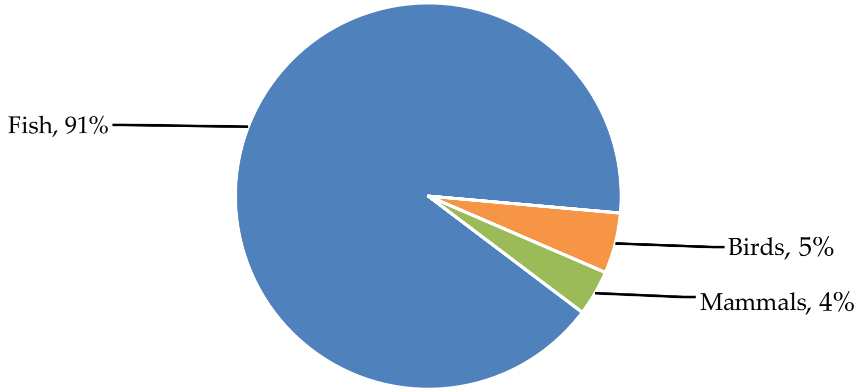


Figure 7-13 Distribution of OTUs detected among classes of vertebrates

Dominant orders for each vertebrate class detected are listed in Table 7-4. The vertebrate assay revealed the presence of 72 different OTUs of fish, 4 birds, and 3 mammals. Among birds, the orders represented were Accipitriformes, Columbiformes, and Passeriformes, including species such as the Black Kite (Milvus migrans) and the Pied Crow (Corvus albus). For mammals, the detected taxa belonged primarily to the orders Chiroptera and Rodentia, represented by species such as the Straw-Coloured Fruit Bat (Eidolon helvum) and the Black Rat (Rattus rattus).

Table 7-4 Dominant orders among freshwater vertebrate OTUs detected

Class	Dominant order(s)
Fish	Anguilliformes, Characiformes, Clupeiformes, Cyprinodontiformes, Mugiliformes, Osteoglossiformes, Perciformes, Siluriformes
Birds	Accipitriformes, Columbiformes, and Passeriformes
Mammals	Chiroptera, Rodentia

The eDNA survey recorded one IUCN threatened Species: the Madeiran Sardinella *Sardinella maderensisi,* which is categorised as Vulnerable. The species was also detected during the aquatic survey. One species assessed as Near Threatened: the Straw-Coloured Fruit Bat (*Eidolon helvum*) was also recorded.

The survey detected *Coptodon zillii (Tilapia zillii*), which is classified as an invasive species in Liberia by the IUCN Invasive Species Specialist Group (2025) (See Section 7.8).

The vertebrate assay detected three mammal taxa: the Straw-coloured Fruit Bat (*Eidolon helvum*), the Black Rat (*Rattus rattus*), and an additional *Rattus sp.* not resolved to species level. *Eidolon helvum*, a Near Threatened, highly mobile frugivorous bat, is common across urban and peri-urban landscapes in West Africa, where it exploits fruiting trees, night-time foraging habitats, and roosting opportunities in anthropogenic structures. Its detection is consistent with the species' broad ecological tolerance and reflects the continued presence of aerial, disturbance-tolerant fauna within the wider project area. In contrast, *Rattus rattus* and the unidentified *Rattus sp.* are synanthropic rodents strongly associated with dense human settlements, waste accumulation, and degraded habitats. Their occurrence aligns with the highly urbanized and environmentally stressed conditions of Northern Bushrod Island and is indicative of persistent human–wildlife interactions typical of such settings. Together, these findings demonstrate a mammal community dominated by generalist and human-tolerant species.

A checklist of all vertebrate species detected is presented in Appendix J.15.1. The full results of the vertebrate assay at the individual sample level including species detected, metrics and quality control applied can be found in Appendix K.1.

7.6.3.2. Mammal Assay

The eDNA sampling identified ten OTUs or DNA sequences of mammals, suggesting a total mammal species richness of ten among the five samples reported using the mammal assay. The average species richness per sample was three.

Species richness was relatively low across the samples. eDNA03_VMF and eDNA07_VM had the highest richness, with 5 OTUs each, followed by eDNA09_VM (3 OTUs), eDNA02_VMF, and eDNA10_VMF (2 OTUs each) (Figure 7-14a). No mammal eDNA was detected in sample eDNA06_V, while eDNA04_VMF and eDNA05_VMF were not reported due to reasons explained in Section 7.6.3.1.

Evolutionary diversity also differed among samples (Figure 7-14b). eDNA03_VMF exhibited the highest evolutionary diversity (1.09), followed by eDNA07_VM (0.97) and eDNA09_VM (0.6), indicating a more resilient mammal community at these sites. eDNA02_VMF and eDNA10_VMF showed lower evolutionary diversity (0.4 and 0.13, respectively) (Figure 7-14b).

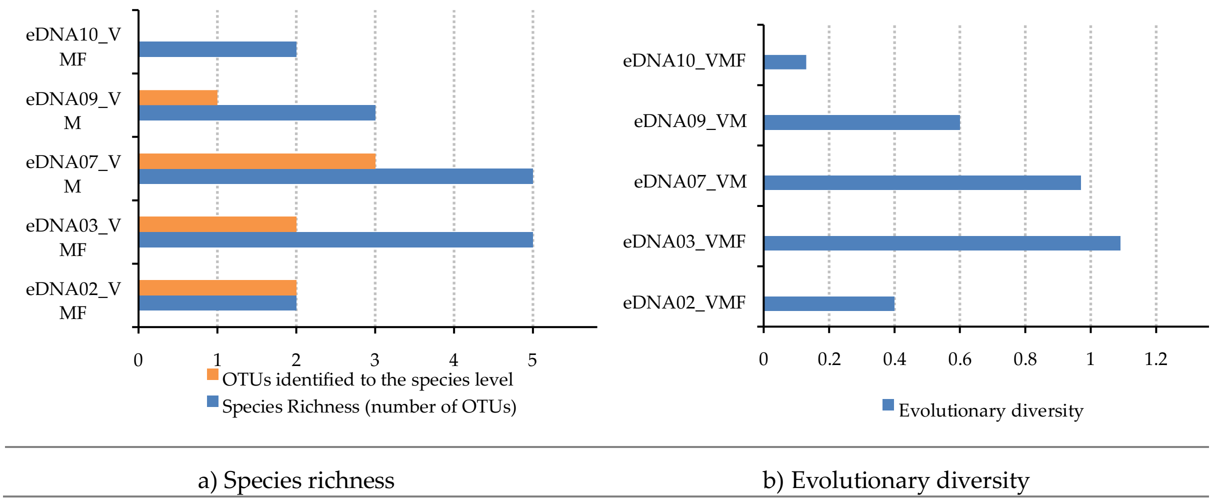


Figure 7-14 Mammal species richness and evolutionary diversity

It should be noted that only 50% of the OTUs could be identified to the species level. The remaining OTUs were identified to the genus, family or order level. This might be attributed to the absence of a corresponding sequence reference in the reference database, stemming from existing gaps within the database. Other factors may include DNA degradation, the limited ability of short barcode regions to distinguish closely related species, and the use of conservative taxonomic assignment thresholds.

Of the 10 OTUs detected, the majority were rodents (Rodentia, 60%), followed by bats (Chiroptera) and even-toed ungulates (Artiodactyla), each comprising 20% (Figure 7-15). No

Carnivores (Carnivora) were detected in the samples. This is mostly related to the predominantly urban and very degraded conditions of the project area.

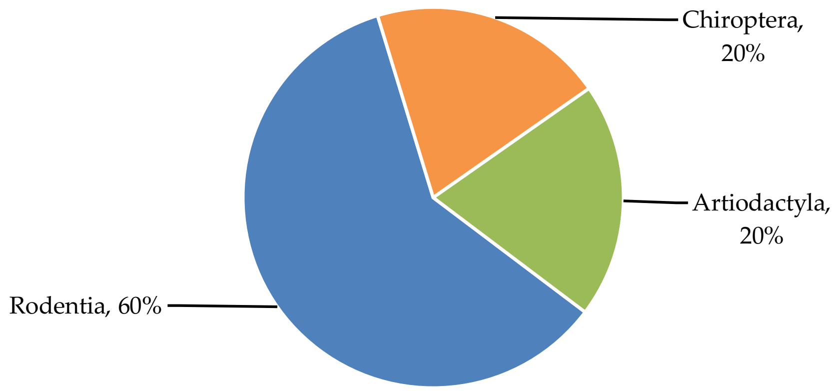


Figure 7-15 Distribution of OTUs detected among classes of mammals

Five taxa of mammals were identified to the species level. These include two belonging to the Artiodactyla (medium- to large-bodied mammals) order. These are:

- the Bushbuck (*Tragelaphus scriptus* – Least Concern), with its eDNA identified in sample eDNA02_VMF
- the Bay Duiker (*Cephalophus dorsalis* – Near Threatened), detected in samples eDNA03_VMF and eDNA09_VM.

The Bushbuck is a widespread and ecologically adaptable species in West Africa, known to utilize forest edges, riparian vegetation, and disturbed habitats. In the context of Northern Bushrod Island, the detection is interpreted as indicative of possible occasional or transient use of peripheral wetland or riparian habitats within the wider area, rather than evidence of a resident population within the project footprint.

On the other hand, the Bay Duiker is a forest-dependent species typically associated with intact lowland rainforest habitats. Given the highly urbanized and fragmented nature of habitats in Northern Bushrod Island, the species' regular presence within the project area is considered unlikely. The detection is therefore interpreted as potentially reflecting environmental DNA transport via connected waterways or indirect sources, rather than local habitat occupancy.

On the other hand, one bat species currently assessed as globally Near Threatened by the IUCN was also detected. This the Straw-Coloured Fruit Bat (*Eidolon helvum*), which DNA was also detected in the vertebrates assay (see Section 7.6.3.1). This species can persist in modified habitats and is often recorded in urban areas in Africa.

In addition, two rodents endemic to West Africa were recorded: the West African Shaggy Rat (*Dasymys rufulus*), which is common in swampy and wetland areas in West Africa, and the Forest Soft-Furred Mouse (*Praomys rostratus*), a common West African small rodent associated with lowland forests. It was detected in eDNA07_VM, which was collected from Stockton Creek and its detection is most plausibly explained by DNA transport from forested areas within the wider catchment rather than confirmed habitat inside the project AoI. Both species are assessed as Least Concern by the IUCN Red List.

No threatened species listed on the IUCN Red List, or classified as invasive were detected in the mammals assay.

Finally, although non-targeted by the mammal assay, 11 fish eDNA were detected. Among these, three fish genus were not initially detected in the vertebrate assay.

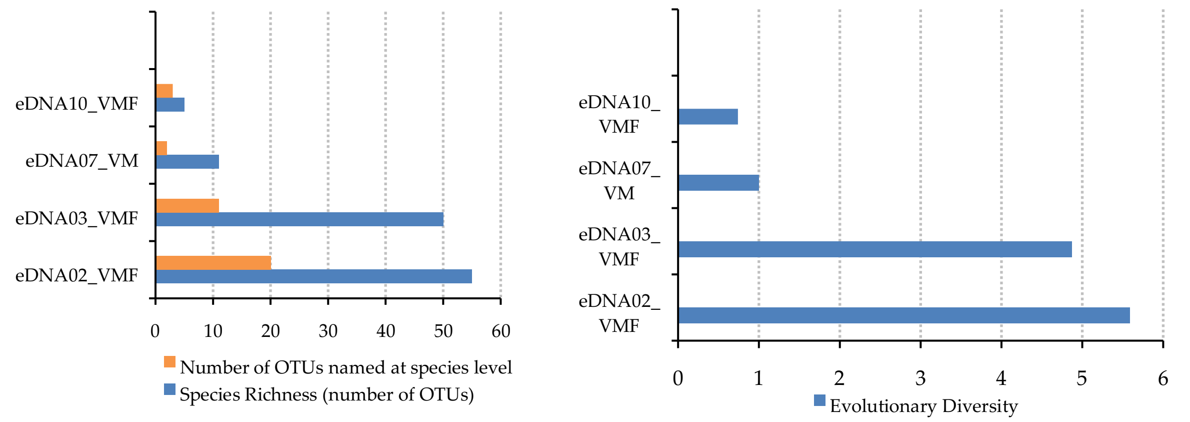
A checklist of all species detected in the mammal assay is presented in Appendix J.15.2. The full results of the mammal assay at the individual sample level including species detected, metrics and quality control applied can be found in Appendix K.2.

7.6.3.3. Fish Assay

The eDNA sampling identified 82 OTUs or DNA sequences of marine fish, suggesting a total fish species richness of 82 among the four samples reported. The average species richness per sample was 30.

Species richness was variable across the samples. eDNA02_VMF (55 OTUs) and eDNA03_VMF (50 OTUs) had a relatively high richness while eDNA07_VM (11 OTUs) and eDNA10_VMF (5 OTUs) had a low richness (Figure 7-16a).

Evolutionary diversity showed a similar pattern. eDNA02_VMF and eDNA03_VMF exhibited the higher evolutionary diversity (between 4 and 6), suggesting a more resilient fish community, while eDNA07_VM and eDNA10_VMF had a lower evolutionary diversity (less than 1, Figure 7-16b).



a) Species richness b) Evolutionary diversity

Figure 7-16 Fish species richness (a) and evolutionary diversity (b)

It should be noted that approximately 28% of the OTUs could be identified to the species level. The remaining OTUs were identified to the genus, family or order level. This might be attributed to the absence of a corresponding sequence reference in the reference database, stemming from existing gaps within the database. Additional contributing factors may include DNA degradation, the limited ability of short barcode regions to distinguish closely related species, and the use of conservative taxonomic assignment thresholds.Of the 82 OTUs detected, the largest proportion comprised perch-like fishes (Perciformes, 65%), followed by bony-tongued fishes (Osteoglossiformes, 7%), mullets (Mugiliformes, 7%), and herrings and anchovies (Clupeiformes, 7%). Catfishes (Siluriformes) accounted for 5%. Needlefish and halfbeaks (Beloniformes) and eels (Anguilliformes) each represented 2%, while carps, minnows, loaches, and goldfish (Cypriniformes), killifish and livebearers

(Cyprinodontiformes), and pufferfishes (Tetraodontiformes) each represented 1%. (Figure 7-17).

The eDNA survey recorded a total of 23 fish species. One IUCN threatened Species: the Madeiran *Sardinella Sardinella* maderensis, which is categorised as Vulnerable, was recorded. The species was also detected in the vertebrate assay results (see Section 7.6.3.1) and during the aquatic survey.

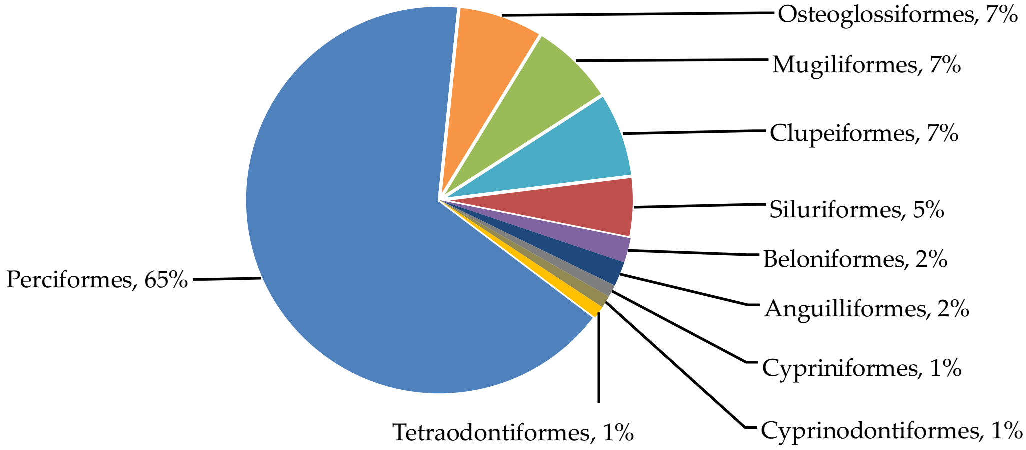


Figure 7-17 Distribution of OTUs detected among classes of fish

The survey detected *Coptodon zillii (Tilapia zillii*), which is classified as an invasive species in Liberia by the IUCN Invasive Species Specialist Group (2025) (See Section 7.8).

A checklist of all species detected in the fish assay is presented in (Appendix J.15.3). The full results of the fish assay at the individual sample level including species detected, metrics and quality control applied can be found in Appendix K.3.

7.7. Overall Biodiversity Sensitivity and ESS6 Critical Habitat Screening

Based on the results of habitat mapping (Section 7.4), targeted field surveys, and species assessments conducted within and around the project area (Section 7.5 and Section 7.6), the habitats potentially affected by the Project do not meet the criteria for critical habitat as defined under World Bank Environmental and Social Standard 6 (ESS6). Although modified and natural habitats are present, including wetlands and mangrove stands, these areas are highly degraded and do not support qualifying critical habitat features. The Mesurado Wetland, a designated Ramsar site, is located outside the Project AoI and is not directly affected by project activities. Given the modified nature of habitats within the project footprint and the absence of ESS6 critical habitat triggers, the project AoI does not meet the criteria for Critical Habitat. Accordingly, biodiversity impacts should be assessed and managed in accordance with the requirements applicable to modified and natural habitats.

A dedicated screening was undertaken against the five ESS6 Critical Habitat criteria using the Project’s baseline evidence (habitat mapping, field surveys and eDNA results), together with the broader regional ecological context presented in Section 7.2. The results of this systematic screening are presented in Table 7-5.

Table 7-5 Critical Habitat screening

ESS6 Critical Habitat trigger	ESS6 definition summary	Baseline evidence reviewed	Assessment outcome	Justification / rationale
Trigger 1: Habitat of significant importance to Critically Endangered (CR) or Endangered (EN) species	Habitat supporting viable populations of species listed as CR/EN (or equivalent)	• Habitat mapping of the Biodiversity AoI and ESS6 habitat categorization • Targeted flora/fauna field surveys and results • eDNA sampling and results (vertebrate/mammal/fish assays; limitations noted)] • Regional biodiversity values associated with the Mesurado Wetland, considered as part of the broader ecological and hydrological context due to connectivity through the estuarine and river system, but not representing confirmed presence or Critical Habitat features within the Project's Biodiversity Area of Influence.	Not triggered	Baseline investigations (field surveys and eDNA) within the Biodiversity AoI do not confirm the presence of viable populations of CR/EN species that are dependent on habitats within the AoI. Section 7 explicitly notes that records of higher biodiversity value species from the wider Mesurado Wetland system are treated as regional ecological context and do not confirm current presence within the project footprint or heavily urbanized wetland margins.
Trigger 2: Habitat of significant importance to endemic or restricted-range species	Habitat supporting endemic species or species with restricted global distributions	• Flora survey findings on endemism/restricted range and conservation status • Fauna survey findings (birds, mammals, herpetofauna, fish), including IUCN status screening and distribution characteristics	Not triggered	The baseline surveys confirm that no endemic or restricted-range species were recorded within the Project's Biodiversity Area of Influence. Flora species identified are widespread across West Africa, Africa, or the tropics, with no endemic or restricted-range taxa. Fauna surveys (birds, mammals, herpetofauna, and fish) and eDNA results similarly indicate species with broad geographic distributions. Species detected through eDNA and field surveys are interpreted as reflecting regional presence and ecological context, rather than restricted-range dependency on habitats within the project area.

		• eDNA survey results for aquatic and semi-aquatic fauna (presence screening and regional distribution context)		

ESS6 Critical Habitat trigger	ESS6 definition summary	Baseline evidence reviewed	Assessment outcome	Justification / rationale
Trigger 3: Habitat supporting globally significant concentrations of migratory or congregatory species	Habitat supporting globally (or regionally) significant concentrations of migratory or congregatory species during key life-cycle stages	• Bird survey results (resident vs. migratory; migratory species list and abundances) • Habitat context (urban coastal setting; disturbed shoreline/wetlands)	Not triggered	The baseline bird survey recorded seven Palearctic migratory species; however, recorded abundances are low (e.g., Grey Plover recorded as 1 individual) and the baseline does not identify the AoI as supporting globally significant concentrations or key congregation features. The baseline also characterizes the project area as a highly disturbed urban coastal environment, supporting mainly opportunistic use by fauna.

Trigger 4: Highly threatened or unique ecosystems	Rare, highly threatened, or unique ecosystems that are irreplaceable or critical at a national/regional/global scale	• Habitat mapping results and habitat descriptions (including mangrove/wetland condition) • ESS6 habitat categorization (Modified habitat vs. Natural habitat (degraded)) • Vegetation/habitat field observations (fragmentation/degradation drivers)	Not triggered	Habitat mapping describes the AoI as an urban-influenced mosaic where habitats are categorized under ESS6 as Modified habitat and Natural habitat (degraded). Mangrove habitats within the AoI are described as urban-modified/fragmented, with "no intact systems remain," and wetlands/mangroves are subject to settlement expansion, waste dumping, altered drainage and related pressures. This baseline characterization does not support the presence of a highly threatened or unique ecosystem meeting the Critical Habitat threshold within the AoI.
Trigger 5: Areas associated with key evolutionary processes / ecological functions needed to maintain biodiversity values in Triggers 1–4	Areas required to maintain ecological functions that sustain qualifying biodiversity values (from 1–4	• AoI definition and baseline ecological context (connected coastal–estuarine system; urban modification) • Linkage to outcomes of Triggers 1–4 based on baseline evidence	Not triggered	Section 7 describes a connected estuarine/coastal system influenced by tidal exchange and urban pressures but does not identify evolutionary hotspots or specific ecological functions within the AoI that are required to sustain qualifying biodiversity values under Triggers 1–4. As Triggers 1–4 are not met based on baseline evidence, the associated "maintenance of those values" criterion is not indicated as applicable for Critical Habitat designation in this case.

7.8. Nuisance Species, Pests and Vectors

Nuisance species, pests, and disease vectors represent significant threats to local biodiversity, impacting both plant and animal populations. Biodiversity itself underpins vital ecosystem services by providing essential resources such as food, medicine, and construction materials. It also supports key ecological functions including carbon sequestration, soil formation, water purification, pollination, and natural pest and disease regulation.

Nuisance species—though not necessarily harmful or toxic—can cause serious disruption to ecological balance. In Liberia, these are typically non-native invasive species that have bypassed natural geographic barriers and become established in new environments. These invasive organisms can outcompete native species, modify habitats, and interfere with ecological processes. A list of key fauna and flora invasive species reported in Liberia is provided in Table 7-6.

The flora survey confirmed the presence of four aggressive invasive flora species, including regionally significant invaders such as Siam Weed (*Chromolaena odorata*), Water Hyacinth (*Eichhornia crassipes*), alongside other potentiel invasive plants recorded during the field assessments. However, some other species listed in Table 7-6 could still occur in the area, particularly in degraded habitats.

The eDNA survey also detected Tilapia zillii (*Coptodon zillii*), a species classified as invasive in Liberia by the IUCN Invasive Species Specialist Group (2025) (Table 7-6).

Table 7-6 Invasive species of Liberia (International Union for Conservation of Nature Invasive Species Specialist Group, 2025)

Invasive flora species	Invasive fauna species
1. *Bidens Pilosa*	1. *Ceratitis capitata*
2. *Cardiospermum grandiflorum*	2. *Civettictis Civetta*
3. *Cenchrus polystachios*	3. *Columba livia*
4. *Chromolaena odorata**	4. *Cricetomys gambianus*
5. *Dioscorea bulbifera*	5. *Estrilda astrild*
6. *Eichhornia crassipes**	6. *Lates niloticus*
7. *Hypnea musciformis*	7. *Maconellicoccus hirsutus*
8. *Imperata cylindrical*	8. *Porphyrio porphyrio*
9. *Lantana camara*	9. *Psittacula krameria*
10. *Leucaena leucocephala*	10. *Solenopsis geminata*
11. *Lygodium microphyllum*	11. *Tilapia zillii**
12. *Panicum repens*	12. *Cyprinus*
13. *Paspalum scrobiculatum*	
14. *Phymatosorus scolopendria*	
15. *Rottboellia cochinchinensis*	
** Identified during field survey*	

Two notable pest species widely present in the project area and across Liberia are mosquitoes and the Variegated Grasshopper (*Zonocerus variegatus*). Liberia hosts numerous mosquito species—many of which bite humans, causing irritation and potentially transmitting disease.

Mosquitoes rely on stagnant or slow-moving water to reproduce, and human activities such as dam construction, poor drainage, and water storage can increase their breeding habitats.

Mosquitoes also act as vectors, transmitting diseases—most notably malaria, which remains the leading cause of illness and death in Liberia. Their breeding sites range from natural features like tree holes and marshes to human-influenced environments such as sewage ponds, irrigation channels, and rain-filled containers. The expansion of human settlements and land use changes are key factors contributing to increased mosquito habitat availability, posing heightened public health and ecological risks.

7.9. Ecosystem Services

Ecosystem services are the benefits people derive from natural ecosystems, including provisioning services (e.g., food, water, fuel), regulating services (e.g., flood control, climate regulation, water purification), cultural services (e.g., recreation, spiritual value, cultural identity), and supporting services (e.g., soil formation, nutrient cycling, pollination). These services underpin local livelihoods, health, and well-being, and are closely linked with biodiversity. Understanding ecosystem services in the project area is essential to assess potential project impacts and design mitigation measures that protect both communities and natural resources.

7.9.1. Data Collection Methodology

Information on ecosystem services in the project area was collected through a combination of participatory and technical approaches:

- **Literature review and secondary data**: Analysis of existing studies, environmental reports, and regional ecosystem assessments.
- **Focus group discussions (FGDs):** Conducted with fishers, fishmongers, and wetland users to document ecosystem-dependent livelihoods.
- **Household survey (HHS)**: The socio-economic survey captured household-level dependence on natural resources and community perceptions of regulating services such as flood regulation, water quality, and drainage performance.
- **Biological field surveys**: Ecological fieldwork was undertaken to assess the condition and functionality of key habitats, including wetlands, rivers, mangrove stands, and nearby forest remnants. Surveys included species observations, habitat characterization, and evaluation of ecosystem features linked to regulating and supporting services (e.g., water quality indicators, vegetation cover, soil condition, hydrological features). These surveys helped verify secondary data and contextualize community-reported ecosystem service use.

While community engagements emphasized on provisioning services and community perceptions of regulating services, the ESIA also considers essential regulating and supporting services (clean water, clean air, soil fertility, flood regulation) addressed in Section 6. These services are vital to community well-being and are closely linked to aquatic, wetland, and coastal ecosystems

Relevant detailed results of the FGDs and HHS are presented in Sections 5 (Volume II) and 8 (this volume) of the ESIA. The subsections below provide a summary of key ecosystem services identified.

7.9.2. Natural Resources Use

Ecosystem services within the project area are influenced by the predominantly urban and peri-urban character of Northern Bushrod Island, alongside the continued presence of coastal, wetland, and aquatic ecosystems. These ecosystems provide a range of provisioning services that remain important for specific livelihood groups, particularly those linked to fisheries and fish trading.

Provisioning services associated with aquatic and coastal habitats include access to fish resources, landing sites, and nearshore waters that support fishing, processing, and trading activities. These services are spatially concentrated around beaches, creeks, and estuarine areas. The biodiversity field survey confirmed the ecological functionality of these habitats and their continued use by local communities.

Use of terrestrial ecosystem provisioning services, such as fuelwood, construction materials, and medicinal plants, appears limited within the project area, reflecting its urban context. Seasonal collection of fruits and seeds occurs at low levels and is primarily for household consumption.

Wildlife-based provisioning services, including birds bushmeat, are not a dominant component of household subsistence and are used primarily on an occasional basis.

Overall, ecosystem service use is closely linked to the accessibility and condition of coastal, wetland, and aquatic habitats, which underpin both ecological functions and livelihood activities for fishing-dependent groups.

7.9.2.1. Non-Timber Forest Products

Use of non-timber forest products within the project area is extremely limited due to habitat loss, mangrove clearing, and continued urban expansion. Results from the social and biodiversity surveys show that mangrove wood is harvested only opportunistically, typically for small-scale household fuel or minor construction activities, and does not seem to be extracted at commercial scale.

Seasonal collection of fruits and seeds was reported during interviews with community members however limited in nature and primarily used for household consumption.

7.9.2.2. Wildlife Consumption

The HHS findings indicate that bushmeat consumption is occasional for most households: 51% consume it occasionally, 40% never consume it, and 9% reserve it for special occasions. Monkey and deer are the most commonly consumed species. The species most commonly reported were monkeys and deer. However, these are not locally sourced within the Project Area; rather, they are typically brought in from rural hinterlands and sold illegally through informal urban markets.

As indicated in Section 7.6.2.1.1, bird hunting is not a common practice in the project area. Reptiles, however, are frequently targeted due to fear and perceived risk (Section 7.6.2.2.1). Snakes— including the nationally protected African Rock Python—are often killed on sight, and West African Mud Turtles and crocodiles are opportunistically captured and consumed. Although these practices do not constitute organized bushmeat trade, they contribute to localized popultaion declines and highlight ongoing human–wildlife conflict in and around the project area.

7.9.2.3. Mineral Resource Extraction

Clay extraction for the production of locally made "Potter" was observed in Logan Town during the undertaking of the biodiversity field survey and represents one of the few notable extractive activities in the project area. This practice nvolves the excavation of shallow pits in wetland and low-lying areas, which subsequently fill with stagnant water. It creates stagnant and polluted pools, increases vector-breeding habitats, disrupts water flows, and fragments mangrove and wetland landscapes.

In addition, river sand mining activities were identified along the banks of Stockton Creek between Jamaica Road Bridge and Caldwell Bridge, contributing to bank instability, habitat degradation, and localized hydromorphological disturbance.

7.9.2.4. River Fishing

River fishing is a key livelihood activity in Stockton Creek and St. Paul River, particularly for fishers, fishmongers, and households economically dependent on aquatic resources.

Fishers commonly employ bamboo prawn traps, crab traps, cast nets, and other artisanal gear to target freshwater species essential for local food security. However, river sand mining between Jamaica Road Bridge and Caldwell Bridge has severely degraded benthic habitats, disrupting crustacean spawning grounds, including those of the African River Prawn. Additional pressures stem from drainage lines at Bong Mine's Bridge and Momo Town West, where polluted water is discharged directly into the waterways, reducing water quality. These cumulative impacts threaten the long-term sustainability of river-based livelihoods and could disproportionately affect fishing-dependent households whose economic resilience is already limited.

7.9.2.5. Marine Fishing

Marine fishing remains central to the livelihoods of coastal communities such as Popo Beah, where small-scale, multi-gear artisanal fisheries target a diverse array of pelagic and demersal species.

Participants in FGDs consistently emphasized that access to beaches, mangroves, nearshore waters, and established landing and trading sites is critical for fishing operations, market access, and community cohesion. Any restriction, degradation, or displacement away from these areas could significantly undermine marine-based livelihoods.

Environmental conditions further exacerbate vulnerability. The direct discharge of polluted drainage water and solid waste into the nearshore environment was repeatedly identified as a major concern. These pollutants degrade water quality, impair fish nursery habitats, and pose risks to marine invertebrates. As such, marine fisheries are both essential and increasingly threatened by cumulative environmental degradation and reduced access to critical coastal zones.

7.9.3. Cultural Services

Despite ongoing degradation, wetlands, creeks, and coastal zones retain cultural significance. Fishing is deeply intergenerational and central to the fishing community identity and livelihoods. These ecosystems serve as gathering spaces and hold spiritual importance especially for the fishing communities.

7.9.4. Regulating Services

Regulating services such as flood control, erosion prevention, water purification, and climate regulation are highly relevant to communities in the project area. Mangroves and wetlands play essential roles in attenuating floods and filtering water, but these functions are increasingly compromised by clearing, pollution, and hydrological disruptions.

Community perceptions investigated during the HHS indicate increasing flood severity across seasons and declining water quality, with solid waste reported as the most common pollutant. Protecting remaining mangrove stands is particularly important, as they provide habitat for species historically recorded in the Mesurado Wetland, such as the Rufous Fishing-owl.

8. Baseline Conditions: The Socio-Economic Environment

This section provides an overview and analysis of the existing socio-economic conditions in the areas to be affected by the Project, including demographics, access to key services and infrastructure, education and skills, health, sanitation facilities, poverty, social capital, livelihoods and land use, economic activities, land ownership and tenure, incomes and expenditures, governance, ecosystem services, and gender issues.

Establishing a clear understanding of the existing socio-economic environment is critical for accurately assessing the potential socio-economic impacts associated with the development of the Project. This baseline serves as a reference point for identifying and evaluating changes that may result from project activities.

8.1. Source of Baseline Data

The socio-economic baseline for the ESIA establishes a pre-project assessment of conditions in affected communities, drawing primarily on a structured household survey that captures key aspects such as demographics, livelihoods, access to services, and social conditions. This quantitative analysis is complemented by qualitative data from community consultations, focus group discussions (FGDs), and key informant interviews (KIIs), which provide insights into community perceptions, priorities, and concerns. The assessment is further strengthened through a review of secondary data from earlier studies undertaken for the Project, including those by WAPCOS, the Ministry of Public Works (MPW), and the Global Center on Adaptation

(GCA) and GCA dataset comprising 27,041 household surveys. Relevant findings from these sources have been integrated where applicable, with a summary of all data collection activities presented in Table 8-1 and further detailed in Section 5 of the ESIA (Volume II).

Table 8-1 Summary of socio-economic data collection activities previously conducted in 2022 and 2024 (Global Center on Adaptation (GCA) et al., 2025; Ministry of Public Works, 2022a, 2022b; WAPCOS Limited, 2024)

Activity	Year	Locations	No. held
Community Consultation	2022 2024	• Northern Bushrod Island • Southern Bushrod Island • Central Monrovia • Southeastern Paynesville • Omega Redhill • Duport Road Area • Central Monrovia / Soniwein	10
High-level Stakeholder Consultation	2022 2024	• Monrovia	4
Town Hall Meetings	2022	• Omega Market • Southeastern Paynesville • Central Monrovia Soniwein / CBD • Northern Bushrod Island	4
Activity	**Year**	**Locations**	**No. held**
Town Survey, Key Informant Interview	2022	• GSA Road Community • Soni Wein • Buzzy Quarter • Capitol Hill • Doula • New Kru town	5
Face-to-face Interviews	2022	• Greater Monrovia	8
Focus Group Discussion	2022	• Omega Market- Tower Hill	1
Household Surveys	2023 2024	• Greater Monrovia • New Kru Town, • Garworlohn Township • Paynesville	27,041
Workshop	2025	• New Kru Town	1

8.2. Methodology

8.2.1. Socio-Economic Baseline Survey Methodology

The socio-economic baseline was developed using a mixed-methods approach combining quantitative household surveys with qualitative data collection tools, including KIIs, FGDs, and community consultations. Together, these methods were designed to capture baseline socio-economic conditions, livelihood patterns, service access, and community perceptions within the area where people's lives, livelihoods, and social conditions may be affected by the project.

The findings from these surveys constitute the primary source of information for the socioeconomic baseline presented in this chapter and provide the basis for subsequent impact assessment and mitigation planning.

The HHS questionnaire used is an updated version of household surveys previously conducted in Liberia for major construction projects over the past 20 years. It collects basic demographic data on residents, including household size, composition, and living conditions, as well as literacy and employment status. The questionnaire also explores family livelihoods in detail, with the aim of identifying ways to mitigate adverse impacts while promoting community benefits.

An overview of topics covered in the HHS questionnaire is presented in Box 8-1, while the full questionnaire is available in Appendix L.1.

Box 8-1 Household survey questionnaire topics

Household Survey Questionnaire Sections
1. Household demographics 2. Household profile 3. Residency, occupancy and housing conditions 4. Land tenure and cultivation, livestock, tree farming, natural resources, regulating services, and other resources collected 5. Food security 6. Household Income, income sources, skills training, assets, expenditure, saving, baking, and credit facilities, loans/debts 7. Marketing of produce 8. Access to facilities 9. Health, disability and chronic illness, fertility and infant mortality 10. Division of labor 11. Social networks 12. Needs analysis, quality of life and services, women in the project area

8.2.2. Social Area of Influence

For the purpose of this ESIA, the Social Area of Influence (SAI) is defined as the geographic area within which people's lives, livelihoods, access to services, and social conditions may be directly or indirectly affected by the Project. Given the urban and largely linear nature of the drainage and associated infrastructure interventions, the SAI extends beyond the immediate construction footprints to include surrounding communities that may experience indirect effects such as temporary access restrictions, altered mobility patterns, construction-related nuisance, changes in flood exposure, and increased pressure on local services.

The Project comprises multiple drainage and associated infrastructure interventions distributed across several urban communities. At the time of ESIA field mobilization, the scope and design of interventions had not yet been finalized and continued to evolve. Accordingly, the socio-economic survey strategy prioritized communities where interventions were considered most likely to occur, based on available footprint provided by the Design Consultant as part of the project's Local Area Resilience Plan (LARP).

The Social Area of Influence (SAI) encompasses selected communities within three principal locations: New Kru Town (Sub-location Atlantic), the St. Paul River area (Sub-location St. Paul Wetlands), and Stockton Creek. The communities included within the SAI are presented in Table 8-2.

Table 8-2 Communities included within the Social Area of Influence (SAI)

Project area	Sub-location	Surveyed communities
New Kru Town Area	Atlantic	Central New Kru Town; Duala Market; Fundaye; Lagoon; Supermarket Community; Popo Beach; Trowin
St. Paul River	St. Paul Wetlands	Bong Mines Bridge; Caldwell Road; Crab Hole; King Peter Town; Island Clinic; Momboe Town; Whea Town; Zuma Town
Stockton Area Creek	Stockton Creek	Cow Factory; Central Jamaica Road; Zondo Town

8.2.3. Survey Strategy and Selected Communities

The survey strategy was based on a two-stage sampling approach designed to enable efficient data collection within limited timeframes while maintaining a reasonable level of accuracy. This approach was considered appropriate given the Project's scale, urban setting, and the evolving status of detailed design during the ESIA process.

Survey locations were defined by establishing the Project's SAI using a narrow buffer around the proposed interventions, focusing on households likely to be directly or indirectly affected. Within this SAI, a simple random sample of structures was drawn from a sampling frame of approximately 4,300 identified structures mapped within the study area.

In the second stage of sampling, one household was randomly selected for interview within each sampled structure where multiple households were present.

This method allowed surveys to be carried out efficiently with a limited sample size while maintaining a randomized selection process. It also allowed the dataset to remain flexible in case the project footprint changes as designs are refined.

8.2.4. Household Survey Sampling Framework

A representative sample of 220 households was targeted within a corridor of influence extending approximately 200 m from initially anticipated intervention areas. The final sample comprised:

- 91 households in New Kru Town
- 90 households in the St. Paul River area
- 39 households in the Stockton Creek area

Enumerators commenced surveying from a selected structure within each location. Where a structure contained a single household, eligibility was assessed and, if confirmed, the household was surveyed. Eligibility indicates that the structure was residential, occupied, safe to enter and an adult household member was present. Where structures contained multiple households, enumerators counted all households (from left to right or bottom to top) and used a random digit table to randomly select one household for interview.

If a household or structure was ineligible, enumerators identified up to ten nearby structures within a 50-meter radius and repeated the random selection process until an eligible household was identified.

8.2.5. Qualitative Data Collection Methods

Qualitative data collection was undertaken to complement the household survey and provide deeper contextual understanding. This included KIIs, FGDs, and community consultations, which were used to explore governance structures, livelihood dynamics, social and gender issues, community priorities, and perceptions of potential project impacts. Further details on these activities are provided in Section 8.3.1 and 8.3.2, as well as Sections 5.3.4 and 5.3.5 in Volume II of the ESIA.

8.2.6. Data Collection Tools and Quality Assurance

All survey instruments were digitized and administered using handheld tablets. Enumerators received a three-day training in Monrovia covering survey objectives, questionnaire content, ethical considerations, health, safety and security aspects, and data collection protocols.

A Quality Assurance and Quality Control framework was implemented by senior consultants throughout data collection to verify data completeness, internal consistency, and reliability. Supervisory spot checks and routine data reviews were conducted to ensure adherence to agreed protocols.

8.3. Data Collection Activities

The collection of socio-economic baseline data about the selected communities was done through four main activities:

- **Community consultations** undertaken with affected communities in the project area. Details are described in Section 5.3.4 (ESIA Volume II).
- **Town surveys conducted** through **KIIs** conducted with one to two key informants from 16 out of the 18 affected communities. Details are described in section 8.3.1.
- A **household survey**: Details are described in Section 8.2.4.
- **FGDs**: Details are described in Section 8.3.2.

A summary of these activities is presented in Table 8-3.

Table 8-3 Summary of socio-economic data collection activities conducted by Earthtime in 2025

Activity	Dates	Location			Total no. held
		New Kru Town	St. Paul River	Stockton Creek	
Community consultation	Nov 13-24, 2025	✓	✓	✓	18
Key informant interviews	Nov 13-22, 2025	✓	✓	✓	27
Household survey	Nov 13-24, 2025	✓	✓	✓	220
Focus group discussions	Nov 13-24, 2025	✓	✓	✓	43

8.3.1. Town Survey and Key Informant Interviews

KIIs were conducted after community consultations with one or two representatives from each community. A total of 27 KIIs were held across different communities. Key informants included chairmen, elders, chairladies, teachers, administrators, religious figures, and other community representatives. These interviews provided qualitative insights into the governance, social and gender dynamics, social services and infrastructure, key concerns, and the environmetnal and social challenges of each community. They also sought to obtain feedback from key informants on the Project as part of the stakeholder engagement activities.

KII questionnaires are provided in Appendix L.2 and selected photographs are shown in Appendix M. A summary of KIIs held is presented in Table 8-4, while details about each interview are given in Appendix N.

Table 8-4 Summary of Key Informant Interviews

Location	Number of consultations	Gender		Total
		Male	Female	
New Kru Town	13	8	5	13
St. Paul River	11	12	4	16
Stockton Creek	3	3	0	3
Total	**27**	**24**	**9**	**32**

8.3.2. Focus Group Discussions

FGDs were undertaken with selected types of groups that were considered to be affected differently by the Project, including women, youth groups, landowners, and the people whose livelihoods depend on provisionning ecosystem services i.e. fishermen , wetlands users, and fishwomen (Table 8-5). Questionnaires and results are available in Volume II of the ESIA, Appendix K and Section 5.3.5.

Table 8-5 Summary of focus group discussions held

Type of FGD	Purpose
Women	Gender roles, concerns, expectations, and overall status of women
Ecosystem services	Livelihoods linked to natural resources (fishing, wetlands, mangroves)
Chiefs and elderly	Community leadership perspectives, cultural validation, project expectations
Youth groups	Youth challenges, employment, gender differences, and participation
Landowners	Youth challenges, employment, gender differences, and participation
Other groups	Sectoral input (transport unions, civil society, services)

8.4. Demographic and Ethnic Composition

8.4.1. Household and Population Characteristics

The total sample size comprised 220 households, covering 1,153 individuals—622 females and 531 males—resulting in a sex ratio of approximately 0.85 males for every female. The average household size was approximately 5.2 persons per household.

Of the total population, 417 individuals (36.1%) are aged 14 or younger, and 85.5% of individuals are below the age of 45, which indicates a relatively young demographic and suggests future pressure on education, employment opportunities, and essential services in the project area. The crude population distribution presented in Table 8-6 may also reflect some under- or over-reporting of age—particularly among older individuals—due to challenges in recalling birth dates.

Table 8-6 Crude population distribution by age groups

Age group	No. males	No. females	Total
0-14	194	223	417
15-29	171	209	380
30-44	80	109	189
45-59	53	53	106
60-74	29	25	54
75-90+	4	3	7
Total	**531**	**622**	**1,153**

The Head of Household (HHH) is typically the landowner or plot user and, in many cases, the oldest individual in the family. In urban and semi-urban areas, a proportion of HHHs are identified based on income contribution rather than age or land ownership. When respondents were asked to explain why a particular individual was considered the HHH, 156 households reported that the HHH was the primary income earner, 45 cited age (oldest household member), 17 indicated land ownership, and 2 households reported ownership of the residential structure (Figure 8-1).

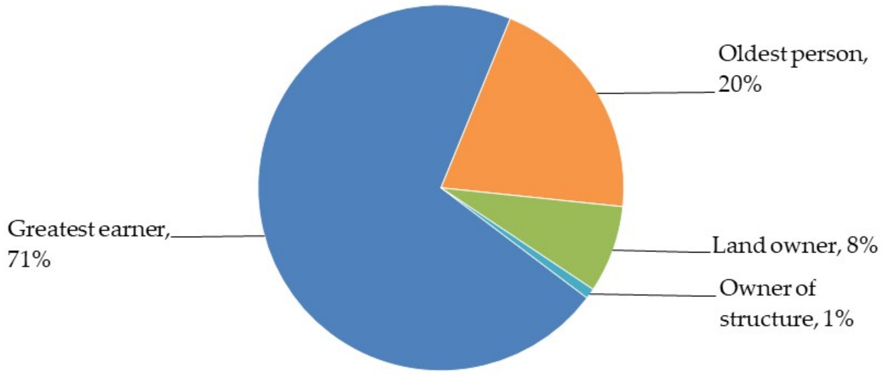


Figure 8-1 Basis for identifying HHH in the surveyed households in the SAI

Out of the 220 surveyed households, 69.1% were male-headed (152 households) and 30.9% were female-headed (68 households). This indicates a higher proportion of male-headed households in the surveyed area compared to the national average reported in the 2022 Population and Housing Census, which shows that 64.4% of households in Liberia are maleheaded and 35.6% are female-headed (Liberia Institute of Statistics and Geo-Information Services, 2023).

Male household heads in the surveyed area are predominantly concentrated within a limited number of adult age groups, whereas female household heads are more evenly distributed across a wider range of age categories, suggesting greater age diversity among female-headed households. Table 8-7 presents the distribution of household heads by age group and sex.

Table 8-7 Head of household distribution by age group and sex

Age group	Number of heads of households	% of heads of households	Total

	Male	Female	Male (%)	Female (%)	
0-14	0	0	0	0	**0**
15-29	11	12	5.00	5.45	**23**
30-44	64	25	29.09	11.36	**89**
45-59	48	22	21.82	10.00	**70**
60-74	26	9	11.82	4.09	**35**
75-90+	3	0	1.36	0	**3**
Total	**152**	**68**	**69.09**	**30.9**	**220**

Out of the 220 households surveyed, 67 respondents (30.5%) reported being married. Among these, 64 respondents (95.5%) reported being in monogamous marriages, while three respondents (4.5%) reported being part of polygamous households. This indicates that while monogamy is the predominant marital arrangement in the surveyed communities, polygamy remains a practiced, though relatively rare, marital structure.

8.4.2. Ethnicity

As presented in Table 8-8, the surveyed population includes a diverse range of ethnic groups, with Kru, Kpelle, and Grebo being the most represented. These ethnic groups are each associated with distinct communities, dialects and traditional practices.

These findings confirm that Monrovia is an ethnically diverse city, with all major Liberian ethnic groups represented. Groups such as the Bassa, Kru, Kpelle, Grebo, Vai, Gola, Lorma, Mano, and others live together in the capital.

In terms of religious affiliation, 198 respondents (90%) across all surveyed communities identified as Christians, reflecting the dominant religious orientation in the region. However, 22 respondents (10%) reported being Muslim, indicating a small but present Islamic representation. These individuals were part of ethnic groups traditionally associated with Islam.

Table 8-8 presents the breakdown of ethnic groups by gender. A map that locates locations of religious places is presented in Appendix O.1.

Table 8-8 Ethnic composition of respondents by gender

Ethnicity	No. men	No. women	Total
Bassa	16	4	**20**
Dei	0	1	**1**
Gbandi	4	4	**8**
Gio	4	0	**4**
Gola	6	4	**10**
Grebo	16	11	**27**
Kpelle	21	9	**30**
Krahn	5	2	**7**
Ethnicity	**No. men**	**No. women**	**Total**

Kru	50	18	**68**
Lorma	6	4	**10**
Mandingo	2	4	**6**
Mano	3	0	**3**
Mende	1	1	**2**
Sapo (Sarpo)	2	0	**2**
Vai	13	9	**22**
Total	**153**	**71**	**220**

8.5. Access to Key Services and Infrastructure

8.5.1. General Access to Services

Access to education, health, and basic services across the surveyed communities is uneven and generally limited. While all communities have access to elementary schools, availability of secondary and vocational education is inconsistent, and no communities have universities, which may constrain opportunities for higher education and contribute to youth unemployment and reliance on informal livelihoods. Health services are also limited, with only partial access to clinics, a single hospital serving the entire project area, and few health posts, requiring many residents to travel for care and potentially leading to overcrowded facilities. Financial, commercial, security, and communication services are similarly sparse, with limited market infrastructure, minimal police presence in some areas, and few active organizations providing social support. Although all communities have access to electricity, water, and transport services, waste management infrastructure is notably lacking, highlighting broader service delivery challenges across the project area. For more details about available services per affecte community, please refer to Appendix P.1. Selected photographs are presented in Appendix M.

8.5.2. Specific Access to Facilities

An analysis of service access across the project-affected communities, based on HHS data, reveals a mixed level of availability and proximity to essential services and infrastructure (see Table 8-9). While most communities report access to churches or mosques (85.5%), markets (80%), hospitals (74%) and clinics (45%).

Education services are moderately accessible: primary schools are reachable by 33% of households, with an average travel time of 18 minutes, while access to junior and senior high schools drops to 25%, with travel times increasing accordingly. Only 7% of households reported access to vocational schools, indicating limited opportunities for technical training.

Access to government administrative services, and financial services (banks/credit) are available in several towns but remains limited overall. Only 4% reported access to financial institutions, and just 3% to government services, with average travel times of 30 minutes and 36 minutes for both services respectively. On the other, 22% reported access to security (police stations) despite an average time of 24 minutes

Access to shops and water sources were reported by a significant number of households. Out of the 220 surveyed households, 38% are able to access shops and water sources with an average time of 7 and 5 minutes respetively, highlighting the proliferation of these two services in the urban area and their proximity to households. However, the GCA reported persisting water quality challenges irrespective of proximity (Global Center on Adaptation (GCA) et al., 2025). More details on this are presented in Section 8.7.

Table 8-9 Summary of household access to key services and average travel time

Service	Access count by household	Average time (min)
Church / mosque	188	25.7
Nursery school	39	17.64
Primary school	73	17.81
Junior school	56	16.04
Senior high school	56	24.02
Vocational school	16	32.38
Transport stop	4	12.5
Clinic	100	28.26
Hospital	164	47.75
Shop	84	6.6
Government administrative offices	6	35.83
Market	177	25.02
Water source	97	4.27
Police station	49	24.02
Pension/grant pay point	0	0
Bank/ credit facilities	9	29.44
Fishing area	16	11.88
Area where medicinal plants are collected	1	2

Seasonal services such as hunting areas and artisinal mining sites, and forest product collection zones are accessed by almost zero households, which is attributed to the urban setting of the project area. Fishing areas, however, were accesed by 7% of households with an average time of 12 minutes, reflecting the area's close proximity to beaches and fishing sites.

A map that shows the location of the main services identidied in the SAI is presented in Appendix O.2.

8.6. Health

8.6.1. Health Care Access and Utilization

Household survey data reveal that public health centers are the most utilized form of healthcare among households across New Kru Town, St. Paul and Stockton Creek (Table 8-10). According to the GCA report, access to healthcare varies across the New Kru Town area. The report mentions that half of the respondents live within at least 1 km from the nearest public hospital. The presence of community clinics also provides healthcare access, though with limited quality and capacity (Global Center on Adaptation (GCA) et al., 2025).

As shown in Table 8-10, access to healthcare services varies across the project area, with public health centers representing the primary source of care (34%), followed by district hospitals (28%) and local clinics (25%). While some facilities are reported to be located within communities (20% for both public health centers and local clinics, and 17% for hospitals), access remains constrained by relatively long travel times, particularly for public health centers and hospitals, which average 47 and 40 minutes respectively and reach up to 67 minutes in some locations. Local clinics are comparatively more accessible, especially in Stockton Creek and St. Paul River, although travel times remain higher in New Kru Town. Use of private facilities is limited (11%), and a small proportion of households rely on selftreatment (5%). Overall, the findings indicate a strong reliance on public healthcare services, coupled with physical access challenges across the project area.

These findings suggest a strong reliance on formal public health system, though access points vary based on proximity and affordability. The continued dependence on public health centers and district hospitals, despite the travel burden, likely reflects limited healthcare alternatives and the constrained socio-economic conditions of households, which restrict their ability to seek services from private or more conveniently located facilities.

Table 8-10 Places the household members visit when ill in the SAI

Facility type	Facility type indicator	New Kru Town	St. Paul River	Stockton Creek	Total	Percentage
District hospital	No. households (HH) using facility	31	27	3	61	28%
	No. HH said facility is located within town	14	10	12	36	16%
	Avg. travel time to facility	36	44	45	40	
Public health center	No. HH using facility	31	32	12	75	34%
	No. HH said facility is located within town	17	22	6	45	20%
	Avg. travel time to facility	36	50	67	47	
Local clinic	No. HH using facility	20	20	14	54	25%
	No. HH said facility is located within town	20	20	5	45	20%
	Avg. travel time to facility	50	26	17	32	
Private health facility	No. HH using facility	7	9	9	25	11%
	No. HH said facility is located within town	6	7	2	15	7%
	Avg. travel time to facility	18	47	36	35	
Selftreatment	No. HH using facility	3	2	1	6	5%
	No. HH said facility is located within town	1	2	1	5	4%
	Avg. travel time to facility	4	10	0	5	

Despite this engagement, many households report challenges when accessing healthcare. As illustrated in Figure 8-2, concerns about the quality of care and the cost of care emerged as the two most significant barriers, reported by 29% and 23% of respondents respectively. This is followed by poor medical supplies and other challenges (16% each). A small number (2%)

mentioned inadequate staffing (10%) and lack of tertiary health services (6%). These reported issues indicate systemic gaps in healthcare service delivery, which may impact health outcomes—particularly for vulnerable groups such as women, children, elderly and persons with chronic conditions.

Out of all the households surveyed, 65 reported that a healthcare worker had visited them at one point, 45 households reported being visited once, yet only 14 households reported being visited twice or thrice, suggeting that outreach is limited. These findings show that there is a real need to improve healthcare affordability, staffing, and access to resources.

A map that locates the health facilities and medicine stores in the SAI is presented in Appendix O.3.

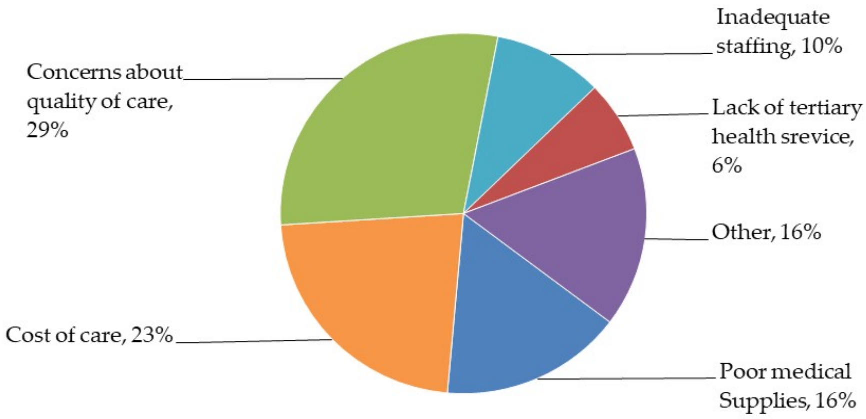


Figure 8-2 Challenges households experience when accessing health services in the SAI

8.6.2. Reported Illnesses, Disabilities and Deaths

Household survey respondents were asked to indicate the number of household members who reported disabilities and illnesses. Out of the 220 surveyed households, 24 households (12%) reported household members with disabilities and 22 households (10%) reported household members with illnesses at the time of the survey.

As shown in Figure 8-3, among the surveyed households who reported disabilities, physical disabilities and other disabilities constituted the largest share of reported disabilities (38% each). The findings indicate that most disability cases are visible or mobility-related.

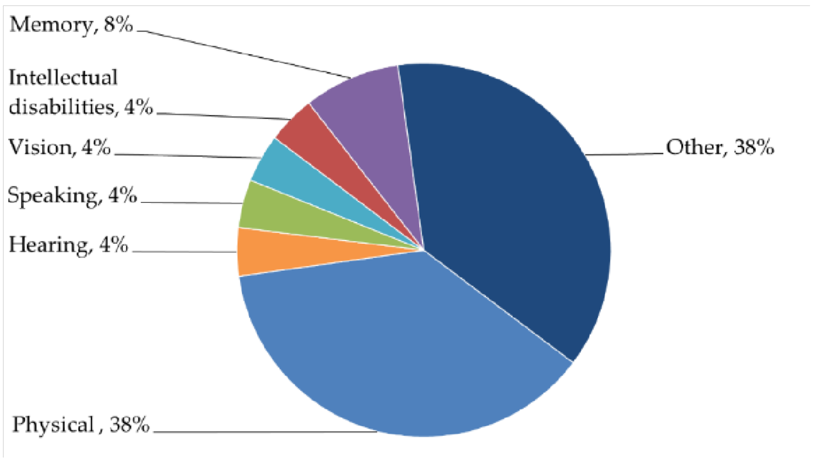


Figure 8-3 Reported disabilities in surveyed households

As shown in Figure 8-4, reported illnesses among surveyed households are led by malaria (14%), followed by typhoid and high blood pressure (9% each), while a majority (55%) fall under other conditions including injuries, age-related issues, and respiratory illnesses.

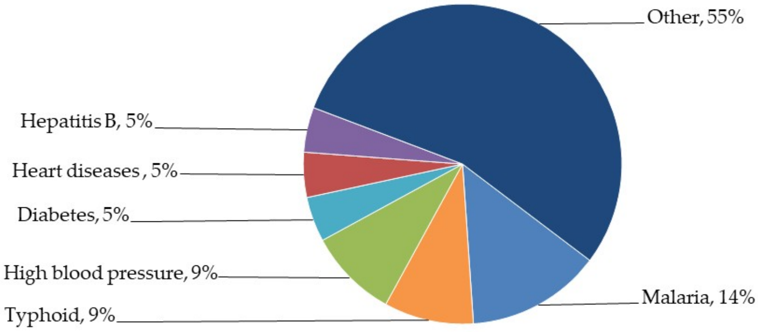


Figure 8-4 Reported illnesses in the surveyed households in the SAI

Data from the GCA report showcases critical health illnesses. Malaria has been shown to be the most critical health concerns, as it affects all.

These findings highlight a need for improved disease prevention, and targeted support for households with members living with disabilities and chronic conditions.

8.6.3. Vaccinations

Liberia is seen as a global model for success in increasing vaccination coverage in post-conflict countries (Ravi et al., 2023). In Liberia, a total of 13 vaccines are offered to protect against major vaccine-preventable diseases, including tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, measles, hepatitis B, Haemophilus influenzae type B, yellow fever, rotavirus, pneumonia, human papillomavirus, and typhoid fever (Republic of Liberia, n.d.).

Free vaccinations for children are provided by government hospitals as follows:

- 0-11 months: BCG (for Tuberculosis), Hepatitis B
- 0-59 months: Polio
- 9 months: Measles, Yellow Fever
- Women 14-49 years old (child-bearing ages): Tetanus Toxinus

8.6.4. Antenatal Care, Birth Outcomes and Civil Registration

During the HHS, there was a clear recognition of the importance of antenatal care among women in the project area. A total of 213 out of 220 households reported that women had given birth at a clinic or hospital, indicating a strong reliance on formal healthcare services for delivery. Only one household reported a home birth, and one household reported hiring a midwife. The remaining households indicated that their women were not pregnant.

Data on antenatal check up are presetned in table Table 8-11.

Table 8-11 Number of women who attended antenatal checkup by location

Community location	Number of women in each HHs that attended antenatal checkups
New Kru Town Area	70

St. Paul River	66
Stockton Area Creek	29
Total	**165**

Table 8-12 presents household responses on children's birth registration and vaccination card availability across the surveyed communities.

Table 8-12 Household responses on availability of birth certificates for children

Community location	No. households surveyed	No. households who have their children registration certificates					No. of the youngest children with vaccination cards
		All	None	Not applicable	Some	Total	
New Kru Town	91	24	32	5	30	91	56
St. Paul River	90	25	34	8	23	90	51
Stockton Creek	39	15	10	2	12	39	24
Total	**220**	**64**	**76**	**15**	**65**	**220**	**131**

8.6.4.1. Immunization Services

Table 8-13 presents household immunization coverage across the surveyed communities, indicating generally low and uneven access, with less than half of households reporting receipt of immunization services in the past year.

Table 8-13 Household immunization coverage by location

Location	Household surveyed	Received immunization services	Percentage of surveyed households that received immunization
New Kru Town	91	35	38.5%
St. Paul River	90	31	34.4%
Stockton Creek	39	19	48.7%
Total	**220**	**85**	**38.6%**

8.7. Water and Sanitation

8.7.1. Sanitation Facilities

Sanitation infrastructure across the project area remains limited and uneven, with households relying on a mix of improved and unimproved facilities. According to the GCA study, 37% of respondents use toilets within their homes, 35% within their yards, 20% access facilities within 200 meters, and 5% travel over 200 meters, while some still rely on open defecation or informal systems (Global Center on Adaptation (GCA) et al., 2025).

As shown in Table 8-14, Household survey results indicate that flush toilets are relatively common (50% in New Kru Town, 68% in St. Paul River, and 69% in Stockton Creek); however, access is often shared (20%, 11%, and 8% respectively), with limited private facilities (6%, 4%, and 13%). Other practices such as burying waste (13%, 3%) and dumping (6%, 4%, 8%) persist across locations. Overall, while access to improved sanitation exists, it is frequently shared and insufficient at the household level, highlighting ongoing risks related to overcrowding, hygiene, and inadequate waste management.

Table 8-14 Distribution of waste disposal practices by location and type

Location	Flush toilet	Personal pit latrine	Shared pit latrine	Dig a hole and bury	Dumping	Other	Total

New Kru Town	45 (50%)	5 (6%)	18 (20%)	12 (13%)	5 (6%)	5 (6%)	**90**
St. Paul River	62 (68%)	4 (4%)	10 (11%)	3 (3%)	4 (4%)	8 (9%)	**91**
Stockton Creek	27 (69%)	5 (13%)	3 (8%)	0 (0%)	3 (8%)	1 (3%)	**39**
Total	**134 (61%)**	**14 (6%)**	**31 (14%)**	**15 (7%)**	**12 (5%)**	**14 (6%)**	**220**

8.7.2. Solid Waste Management

Table 8-15 shows that solid waste disposal across the project area is dominated by communal pits and dumpsites, indicating a strong reliance on shared infrastructure. Informal practices such as open dumping and the use of private household pits are also common, particularly in St. Paul River and Stockton Creek, reflecting limited access to formal waste management services. The near absence of composting highlights low uptake of sustainable practices, while the use of "other" disposal methods—especially in New Kru Town—suggests potential environmental and public health risks. Overall, waste management practices remain mixed and largely informal, pointing to gaps in service coverage across communities.

Table 8-15 Household solid waste disposal methods by location

Disposal method / location	New Kru Town	St. Paul River	Stockton Creek	Total
Burn	10 (11%)	17 (19%)	1 (3%)	28 (13%)
Bury	9 (10%)	4 (4%)	1 (3%)	14 (6%)
Communal pit / dumpsite	64 (70%)	43 (48%)	21 (54%)	128 (58%)
Compost organic waste	0 (0%)	1 (1%)	0 (0%)	1 (<1%)
Feed waste to animals	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Disposal method / location	**New Kru Town**	**St. Paul River**	**Stockton Creek**	**Total**
Private pit at households	5 (5%)	11 (12%)	7 (18%)	23 (10%)
Throw in bushes	15 (16%)	33 (37%)	12 (31%)	60 (27%)
Other	14 (15%)	16 (18%)	5 (13%)	35 (16%)
Total HH	91	90	39	220

8.7.3. Access to Water

According to the GCA report, most water sources in New Kru Town are located within a 200 m walk of the households , indicating good proximity for a majority of residents. It is crucial to note that the report mentioned that 59% of its repondents experienced salinity intrusion in their water sources, whereas 34% of respondents reported interruptions in water supplies (Global Center on Adaptation (GCA) et al., 2025).

According to the HHS results, wells and handpumps are the dominant water sources in all three locations, though access to local taps remains limited. Relevant data is presented in Figure 8-5.

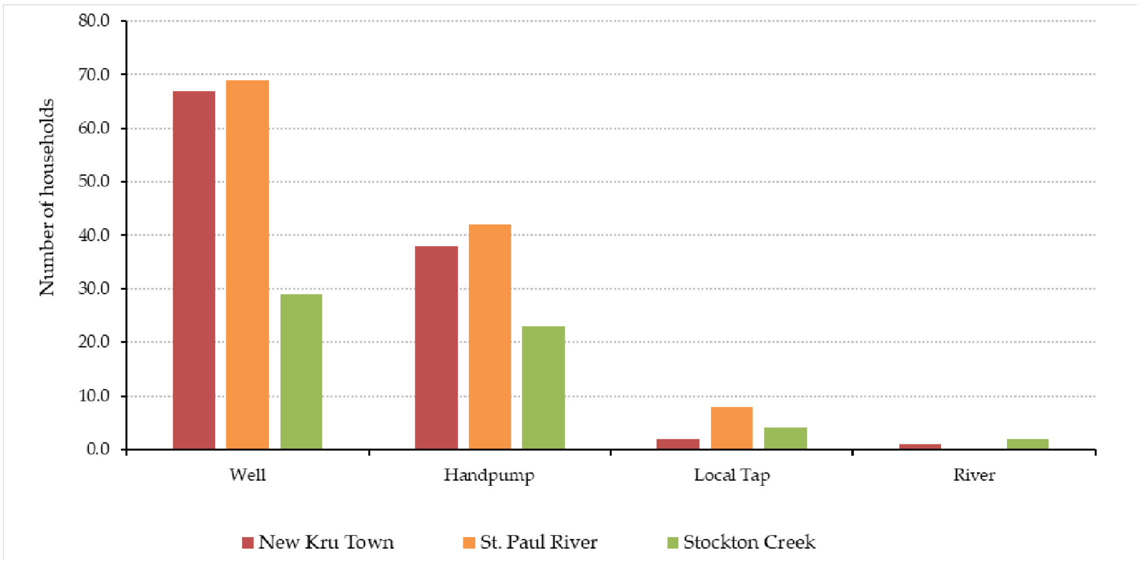


Figure 8-5 Access to drinking water in the SAI

In New Kru Town, a total of 67 households reported using wells, with an average walking time of 5.85 minutes (min), while 38 households used handpumps, which required an average time of 5.29 min. Only one houeholds reported fetching water from a river and two households had access to a local tap with an average time of 10 and 11 min respectively.

HHS results show that surveyed households in the St. Paul area greatly rely on wells and handpumps. The reliance on handpumps was even greater, with 42 households using this source, and reporting an average walking time of 7.26 min. Additionally, 69 households used wells (average time 5.74 min) and only 8 households reported access to a local tap, which had an average walking time of 4.20 min.

In Stockton Creek, 29 households reported using wells (average walking time 2.93 min), while 23 households had access to a handpump (average time 5.70 min). Only two households reported acces to a river and four households used a local tap.

While these findings suggest that accessibility is relatively adequate, water safety, reliability, and infrastructure quality remain significant challenges.

8.8. Education and Skills

8.8.1. Access to Education

According to KIIs conducted in the SAI, almost all surveyed communities reported having at least one elementary school with easy or good access, whereas half of the communities reported having one or two seconday schools with easy or good access (Bong Mines Bridge, Caldwell Road, Duala Market, King Peter Town, Fundaye, Momboe Town, Popo Beach, Trowin, Zondo Town). Only Duala Market reported having three vocational schools, while Lagoon and Zondo town recorded having one vocational school each with easy access. None of the surveyed communities reported having any universities. Photogrpahs of identified educational facilities taken during fieldwork is presented in Appendix M whereas the location of some of the educational facilities identified is shown in Appendix O.4. A list of educational facilities attended by children and youth in the SAI communities is presented in Appendix P.2.

8.8.2. Educational Indicators

Educational attainment among individuals aged five and above shows generally low levels of higher education and some gender disparities (Table 8-16). A total of 16% of respondents have never attended school, with a higher proportion among females (10%) than males (6%). Enrollment is relatively balanced between males and females at nursery and primary levels, but declines significantly at higher education levels, with only 3% of males and 1% of females reaching undergraduate level. Diploma-level attainment is comparatively higher (9% males, 8% females), though still limited overall, while vocational education participation is negligible.

Household survey responses indicate a strong reliance on private education, with 46% of households reporting children attending private schools, compared to 8% attending government schools and 11% attending both. Low school attendance is primarily driven by financial constraints, alongside factors such as lack of interest, early pregnancy, and disability.

Table 8-16 Reported household members' school achievement to date

Level of Education	Number of			Percentage of	
	Males	Females	Total	Males (%)	Females (%)
No education	67	115	**182**	6	10
Nursery; KG	59	57	**116**	5	5
Primary (P1 – 4)	58	79	**137**	5	7
Level of Education	**Number of**			**Percentage of**	
	Males	**Females**	**Total**	**Males (%)**	**Females (%)**
Primary (P5 – 7)	64	83	**147**	6	7
Junior School	88	104	**192**	8	9
Secondary (S1 – 4)	0	3	**3**	0	0.26
Secondary (S5 – 6)	22	25	**47**	2	2
Vocational	0	1	**1**	0	0.09
Diploma	101	88	**189**	9	8
Undergraduate	29	13	**42**	3	1
Graduate	35	45	**80**	3	4
No response	1	0	**1**	0.09	0
Not known	3	1	**4**	0.26	0.09
Not applicable	0	4	**4**	0	0.35
Total	**531**	**622**	**1145**	**46.05**	**53.95**

8.8.3. Skills and Training

8.8.3.1. Skills

The range of skills prevalent within the community often serve as an indicator of employment opportunities available to residents, particularly when development projects are underway in their areas.

Table 8-17 shows a clear gendered division of skills within the surveyed communities. Male respondents predominantly report technical and vocational skills such as construction, carpentry, mechanics, plumbing, and driving, with particularly high participation in construction and driving.

In contrast, female respondents are concentrated in service-oriented and informal trades, including hairdressing, sewing, food processing, and nursing, with very limited representation in technical fields. Participation in higher-skilled or formal sectors such as accounting and computer-related skills remains low overall.

These patterns suggest that while men may be better positioned to access employment opportunities linked to infrastructure and construction projects, women are more likely to be excluded from direct economic benefits. The limited presence of advanced and digital skills further indicates constraints in accessing higher-value employment opportunities within the community.

Table 8-17 Skills reported in the surveyed households

Type of skill	Number of		Total
	Men	Women	
Accounting	1	0	**1**
Carpenter/Woodworking	14	0	**14**
Commercial food processing	0	13	**13**
Computer skills	9	22	**11**
Driver with license	23	0	**23**
Type of skill	**Number of**		**Total**
	Men	**Women**	
Electrician	14	0	**14**
Engineering	3	0	**3**
Hairdressing	1	33	**34**
House construction	24	0	**24**
Mechanics (vehicle repair)	12	0	**12**
Nurse	0	4	**4**
Plumber	5	0	**5**
Sewing/Tailoring	2	17	**19**
Weaving	1	2	**3**
Other	26	23	**49**
Total	**135**	**94**	**229**

8.8.3.2. Training

Based on the HHS results, several training programs are present in the SAI, reflecting the presence of both governmental and non-governmental presence in the area. The data is presented in Appendix P.3.

A total of 94 individuals reported participating in formal training, comprising 52 men and 42 women. The most commonly attended training programs included driving (13 participants, exclusively men), computer skills (8 participants, 5 men and 3 women), and hairdressing (12 women).

Government-led programs were responsible for training in fields of electonics, electricity, engineering. NGOs are also present and offer trainings across many sectors such as business, computer skills, driving, electricity, technician, hairdressing, catering, tailoring and soap making. CBOs also play a role in delivering trainings on accounting, carpentry, and construction, and mechanics.

While men dominated most technical fields such as carpentry, computer skills, construction, and driving, women's involvement was more prominent in the services and artisinal sectors, suggesting gendered patterns in access and interest.

These training efforts could offer a foundation for enhancing employment prospects for projects operating in the area.

8.9. Social Capital

8.9.1. Participation in Community Activities

Participation in community groups serves as a strong indicator of social cohesion, civic engagement, and collective capacity within a population. Community meetings in the SAI provide platforms for residents to discuss local concerns, share development updates, and coordinate initiatives. The lower level of participation reported in Stockton Creek should be interpreted in light of the smaller number of households surveyed in this area compared to St. Paul River and New Kru Town.

Participation in community groups across the SAI is moderate, with 154 out of 220 surveyed households reporting involvement in community meetings and related activities. In total, 34 individuals were identified as participating in community groups, including 25 general members and 9 executive members. Youth groups record the highest level of participation, followed by women's/mother's groups, church groups, and saving/credit (Susu) groups. Women's and Susu groups are composed entirely of female members, while youth and church groups show more mixed gender representation. Overall, participation remains relatively limited, particularly in executive roles, indicating scope to strengthen community engagement and leadership in project-related activities.

8.9.2. Social Mobilization and Community Engagement

8.9.2.1. Social Participation and Community Activities

As presented in Table 8-18, community gatherings and meetings have the highest participation, with 34 male and 36 female participants in New Kru Town, 38 males and 47 females in St. Paul River, and 14 males and 18 females in Stockton Creek. These are followed by social and religious gathering, with 12 males and females each in New Kru Town, 3 males and 12 females in St. Paul River, and 3 males and 4 females in Stockton Creek.

Community members also record participation in community construction work, with 5 males and 2 females in New Kru Town, 11 males and females each in St. Paul River, and 5 males and females each in Stockton Creek, indicating a level of experience or skills in construction among the project-affected community members.

In terms of political gatherings, 7 males and 4 females recorded participation in New Kru Town, 9 males and 7 females in St. Paul River, and 4 males and females each in Stockton Creek. Only one male was reported in St. Paul River.

Notably, the participation of both genders almost equally represents some inclusive nature of these engagements.

Table 8-18 Distribution of household members over social activities by gender

Social Activities	Location	No. male participants	No. female participants	No. total participants
Social / religious work	New Kru Town	12	12	**24**
	St. Paul River	3	12	**15**
	Stockton Creek	3	4	**7**
Community gathering / meetings	New Kru Town	34	36	**70**
	St. Paul River	38	47	**85**
	Stockton Creek	14	18	**32**
Social Activities	**Location**	**No. male participants**	**No. female participants**	**No. total participants**
Political gatherings / meetings	New Kru Town	7	4	**11**
	St. Paul River	9	7	**16**
	Stockton Creek	4	4	**8**
Charity / club	St. Paul River	1	0	**1**
Community construction works	New Kru Town	5	2	**7**
	St. Paul River	11	11	**22**
	Stockton Creek	5	5	**10**
Total		**153**	**161**	**314**

8.9.2.2. Social Mobilization and Community Support Programs

According to the HHS results, social mobilization activities are present in the communities within SAI. These programs can be categorized into two types: awareness programs and income-generating programs.

Table 8-19 presents the data of the awareness programs. Under awareness programs, the most reported is Health annd Sanitation, with a total of 92 households. New Kru Town reported 35 households receiving this awareness program, followed by 39 households in St. Paul and 18 households in Stockton Creek.

Health and Sanitation initiatives were followed by other programs, with 32 households in New Kru town, 38 households in St. Paul, and 18 households in Stockton Creek, making up for a total of 88 households.

The surveyed households also recorded empowerment awareness programs. New Kru Town recorded the highest number (30 households), followed by St. Paul River (18 households), and Stockton Creek (4 households) .

Other awareness activities include programs on Women and Reproductive Health (two households in New Kru Town, four households in St. Paul River, and one household in Stockton Creek) as well as Women Literacy (three households in each of New Kru Town and St. Paul).

Adult Litercy programs were reported by one household in New Kru Town and one household in the St. Paul River area.

Table 8-19 Awareness programs in the SAI (source: Earthtime HHS, November 2025)

Program	Location	No. households	Total
Empowerment	New Kru Town	30	**52**
	St. Paul River	18	
	Stockton Creek	4	
Health and sanitation	New Kru Town	35	**92**
	St. Paul River	39	
	Stockton Creek	18	
Program	**Location**	**No. households**	**Total**
Women and reproductive health	New Kru Town	2	**7**
	St. Paul River	4	
	Stockton Creek	1	
Women literacy	New Kru Town	3	**6**
	St. Paul River	3	
	Stockton Creek	0	
Adult literacy	New Kru Town	1	**2**
	St. Paul River	1	
	Stockton Creek	0	
Other	New Kru Town	32	**88**

Table 8-20 presents the data of the income generating programs. In terms of incomegenerating programs, the most reported initiative is informal savings initiatives or Susu programs, with a total of 150 households. New Kru Town reported 53 households, followed by 69 households in St. Paul and 28 households in Stockton Creek.

These are followed by formal saving and credit initiatives, with 30 households in New Kru town, 26 households in St. Paul, and 7 households in Stockton Creek, making up for a total of 88 households. The surveyed households also recorded other initiatives. New Kru Town recorded the highest number (21 households), followed by St. Paul (16 households), and Stockton Creek (10 households). Finally, three household in New Kru Town recorded cooperative initiatives.

Table 8-20 Income-generating activities in the SAI

Program	Location	No. HHS	Total
Formal saving and credit	New Kru Town	30	**63**
	St. Paul River	26	
	Stockton Creek	7	

Informal saving / SuSu	New Kru Town	53	**150**
	St. Paul River	69	
	Stockton Creek	28	
Co-operative	New Kru Town	3	**3**
Other	New Kru Town	21	**47**
	St. Paul River	16	
	Stockton Creek	10	

8.9.2.3. Community Perceptions and Expectations Regarding the Project

According to findings from HHS, KIIs, and FGDs, across all communities, perceptions of LURP are largely positive. Residents generally view the Project as long overdue, particularly in flood-prone areas, and associate it with the potential to reduce suffering, improve living conditions, and restore dignity to affected communities.

Communities in New Kru Town, St. Paul River, and Stockton Creek consistently expressed positive expectations regarding the Project. Anticipated benefits most frequently cited include flood reduction and improved drainage, enhanced public health outcomes, improved mobility and access during the rainy season, employment opportunities during construction, and cleaner and safer living environments. Many respondents expected the Project to address recurring flooding that damages homes, blocks access routes, and has resulted in injuries and fatalities during heavy rains. Improved drainage was also widely associated with reduced waterborne diseases and fewer childhood illnesses.

Several communities, including Caldwell, Central Jamaica Road, and Duala Market Community, emphasized the importance of improved roads and culverts in enabling yearround movement. Expectations regarding temporary employment during construction were also common, with some communities—such as Bong Mines Bridge, Cow Factory, and Mombo Town—linking these opportunities to improved household income and the ability to support education and family needs. In Supermarket Community, residents additionally noted that flood control could allow the resumption of gardening and small-scale trading activities.

Despite broad support for the Project, communities also raised concerns that it could affect social cohesion and trust if not adequately addressed. These included fears of delays or incomplete implementation of drainage work, concerns related to resettlement and unfair compensation, potential increases in crime or social tension linked to an influx of workers, and health and safety risks during construction. Whea Town, Zondo Town, and Bong Mines Bridge in particular expressed concern that incomplete drainage works could result in continued flooding. Communities also stressed the importance of fair and transparent compensation processes, with Caldwell emphasizing that legitimate land and structure owners should be the primary beneficiaries of resettlement measures.

Communities put forward several recommendations aimed at maintaining trust and strengthening engagement. These included regular and timely information sharing before and during construction through community leaders and meetings, inclusive participation of women and youth in planning and implementation processes, and transparent procedures for mapping, compensation, and grievance handling. Some communities, including Zondo Town, also recommended scheduling construction activities during the dry season to ensure quality implementation and minimize disruption.

Overall, communities perceive the Project as potentially transformational, particularly in relation to flood control, public health improvement, and livelihood enhancement. However, sustaining strong community support will depend on timely implementation, fair compensation, effective communication, and inclusive engagement throughout the Project lifecycle.

Section 5 of the ESIA (Volume II) provides a more detailed account of stakeholder expectations and concerns related to the Project.

8.9.3. Community Governance

Findings from the HHS, KIIs, and FGDs reveal that in the 18 communities surveyed, community governance is largely shaped by local leadership structures and traditional decision-making processes. However, the structure, functionality, and effectiveness of governance arrangements vary considerably across locations, influencing how communities organize, make decisions, and engage with external actors.

8.9.3.1. New Kru Town

In New Kru Town, local leadership structures such as community chairpersons, elders, block leaders, and secretaries are present across communities including Duala Market, Fundaye, Lagoon, Supermarket Community, Popo Beach, and Trowin. Formal Community Development Committees (CDCs) are either not established or largely inactive, which limits organized and inclusive community participation in development planning.

Community meetings are irregular and typically convened in response to specific events, such as flooding, evictions, or visits by government authorities or NGOs. Meetings are usually called by community chairpersons, block leaders, or elders, and information is disseminated through informal communication channels, including word of mouth, town criers, or block representatives. There is no fixed meeting schedule, and attendance varies depending on the issue discussed.

In terms of community meetings, several respondents noted that meetings are frequently dominated by a small group of leaders. Community meetings are seen more as informationsharing forums than platforms for consultation or joint decision-making.

Decision-making processes are predominantly top-down. Women and youth are said to be represented through informal leadership roles or community groups. Notably, all respondents from New Kru Town mentioned that women participate in decision-making particularly in handling disputes. This was mostly shared by the respondents of Central New Kru Town and Duala Market who remarked that chairladies and women leaders help to resolve disputes in the community.

On the other hand, several respondents noted that leadership capacity is constrained by a lack of training and resources, reducing the ability of communities to engage meaningfully with external projects. As a result, residents fear exclusion from development benefits such as compensation, employment opportunities, and information sharing.

8.9.3.2. St. Paul River

In communities surveyed within the St. Paul River area, governance structures are more clearly defined and visible. Leadership typically revolves around community chairpersons, chairladies, elders' councils, and community secretaries, who are widely recognized as official representatives in engagements with government institutions and project actors. These leaders are responsible for mobilizing residents, resolving disputes, and communicating community concerns.

Community meetings are more structured and held more frequently compared to other locations. Meetings are usually organized by community leadership structures, including chairpersons, chairladies, and elders' councils, and commonly address development projects, security concerns, or environmental challenges. Information about meetings is shared through community leaders, block representatives, and occasionally religious or social gatherings.

Attendance at meetings is generally higher, and residents are more accustomed to participating in community discussions. However, decision-making authority remains concentrated among senior leaders, with limited influence from women and youth participants. Crab Hole community was an exception, where respondents noted that women and youth leaders are also involved in resolving community disputes. Overall, community meetings in St. Paul River are viewed as important mechanisms for mobilization and information dissemination, particularly during engagements with external actors.

Similar to New Kru Town, CDCs remain largely inactive . While women and youth are reportedly included in leadership structures, their participation is often consultative rather than decision-making, with key decisions dominated by senior male leaders. Respondents expressed concern that weak accountability mechanisms may result in elite capture or unequal distribution of project benefits, emphasizing the need for clearer roles, stronger coordination, and improved transparency to improve community trust.

8.9.3.3. Stockton Creek

In Stockton Creek communities, governance systems are generally weak and fragmented. Many respondents reported the absence of functional CDCs. Leadership arrangements in Cow Factory, Central Jamaica Road, and Zondo Town are largely informal and centered around a small number of recognized individuals such as chairpersons or elders. These structures lack authority, consistency, and organizational capacity.

Community meetings are infrequent and poorly coordinated, and are often convened only when promoted by external actors such as project teams or local authorities. Leadership responsibilties for organizing meetings is not always clearly defined, leading to confusion about who should convene or chair discussions.

Information about meetings is inconsistently shared, leading to low turnout and limited representation. Women and youth participation is especially low, partly due to short notice and perceptions that meetings do not lead to tangible outcomes. Several respondents described community meetings in Stockton Creek as largely symbolic, with limited followup, which has reinforced community disengagement.

Decision-making processes are heavily dependent on external actors, rather than internal consultation. Although women and youth groups exist, they operate largely in isolation from broader governance structures and have minimal influence over community-level decisions. The absence of formalized governance systems and capacity-building opportunities has undermined effective participation, leading to concerns that development projects may not adequately reflect community priorities or may exacerbate existing social tensions if governance gaps are not addressed.

8.10. Livelihoods and Land Use

8.10.1. Division of Labor at the Household Level

8.10.1.1. Household Crop and Tree Activities

Data collected in the HHS provided some insight into which agricultural and domestic tasks are predominantly performed by which gender in adults and children. Agricultural tasks carried out at the household level were identified and interviewees were asked which member performed each agricultural task. A detailed breakdown of these findings can be found in Table 8-21.

Table 8-21 Division of agricultural tasks by gender

Household activity	Number of adults			Number of children			Hired labor
	Male	Female	Total	Boy	Girl	Total	
Brushing	218	2	**220**	0	0	**0**	0
Felling	163	31	**194**	20	6	**26**	0
Burning	158	36	**194**	21	5	**26**	0
Land preparation	168	34	**206**	12	6	**18**	0
Sowing	157	43	**200**	15	5	**20**	0
Seed nursery	157	46	**203**	13	4	**17**	0
Transplantation	158	42	**200**	16	4	**20**	0
Weeding	147	49	**196**	16	8	**24**	0
Fencing	163	37	**200**	14	6	**20**	0
Manuring	160	39	**199**	15	6	**21**	0
Harvesting	150	52	**202**	13	5	**18**	0
Transportation	161	39	**200**	15	5	**20**	0
Stoning	158	42	**200**	15	5	**20**	0
Marketing	127	77	**204**	11	4	**15**	1

8.10.1.2. Domestic Labor

With regards to domestic labor, women and girls continue to bear the greater share of responsibility. As presented in Table 8-22, adult women show higher participation in activities such as cooking and cleaning (118 women vs. 68 men), childcare (119 women vs. 73 men), and care for the elderly (117 women vs. 85 men).

Children also contribute to domestic tasks, with boys more involved than girls in certain activities, such as fetching drinking water (46 boys versus 31 girls), collecting firewood (28 boys versus 17 girls), childcare (16 boys versus 11 girls), and care for the elderly (11 boys versus 7 girls). Girls show higher participation in cooking and cleaning (19 girls versus 15 boys) and washing clothes (27 girls versus 26 boys).

Hired labor is minimal and primarily appears in fetching drinking water, laundry, and caregiving, reinforcing the reliance on unpaid household labor.

Table 8-22 Division of domestic tasks by gender

Household activity	Number of adults			Number of children			Hired labor
	Male	Female	Total	Male	Female	Total	
Collecting firewood	109	66	**175**	28	17	**45**	0
Fetching drinking water	69	73	**142**	46	31	**77**	1
Grinding grains	117	76	**193**	17	10	**27**	0
Washing clothes	62	102	**164**	26	27	**53**	3
Cooking and cleaning	68	118	**186**	15	19	**34**	0
Childcare	73	119	**192**	16	11	**27**	1
Care for the elderly	85	117	**202**	11	7	**18**	0

8.11. Economic Activities

Economic activities were also surveyed as part of the HHS. All interviewed individuals were asked about their primary and secondary occupation. Table 8-23 shows a clear gendered division of labor across both primary and secondary economic activities. In terms of primary occupations, business ownership is the most common activity (222 individuals), dominated by women (163 females), while a large proportion of respondents are students (464), with slightly higher female participation. Male respondents are more engaged in formal and laborintensive occupations, including private employment (72 individuals, majority male), daily wage labor (31), and government employment (21), while fishing is reported exclusively by men. In contrast, unpaid care work remains almost entirely female, with 16 women reporting "housewife/carer" as their primary occupation. Unemployment also remains notable, particularly among women (60 individuals seeking work).

For secondary occupations, 214 individuals reported additional economic activities, with higher female participation (132 females). Unpaid care work again dominates (93 individuals, almost all female), while business ownership (55 individuals) is more male-dominated in secondary roles. Male participation remains higher in activities such as daily wage labor, fishing, and formal employment, whereas female participation in these sectors is limited.

Overall, the findings highlight persistent gender disparities in economic participation, with men more represented in formal and income-generating roles, while women are concentrated in unpaid care work and small-scale or informal activities, limiting their access to economic opportunities.

Table 8-23 Economic activities in the SAI per gender

Primary economic activity	Number of			Secondary economic activity	Number of		
	Males	Females	Total		Males	Females	Total
Daily wage earner	27	4	**31**	**Crop farmer**	0	1	**1**
Primary economic activity	**Number of**			**Secondary economic activity**	**Number of**		
	Males	**Females**	**Total**		**Males**	**Females**	**Total**

Fishermen/women	7	0	7	Daily wage earner	6	1	7
Government employee	14	7	21	Fishermen/women	1	0	1
Housewife/carer	0	16	16	Government employee	1	0	1
Other	60	59	119	Housewife/carer	1	92	93
Own business	59	163	222	Other	9	9	18
Private employee	56	16	72	Own business	37	18	55
Retired (With pension)	3	1	4	Private employee	11	3	14
Salesman	0	1	1	Salesman	1	0	1
Student	213	251	464	Teacher	3	0	3
Teacher	4	5	9	Tutor	1	0	1
Trader	0	2	2	Trader	3	1	4
Under 5 years, in school	17	13	30	Unemployed, not seeking work	2	2	4
Under 5 years, not in school	35	37	72	Unemployed, not seeking work	6	5	11
Unemployed, not seeking work	5	4	9				
Unemployed, seeking work	24	36	60				
Total	531	622	1,153	Total	82	132	214

8.12. Land Ownership and Tenure System

8.12.1. Land Acess, Tenure and Use

As part of the HHS, respondents were asked about access to land, land characteristics, ownership status, and land use. As shown in Table 8-24, out of the 220 households surveyed, 26 households (11.8%) reported having access to land. These households reported a total of 27 land parcels, as some households had access to more than one distinct piece of land.

Most households with land reported access to a single land parcel, indicating limited landholdings within the study area. One household only reported access to two land parcels and another household reported access to three land parcels.

The characteristics of the reported land parcels are presented in Table 8-24, covering land type, ownership/tenure, and current land use.

Table 8-24 Type, ownership, and use of land parcels

Land Characteristic	Category	Parcels (n*)	% of Parcels	Households
Type of land	House plot	10	37	10
	Lowland swamp	7	25.9	7
	Upland farm	6	22.2	5
	Other	4	14.8	4
Ownership / tenure	Landowner with title	25	92.6	22
	Landowner without title	2	7.4	2
Land use	Not used	15	55.6	14

Land Characteristic	Category	Parcels (n*)	% of Parcels	Households
	Business	2	7.4	2
	Recreation	1	3.7	1
	Other	9	33.3	8

*n= *number*
Note: Percentages are calculated based on the total number of land parcels reported (n = 27). Some households reported access to more than one land parcel.

The household survey results indicate that land access within the study area is limited. Out of 220 households surveyed, only 26 households reported having access to land. Most of these households (84.6%) reported access to one land parcel only, while a small number reported access to two or three parcels.

In terms of land type, a total of 27 land parcels were reported. The most common land type is house plots, which account for 10 parcels (37.0%), followed by lowland swamp areas (7 parcels, 25.9%) and upland farm land (6 parcels, 22.2%). Other land types account for 14.8% of the reported parcels. Overall, this indicates that land ownership is mainly related to housing and settlement, with limited agricultural landholdings.

More than half of the reported land parcels (15 parcels, 55.6%) are currently not in use. Among parcels that are in use, the most common use relates to construction or preparation for housing, accounting for 9 parcels (33.3%). Only a small number of parcels are used for business activities (2 parcels, 7.4%) or recreational purposes (1 parcel, 3.7%), indicating limited reliance on land for income-generating activities.

With respect to ownership, most land parcels are reported to be owned with formal land titles (25 parcels, 92.6%, held by 22 households). Only 2 parcels (7.4%), belonging to 2 households, are reported as being owned without formal title.

Overall, the findings indicate that land ownership and use in the study area are closely linked to housing and settlement patterns.

8.13. Income and Household Expenditure Patterns

8.13.1. Sources of Household Income

According to the HHS, and as results are presented in Table 8-25, business is the most common source of income (111 individuals), with higher female participation (65 women vs. 46 men), followed by formal employment (61 individuals), which is strongly male-dominated (50 men vs. 11 women). Men are also more engaged in specialized and formal income activities, while women participate to a lesser extent in small-scale, informal activities such as petty trading and agriculture. Other income sources, including remittances and miscellaneous activities, are reported by a smaller number of individuals. Overall, the findings highlight a clear gendered pattern of livelihoods, with women concentrated in informal, trade-based activities and men dominating formal and higher-income sectors.

Table 8-25 Household members earning income

Income Source	No. of Income Earners in Each Household			Total

	Male	Female	Children	
Business	46	65	0	**111**
Formal employment	50	11	0	**61**
Non-farm wage labor	6	0	1	**7**
Agriculture wage labor	0	1	0	**1**
Income from micro-enterprises	2	0	0	**2**
Cassava	0	1	0	**1**
Rice	1	2	0	**3**
Pension/remittances	1	4	0	**5**
Professional fees / charge	9	0	0	**9**
Rent/Interest	0	1	0	**1**
Vegetables and fruits	0	1	0	**1**
Mining	2	0	0	**2**
Selling charcoal	1	0	0	**1**
Other	7	8	0	**15**
Total	**125**	**94**	**1**	**220**

Respondents were asked whether they engaged in cash-generating or food-producing activties. As illustrated in Figure 8-6, cash-generating activities dominate (83%). Only few of respondents recorded engaging in food-producing activities (4%), though a slightly higher percentage is recorded in households who engage in both types (6%), and neither (7%), highlighting the economic vulnerability of some households.

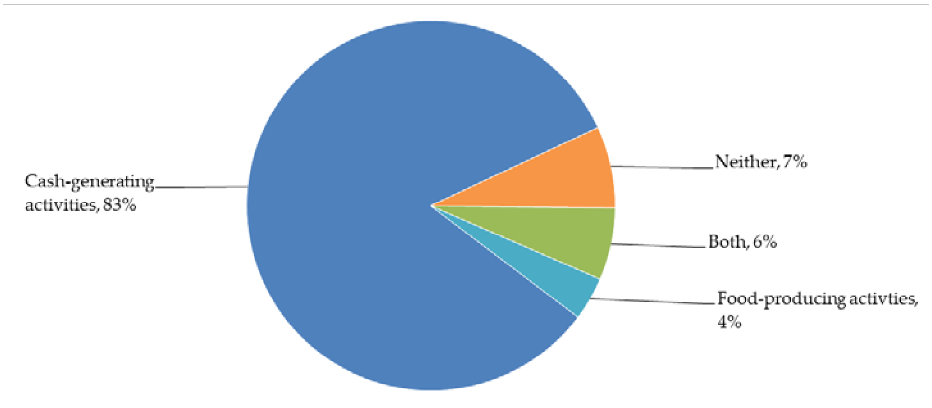


Figure 8-6 Percentage of households engaged in cash-generating activities

8.13.2. Household Expenditure Patterns

The generated income is primarily spent on meeting essential household needs. As shown in Table 8-26, the highest reported expenditures were on food, followed by education, medicine, clothing, and transportation. Men dominate major expenditures particularly for food (125 men vs. 92 women) and education (111 men vs. 56 women), reaffirming their their role as primary financial providers. Women dominate household management and social expenditures including cooking fuel, farming inputs, and savings groups (Susu), highlighting their role in sustaining household welfare and resilience.

Table 8-26 Household expenditure distributed by gender

Expenditure	For each expenditure, number of	Total

	Males in household spending	Females in household spending	Children in household spending	
Alcohol/Palm wine	5	5	0	**10**
Bushmeat	11	3	0	**14**
Charcoal	25	49	2	**76**
Clothing	42	36	1	**79**
Donation for social action	7	7	0	**14**
Expenditure for income generating activities	4	6	0	**10**
Education / reading material	111	56	0	**167**
Farm inputs: seed, fertilizer, pesticides	0	3	0	**3**
Foods	125	92	1	**218**
Lighting and cooking fuel	1	4	0	**5**
Livestock	2	3	0	**5**
Marriage and funeral expenses	6	9	0	**15**
Medicine / doctor / hospital charges	83	59	0	**142**
Saving /loan and interest payment/ Susu	10	21	0	**31**
Taxes / fees / fines etc.	1	0	0	**1**
Transportation / communication	69	61	1	**131**
Other	1	2	0	**3**

8.13.3. Barriers to Women's Participation in Income-Generating Activities

Out of all the surveyed households, 197 households reported having cash incomes. When asked about the total number of earning members in households, women outnumbered men, for a total of 191 women vs. 173 men. One hundred and thirty-five households out of 220 (approximately 61%) also reported that women have the same opportunities as men to engage in cash-generating activities.

In terms of participation in income-generating activities, Figure 8-7 shows that lack of employment opportunities remain the leading barrier for women, reported by 51 households (40%), followed by household responsibilities (28%), and lack of education (24%). Social norms and other factors had a more limited role, and were reported by a few households (2% and 6% respectively). These findings underscore structural and gender-based constraints that limit women's access to income-generating opportunities, particularly due to limited employment options and disproportionate unpaid care responsibilities.

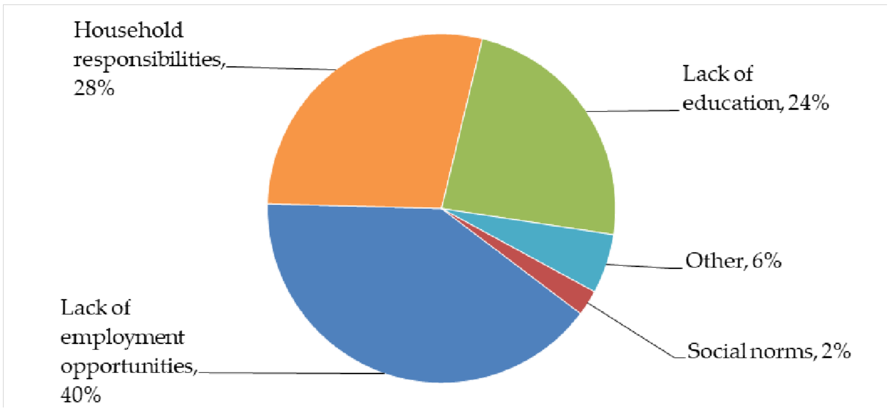


Figure 8-7 Barriers facing women from participating in income-generating activities

8.13.4. Ownership of Animals

Raising livestock is an uncommon livelihood activity within the SAI, with only 18 households (8% of surveyed HHs) reporting owning animals. The detailed breakdown is presented in Table 8-27.

Chickens and poultry were reported as the most owned livestock, with a total of 144 animals, 142 of which are local breeds. Other animals which include rabbits, dogs, and guinnea fowl, ducks, or geese are rarely raised. Households reported owning one, six, and three of these animals respectively.

Table 8-27 Livestock ownership and usage by type, including sale, slaughter, and female ownership

Type	Local	Exotic	Total
Rabbits	1	0	**1**
Chickens / Poultry	142	2	**144**
Guinea fowl/ ducks/ geese	3	0	**3**
Dogs	6	0	**6**

8.14. Poverty, Vulnerability, and Livelihood Conditions in the Project Area

8.14.1. Poverty at the National Level

Poverty remains pervasive in Liberia, with about 30% of people living below the extreme international poverty line of USD 2.15 per day (Embassy of Sweden in Liberia & Swedish International Developmental Cooperation Agency, 2024). The poverty line, as defined by the World Bank, is the minimum income required to meet essential needs such as food, shelter, clothing, and healthcare (Rose Mungai, 2024). The distribution of poverty in Liberia is notably uneven. In fact, rural poverty was 71.6% compared to 31.5% in urban areas in Liberia (Liberia Institute of Statistics and Geo-Information Services & United Nations Development Programme, 2023).

In 2023, the country's gross national income per capita was only $710, and income inequality, measured by the Gini index, was 35.3 (United Nations Children's Fund, 2025). In addition to income poverty, most Liberians experience deprivation in one or multiple other dimensions of poverty (Embassy of Sweden in Liberia & Swedish International Developmental Cooperation

Agency, 2024). According to a 2019/2020 survey data, 52.3% of Liberia's population is multidimensionally poor, while a further 23.3% is considered vulnerable to multidimensional poverty (Liberia Institute of Statistics and Geo-Information Services & United Nations Development Programme, 2023). This means that many households face overlapping deprivations even when they are not income-poor.

From the 1980s onward, Liberia experienced severe economic mismanagement and a prolonged civil conflict lasting 14 years (1989–2003), which resulted in an estimated 270,000 deaths and displaced hundreds of thousands of people as refugees or internally displaced persons (Republic of Liberia, 2008). The conflict deepened poverty by destroying core governance institutions, damaging physical infrastructure, eroding social capital, and triggering an economic collapse that left much of the population impoverished.

Despite two decades of relative stability, more than half of Liberia's population continues to live in poverty, underscoring the lasting impacts of the civil war and the Ebola epidemic. Liberia's GDP per capita in 2021 was among the lowest globally. A combination of conflict, economic shocks, health emergencies, fluctuations in international prices, and sustained economic downturns—together with rapid population growth—has kept GDP per capita low and largely stagnant (World Bank, 2023). Additionlly, the 2025 Global Hunger Index ranked Liberia the 112th country among 123 countries, with a score of 30.0 that places the country in the serious hunger category (Global Hunger Index, 2025). Furthermore, in 2024, it ranked 177th out of 191 countries on the Human Development Index (United Nations Children's Fund, 2025).

8.14.2. Vulnerability

Vulnerability in Liberia is not just about income. The Multidimensional Poverty Index (MPI) shows that 23.3% of the population is vulnerable to multidimensional poverty, meaning they are deprived in 20%–33% of key indicators related to health, education, and living standards (United Nations Development Programme, 2023).

In Liberia, vulnerability is broadly defined as the risk of falling into poverty or the inability to cope with economic shocks, even if a household is not currently classified as poor (Liberia Institute of Statistics and Geo-Information Services, 2017). Households that live just above the poverty line often lack the financial buffers, assets, or social protection necessary to maintain their standard of living in the face of adversity. As a result, they are highly susceptible to downward mobility due to events such as illness, price inflation, environmental shocks, or loss of income.

In the pre-war era, traditional society respected and cared for elderly members who contributed to community welfare. Children took care of their older relatives, reducing their vulnerability to basic needs like shelter, food, and care. However, the civil war disrupted families significantly, leading to various consequences:

- Forced displacement led to families being torn apart, multiple relocations, loss of connections, possessions, land, and means of livelihood.
- Many died due to violence, diseases, and inadequate healthcare, leaving the less capable family members without necessary support. Social problems like alcoholism,

gambling, and drug abuse grew, further diminishing familial support, and the presence of post-traumatic stress disorder which is prevalent among the population.

- Girls continue to face abuse and abandonment, resulting in young girls raising children without any support. Prostitution has increased as women struggle to survive, often without any family backing.
- Educational services ceased or didn't lead to employment, leaving young individuals with poor literacy and numeracy skills and no access to training opportunities requiring foundational knowledge.
- Households had to strive to survive, leading members to migrate for work.

This turmoil caused fractured families, strained relationships, neglected elders and children, and young people devoid of educational opportunities or forced out of school due to insufficient support. Progress in rectifying this situation has been gradual, improving slowly with increased social cohesion during post-war recovery.

The Household Income and Expenditure Survey (HIES) of 2017 revised poverty and vulnerability measurements (Liberia Institute of Statistics and Geo-Information Services, 2017). Vulnerable groups are now defined as:

- Households led by illiterate individuals with other family members lacking education or being school dropouts.
- Women headed HHS.
- Families with disabled members.
- HHS comprising only people older than 55.
- HHS is headed by children under 18 years.
- Landless rural HHS.

8.14.3. Household Economic Stress and Financial Coping

8.14.3.1. Income Shortages

Households in the project area were asked whether they experienced any shortage of money in the past, and a total of 115 households out of 220 (more than 50%) reported that they have. When asked about the number of month in which they experienced that shortage, the most common answer was one month (55 households), followed by 2 months (23 housholds), 3 months (18 households), and 4 months (9 households). Some of households experienced money shortages for 5 months or more (a total of 19).

8.14.3.2. Access to Financial Services

Households rely on a mixture of both formal and informal financial services to manage their economic needs, often relying on debt to provide needs. According to HHS, out of the surveyed households, 59 reported accessing financial services, with a preference for informal mechanisms over institutional ones. As shown in Figure 8-8, households mostly relied on other services (35%) followed by Susu Clubs (32%), loans from family and friends and bank service (each 10%). Only a few households relied on mutual credit services (5%), indicating limited availability and/or awareness of community-based financial support mechanisms.

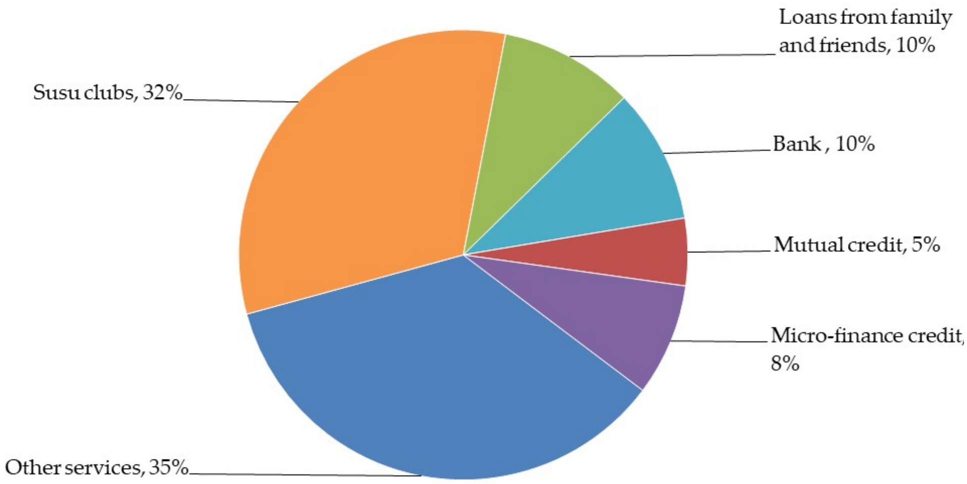


Figure 8-8 Types of financial services reported by households

8.14.3.3. Loans, Debts, and Borrowing Reasons

A total of 66 households out of 220 reported having an outstanding loan or debt at the time of the survey. As presented in Figure 8-9, the most frequently mentioned reason for borrowing was to cover education-related expenses (28%). This was followed by business investment (24%), food purchases (14%), medical expenses (9%), house repairs and meeting daily needs(6% each). A smaller number of households borrowed to pay utility bills and rent, repay debts, help relatives, and meet social obligations, reflecting more immediate and basic needs as well as limited finances to cover social expenditure.

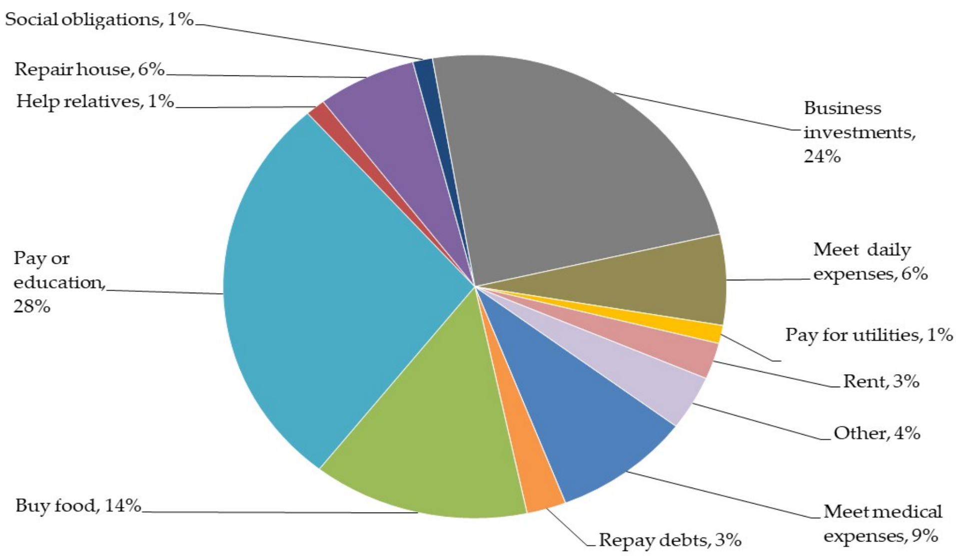


Figure 8-9 Reasons for burrowing loans reported by households

When examining the sources of credit, informal lending mechanisms were significantly more common than formal ones. As shown in Figure 8-10, many indebted households had borrowed from relatives or friends (34%), local or private money lenders (31%), or microcredit institutions (24%). Only a fewhouseholds recorded burrowing money from a banks (3%), while others reported other means of burrowing (6%). One households relied on a committee or and another on a shopkeeper/trader (1% each), while none of the households relied on NGOs or Self-Help Groups. This distribution points to limited access to formal financial institutions and a heavier reliance on community-based or informal financial networks.

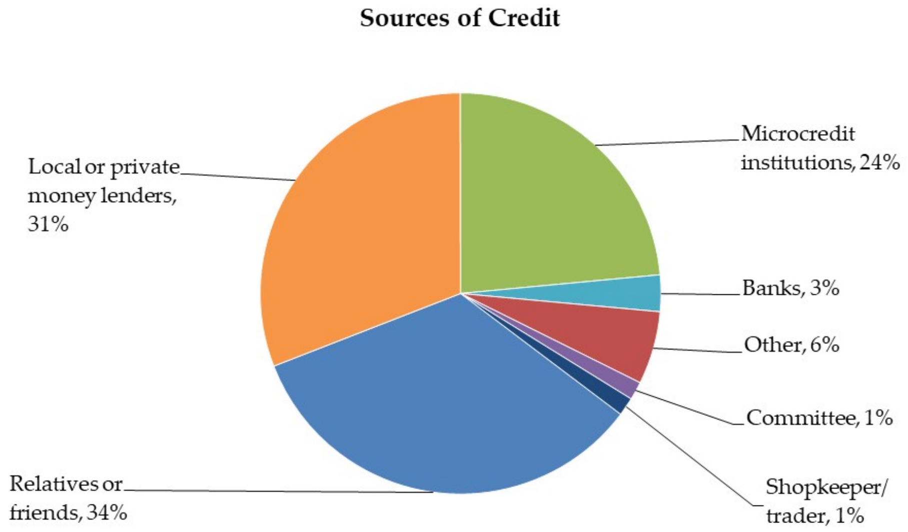


Figure 8-10 Types of financial services reported by households

8.14.3.4. Debt Repayment and Coping Strategies

Despite their reliance on debt, many households were able to manage their repayment obligations to some degree. Thirty-four households reported consistently making repayments on time, while 16 indicated that they sometimes met repayment deadlines. Seventeen households stated that they were unable to repay their debts when due.

In response to repayment challenges, households employed a variety of coping mechanisms. The most common approach was using savings from earnings (32%). Others addressed financial strain by rescheduling their loan terms (27%), taking out new loans (19%), borrowing from relatives (11%), and paying additional interest (5%). A few households reported other coping mechanisms (6%). Data is presented in Figure 8-11.

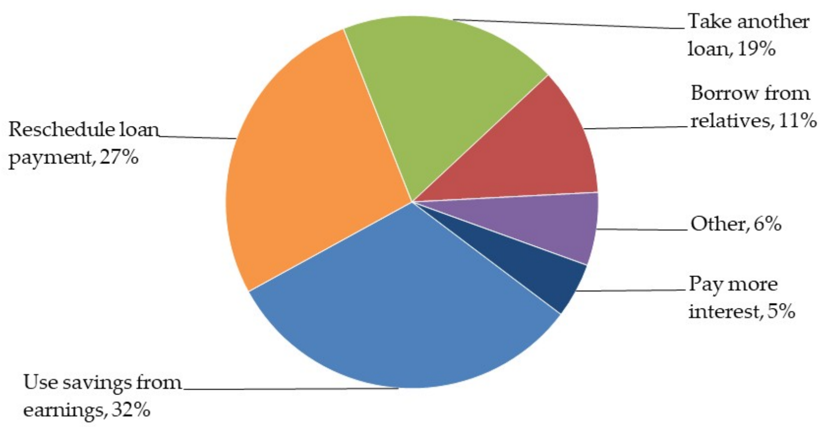


Figure 8-11 Approaches to repaying debt reported by households

8.14.3.5. Access to Banking Services

According to HHS data, only 11% of households reported owning a bank account, reflecting limited engagement with formal financial systems. This is driven by a combination of economic constraints—such as low or irregular income—as well as institutional and behavioral barriers, including low trust in banks and preference for more accessible alternatives. Despite this, nearly half of households (107 households) reported having savings. As shown in . Figure 8-12, savings are primarily held through mobile money (39%) and Susu groups (36%), followed by home savings (12%) and other informal mechanisms, while formal bank savings remain low (6%). Overall, households rely heavily on informal and accessible saving methods rather than formal banking services.

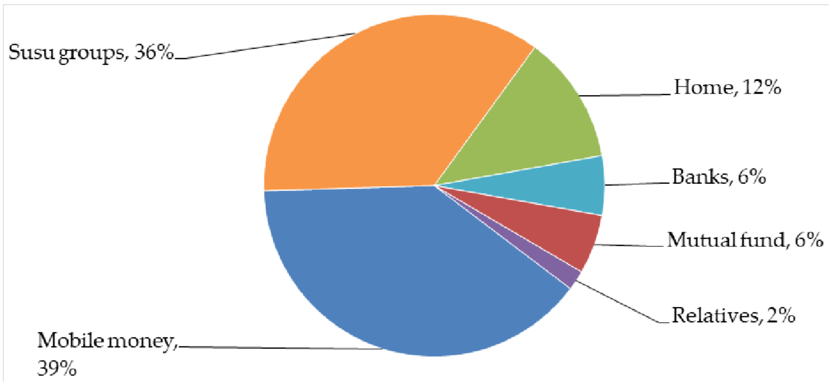


Figure 8-12 Methods of saving money reported by households

Households were also questioned about how they would use these savings in the future. The most frequent reported investment was children's education (27%). Other respondents stated that they would use these investments to start or upgrade businesses (20%), while others reported using savings to purchase or improve property (20%). These are followed by savings investments include emergencies (17%) and purchasing land (13%) A small number of households reported using savings to invest in agriculture, purchase vehicles, pay existing debts, or other investments (1% each). Data is presented in Figure 8-13.

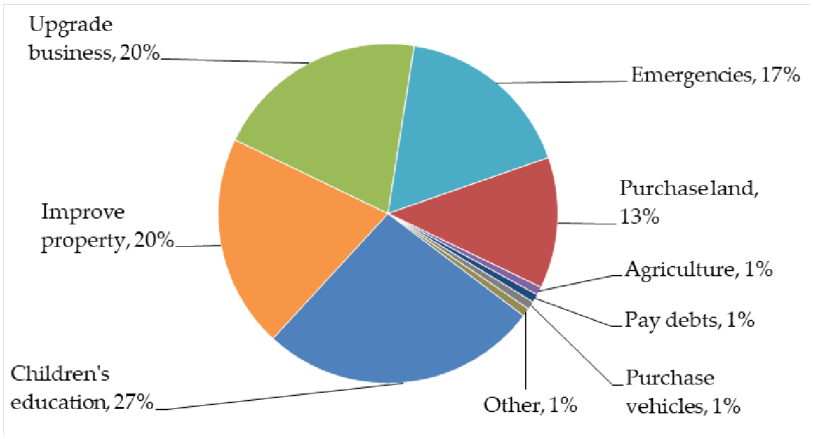


Figure 8-13 Use of savings reported by households

8.14.4. Household Wealth and Resilience

8.14.4.1. Asset Ownership

To assess household wealth, the baseline socio-economic survey collected data on assets that indicate a history of disposable cash income and access to markets. These include both productive assets (e.g., motorcycles, canoes, sewing machines) and household comfort or utility items (e.g., televisions, refrigerators, solar panels).

Figure 8-14 presents the number of each item owned and in working order across surveyed households.

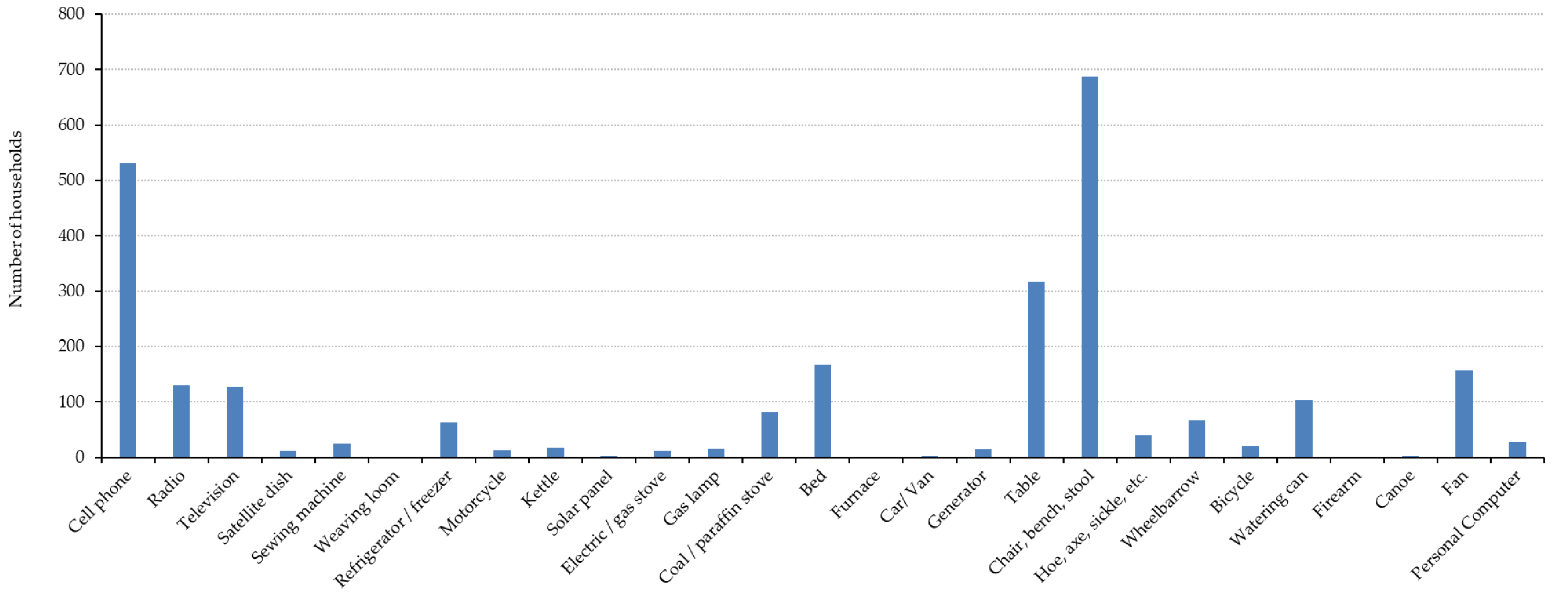


Figure 8-14 Total number of each household item currently owned and in working order, as reported by survey respondents132

8.14.4.2. Asset Sales

Household members were questioned whether any member of the household has been compelled to sell any household asset, and 35 households reported that they have. As presented in Figure 8-15, the most frequently mentioned reason for selling assets was food purchases (18%). This was followed by education payments (25%), and medical expenses (15%). A smaller number of households sold assets to meet daily needs, repair their house, repay debts, pay for utility bills, meet social obligations, and invest in businesses. This suggests that some of the households face delicate financial stress that forces them to liquidate assets to meet basic needs and obligations, potentially undermining their long-term resilience and livelihoods.

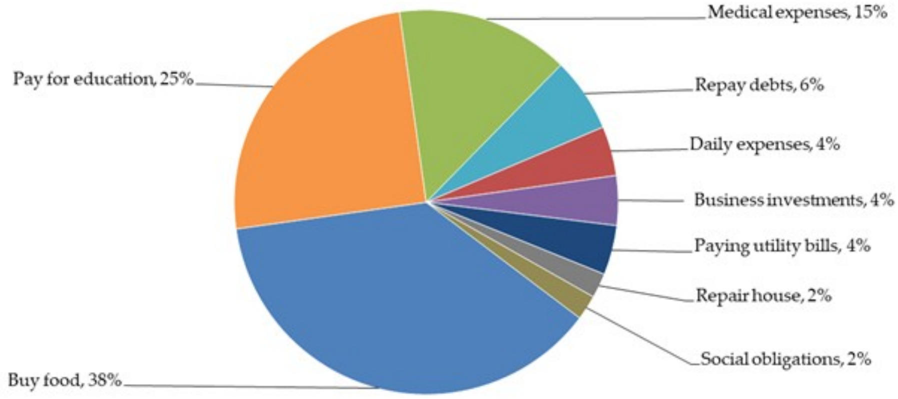


Figure 8-15 Reasons for selling assets reported by households

8.14.4.3. Gendered Control over Assets and Benefits

Table 8-28 reveals a clear gendered pattern between control over use and control over benefits of assets. Overall, men dominate control over use across nearly all asset categories, while women tend to have relatively stronger representation in control over benefits, though still uneven.

Men exercise greater control over the use of productive and strategic assets, particularly land (139 men vs. 81 women), transport machinery (147 men vs. 73 women), education (141 men vs. 79 women), and access to training (136 men vs. 84 women). This suggests that men are more likely to make decisions about how key livelihood-related resources are utilized. The gender gap is evident for assets linked to mobility, skills, and income generation, which shows that men have stronger decision-making power in public and economic spheres.

While men still dominate benefit control in several categories (e.g. land and transport machinery), women either match or surpass men in others. Women control benefits more than men in labor (115 women vs. 105 men), cash (125 women vs. 95 men), outside income (117 women vs. 103 men), and basic needs provision (112 women vs. 97 men). This indicates that women play a central role in managing and allocating the outcomes of assets—particularly those linked to household welfare and day-to-day consumption—even when they do not control how the assets are used.

Table 8-28 Gendered patterns of control over resource use and benefit sharing at the household level

Resource Asset	Control Over Use	Control Over Benefit

	Males	Females	Males	Females
Land	139	81	116	104
Domestic equipment (bicycles, tools, etc.)	135	85	112	108
Labor	134	86	105	115
Cash	128	92	95	125
Access to training	136	84	110	110
Outside income	138	82	103	117
Asset ownership	139	81	112	108
Basic needs provision	118	102	97	112
Education	141	79	117	103
Transport machinery	147	73	124	96

8.14.5. Food Security

8.14.5.1. Duration and Seasonality

Food insecurity is a critical concern across the surveyed areas. Out of 220 households surveyed, 130 (59%) reported experiencing a shortage of basic food during the past 12 months.

According to the GCA report, food insecurity constitutes a significant concern factor in New Kru Town, with 58% of respondents unable to meet daily food requirements, while 49% skip food meals 2-3 times a week. Almost a quarter (23%) skip meals daily, and 8% skip meals 4-6 times a week (Global Center on Adaptation (GCA) et al., 2025).

As presented in Figure 8-16a, the duration of food insecurity varied among surveyed households. The largest group (42%) reported experiencing food shortages for one month, followed by two months (34%) and three months (14%). A smaller number experienced more prolonged hardships, including a few households who reported food shortages for half a year (2%) and even one household who reported shortages lasting all 12 months of the year (1%).

Food shortages were most reported in August (21%), September (18%), and October (14%)—months that coincide with the agricultural lean season before harvests. These trends underscore the seasonal vulnerability of households, particularly in the second half of the year. Data is presented in Figure 8-16b.

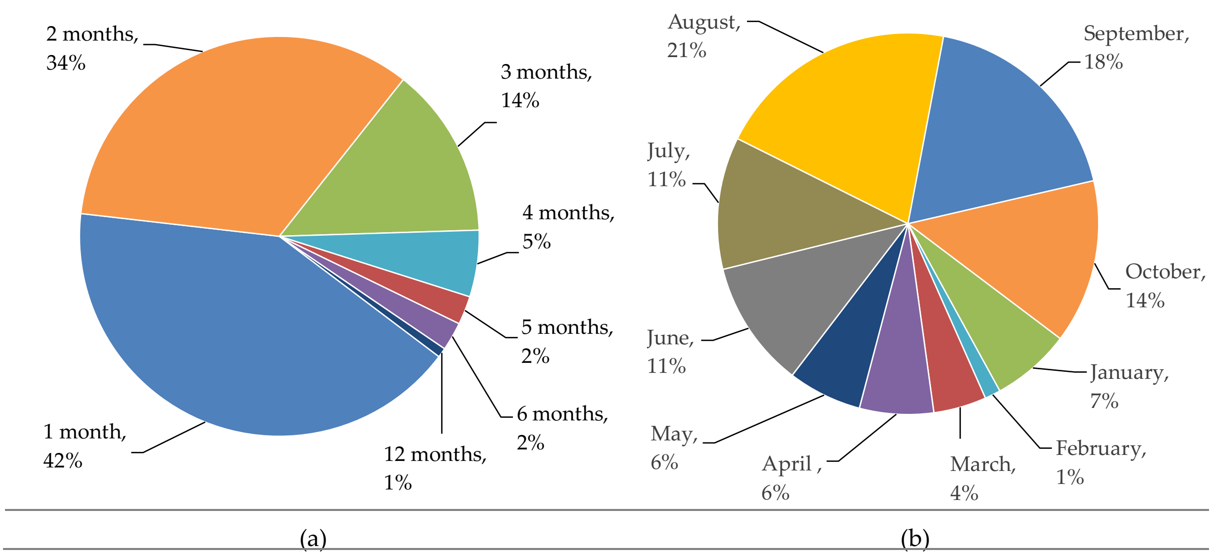


Figure 8-16 (a)Duration of food shortages reported by households; (b) Months in which food shortage was reported by households

8.14.5.2. Reasons for Food Shortages

These shortages are largely mostly linked to insufficient income (78%) and other reasons such lack of job opportunities or stable working (8%). Data is presented in Figure 8-17.

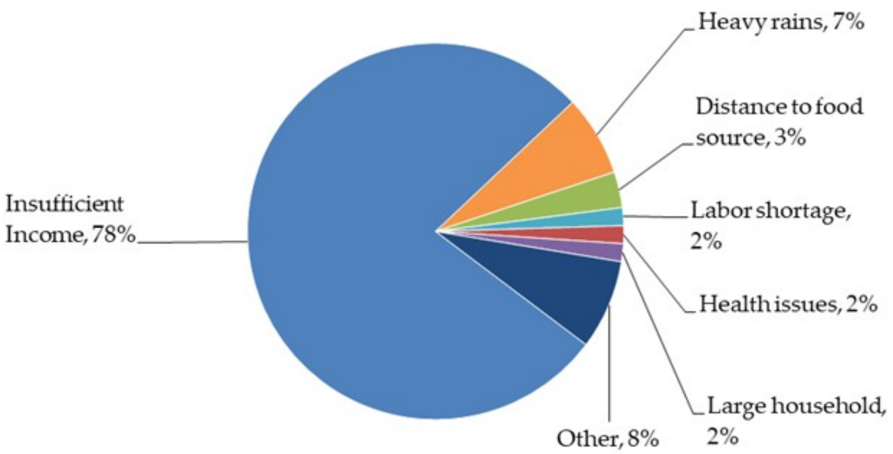


Figure 8-17 Reasons for food shortage reported by households

8.14.5.3. Coping Approaches

In response to the food shortages, households employed a variety of coping mechanisms. Data is presented in Figure 8-18.

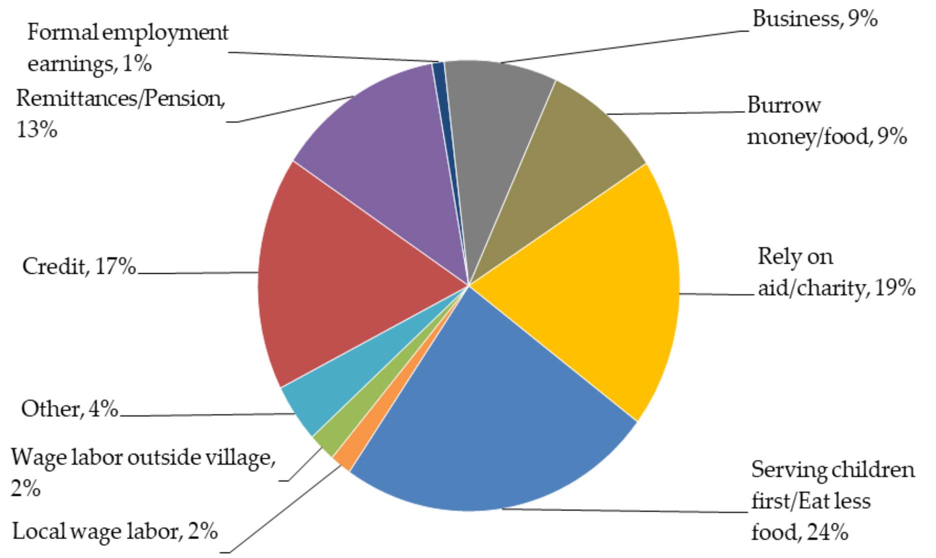


Figure 8-18 Coping approaches to food shortages reported by households

Overall, the findings indicate that food insecurity is widespread, income-driven, and highly seasonal, with most households relying on short-term, often erosive coping strategies that reflect limited livelihood stability and heightened vulnerability during the lean agricultural months.

8.14.6. Quality of Life

The responses collected during the HHS provide important insights into community members' perceptions of their living conditions, including access to public services, economic well-being, personal satisfaction, and time for leisure. These indicators together reflect the general quality of life across SAI.

8.14.6.1. Problems Facing Households

According to HHS findings, the households surveyed reported having several problems. The most frequent problems were cost of living (162 households), employment problems (121 households), availability of drinking water (57 households), lack of skills (50 households), poor solid waste management (42 households), and quality of drinking water (39 households). A notable number of households also reported problems such as bad roads/bridges, crimes, drug abuse, lack of electricity, lack of healthcare facilities, problems with waste disposal, and unfair prices. Other problems include eviction from land, hunger or nutrition problems, poor education, leadership, road conditions, as well as problems with sewage. Less common problems include alcohol abuse, illegal land use, lack of credit facilities, and quality of healthcare services. Details are presented in Figure 8-19. A detailed breakdown by location is presented in Appendix P.4.

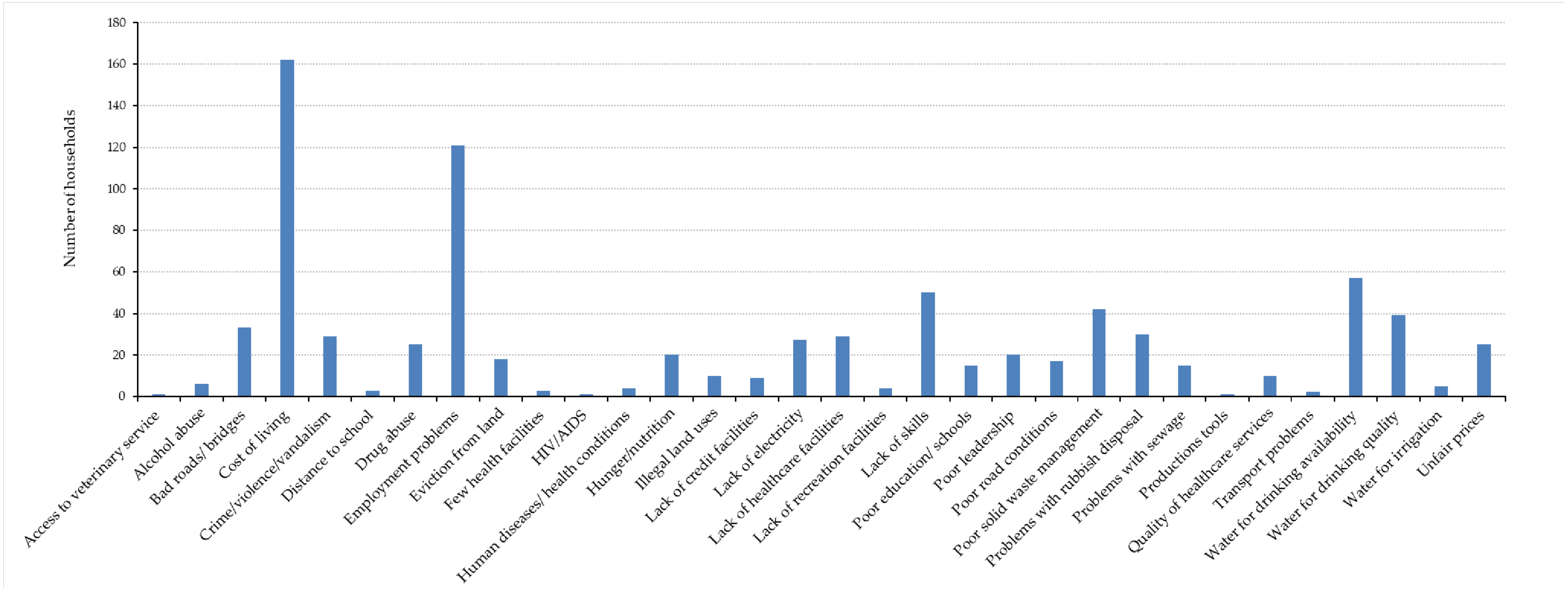


Figure 8-19 Problems facing households in the SAI 137

8.14.6.2. Satisfaction with Public Services

Satisfaction with government health services varied across households. While 24% of respondents reported being satisfied, a larger portion expressed dissatisfaction. Specifically, 38% were dissatisfied and 27% were very dissatisfied. Additionally, 5% of respondents were neutral, and 4% indicated that they do not use these services. Only 2% reported being very satisfied with the government health services they use. These figures suggest that while some households are content with available healthcare, many face barriers or have concerns about the adequacy of services. Data is presented in Figure 8-20.

Satisfaction with the schools in which the respondents' children attend was largely positive. The largest portion of respondents (58%) reported being satisfied, and 15% were very satisfied. Some respondents expressed dissatisfaction (10%), while a smaller number remained neutral (10 respondents). Twenty respondents did not use these services and six provided no response. Data is presented in Figure 8-20 and Figure 8-21

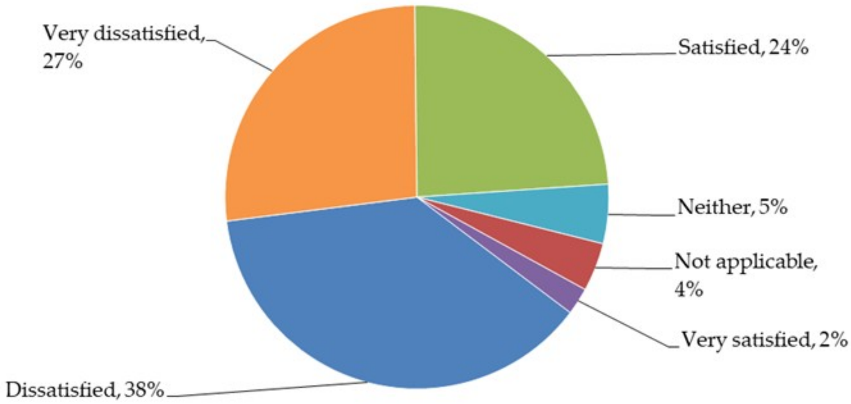


Figure 8-20 Satisfaction with public health services reported by households

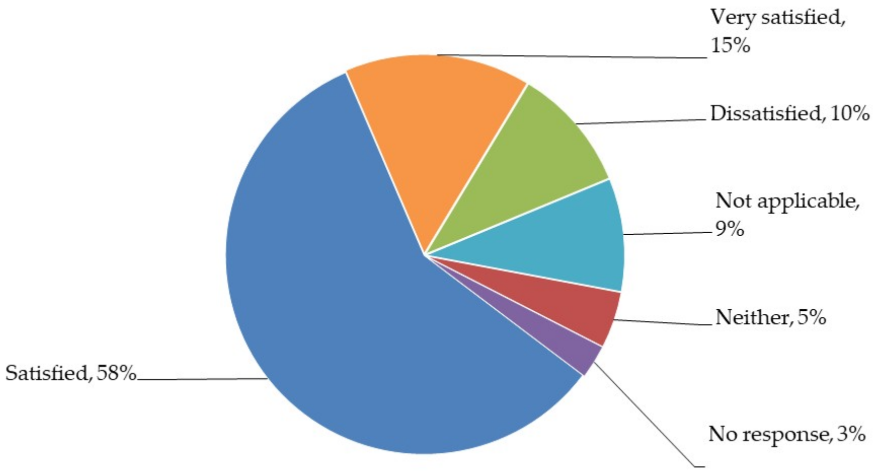


Figure 8-21 Satisfaction with school services reported by households

8.14.6.3. Perceived Changes in Household Economic Status and Contributing Factors

When asked about changes in household economic status over the past three years, 31% of respondents felt their situation had "improved a little," and 2% said it had "improved a lot." However, 23% indicated their situation remained the same, while many reported a worsening condition (28% reported "a little worse" and 16% reported "a lot worse"). Data is presented in Figure 8-21.

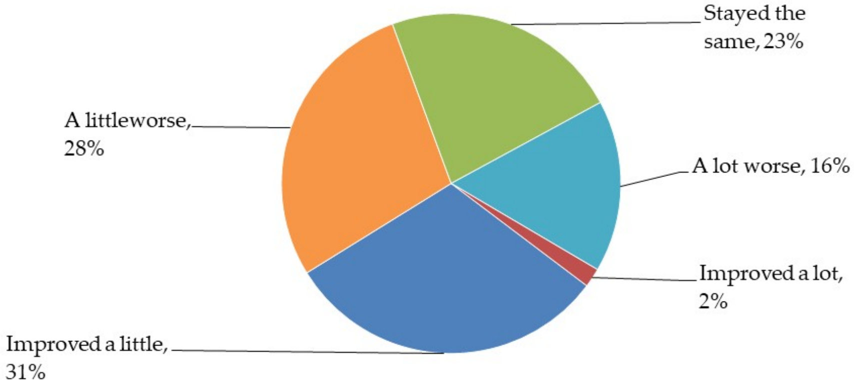


Figure 8-22 Changes in economic status over the past three years reported by households

The reasons for this change is presented in Table 8-29.

Table 8-29 Distribution of reported reasons for changes in household conditions across key thematic categories

Category	Reason	No. of households
Economic and livelihood-related	Low or insufficient income, Unemployment, Income instability / salary delays, high cost of business , and high cost of living	104
Category	**Reason**	**No. of households**
Well-being and living conditions	Lack of employment opportunities, poor living conditions, poor quality of services	61
Services, governance, structural	Poor quality of services, lack of government support, political situation affecting livelihoods, infrastructure issues	29
Health-related	Health problems, difficulty accessing healthcare, cost of healthcare	13
Social and household factors	Large household size , increased family responsibilities	9

8.14.6.4. Leisure Time and Personal Satisfaction

Time available for leisure is another critical indicator of quality of life. Most respondents described their leisure time as "moderate" (57%), while smaller numbers reported having "little" (12%), "not at all" (4%), or "mostly/completely" sufficient time (17% and 9% respectively). These findings suggest that while some individuals maintain a balance between work and rest, many have limited opportunities for leisure, likely due to economic pressures or labor demands. Data is presented in Figure 8-22.

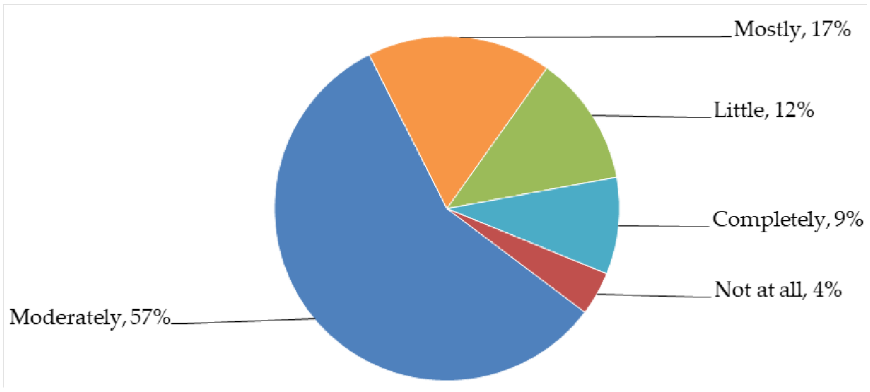


Figure 8-23 Time available for leisure reported by households

8.14.6.5. Self-Rated Quality of Life

When rating their overall quality of life, most respondents chose "good" (35%) or "poor" (33%), while a notable number selected "neither good nor poor" (20%), "very poor" (10%), or "very good" (2%). This general leaning toward moderate satisfaction aligns with earlier findings on economic conditions and access to services. Data is presented in Figure 8-23a.

Finally, when asked whether their quality of life had changed in the last three years, a notable number of respondents said it had improved a little (33% "a little," 3% "a lot"), while 24% indicated that it remained the same, and 27% recorded that it "became a little worse". Some reported that it became a lot worse (13%). Data is presented in Figure 8-23b.

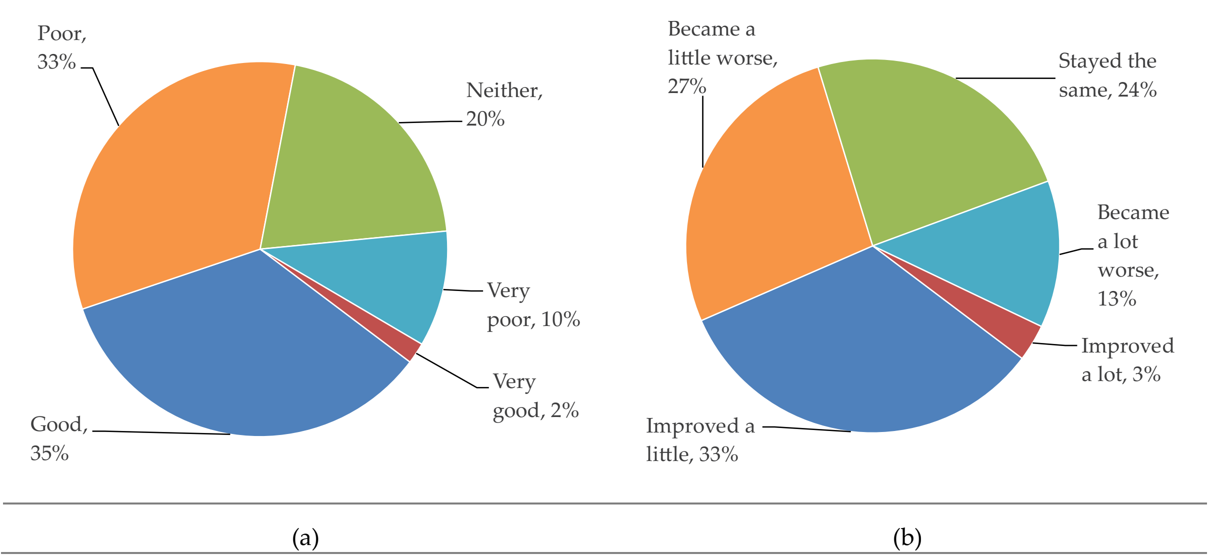


Figure 8-24 (a) Quality of life reported by households; (b) Changes in the the households' quality of life over the past three years

Communities were also asked about the main changes in their environment that would contribute to a better quality of life for them. The main improvements cited by respondants were related to drainage and flood control, employment opportunities, supply of water and electricity, access to health and imporoved education. More details on these findings are presented in Appendix P.5.

8.14.6.6. Household Problems by Levels of Urgency

Table 8-30 shows that households prioritize employment (202 very urgent) and education (200 very urgent; 175 urgent), followed by skills training (167), food (160), water (149), and health services (134). Access issues such as transport (116) and roads (108) are also important. In contrast, agricultural services are largely considered not urgent, indicating a focus on immediate livelihood and basic service needs over longer-term agricultural support.

Table 8-30 Level of urgency for problems facing households in the SAI

Reported Problems	No. of Households Reporting Level of Urgency		
	Very urgent	Urgent	Not urgent
Agricultural clinic	53	51	116
Agricultural equipment	60	44	116
Clinic	134	75	11
Community gardens	54	41	125
Employment	202	16	2
Food items	160	48	12
Improved roads	108	53	59
Improved seeds and livestock breeds	52	45	123
Livestock watering hole	47	42	131
Maternity clinic	130	48	42
Police station	64	58	98
Schools	200	175	65
Reported Problems	No. of Households Reporting Level of Urgency		
	Very urgent	Urgent	Not urgent
Skills training	167	46	7
Transport	116	56	48
Water	149	57	14

8.15. Access to Energy Sources

As is the case in all urban Liberia, most people in the project area rely mostly on energy sources. The data reveals that electricity is the dominant energy source, but access often requires travel, especially for those relying on town-based or external sources. Coal tar —a seondary energy source—was also reported by some households, though it is used less frequently than electricity.

According to HHS data, Table 8-31 shows that electricity is the dominant energy source, used by 134 households, mainly accessed within the community (64) or around the house (62), with only a small number relying on sources outside the community (8). Coal tar is used by very few households (13), indicating limited diversification of energy sources. The data also shows gender disparities, with men reporting higher access overall, while women—particularly those accessing electricity outside the community—experience longer travel times, reflecting greater time and mobility burdens. Overall, households remain highly dependent on electricity despite uneven and gendered access conditions.

Table 8-31 Access to energy sources in the SAI

Resource	Source origin	Who collects	Count no.	Total	Average travel time (min)
Electricity	Outside the town	Male	5	**8**	22
		Female	3		55
	Town	Male	39	**64**	24
		Female	25		19
	Around the house	Male	37	**62**	12
		Female	25		12
Coal tar	Town	Male	1	**2**	10
		Female	1		15
	Around the house	Male	10	**13**	4
		Female	3		1
Total			**151**	**151**	-

8.16. Ecosystem Services

Ecosystem services are the benefits that humans obtain from the natural environment and healthy ecosystems. They are generally used to inform the management goals of new ecosystems (Evers et al., 2018). Ecosystem services include (Millennium Ecosystem Assessment, 2003):

- **Provisioning services**, such as food, drinking water, timber, wood fuel, medicinal plants.
- **Regulating services**, such as clean air, clean water, waste decomposition, pollination, erosion control, and the regulation of floods, droughts, land degradation, disease and climate.
- **Cultural services**, such as recreational, spiritual, religious, and other non-material benefits.
- **Supporting services**, such as photosynthesis, soil formation, nutrient cycling and the water cycle.

8.16.1. Provisioning Services Collected

Provisioning ecosystem services refer to the material benefits that households obtain from natural ecosystems, including food, fuel, raw materials, and other natural products used for subsistence or income generation. The assessment of provisioning services focuses on household-level use of natural resources and products, drawing on household survey data and qualitative findings from FGDs and KIIs to capture location-specific and livelihooddependent resource use patterns.

8.16.1.1. Natural Resources

Based on the HHS, reported household-level use of ecosystem-based natural resources within the SAI appears limited. Access to firewood was reported only in New Kru Town by six households out of 220 surveyed households, reflecting minimal reliance on forest-based provisioning services within the largely urban project area. Among these households, one female respondent reported travelling approximately 15 minutes to collect firewood within the town, while two male and three female respondents collected firewood around their homes, with average travel times of approximately six and nine minutes, respectively.

Other natural resources were reported only sporadically in the HHS. A small number of households reported limited access to fish from wetland or beach areas, as well as the collection of soil or earth materials from town areas, suggesting that these resources are not widely relied upon for subsistence at the household level within the surveyed sample. Notably, none of the surveyed households reported collecting medicinal plants, bamboo, honey, or construction wood. These findings are summarized in Table 8-32.

Table 8-32 Summary of natural resources collected and sold by households

Resource	Source origin	No. of households engaged in collection and sale
Firewood	Town	1
	Around the house	5
Fish	Wetlands	1
	Beach	1
Soil / earth	Town	1

However, findings FGDs and KIIs indicate that fishing and fish-related livelihoods remain critically important for specific population groups within the SAI, particularly fishers, fishmongers, and households economically dependent on fishing activities. These livelihoods are highly location-specific and concentrated around coastal areas, riverbanks, beaches, and landing sites.

The apparent discrepancy between the household survey results and qualitative findings is largely attributable to the random sampling approach adopted for the HHS, which was designed to capture a representative cross-section of households across predominantly urban communities. Qualitative data collected through FGDs and KIIs—specifically with fishers, fishmongers, and fishing-dependent groups—provide a more detailed and accurate picture of reliance on aquatic and coastal ecosystem services, including access to beaches, wetlands, mangroves, and landing sites.

Across FGDs and KIIs, participants emphasized that any restriction to beaches, wetlands, mangroves, or established landing and trading sites, or relocation away from these areas, could significantly undermine fishing-based livelihoods, disrupt social networks, and reduce access to markets. These findings underscore the importance of interpreting household survey data alongside qualitative and ecological evidence when assessing ecosystem service use and dependency within the SAI.

Further evidence of the ecological and livelihood importance of these ecosystems is provided in Section 7, which presents findings from biodiversity surveys documenting the presence and use of coastal, wetland, and aquatic habitats within the project Area. In addition, detailed accounts of fishing livelihoods, market dynamics, and social dependence on these resources are presented in the stakeholder engagement and consultation findings (Section 5 of the ESIA, Volume II).

8.16.1.2. Use of Seeds and Fruits

Respondents were asked about the natural products they use, the frequency of use, and the activities for which these products are used. The only reported natural products used were fruits and seeds. As shown in Table 8-33, these resources are primarily used on a seasonal basis, with 15 respondents reporting the use of fruits and only 2 respondents reporting the use of seeds. Only two respondents reported using fruits on special occasions, and 1 respondent recorded using fruits on other occasions. None of the respondents recorded using seeds on special or other occasions.

Table 8-33 Frequency of collecting fruits and seeds as part of the provisioning ecosystem services

Product	Iumber of households per frequency			
	Seasonally	Special occasions	Other	Total
Fruit	15	2	1	**18**
Seeds	2	-	-	**2**

Regarding the activities in which these products are used, 17 respondents reported using fruits for household consumption and 1 respondent reported using them for both household consumption and trading. Notably, none of the surveyed households reported using firewood, wood poles, or medicinal plants for these purposes. Data is presented in Table 8-34.

Table 8-34 Purpose of use of fruits and seeds as part of the provisioning ecosystem services

Product	No. of households reporting household use only	No. of households reporting household use and trade
Fruit	17	1
Seeds	2	0

8.16.1.3. Hunting and Bushmeat

According to the HHS, bushmeat is not consumed regularly by most households. As shown in Table 8-35, the largest share consume bushmeat occasionally (112 households or 51%), followed by 88 households (40%) who stated they never consume it, and 20 households (9%) who reserve it for special occasions. These figures suggest that bushmeat consumption in the project area is primarily occasional and not a regular part of most households' diets.

Additionally, the purchase of bushmeat is like that of consumption. One hundred and twelve households (51%) reported buying bushmeat only occasionally, and 88 households recorded that they never purchased it (40%). A smaller segment buys it on special occasions (19 housholds or 8%), while only one household (0.4%) reported buying bushmeat daily.

In terms of preferred species, monkey was the most commonly reported type of bushmeat consumed (71 households or 54.6%), followed by deer (56 households or 43%). A very small number of households reported consuming other species such as ants, bear, raccoon, groundhog, and red deer (nearly 1% each).

Table 8-35 Frequency of bushmeat consumption, purchase, and type bought in the SAI

Type of Activity	Frequency or Type	Number of Households	% of Households
Bushmeat consumption	Never	88	40
	Occasionally	112	51
	Special Occasions	20	9

Bushmeat Purchase	Never	88	40
	Daily	1	0.4
	Occasionally	112	51
	Special Occasions	19	8
Type of bushmeat often bought	Deer	56	43
	Monkey	71	54.6
	Ants, bear, and raccoon	1	0.8
	Groundhog	1	0.8
	Red deer	1	0.8

8.16.2. Regulating Services

Regulating ecosystem services were identified as highly relevant to communities within SAI, particularly in relation to flooding, drainage, water quality, and environmental degradation.

8.16.2.1. Mangrove / Wetlands and Flood Regulation

Surveyed households were asked whether nearby wetlands, mangroves, or green spaces help reduce flooding in their area. Most respondents across all locations reported that these ecosystems do not significantly reduce flooding. However, a notable number of households reported uncertainty (34 households), while others indicated that wetlands somewhat reduce flooding (32 households). Only a small number of respondents stated that wetlands largely reduce flooding (13 households). Data is presented in Table 8-36.

Table 8-36 Surveyed household perception of the flood regulating role of wetlands and mangroves

Location	Not at all	Note sure	Somewhat	Yes, a lot
New Kru Town	44	1	6	10
St. Paul Wetlands	52	16	19	3
Stockton Creek	25	7	7	0
Total	**121**	**34**	**32**	**13**

In addition, findings from FGDs with wetland and mangrove users indicate that communities have mixed perceptions regarding flood regulation interventions. While participants expressed concerns that drainage infrastructure may result in house demolitions, encroachment into wetland areas, and reduced access to traditional fishing and hunting grounds, they also emphasized expectations that the project should contribute to tangible benefits such as flood reduction, improved waste management, community development, and stronger government regulation and protection of wetlands and mangroves.

8.16.2.2. Flooding Patterns and Drainage Capacity

8.16.2.2.1. Flooding Patterns

Household survey results, FGDs, and KIIs indicate that flooding is a significant and worsening concern across SAI. FGDs further highlighted that recurrent flooding, and drainage works pose safety risks and livelihood disruptions, particularly for households living in low-lying and wetland-adjacent areas, reinforcing survey findings that flooding is a worsening concern across SAI.

According to HHS results, respondents identified August as the worst month for flooding, followed by September and July, corresponding with the peak rainy season. Details are presented in Figure 8-24.

Across all locations, most households reported that flood depth is higher than it was three years ago, indicating increasing flood severity. Only a small number of households reported stable or reduced flood levels. A detailed breakdown of responses per location is presented in Appendix N P.6.

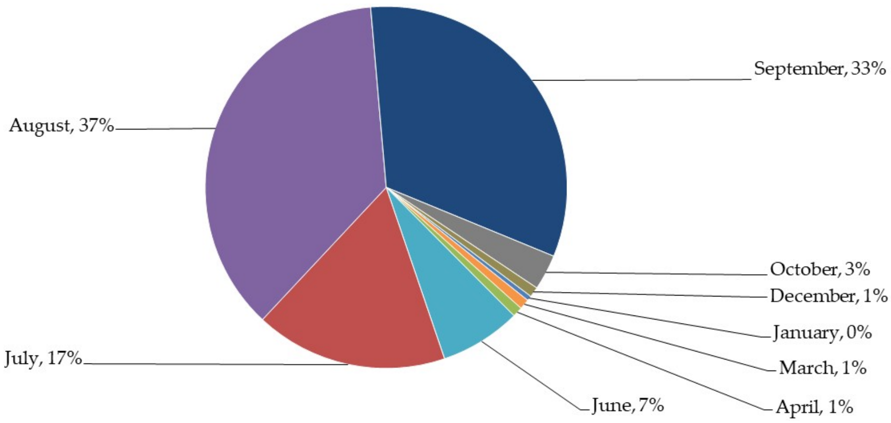


Figure 8-25 The surveyed households' perception of flood severity by month

Respondents were asked to compare the current flood depth with conditions three years ago. Across all three locations, most households reported an increase in flooding. In New Kru Town, 63 out of 91 (69%) surveyed households indicated higher flooding, 19 reported no change (21%), and 9 (10%) reported lower flooding. In St. Paul Wetlands, 76 of 90 (84%) surveyed households observed increased flood depth, 6 (7%) reported no change, and 8 (9%) reported lower levels. In Stockton Creek, 35 out of 39 (90%) surveyed households reported higher flooding, 3 (8%) noted no change, and 1 (3%) reported lower flooding. Data is presented in Table 8-37.

Table 8-37 Surveyed household perception of flood depth compared to three years ago

Location	Higher	Lower	Same
New Kru Town	63	9	19
St. Paul Wetlands	76	8	6
Stockton Creek	35	1	3
Total	**174**	**18**	**28**

8.16.2.2.2. Drainage Capacity

Respondents were asked how long it takes for water to drain from their streets or homes following heavy rain. Data is presented in Table 8-38.

In New Kru Town, out of 91 surveyed households, the largest group (36 households or 40%) reported that water drained within 6 hours. Additionally, 22 households (24%) reported it took 1–3 days, 20 households (25%) reported more than 3 days, and 13 (15%) households reported drainage occurred within 6–24 hours.

In St. Paul Wetlands, the highest number of households (36 households or 40%) reported that water took more than 3 days to drain. Thirty-one households reported 1–3 days (34%), 17 (19%) reported 6 hours, and 6 (7%) households reported 6–24 hours.

In Stockton Creek, out of 39 households surveyed, the largest group (17 households or 44%) reported that water drained in 1–3 days. Eleven households (28%) reported drainage took more than 3 days, 9 (23%) reported 6 hours, and 2 (5%) households reported 6–24 hours.

Table 8-38 Reported drainage durations following heavy

Location	1-3 days	6 hours	6-24 hours	More than 3 days
New Kru Town	22	36	13	20
St. Paul River	31	17	6	36
Stockton Creek	17	9	2	11
Total	**70**	**62**	**21**	**67**

8.16.2.3. Water Quality Regulation and Pollution

In terms of perceived water quality in the river, across all three location, the highest number of households reported that it was worse (44 households in New Kru Town, 62 in St. Paul and 34 in Stockton Creek). Some households recorded that it was the same (43 in New Kru Town, 26 in St. Paul, and 4 in Stockton Creek). Only a few households reported that water quality is better (4 in New Kru Town, 2 in St. Paul, and 1 in Stockton Creek). Data is shown in Figure 8-25 and a detailed breakdown of the results per location is presented in Appendix P.7.

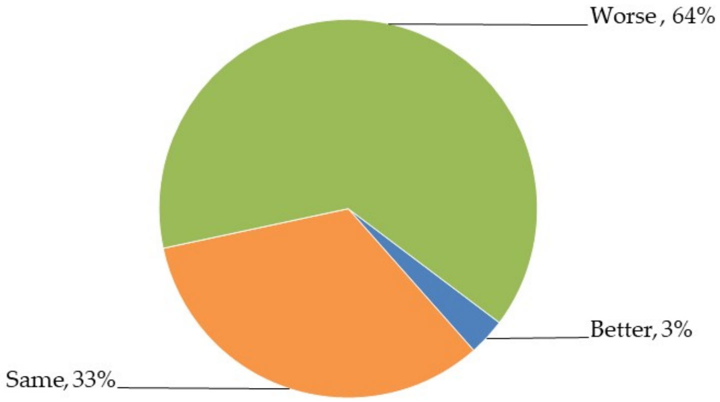


Figure 8-26 The surveyed households' perception of water quality

When asked about the main pollutants noticed in the water, the majority of respondents in all of New Kru town reported solid waste (77 households in New Kru Town, 81 households in St. Paul, and 34 households in Stockton Creek). A few respondents reported sewage (7 households each in New Kru Town and St. Paul, and 3 in Stockton Creek) as well as unknown pollutants (7 in New Kru Town , 1 in St. Paul, and 2 in Stockton Creek). Only one household in St. Paul reported oil or grease as a a main pollutant.

Key informant interviews further indicated that increasing water debris and pollution disrupt fishing activities, reduce catch efficiency, and negatively affect fish quality, reinforcing household perceptions of declining water quality.

Findings are presented in Figure 8-26, and a detailed breakdown per location is presented in Appendix P.8.

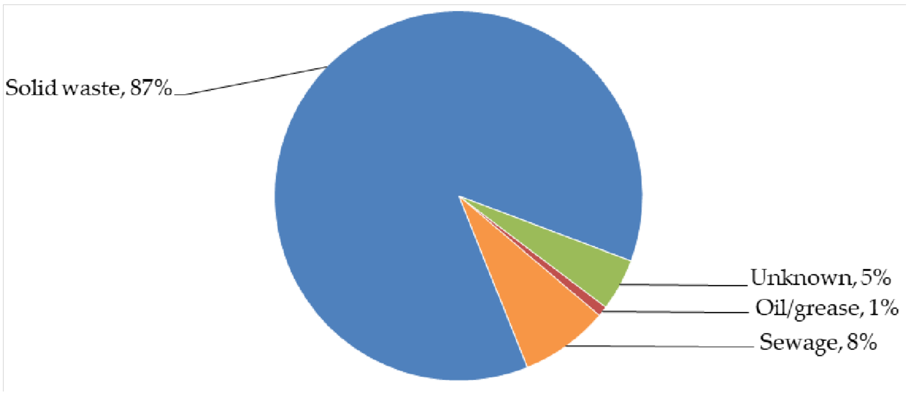


Figure 8-27 Reported pollutants noticed in water

Respondents were asked whether they had experienced erosion or land loss over the past three years. As shown in Figure 8-27, the majority of respondents across all three locations reported that they had not experienced erosion or land loss, while a smaller proportion indicated that such impacts had occurred. A detailed breakdown of responses by location is provided in Appendix P.9.

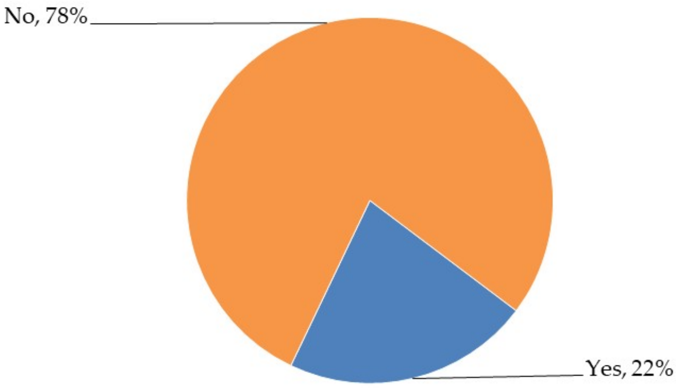


Figure 8-28 The surveyed households' perception of shoreline erosion

8.17. Gender Issues

8.17.1. National Setting on Harassment and Gender-Based Violence

8.17.1.1. Legal Setting

Liberia has ratified or acceded to the core international human rights treaties. It is a party to the major regional human rights instrument which obliged states to respect, protect and fulfill human rights of all persons within the territory and subject to the jurisdiction of the state, without discrimination. As a state party to the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (the "Maputo Protocol"), Liberia has made legally binding commitments to exercise due diligence to combat gender-based violence (GBV) and discrimination.

Accordingly, Liberia has an obligation to take all appropriate measures to prevent rape, ensure that there are adequate sanctions for rape in law and in practice, and ensure access to reparation for the victims. CEDAW art. 2(c), for example, provides that states must "establish legal protection of the rights of women on an equal basis with men and ensure through competent national tribunals and other public institutions the effective protection of women against any act of discrimination." The Maputo Protocol, art. 4, paras. 2(a) and (e), explicitly provides that laws prohibiting violence against women must be enforced and perpetrators held accountable. Furthermore, several human rights instruments (i.e., the CEDAW, the Convention on the Rights of the Child (CRC), the Convention on the Rights of Persons with Disabilities (CRPD), the African Charter on the Rights and Welfare of the Child (ACRWC), and the Maputo Protocol) require Liberia to take special measures to protect the rights of individuals who are vulnerable to sexual violence – mainly women, children, and persons with disabilities.

The Government of Liberia enacted legislation in June 1976 to amend the new Penal Code Chapter 14, Section 14.70 and 14.71 (the amendment is known as the Rape Law) (United Nations Country Team, 2013). The Act states that a person who has sexual intercourse with another person (male or female) without his/her consent has committed rape that is punishable by ten years or lifetime imprisonment depending on the degree of the rape, whether rape of a minor, rape resulting in serious bodily harm, rape using a weapon, gang rape (African Child Policy Forum, 2005). This was amended and diluted in 2017.

The United Nations Special Rapporteur on violence against women has provided guidance on states' due diligence obligations in combating sexual violence, noting that it must be implemented at both individual and systemic levels. Individual due diligence focuses on the needs of individual survivors and "places an obligation on the state to assist victims in rebuilding their lives and moving forward," for instance through the provision of psychosocial services. Individual due diligence "requires states to punish not just the perpetrators, but also those who fail in their duty to respond to the violation"(United Nations, 2013). As for systemic due diligence, it includes ensuring "a holistic and sustained model of prevention, protection, punishment, and reparations for acts of violence against women.

8.17.1.2. Gender-Based Violence on a National Level

GBV against women and girls remains a persistent challenge in Liberia, undermining human rights and impeding social development. In the aftermath of Liberia's civil conflicts, violence – especially sexual violence – became alarmingly normalized (Henry Sumo, 2025). According to the United Nation in Liberia, Liberia has seen a concerning upward trend in reported GBV cases in the last 2–3 years. Official data from the Ministry of Gender, Children and Social Protection (MGCSP) indicate that cases of sexual and gender-based violence (SGBV) have increased annually (United Nations in Liberia, 2024).

According to a demographic and health surveyed conducted in 2019 and 2020, 60% of women aged 15–49 have experienced physical violence at some point, with 33% reporting incidents within the previous year and 7% experiencing violence during pregnancy; these rates have risen notably since 2007 . Sexual violence also persists, with 9% of women reporting lifetime experiences and 5% experiencing it in the last 12 months, while 5% faced such abuse before age 18; prevalence is lower in Greater Monrovia compared to other regions. Overall, 61% of women have suffered either physical or sexual violence, with 52% experiencing only physical violence, 1% only sexual violence, and 9% enduring both (Liberia Institute of Statistics and Geo-Information Services, 2021).

8.17.2. Women in the Social Area of Influence

Findings from KIIs, FGDs, and household surveys collectively depict women across the social area of influence as economically active yet structurally vulnerable, navigating layered social, environmental, and economic constraints. Women are deeply embedded in informal livelihoods such as petty trading, food vending, charcoal and vegetable sales, laundry services, backyard gardening, and small kiosks located near schools, beaches, hospitals, and major access roads.

Despite their economic contributions, women's livelihoods remain highly exposed to environmental shocks, particularly flooding. Across several communities, stagnant water during the rainy season destroys market stalls and goods, restricts mobility, and disrupts access to trading spaces, leading to significant income losses. Flooding also intensifies women's unpaid care responsibilities, as they care for sick children and elderly family members during disease outbreaks linked to poor sanitation and contaminated water. Health risks are heightened, with women and girls facing increased exposure to waterborne diseases, skin infections, and dignity-related challenges due to limited access to safe sanitation facilities. Pregnant women and adolescent girls are identified as particularly vulnerable during these periods.

Socially, findings indicate women participate in decision-making processes within their communities. A substantial proportion of households reported that women in the household are consulted on community-level decisions (135 households). Additionally, according to KIIs, many communities reported that women actively participate in community meetings and local governance processes, with some explicitly referencing women leaders or chairladies who represent women's interests. These participation and leadership roles function as local mechanisms for women's social inclusion, enabling access to information, representation, and engagement in community and project-related processes, despite remaining largely informal. However, participation remains uneven, and several women interviewed through the household survey reported barriers to meaningful engagement in community meetings.

In the household, women—especially female-headed households—face distinct challenges, including limited access to stable income, higher care burdens, and greater exposure to economic shocks. Adolescent girls and young women face additional pressures, with reports of school dropout linked to poverty, early pregnancy, drug abuse, and, in some fishing communities, engagement in transactional sex as a coping mechanism for food and income insecurity.

Gender-based risks further increase women's vulnerability. Incidents of domestic violence and SGBV, including verbal, physical, and sexual abuse, are reported across communities, often resolved informally without legal recourse. According to HHS results, 68 households reported cases of GBV in the community. On the other hand, many households indicated that women feel safe in their community (148 households). Despite this, women and girls expressed concern that economic hardship, displacement, and the influx of external workers during construction activities could exacerbate risks of harassment, exploitation, and abuse if adequate safeguards are not in place. These dynamics highlight the need for strengthened community awareness, protection mechanisms, and referral pathways.

Regarding support systems for women facing domestic violence, 174 respondents to the HHS reported that such systems exist. The types of support reported were police or legal services (98 households), community leaders (59 households), family support (14 households), health facilities (3 households), and other means of support (1 household). The findings indicate a heavy reliance on informal and formal authority structures (police and community leaders). Moreover, specialized GBV support services (e.g. shelters, counselling services, women's organizations) were rarely mentioned, suggesting limited awareness or availability. Health facilities are not widely perceived as a primary entry point for GBV support.

Across locations, women consistently expressed strong support for the proposed project, viewing it as an opportunity to reduce flooding, improve health and hygiene conditions, restore livelihoods, and enhance household stability. Women emphasized that effective flood mitigation would allow them to trade more consistently, increase incomes, and enable children to attend school more regularly. At the same time, they underscored the importance of meaningful inclusion throughout the project lifecycle, calling for early and transparent engagement of women leaders and groups, equitable access to employment opportunities beyond menial roles, and fair and inclusive compensation processes that do not overlook female-headed households. Overall, the findings show that women play a central role in community stability, but their wellbeing and outcomes depend on targeted efforts to reduce inequalities, environmental risks, and gender-specific vulnerabilities.

Land tenure arrangements across the social area of influence are mixed, including private ownership, rental, and informal occupation. As a result, omen's access to land is primarily exercised through household and community structures rather than formal ownership. Women's participation in community leadership and decision-making therefore represents an important entry point for ensuring their effective inclusion in land-related consultations, compensation discussions, and resettlement processes.

8.17.2.1. New Kru Town

Data from HHS, FGDs, KIIs, community consultations, and field visits to New Kru Town reveals nuanced insights into the experiences and challnges of women in this area. Across New Kru Town communities - including Central New Kru Town, Supermarket Community, Duala Market, Popo Beach, Trowin Community, and surrounding settlements - women emerge as the main financial and social support in their households. They are heavily engaged in food vending (cook-blow), petty trading, charcoal sales, laundry services, and small kiosks located near markets, beaches, schools, and health facilities. In several of these communities, women are reported to be the main income earners, including a significant number of femaleheaded households.

Women also participate in informal trade and informal savings mechanisms such as daily or weekly susu groups, village savings and loan associations, and women's cooperatives, which serve as critical tools for maintaining cash flow and sustaining small businesses. Income generated by women is largely directed toward meeting essential household needs—particularly food, education, and healthcare—underscoring their central role as household providers, including in many female-headed households.

Flooding poses a persistent threat to these livelihoods, frequently destroying goods and restricting access to trading spaces, which directly undermines household food security. In Trowin, women highlighted an acute sanitation crisis, where damaged toilet facilities with exposed feces located near uncovered water sources pose serious health risks, particularly for women and girls. At Popo Beach, women's livelihoods are closely tied to the fishing economy, relying on the purchase of fish from Popo Beach, King Gray, Cape Mount, and cold storage facilities. While the community faces environmental, livelihood, and safety challenges, women's cooperatives, village savings and loan groups, and daily savings schemes play a critical role in strengthening resilience. Women in Popo Beach emphasized the urgent need for targeted livelihood support for women fishmongers, including access to grants or loans and rehabilitation of market and storage infrastructure.

In Duala Market, residents expressed a strong desire for local employment opportunities, particularly for women, highlighting the need for project-related jobs that are accessible, fairly compensated, and inclusive.

Gender dynamics in New Kru Town remain uneven, with men often controlling financial and education-related decisions, while women carry most of the responsibility for caregiving and dealing with crises. Reports of domestic violence, SGBV, and transactional sex among adolescent girls—especially in fishing and coastal zones—underscore the compounded social risks women face in this urban, flood-prone context.

8.17.2.2. St. Paul River

Data from HHS, FGDs, KIIs, and community consultations reveal key patterns and challenges faced by the women in St. Paul. In the St. Paul River corridor—including Caldwell Road, King Peter Town, Island Clinic, Zuma Town, and Whea Town—women's roles are closely tied to subsistence activities, small-scale trading, farming, gardening, and household management within an environmentally fragile context. Women frequently rely on informal savings schemes to stabilize income in the face of seasonal disruptions. Flooding and stagnant water in these low-lying areas significantly increase women's exposure to waterborne diseases and intensify unpaid care responsibilities during the rainy season.

Women in St. Paul River communities emphasized that reduced flooding would substantially improve their ability to trade consistently and support children's schooling. In Whea Town, community members stressed the importance of hiring women for project-related employment. However, women's participation in KIIs and FGDs in Whea Town was notably low, limiting inclusivity and reducing opportunities for women to influence project planning and decision-making. Women called for more deliberate engagement through women's groups and tailored consultation processes.

8.17.2.3. Stockton Creek

Based on results from HHS, FGDs, KIIs, and community consultations within Stockton Creek communities, including Cow Factory and Zondo Town, women play a central role in sustaining households through informal economic activities linked to fishing, food processing, petty trade, and backyard gardening. Livelihoods are highly sensitive to environmental shocks and seasonal income fluctuations, leaving women with limited buffers against food shortages. Women reported reliance on informal credit, remittances, and shortterm coping strategies, reflecting constrained access to formal financial services.

Gender dynamics in Stockton Creek indicate that while women contribute substantially to household income, their participation in leadership structures, KIIs, FGDs, and compensation discussions remains limited. In Zondo Town, particularly low participation of women in consultations was noted, raising concerns about inclusivity. Women expressed apprehension regarding fair compensation, safety risks linked to construction activities, and the need for equitable access to employment opportunities beyond low-paid or temporary roles.

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Environment and Social Assessment of Impacts

9.1. Approach

The impact assessment for the Project has been undertaken in accordance with the Environment Protection and Management Law (EPM) of 2003 and aligned with the requirements of the World Bank Environmental and Social Framework (ESF). The approcah, presented in Figure 9-1 and described in details Appendix A, aims to systematically identify, predict, and evaluate both positive and negative environmental and social impacts associated with the Project, in quantitative terms to the greatest extent possible, and to define appropriate mitigation and management measures. It also identifies mitigation strategies and any residual negative impacts that cannot be mitigated and explores opportunities for enhancement.

Impact significance		**Impact sensitivity**		
		Low	**Moderate**	**High**
Impact magnitude	**Negative impacts**			
	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

	Positive impacts			
	Positive	Minor	Moderate	Major

Figure 9-1 Assessment of impacts approach

A thorough review of project plans was carried out to ensure that all details are considered when analyzing impacts. This is followed by an extensive assessment of the baseline data which provides the reference point against which potential impacts are assessed.

Potential environmental and social impacts are identified based on the interaction between Project activities and baseline conditions. These impacts include both beneficial and adverse effects and are informed by stakeholder consultations and specialist input.Each identified impact is characterised using a set of standard criteria to ensure consistency across the assessment. These characteristics include causality, spatial extent and scale, duration, frequency, magnitude and receptor sensitivity.

The significance of each impact is then determined through the interaction between impact magnitude and receptor sensitivity. To support this evaluation, a standardised significance matrix is applied, as presented in Table 9-1.

Table 9-1 Impact significance matrix

Once impact significance has been determined, mitigation measures are identified in accordance with the internationally recognised **mitigation hierarchy**, which is illustrated in Figure 9-2. In addition, enhancement measures may be applied to maximise positive impacts, particularly in relation to socio-economic benefits such as employment and capacity building.

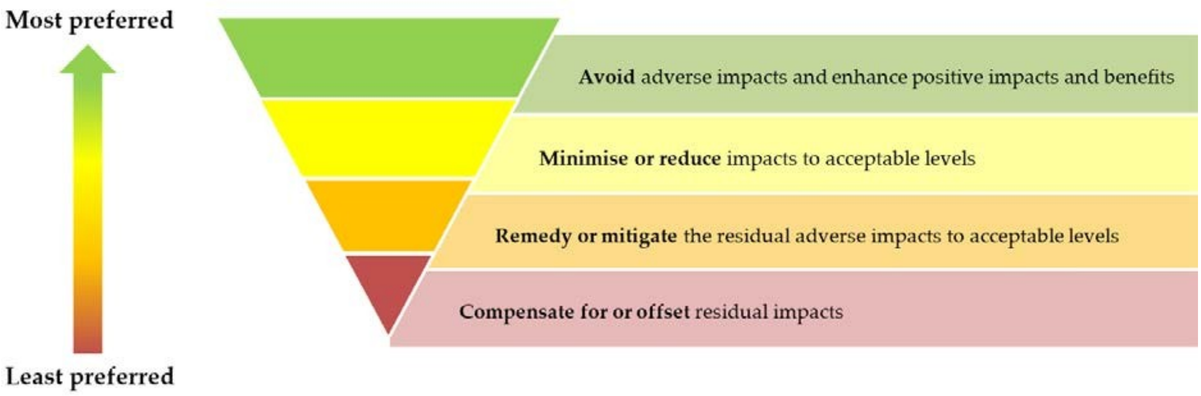


Figure 9-2 Mitigation hierarchy

Following the identification of mitigation measures, the significance of impacts is reassessed to determine the residual impacts, that is, impacts that remain after mitigation has been implemented.

This step provides an understanding of the effectiveness of proposed mitigation measures and identifies any impacts that cannot be fully addressed. Residual impacts are then managed through the Environmental and Social Management Plan (ESMP), including monitoring and adaptive management where required.

9.2. Assessment of Impacts

The impact matrix works through a series of categories, listed in Box 9-1. The matrix (Table 9-2) shows the actual assessment of the environmental and social impacts identified as likely to occur as a result of the Project. This follows the methodology described in Section 9.1. The column 'Mitigation strategy' only includes the strategy that will be followed. Mitigation actions to be implemented are defined in the ESMP.

Box 9-1 Impact assessment matrix categories

Impact assessment matrix categories
A. Positive Impacts B. Negative Impacts 1. Impacts on the general environment 2. Impacts on soil and land resources 3. Impacts on water resources 4. Impacts on air quality 5. Impacts from noise and vibration 6. Impacts from visual intrusion 7. Impacts related to climate change and resilience 8. Impacts from waste generation 9. Impacts from traffic and transport 10. Impacts from drainage and stormwater runoff 11. Impacts from hazardous materials 12. Impacts from construction materials 13. Impacts on biodiversity 14. Impacts on ecosystem services 15. Impacts on community relations 16. Impacts on livelihoods 17. Impacts from influx of people 18. Impacts on cultural heritage 19. Impacts on public health and safety 20. Impacts on labor and working conditions 21. Impacts on occupational health and safety

Table 9-2 Impact assessment matrix

Potential impact and cause		Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
A.	POSITIVE IMPACTS											
A1.	Economic benefits and increased investment opportunities due to infrastructure development, improved accessibility and reduced flood related losses.	O	ATL-SPW	Indirect	Regional	Medium-term	Occasional	Small	Moderate	Moderate	N/A	N/A
A2.	Rehabilitation and upgrading of drainage and urban infrastructure, improving flood resilience and reducing flood risk and property damage.	O	ATL-SPW	Direct	Project	Long-term	Constant	Large	High	Major	N/A	N/A
A3.	Improved soil and water quality through reduced stagnation and waste accumulation.	O	ATL-SPW	Indirect	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A4.	Improved soil stability and reduced waterlogging in rehabilitated drainage corridors.	O	ATL-SPW	Direct	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A5.	Reduction in methane emissions from stagnant drains and flooded areas.	O	ATL-SPW	Indirect	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A6.	Improved visual amenity due to drainage rehabilitation and reduced waste accumulation.	O	ATL-SPW	Indirect	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A7.	Reduced solid waste accumulation and pollutant inflow into receiving aquatic, wetland and marine environments, supporting healthier ecosystems and enhancing provisioning ecosystem services (fishing).	O	ATL-SPW	Indirect	Local	Long-term	Constant	Small	Moderate	Minor	N/A	N/A
A8.	Improved hydrological functioning of wetlands and strengthened longterm flood regulation capacity resulting in enhancing and regulating ecosystem services.	O	SPW	Direct	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A9.	Protection of remaining mangrove and marshy wetlands from further fragmentation from encroachment and land reclamation and pollution from ongoing solid waste dumping, through wetland zoning.	O	SPW	Direct	Project	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A10.	Temporary employment opportunities for local communities during the construction phase.	C	ATL-SPW	Direct	Local	Project duration	Frequent	Medium	High	Moderate	N/A	N/A
A11.	Improved access and mobility for community members due to reduced flooding, facilitating access to schools, health facilities, and markets.	C	ATL-SPW	Direct	Local	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A12.	Improved road conditions as a result of reduced flood occurrence and improved drainage infrastructure.	C	ATL-SPW	Direct	Local	Long-term	Constant	Medium	Moderate	Moderate	N/A	N/A
A13.	Increased demand for local goods and services during construction, supporting small businesses and informal economic activities.	C	ATL-SPW	Direct	Local	Project duration	Frequent	Small	Low	Minor	N/A	N/A
A14.	Improved public health conditions due to reduced stagnant water and lower exposure to flood-related health risks.	C	ATL-SPW	Direct	Local	Long-term	Constant	Medium	High	Moderate	N/A	N/A
A15.	Reduction in vector-borne disease risks due to flood control measures that minimize standing and stagnant water.	O	ATL-SPW	Indirect Cumulative	Local	Long-term	Seasonal	Medium	High	Major	N/A	N/A
B.	NEGATIVE IMPACTS											
1.	Impacts on the general environment											
1.1.	Temporary environmental disturbance due to site preparation, clearing, and earthworks.	C	ATL-SPW	Direct	Project	Project duration	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
1.2.	Degradation of local environmental conditions (dust, noise, air quality) from construction activities.	C	ATL-SPW	Direct	Project	Project duration	Occasional	Medium	Moderate	Moderate	Reduction Mitigation	Negligible

Potential impact and cause		Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
1.3.	**Accidental environmental damage from fuel spills and improper waste handling.**	C-O	ATL-SPW	Accidental	Project	Medium-term	Occasional	Medium	Moderate	Moderate	Avoidance, Mitigation	Negligible
1.4.	**Risk of general environmental and social damage due to inadequate implementation of the ESMP, including insufficient supervision and lack of an effective management system.**	C-O	ATL-SPW	Indirect	Project	Medium-term	Occasional	Medium	Moderate	Moderate	Avoidance	Minor
1.5.	**Potential non-compliance with national environmental regulations, permit conditions, and World Bank ESF/ESS requirements.**	C-O	ATL-SPW	Direct	Project	Medium-term	Occasional	Medium	Moderate	Moderate	Avoidance	Minor
1.6.	**Long-term environmental degradation in absence of proper operation and maintenance.**	O	ATL-SPW	Indirect	Regional	Long-term	Seasonal	Large	Moderate	Major	Avoidance Mitigation Compensation	Minor
2.	Impacts on soil and land resources											
2.1.	**Soil erosion and degradation from excavation, earthworks, construction and operation activities.**	C-O	ATL-SPW	Direct	Project	Project duration	Frequent	Medium	Moderate	Moderate	Reduction Mitigation	Minor
2.2.	**Soil contamination from spills and leaks.**	C-O	ATL-SPW	Accidental Cumulative	Local	Medium-term	Occasional	Small	Moderate	Minor	Mitigation	Negligible
2.3.	**Soil compaction from repeated movement of heavy machinery.**	C	ATL-SPW	Direct	Local	Project duration	Occasional	Small	Moderate	Minor	Reduction	Negligible
2.4.	**Degradation of soil structure and permeability in wetlands and lowlying areas due to drainage construction.**	C-O	SPW	Direct	Local	Permanent	Constant	Medium	Moderate	Moderate	Mitigation	Minor
3.	Impacts on water resources											
3.1.	**Water pollution from poor drainage systems, contaminated sediments, and sediment-laden runoff entering watercourses and wetlands during channel excavation and rehabilitation and maintenance works**	C-O	ATL-SPW	Direct Cumulative	Project	Project duration	Occasional	Medium to Large (C) Small to Medium (O)	Moderate	Moderate to Major (C)) Minor to Moderate (O)	Reduction Mitigation	Minor
3.2.	**Contamination of surface and groundwater from spills, leaks and contaminated runoff.**	C-O	ATL-SPW	Accidental Cumulative	Local	Project duration	Occasional	Medium to Large (C) Small to Medium (O)	Moderate	Moderate to Major(C)) Minor to Moderate (O)	Avoidance Mitigation	Minor
3.3.	**Alteration of natural drainage patterns, hydrological connectivity and wetland water retention characteristics resulting from construction of new channels, drain rehabilitation and Long-term improvement of drainage efficiency**	C-O	ATL-SPW	Direct	Project	Long-term	Constant	Large	Moderate	Major	Reduction Mitigation	Minor
3.4.	**Depletion of local water resources due to increased abstraction for project (e.g., concrete production, dust suppression, cleaning, domestic use).**	C	ATL-SPW	Direct	Project	Short-term	Occasional	Small	Moderate	Minor	Reduction	Negligible
4.	Impacts on air quality											
4.1.	**Dust emissions from land clearing, excavation, construction activities and vehicle movement.**	C-O	ATL-SPW	Direct Cumulative	Project	Project duration	Frequent	Medium	Moderate	Moderate	Reduction Mitigation	Minor
4.2.	**Exhaust emissions from machinery, generators, and transport vehicles.**	C-O	ATL-SPW	Direct Cumulative	Project	Project duration	Frequent	Medium	Moderate	Moderate	Reduction Mitigation	Minor
4.3.	**Odor impact from disturbed drains and organic waste during works**	C	ATL-SPW	Direct	Project	Project duration	Occasional	Medium	Moderate	Minor	Reduction	Negligible

Potential impact and cause		Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
5.	**Impacts from noise and vibration**											
5.1.	**Noise and vibration from construction activities, blasting, operation of heavy equipment, and transport.**	C-O	ATL-SPW	Direct Cumulative	Project	Project duration	Frequent	Medium	Moderate	Moderate	Reduction Mitigation	Minor
6.	**Impacts from visual intrusion**											
6.1.	**Visual intrusion from vegetation clearance and new linear drainage contrasting with natural landscape.**	C-O	ATL-SPW	Direct	Project	Permanent	Constant	Negligible	Low	Negligible	Mitigation	Negligible
6.2.	**Light pollution, defined as excessive, misdirected, or obtrusive artificial lighting, from nighttime operations and security lighting.**	C	ATL-SPW	Direct Cumulative	Local	Project duration	Occasional	Small	Low	Negligible	Avoidance Mitigation	Negligible
6.3.	**Visual degradation from temporary stockpiles, machinery, construction materials, improper waste handling and poor housekeeping practices.**	C	ATL-SPW	Direct Cumulative	Local	Project duration	Occasional	Small	Low	Negligible	Reduction Mitigation	Negligible
7.	**Impacts related to climate change**											
7.1.	**Greenhouse gas emissions from vehicles, heavy machinery, generators and from routine operation and maintenance activities.**	C-O	ATL-SPW	Direct Cumulative	Project	Project duration	Frequent	Medium	Moderate	Moderate	Reduction Mitigation	Minor
7.2.	**Failure of Project infrastructure due to improper operation and maintenance or to extreme climate-related events (e.g., flooding, storms, sea-level rise) leading to increased vulnerability.**	O	ATL-SPW	Direct Accidental	Local	Long term	One-off Seasonal	Medium to Large	High	Major	Reduction Mitigation	Minor
8.	**Impacts from waste generation**											
8.1.	**Increased waste volume due to failure to recycle or reuse materials.**	C	ATL-SPW	Direct	Project	Project	Occasional	Small	Moderate	Minor	Avoidance Reduction Mitigation	Negligible
8.2.	**Pollution of soil and water from improper waste handling and disposal.**	C-O	ATL-SPW	Direct	Local	Project	Occasional	Medium to Large	Moderate	Moderate to Major	Avoidance Reduction Mitigation	Minor
8.3.	**Contamination of water and soil, health and safety risks, and legal penalties due to mismanagement of hazardous waste.**	C	ATL-SPW	Direct	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Mitigation	Negligible
8.4.	**Soil and water contamination from mismanaged domestic wastewater and sludge.**	C	ATL-SPW	Direct	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Mitigation	Negligible
8.5.	**Soil and water contamination from mismanaged effluent at vehicle washing stations.**	C	ATL-SPW	Direct	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
8.6.	**Soil and water contamination from improper disposal of chemicals or fuel into site drains.**	C	ATL-SPW	Direct	Local	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
8.7.	**Soil and water pollution due to discharge of untreated or inadequately treated effluents into the environment.**	C	ATL-SPW	Direct	Local	Project	Occasional	Medium	Moderate	Moderate	Avoidance Mitigation	Negligible
9.	**Impacts from traffic and transport**											
9.1.	**Traffic congestion, dust, and accidents from project vehicle movement on public roads.**	C	ATL-SPW	Direct Indirect	Local	Project	Frequent	Large	High	Major	Avoidance Reduction Mitigation	Minor
9.2.	**Temporary safety hazards, dust, noise, land access conflicts, local traffic and community mobility disruption due to road diversions.**	C	ATL-SPW	Direct Indirect	Local	Project	Frequent	Large	High	Major	Avoidance Reduction Mitigation	Minor

Potential impact and cause		Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
10.	**Impacts from drainage and stormwater runoff**											
10.1.	**Increased surface runoff and localized flooding due to poor drainage design and increase of impermeable surfaces.**	C-O	ATL-SPW	Indirect	Local	Long-term	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Minor
10.2.	**Sediment loading in nearby water bodies from unprotected earthworks.**	C	ATL-SPW	Indirect	Local	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
10.3.	**Blockage or overloading of natural waterways from inadequate culverts and drainage.**	C-O	ATL-SPW	Indirect	Local	Long-term	Seasonal	Medium	Moderate	Moderate	Avoidance Mitigation	Negligible
10.4.	**Contaminated stormwater runoff from project activities.**	C-O	ATL-SPW	Direct	Local	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
11.	**Impacts from hazardous materials**											
11.1.	**Incidents, regulatory violations, or safety hazards from inadequate monitoring and documentation of hazardous materials.**	C	ATL-SPW	Accidental	Project	Project	One-off	Small	Moderate	Minor	Avoidance Mitigation	Negligible
11.2.	**Leaks, spills, or fire hazards from inadequate storage conditions.**	C	ATL-SPW	Accidental	Project	Project	Occasional	Small	Moderate	Minor	Avoidance Mitigation	Negligible
11.3.	**Leaks or overflows of hazardous materials from inadequate containment systems, especially during heavy rainfall.**	C	ATL-SPW	Accidental	Project	Project	Occasional	Small	Moderate	Minor	Avoidance Mitigation	Negligible
11.4.	**Soil and water pollution due to poorly maintained or designed oilwater separators.**	C	ATL-SPW	Accidental	Project	Project	Occasional	Small	Moderate	Minor	Avoidance Mitigation	Negligible
11.5.	**Environmental contamination from uncontrolled discharge of oils, greases, detergents, and sediments during vehicle or equipment washing.**	C	ATL-SPW	Accidental	Project	Project	Occasional	Small	Moderate	Minor	Avoidance Mitigation	Negligible
11.6.	**Fires or explosions from improper management of reactive, flammable, or explosive materials.**	C	ATL-SPW	Accidental	Project	Project	One-off	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Negligible
11.7.	**Soil or groundwater contamination from spills during manual or mechanical transfers of hazardous materials, including vehicle refueling operations.**	C	ATL-SPW	Accidental	Project	Project	One-off	Small	Low	Negligible	Avoidance Mitigation	Negligible
11.8.	**Human injury and environmental damage from slow or inefficient spill response.**	C	ATL-SPW	Accidental	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Mitigation	Negligible
12.	**Impacts from construction materials**											
12.1.	**Land damage (degradation, loss of soil and cover, reduced productivity) and environmental disturbance (noise, vibration, dust, water pollution) from borrow pits and quarries.**	C	ATL-SPW	Direct	Local	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Minor
13.	**Impacts on biodiversity**											
13.1.	**Loss of modified or natural (degraded) habitats due to vegetation clearing and infrastructure development.**	C	ATL-SPW	Cumulative	Project	Permanent	One-off	Medium	Moderate	Moderate	Avoidance Reduction Mitigation Remediation	Minor

13.2.	**Increased degradation of modified or natural (degraded) habitats quality due to noise, vibration, light, and pollution of water, air and/or soil.**	C	ATL-SPW	Cumulative	Project	Project duration	Frequent	Medium	Low	Minor	Reduction Mitigation	Negligible
13.3.	**Direct loss of flora and fauna from vegetation clearing or removal by workers.**	C	ATL-SPW	Direct	Project	Permanent	One-off	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Minor
13.4.	**Disturbance to hydrological and associated ecological processes due to temporary flow diversions and channel works.**	C	ATL-SPW	Direct	Project	Project duration	Occasional	Small	Moderate	Minor	Reduction Mitigation Remediation	Negligible
13.5.	**Spread of invasive species from vegetation clearing and disturbance, movement of trucks, waste disposal, and/or transport of soil containing invasive species to less disturbed areas.**	C	ATL-SPW	Indirect	Regional	Project duration	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation Remediation	Negligible
14.	**Impacts on ecosystem services**											
14.1.	**Disruption of artisanal fishing activities and related cultural habits near active construction zones due to construction works and potential associated increased turbidity and sediment mobilization.**	C	ATL-SPW	Indirect	Project	Project duration	Occasional	Small	High	Moderate	Avoidance Reduction Mitigation Remediation	Minor
14.2.	**Interference with small-scale extractive activities (e.g. clay extraction from wetlands)**	C-O	SPW	Indirect	Project	Project duration	Occasional	Small	Moderate	Minor	Reduction Mitigation	Negligible

Potential impact and cause		Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
15.	**Impacts on community relations**											
15.1.	**Damage to land, yards, access paths, and communal spaces due to construction activities, material storage, and movement of machinery.**	C	ATL-SPW	Direct	Local	Project duration	Frequent	Medium	High	Major	Avoidance Reduction Mitigation Compensation	Minor
15.2.	**Nuisance impacts from construction activities (including dust, noise, and vibration) disrupt daily life, affect community well-being, and affect sensitive receptors such as places of worship, schools, and health centers.**	C	ATL-SPW	Direct	Local	Project duration	Frequent	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Minor
15.3.	**Safety risks to community members from increased road traffic.**	C	ATL-SPW	Direct	Local	Project duration	Frequent	Small	High	Moderate	Mitigation	Minor
15.4.	**Damage to or contamination of drinking water supplies from project activities.**	C	ATL-SPW	Direct	Local	Project duration	Frequent	Medium	Moderate	Moderate	Mitigation	Minor
15.5.	**Conflicts or tension due to inadequate consultation or exclusion from benefits.**	C	ATL-SPW	Indirect	Local	Medium term	Occasional	Small	High	Moderate	Avoidance Reduction Mitigation	Minor
15.6.	**Inappropriate or disrespectful worker behavior toward other workers and community members, especially women.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Reduction Mitigation	Negligible
15.7.	**Disruption of social networks, community ties, and informal support systems for households relocated to new areas or new communities, with associated pressure on housing, services, and livelihood opportunities in host communities.**	C-O	ATL-SPW	Direct	Local	Long term	Frequent	Medium	High	Major	Reduction Mitigation Compensation	Moderate
16.	**Impacts on livelihoods**											

16.1.	**Temporary or permanent economic displacement due to loss or restriction of access to livelihood spaces and resources as a result of construction activities and access controls.**	C-O	ATL-SPW	Cumulative	Local	Short term or Permanent	One-off	Medium	High	Major	Avoidance Reduction Mitigation Compensation	Moderate
16.2.	**Physical displacement of households due to permanent land acquisition, resulting in loss of housing, relocation, and disruption of established social and economic systems.**	C-O	ATL-SPW	Direct	Local	Permanent	Constant	Medium	High	Major	Avoidance Reduction Mitigation Compensation	Moderate
17.	**Impacts from influx of people**											
17.1.	**Influx of people seeking employment puts pressure on local resources and services, leading to social tensions with host communities.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Mitigation	Minor
17.2.	**Social tension — including frustration, feelings of exclusion, and decreased local support for the project — arising from unequal employment opportunities and the failure to prioritize affected communities in hiring.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Medium	High	Major	Avoidance Mitigation	Moderate
17.3.	**Increased social ills (e.g., prostitution, gambling, drinking, substance abuse) due to poor worker behavior.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Mitigation	Negligible
17.4.	**Risk of child labor, sexual exploitation and abuse/sexual harassment (SEA/SH), GBV, and other forms of labor-related misconduct from inadequate labor management and supervision within the workforce.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Mitigation	Minor
17.5.	**SEA/SH and gender-based violence (GBV) increase in the affected communities due to the presence and influx of temporary laborers.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Mitigation	Minor
17.6.	**Pressure on housing, services, and livelihood opportunities, including increased competition for informal employment and local resources, due to the presence of workers, leading to tension with host communities.**	C	ATL-SPW	Indirect	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Mitigation	Minor

	Potential impact and cause	Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
17.7.	**Improved living conditions in project areas may attract immigration, increase population density hence placing additional pressure on housing, services, infrastructure, and livelihood opportunities, thus leading to increased social stress within host communities.**	O	ATL-SPW	Indirect	Local	Long term	Constant	Small	High	Moderate	Avoidance Reduction Mitigation	Minor
18.	**Impacts on cultural heritage**											
18.1.	**Loss, disturbance, or restricted access to cultural sites — disturbs or damages sites of historical, spiritual, or cultural significance and limits communities' ability to perform traditional and spiritual practices.**	C	ATL-SPW	Direct	Local	Project duration	Occasional	Small	High	Moderate	Avoidance Reduction Mitigation	Minor
19.	**Impacts on public health and safety**											
19.1.	**Increased road accidents during construction and operation.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Medium	Moderate	Moderate	Reduction Mitigation	Minor
19.2.	**Higher risk of communicable diseases (e.g., sexually transmitted diseases, , vector-borne diseases) linked to workforce influx, temporary stagnant water during construction and limited health awareness.**	C	ATL-SPW	Indirect	Local	Project duration	Constant	Small	High	Moderate	Mitigation	Minor
19.3.	**Community exposure to hazards from open trenches, inadequate fencing, and unsafe work sites, particularly affecting children.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	High	Moderate	Mitigation	Minor
20.	**Impacts on labor and working conditions**											

Potential impact and cause	Phase*	Sub-location	Causality	Extent and scale	Duration	Frequency	Magnitude	Sensitivity	Significance	Mitigation strategy	Residual significance after mitigation
20.1. **Local communities are excluded from employment if project opportunities are preferentially given to outsiders.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	High	Moderate	Mitigation Avoidance Reduction	Minor
20.2. **Increase in vulnerable groups being excluded from employment.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	High	Moderate	Mitigation	Minor
20.3. **Gender inequality and exclusion of women from employment.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	High	Moderate	Mitigation	Minor
20.4. **Lack of access to a fair grievance mechanism for employees.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	Moderate	Minor	Mitigation	Negligible
20.5. **Employees face exploitation due to low pay, long hours, and inadequate contracts.**	C	ATL-SPW	Direct	Local	Project duration	Constant	Small	High	Moderate	Mitigation	Minor
21. **Impacts on occupational health and safety**											
21.1. **Occupational injuries resulting from inadequate training, hazard awareness, or supervision.**	C-O	ATL-SPW	Accidental	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction	Negligible
21.2. **Occupational injuries due to inadequate provision of safety equipment.**	C-O	ATL-SPW	Accidental	Project	Project	Occasional	Large	Moderate	Major	Reduction Mitigation	Negligible
21.3. **Fire, explosion, and electrical hazards caused by poor facility design, inadequate maintenance, or unsafe handling of flammable and reactive materials.**	C	ATL-SPW	Accidental	Project	Project	One-off	Large	Moderate	Major	Avoidance Reduction Mitigation	Minor
21.4. **Accidents from unsafe work environments, such as inadequate lighting, ventilation, sanitation, access routes, or emergency exits.**	C	ATL-SPW	Accidental	Project	Project	One-Off	Small	Moderate	Minor	Avoidance Reduction Mitigation	Negligible
21.5. **Traffic and machinery-related injuries due to inadequate segregation of work zones, poor traffic management, and untrained vehicle or equipment operators.**	C-O	ATL-SPW	Accidental	Local	Project	One-Off	Large	Moderate	Major	Avoidance Reduction Mitigation	Minor
21.6. **Health risks and disease transmission from poor hygiene, inadequate potable water, lack of clean eating areas, or unsanitary living conditions.**	C-O	ATL-SPW	Indirect	Project	Project	Occasional	Medium	Moderate	Moderate	Avoidance Reduction Mitigation	Minor
21.7. **Injuries are exacerbated due to inadequate emergency response.**	C-O	ATL-SPW	Indirect	Project	Project	One-Off	Large	Moderate	Major	Avoidance Mitigation	Minor
21.8. **Increased OHS hazards for workers operating on or near water bodies including drowning, slips and falls on wet or unstable surfaces, and risks associated with vessel or pontoon instability.**	C	ATL-SPW	Direct	Project	Project	Occasional	Large	Moderate	Major	Avoidance Mitigation	Minor
21.9. **Risk of serious injury from encounters with venomous or constrictor snakes and crocodiles, including snakebite envenomation, crushing injuries, severe trauma, or drowning.**	C-O	SPW	Accidental	Project	Project	Occasional	Large	Moderate	Major	Avoidance Mitigation	Minor

** Phases: C = construction; O = operation* *° Sub-locations: ATL = Atlantic; SPW = St. Paul Wetlands*

9.3. Impact Location

The environmental and social impacts identified for the project will not all occur uniformly across the project area. Some impacts are broad in nature and may arise almost anywhere—for example, soil erosion or loss of vegetation. Other impacts are more localized and are expected only at specific sites; fuel spills, for instance, are most likely to occur at fuel storage areas and refueling points.

Table 9-3 outlines the primary locations where each category of impact is likely to occur. Accordingly, the mitigation measures will be tailored to these specific locations, and the monitoring of environmental and social performance will also be guided by the spatial distribution of impacts and their corresponding mitigation actions

Table 9-3 Outline of the possible locations where the identified environmental and social impacts may occur

No.	Impact category	Likely impact location
1.	**Impacts on the general environment**	Along existing and new drainage corridors, culvert excavation areas, channel realignment sections, temporary stockpiles, and access routes within the Atlantic (New Kru Town) and St. Paul Wetlands sub-locations.
2.	**Impacts on soil and land resources**	In and around surface and groundwater bodies and wetlands near project activities.
3.	**Impacts on water resources**	In and around active construction sites, transport routes, and material handling areas.
4.	**Impacts on air quality**	Near construction zones, transport corridors, and settlements close to project operations.
5.	**Impacts from noise and vibration**	Within and around the project footprint, especially where works are visible from communities or public roads.
6.	**Impacts from visual intrusion**	Across the project area and its broader area of influence.
7.	**Impacts related to climate change**	At all project sites, including offices, camps, workshops, and material extraction or processing areas.
8.	**Impacts from waste generation**	At all project sites, including offices, temporary facilities, workshops, and material extraction or processing areas.
9.	**Impacts from traffic and transport**	Along all access roads, transport routes, and areas affected by project-related vehicle movement.
10.	**Impacts from drainage and stormwater runoff**	In areas of earthworks, drainage channels, and locations with modified surface runoff.
11.	**Impacts from hazardous materials**	At storage areas, maintenance workshops, refueling points, and spill-prone zones.
12.	**Impacts from construction materials**	At quarries, borrow pits, storage areas, and material stockpiling locations.
13.	**Impacts on biodiversity**	Within and around project-affected coastal, wetland, mangrove, and drainage-line habitats across Bushrod Island, including the St. Paul Wetlands and adjacent Atlantic nearshore areas.
14.	**Impacts on ecosystem services**	In communities and ecosystems that rely on coastal, riverine, wetland, and nearshore marine resources within the project's area of influence, particularly fishing-dependent groups around Popo Beach and the St. Paul River Estuary.

No.	Impact category	Likely impact location
15.	**Impacts on community relations**	Communities in the social area of influence where drainage works, excavation, material storage, movement of machinery affect residential areas, access paths, and shared community spaces.
16.	**Impacts on livelihoods**	Construction sites and drainage upgrading areas are affected by physical or economic displacement.
17.	**Impacts from influx of people**	Communities hosting the Project where the influx of project workers is expected, and host communities of relocated households.
18.	**Impacts on cultural heritage**	Worship places, cultural practices sites and graves near or located within project footprint.
19.	**Impacts on public health and safety**	The communities that are exposed to construction activities, open trenches, altered drainage patterns, construction traffic, and changes in wetland conditions.
20.	**Impacts from labor and working conditions**	Across all construction sites and temporary work areas.
21.	**Impacts on occupational health and safety**	Across all work sites and project-related facilities.

9.4. Implications of the Impact Assessment

The impact assessment indicates that the Project will generate a range of environmental and social impacts during the construction and operation phases. These impacts have been assessed in terms of their magnitude, duration, spatial extent, and receptor sensitivity, and mitigation measures have been developed following the mitigation hierarchy and detailed in the ESMP. Following the implementation of these measures, many potential impacts are expected to be reduced to negligible or minor residual significance, reflecting their localized and temporary nature. However, some moderate residual impacts remain, particularly in the social domain, including impacts associated with physical and economic displacement, livelihood disruption, and community dynamics related to project implementation. These impacts will be addressed through dedicated management measures, including the Resettlement Action Plan, livelihood restoration measures, and continued stakeholder engagement.

9.4.1. Impacts on the Physical Environment

9.4.1.1. Positive Impacts on the Physical Environment

The proposed Liberia Urban Resilience Project (LURP) is expected to generate several impacts on the physical environment especially during the operation phase. These benefits are primarily associated with improved drainage performance, flood risk reduction, and enhanced environmental conditions within Northern Bushrod Island. Key positive impacts include:

- **Improved surface water management and flood reduction**: Rehabilitation of existing drains, construction of new drainage channels, and replacement of old culverts will significantly improve stormwater conveyance, reducing flood depth, duration, and frequency in low-lying and flood-prone areas.

- **Reduction in water stagnation and pollution**: Improved drainage efficiency and routine maintenance will reduce stagnant water in drains and wetlands.
- **Enhanced environmental resilience**: The Project integrates climate-resilient design measures that improve the capacity of drainage infrastructure to withstand extreme rainfall events and future climate variability.
- **Improved visual and environmental quality**: Removal of accumulated waste from drainage corridor and rehabilitation of channels will contribute to a cleaner urban environment and result in less greenhouse gas emissions and reduced water contamination.

9.4.1.2. Negative Impacts on the Physical Environment

The impact assessment matrix indicates that the proposed Project will generate a range of impacts on the physical environment during both construction and operational phases. These impacts were evaluated across several thematic areas, considering factors such as extent, duration, receptor sensitivity, and the significance of effects before and after mitigation. The most relevant impacts are summarized below:

- **Soil loss, erosion and compaction:** Site clearing, construction of drainage infrastructure, and repeated use of heavy machinery are expected to disturb surface soils and cause erosion and compaction of topsoil, reducing soil permeability and productivity, particularly in sandy, alluvial and wetland margins and green corridor areas where soils are vulnerable to disturbance.
- **Contamination of soil and water:** Construction and excavation activities, along with the removal of accumulated waste and sediments from drainage channels, can generate high loads of sediment and contaminated materials that may enter the surrounding environment. Additionally, accidental spills or leaks of fuel, lubricants, and other hazardous substances during construction, operation, or stockpiling activities pose a risk of localized soil and groundwater contamination if not properly contained.
- **Alteration of natural drainage and hydrological connectivity:** Earthworks and infrastructure development may block or divert natural drainage channels. In addition, increased drainage efficiency could lower water levels and reduce the waterretention capacity of wetlands, disrupting hydrological connectivity, affecting groundwater levels, and placing additional pressure on water resources, particularly during the dry season.
- **Air quality degradation:** Emissions from construction activities, machinery, and trucks, are likely to result in cumulative impacts on air quality, with localized exceedances of particulate levels and gaseous pollutants.

- **Noise and vibration impacts:** Elevated noise levels during construction and operational activities may exceed the Environmental Protection Agency (EPA) and World Bank guideline values contributing to cumulative urban noise pollution.
- **Operational Impacts on General Environmental Conditions:** During the operational phase, the environmental performance of the Project will be strongly influenced by the effectiveness of operations and the maintenance activities on the long term. Proper and sustained maintenance of drainage infrastructure is essential to maintain drainage efficiency, prevent the accumulation of sediments and waste, and avoid renewed water stagnation within drainage channels and adjacent wetlands.

9.4.1.3. Residual Impacts on the Physical Environment

Even with good impact control and management practice, some impacts on the physical environment cannot be fully mitigated and certain residual impacts will still happen. These typically involve aspects that are unavoidable due to the project's scale, location, or nature of operations, and where mitigation can only reduce, not eliminate, the impact.

- **Loss and degradation of soil structure in wetlands**

  Despite efforts to limit the project footprint, and despite the use of erosion control measures, some degree of long-term soil compaction and alteration of soil structure may remain along drainage corridors. This impact is considered minor and localized.

- **Possible alteration of the hydrological connectivity and general water level**

  Notwithstanding design measures intended to maintain natural drainage patterns and groundwater level as intact as possible, project earthworks and infrastructure may alter surface water flow paths and wetland connectivity. These changes could result in localized modifications to water levels and flow regimes within affected wetlands. The impact is anticipated to be minor and localized.

- **Residual impact on soil and water quality:**

  Residual impacts on soil and water quality may persist where disturbed surfaces, exposed soils, and altered drainage pathways continue to generate sediment-laden runoff, allowing fine particles to enter adjacent wetlands and waterways even after mitigation measures are applied. In addition to suspended sediments, remnants of cleaned wastes and construction-related materials, such as small debris, improperly stored materials, fuel or lubricant residues, and other trace contaminant, can be mobilized by stormwater flows, contributing to localized degradation of soil structure and deterioration of surface-water quality. These residual effects, though reduced through erosion control, proper waste management, and site-housekeeping practices, may still occur where complete containment is challenging, resulting in minor but ongoing impacts on both soil integrity and hydrological systems.

- **Residual air quality impacts from particulate and gaseous emissions**

  Although dust suppression systems, regular maintenance of machinery, and emission controls will be implemented, residual air quality impacts still occur, especially during dry, windy periods or peak operational activity. Residual impacts are expected to be minor.

- **Persistent noise disturbance**

  Despite the implementation of noise mitigation strategies, Short-term noise exceedances may occur during periodic maintenance or desilting activities. Given the already elevated urban noise baseline, residual impacts are considered minor.

- **Residual operational risk related to long-term maintenance**

  A minor residual risk of localized environmental degradation may remain over the long term, reflecting the inherent challenges of maintaining urban drainage infrastructure in a densely populated setting. Even with mitigation and routine maintenance, localized re-accumulation of sediments and waste, intermittent water stagnation, and associated minor deterioration of soil and surface-water quality may occur, particularly when maintenance is delayed or constrained.

9.4.2. Impacts on the Biological Environment and Ecosytem Services

9.4.2.1. Positive Impacts on the Biological Environment and Ecosytem Services

Once operational and if maintenance is done properly and consitently throughout the project lifetime, the Project is expected to generate several positive impacts on biodiversity and ecosystem services particularly across the St. Paul Wetlands Sub-Location and its marshy wetlands and the St. Paul River Estuary and associated mangroves, along the drainage channels in Sub-location Atlantic and the Atlantic nearshore zone and, to a lesser extent, along Stockton Creek and its mangrove patches. While the Project is not primarily designed as a biodiversity restoration initiative, its interventions address key pressures currently affecting aquatic, wetland, and coastal ecosystems. These benefits are summarized below:

- **Improved aquatic and wetland habitat quality**

  The Project will improve the ecological integrity of aquatic and wetland habitats by enhancing flow conditions, reducing sediment blockage, and restoring more stable physical habitat structure within drainage channels. These changes will support healthier wetland and coastal biodiversity by improving nursery grounds, feeding areas, and movement pathways for aquatic organisms. As cleaner and more controlled drainage outflows reach the St. Paul River Estuary and the Atlantic nearshore zone, the Project will help reinforce the resilience of interconnected wetland, estuarine, and coastal ecosystems, supporting gradual and long-term biodiversity recovery and provisioning ecosystem services.

- **Enhancement of regulating ecosystem services through improved hydrological functioning**

  By improving drainage efficiency and restoring more natural flow regimes, the Project is expected to enhance the hydrological functioning of marshy wetlands and connected water bodies. These improvements will support better flood attenuation, reduce prolonged water stagnation, and promote more stable wetland water levels.

Over time, this is anticipated to strengthen regulating ecosystem services within the Project's Area of Influence, particularly flood regulation and water flow regulation, thereby contributing to increased climate resilience and improved ecological stability.

- **Protection of remaining mangrove and marshy wetlands.**

  The introduction of wetland zoning measures will provide long-term protection to remaining mangrove stands and marshy wetlands by reducing risks of further fragmentation from encroachment, informal land reclamation, and uncontrolled solid waste dumping. While not a restoration measure, this protection is expected to slow ongoing degradation trends and safeguard key ecological functions and ecosystem services provided by these habitats.

However, these positive effects will occur within a broader context of existing and ongoing pressures that are beyond the scope of the Project. Aquatic, wetland, and coastal ecosystems within Bushrod Island and the wider St. Paul River system and Stockton Creek are affected by multiple cumulative stressors, including upstream pollution inputs from the broader catchment, informal sanitation, unregulated waste disposal, small-scale extractive activities, coastal erosion processes, industrial and port operations, and continued urban expansion. These factors will continue to influence ecosystem condition and biodiversity recovery, and the Project alone will not resolve all drivers of ecological degradation. As such, while the Project is expected to deliver meaningful and localized improvements in habitat quality and ecosystem service delivery, long-term biodiversity outcomes will depend on complementary catchment-level management measures, enforcement of land-use controls, and improved waste management within and beyond the Project's Area of Influence.

9.4.2.2. Negative Impacts on the Biological Environment and Ecosytem Services

The impact assessment matrix indicates that the proposed Project will generate a range of impacts on the biological environment and ecosytem services mainly during the construction phase. These impacts were evaluated across several thematic areas, considering factors such as extent, duration, receptor sensitivity, and the significance of effects before and after mitigation. The most relevant impacts are summarized below:

- **Loss of habitats and associated loss of flora and fauna**

  The moderate significance assigned to this impact reflects the permanent loss of limited areas of modified or degraded natural habitats, together with the direct and irreversible loss of flora and incidental mortality of fauna resulting from vegetation clearing and infrastructure development. Habitat removal will reduce the availability of vegetated areas within the project footprint, while clearing activities may result in the loss of individual plants and mortality or displacement of small mammals, reptiles, amphibians, invertebrates, and ground- or low-nesting birds occupying these habitats. Although affected habitats are already degraded and subject to ongoing disturbance from urban encroachment, waste dumping, and altered hydrology, the loss represents an incremental reduction in ecological space and biodiversity within the highly modified Bushrod Island landscape. At the site level, losses of individual organisms are non-recoverable, even where recolonization may occur over time in adjacent areas. However, the broader ecological implications are moderated by the avoidance of wetland cores and mangrove stands, and the absence of critical habitats, good natural habitats and known populations of threatened species within the affected areas.

- **Spread of invasive species**

  The potential spread of invasive plant species represents a moderate impact due to the risk of longer-term and spatially diffuse ecological consequences beyond the immediate construction footprint. Invasive species establishment can alter habitat structure, reduce native species diversity, and compromise ecosystem function, particularly in wetlands. If invasive species spread to less disturbed areas, this could undermine the ecological gains associated with improved hydrological functioning and pollution reduction. The moderate significance reflects the fact that, while the Project does not introduce new invasive species, such species are widespread in the project area and construction and disposal activities may act as a vector for further spread if not carefully managed.

- **Disruption of artisanal fishing activities**

  Disturbance to artisanal fishing activities in marine and riverine environments has been assessed as a moderate impact due to its implications for provisioning and cultural ecosystem services. Temporary access restrictions, construction activity near fishing grounds, and short-term increases in turbidity or sediment mobilization may disrupt fishing practices, reduce catch efficiency, and affect culturally embedded livelihoods and traditions. While such disturbances are expected to be localized and temporary, they may have disproportionate short-term effects on households that rely heavily on fishing for subsistence or income. The moderate significance reflects the sensitivity of these ecosystem services and their importance to community well-being.

9.4.2.3. Residual Impacts on Biodiversity

Based on the findings of the baseline assessment and the mitigation measures proposed in the ESIA, some biodiversity-related impacts are expected to persist even after the implementation of avoidance, minimization, and control measures. Residual effects will depend on the rigour of construction environmental control, adherence to pollution prevention measures at drainage outfalls, effectiveness of invasive species management and manage contaminated soil and vegetation, as well as the succes of reinstatement activities. These residual impacts are summarized below:

- **Residual loss of modified or degraded wetland habitats**

  A residual impact remains in relation to the permanent loss of areas of modified or degraded wetland habitat associated with the construction of perimeter drainage channels within the St. Paul Wetlands Sub-Location. Despite efforts to minimize footprint, avoid wetland cores, and confine works to degraded margins, some habitat loss is unavoidable where drainage infrastructure must be constructed. This residual loss represents a localized and incremental reduction in wetland habitat availability within an already highly modified urban wetland system. However, the residual impact is moderated by the degraded condition of affected habitats, and the long-term protective benefits associated with wetland zoning and improved hydrological management.

- **Residual direct loss of flora and fauna**

  Even with controlled vegetation clearing, phased works, and biodiversity protection procedures in place, a residual level of direct loss of flora and incidental mortality of fauna will occur as a result of unavoidable vegetation removal. This includes the irreversible loss of individual plants and the potential mortality of small, less mobile fauna present within cleared areas. While affected species are expected to be common and disturbance-tolerant, and losses are limited in scale, these impacts remain nonrecoverable at the individual level and therefore constitute a residual biodiversity impact following mitigation.

- **Residual impacts on beach-based artisanal fishing at Popo Beach**

  At Popo Beach, a residual impact is anticipated due to the presence of the permanent drainage outlet structure within the active beach environment. Although the outlet has been designed to minimize footprint and avoid unnecessary interference with beach processes, its permanent installation will alter local beach conditions and may continue to affect artisanal fishing activities that rely on unobstructed access to the shoreline. Residual effects may include localized displacement of fishing activities, changes in landing practices, and continued sensitivity to perceived or actual changes in nearshore conditions around the outlet. While these impacts are expected to be localized and not to preclude fishing activities along the wider beach, they represent a lasting change to how the Popo Beach fishing community interacts with this specific section of the shoreline.

9.4.3. Impacts on the Social Environment

9.4.3.1. Positive Social Impacts

The Project is anticipated to generate positive socio-economic benefits primarily through enhanced mobility, reduced flood exposure, and improved access to essential services. By improving drainage efficiency and reducing the depth, duration, and frequency of flooding, the Project is expected to decrease disruptions to daily life, limit damage to homes and assets, and reduce health risks associated with prolonged water stagnation, such as vector-borne diseases.

Improved accessibility during and after rainfall events will facilitate safer movement of residents, and enhance access to schools, healthcare facilities, markets, and places of worship. Over time, these improvements are expected to support more stable livelihoods, reduce vulnerability to climate-related flooding, and strengthen overall community resilience.

During the construction phase, the Project will generate temporary employment opportunities and increase demand for local goods and services, potentially benefiting small businesses and informal vendors. While these economic benefits are expected to be short-term, they may provide important supplementary income for households within the Project's Area of Influence.

9.4.3.2. Negative Social Impacts

As presented in the impact assessment matrix in Table 9-2, numerous potential impacts have been identified. Several of these may be significant and will therefore require the implementation of appropriate mitigation measures to reduce them to minor and moderate impacts. Detailed guidance on the practical application of these measures is provided in the ESMP. Impacts assessed as being of major significance are afforded particular attention and are discussed in further detail.

In general, the implementation of robust mitigation measures is expected to significantly reduce the severity of many potential impacts. While Table 9-2 provides an overview of the residual significance after mitigation; it is important for decision-makers to understand the nature and magnitude of these residual impacts. A full description of the latter is provided in Section 9.4.3.3.

- **Impacts on community relations**

  Construction activities are expected to generate a range of direct and indirect impacts on community relations, primarily related to physical disturbance, access restrictions, increased movement of machinery and vehicles, and interactions between workers and local communities. While many impacts will be temporary and localized, some may be frequent and disruptive.

  A major community relations impact concerns damage to land, yards, access paths, and communal spaces due to excavation and construction works, material storage, and movement of machinery. These disturbances may restrict access, disrupt daily routines, and affect shared spaces of social importance. Given their frequency and the high sensitivity of affected communities, these impacts are assessed as of major significance before mitigation.

  Additional nuisance impacts, including dust, noise, and vibration, may disrupt daily activities and negatively affect community well-being and daily life including sensitive receptors such as schools, health centers, and places of worship. Increased construction traffic also presents safety risks to pedestrians, particularly children, the elderly, and persons with disabilities.

  Community relations may further be affected by social tensions arising from inadequate consultation, unmet expectations, or perceived exclusion from project benefits, as well as by inappropriate or disrespectful worker behavior, particularly toward women. Although expected to be occasional, the high sensitivity of affected receptors results in moderate significance for these impacts.

  Another major impact relates to the loss of social networks, community ties, and informal support systems for households relocated to new areas or host communities. Such disruption may have long-term implications for social cohesion and community well-being, particularly for vulnerable households. In addition, the integration of relocated households into host communities may place localized pressure on housing, basic services, and livelihood opportunities, potentially contributing to social tension where host communities already experience service constraints.

- **Impacts on livelihoods**

The project may result in temporary or permanent economic displacement through loss of access to livelihood spaces, including roadside vending areas, market spaces, fishing landing sites, drying areas, wetlands use, small workshops and other formal and informal livelihood activities. These impacts are particularly significant for households dependent on informal economic activities.

Construction activities and restricted access may disrupt fishing, fish processing, fish trading, and other wetland- and coastal-based livelihoods, including the collection of natural resources used for subsistence and income generation. Such disruptions may be temporary and rarely prolonged, depending on the duration, frequency, and spatial extent of works.

Cumulative livelihood impacts are a major concern, as many households have already experienced repeated displacement, previous resettlement, or gradual loss of livelihood space. These cumulative pressures increase vulnerability, the risk of longterm impoverishment, including increased reliance on household debt, particularly for female-headed households and other vulnerable groups.

In addition, permanent land acquisition may result in physical displacement, requiring relocation and compensation and leading to disruption of established social, economic and community systems. Impacts may be particularly significant where physical displacement coincides with loss of access to income sources or affects households that have experienced previous displacement or livelihood disruption.

Overall, impacts on livelihoods are assessed as major prior to mitigation, reflecting the high sensitivity of affected households, the informal and location-dependent nature of livelihoods, and the cumulative effects of repeated displacement and access restrictions. While the magnitude of impacts may be localized or temporary in some cases, the limited adaptive capacity of affected households elevates the overall significance. With implementation of avoidance, reduction, mitigation, compensation, and livelihood restoration measures in accordance with ESS5, residual impacts are expected to be reduced significantly to minor effect but in some cases impacts may remain moderate.

- **Impacts from influx of people**

The temporary influx of construction workers and people seeking employment may result in a range of relatively moderate social impacts affecting community relations and social dynamics. Increased competition for employment opportunities may generate frustration and perceptions of exclusion, particularly where expectations for local hiring are high or where affected communities feel insufficiently prioritized. Such perceptions may reduce community support for the Project and lead to grievances if not adequately managed.

Interactions between workers and local residents may further raise concerns related to inappropriate or disrespectful behavior, including toward women, and social ills such as alcohol use or other disruptive activities. In economically vulnerable contexts, increased competition for employment and weak labor management controls may elevate the risk of child labor, sexual exploitation and abuse / sexual harassment (SEA/SH), and gender-based violence (GBV). Although such incidents are not expected to be widespread, the sensitivity is high, resulting in a moderate overall significance of the impacts.

Overall, influx-related impacts are expected to be localized, temporary, and manageable, with their significance driven primarily by community sensitivity rather than the scale of workforce presence.

- **Impacts on cultural heritage**

Project activities may result in the disturbance of, restricted access or displacement of cultural heritage receptors, including places of worship, sites used for fishing-related cultural practices, and graves. Construction-related activities and increased activity near these sites may interfere with religious observance, cultural rituals, or customary practices.

Even where impacts are moderate, temporary, disturbance or access restrictions may be perceived as significant due to the high cultural sensitivity of these sites, particularly graves and active places of worship. Such impacts may affect community well-being, cultural identity, and respect for ancestral and spiritual traditions.

- **Impacts on public health and safety**

Project construction and operation may result in moderate community health and safety risks, primarily associated with increased traffic, construction activities, and workforce presence. Increased movement of construction vehicles and equipment may elevate the risk of road accidents. Workforce influx may contribute to higher risks of communicable diseases, including sexually transmitted infections, in communities with limited health awareness and services.

In addition, construction activities may expose community members to physical hazards, including open trenches, poorly demarcated work areas, and unsafe construction sites. These hazards pose particular risks to children, who may enter construction areas unintentionally. Although such risks are localized and temporary, their potential consequences warrant a moderate significance rating prior to mitigation.

- **Impacts on labor and working conditions**

Project activities may result in various impacts related to labor and working conditions, particularly where recruitment processes are not transparent or effectively controlled. Local communities, women, youth, and other vulnerable groups may feel excluded from employment opportunities if project jobs are perceived to be preferentially allocated to non-local workers or dominated by male participation.

In contexts of economic vulnerability, weak recruitment oversight may also increase the risk of child labor, particularly through informal hiring or subcontracting arrangements. In addition, workers may face unfair or exploitative conditions, including low pay, excessive working hours, insecure contracts, or lack of access to a fair and accessible grievance mechanism.

9.4.3.3. Residual Impacts on the Socio-Economic Environment

Even with good impact control and management practice, some impacts on socio-economy cannot be fully mitigated and certain residual impacts will still happen. These mainly include the following.

- **Economic and physical resettlement impacts**

  Where permanent land is acquired, resettlement will be carried out under a RAP. Even so, some impacts may remain, including loss of attachment to place, weaker social networks, and temporary income loss as households adjust to new locations, despite compensation and livelihood support.

  Some vendors and resource users may also continue to face income loss if access to their usual work or resource areas cannot be fully restored. These impacts are likely to affect vulnerable groups—such as female-headed households, the elderly, and persons with disabilities—more strongly.

- **Impacts on livelihood and income**

  Even with livelihood support and measures to manage access, some households may still lose part of their income, especially where access to vending areas, landing sites, drying areas, workshops, or wetland resources cannot be fully restored or takes time to recover. Households that have already been displaced or repeatedly affected may continue to face difficulties, increasing their vulnerability even after support is provided.

- **Community health and safety**

  Traffic management, fencing, and safe-site protocols will reduce risks, but residual road-safety hazards (near schools, markets, and crossings), sporadic exposure to open trenches/temporary diversions, and public-health risks associated with altered water conditions (e.g., vector-borne disease potential) may persist at low levels until full reinstatement and drainage stabilization are achieved.

- **Influx-related social pressures (including SEA/SH and GBV)**

  Even with Codes of Conduct, worker rules, and community safeguards in place, some pressure on local services and housing may still occur. There may also remain a small risk of SEA/SH, GBV, and child labor, especially where enforcement is still developing and access to support services is limited. Ongoing community engagement and survivor-focused support and referral systems will be needed to manage these remaining risks.

- **Noise**

  Controls on construction equipment and vehicle movement will reduce nuisance; however, some noise may still be heard near homes, schools, hospitals and clinics, especially during busy construction periods.

- **Impact on cultural heritage**

  Avoidance and chance-find procedures will protect significant resources; nevertheless, residual constraints on access to certain cultural or spiritual sites and altered practice patterns may continue where safety zones or alignments limit traditional use—even if physical impacts are avoided.

- **Labor and working conditions**

  With labor-management procedures and grievance mechanisms in place, residual risks may persist around uneven access to jobs for local and vulnerable groups, perceived fairness of recruitment, and isolated non-compliances (e.g., late payments, overtime), which require sustained monitoring and contractor performance management.

- **Community relations and social cohesion**

  Comprehensive stakeholder engagement will mitigate tensions; however, localized mistrust and conflict risks may remain where property damage occurred, where benefits are seen as uneven, or where behavior of a minority of workers affects perceptions. Households relocated away from social networks may continue to experience reduced informal support even after resettlement assistance.

9.4.4. Cumulative Impacts

Cumulative impacts are environmental and social impacts caused by the combined effect of past, present, and potential future human activities and natural processes, including those from concurrent or planned future third-party activities. In general, cumulative impacts act in such a way that the sum of impacts is greater than the parts.

Cumulative impact interactions result either from:

- Interactions between impacts associated with the Project, and / or
- Interactions between the impacts associated with one or more other developments within or in proximity to the project area.

Several project activities interact with existing pressures (e.g., high population density, mismanagement of solid waste, settlement encroachment on wetlands, etc.) and with each other, contributing to cumulative impacts. Cumulative impact interactions during construction and operation that have been identified as having the potential for adverse effects are listed below.

Degradation of soil and water quality

-
  Project-related construction activities (excavation, drainage cleaning) may interact with existing sources of pollution such as untreated wastewater discharges, solid waste dumping, and urban runoff. In addition, ongoing urban and industrial activities in the project area contribute to turbidity, organic loading, fisheries-related wastewater, and solid waste in coastal and estuarine waters. Together, these activities may result in short-term cumulative degradation of water quality in wetlands, Stockton Creek, the St. Paul River Estuary, and Atlantic Ocean outfalls if not properly managed.

- **Air quality and noise stress in dense urban areas**

  Temporary dust, exhaust emissions, and construction noise from project activities may add cumulatively to existing urban sources such as heavy traffic, generators, market activity, industrial facilities, port operations, and road construction.

- **Cumulative disturbance, nuisance, and traffic-related impacts**

  The proposed development, in combination with nearby and concurrent projects (see Section 3.9 of the ESIA, Volume II), is expected to result in cumulative disturbance and nuisance impacts to surrounding businesses and residential areas. These impacts may arise from overlapping construction and operational activities associated with the Project, the UN Drive Road Expansion Project, port-related trucking, and other industrial operations across Bushrod Island.

  Cumulative effects may include increased noise, dust emissions, waste generation, visual intrusion, and traffic movements, leading to congestion, reduced accessibility, and elevated road safety risks. These impacts are likely to be most pronounced along UN Drive, Jamaica Road, and market access routes, particularly where construction schedules and traffic management measures are not coordinated.

- **Cumulative habitat loss**

  Over time, Bushrod Island has experienced incremental loss of natural and seminatural habitats due to urban expansion, informal settlement growth, land reclamation, infrastructure development, including the largest port in Liberia, and small-scale extractive activities. Although the Project will result in only localized and limited additional habitat loss, particularly associated with perimeter channels, it contributes incrementally to an existing pattern of habitat reduction within an already highly modified landscape. At the cumulative level, this gradual erosion of habitat availability reduces ecological space for wetland. While no critical habitats are affected and remaining habitats are largely degraded, cumulative habitat loss represents a long-term pressure on biodiversity that extends beyond the influence of any single project.

  Cumulative pressure on waste management systems

  Construction activities associated with the Project, particularly drainage cleaning, excavation works, rehabilitation of drainage channels, and construction of culverts and associated infrastructure, will generate significant quantities of waste materials.

- These may include excavated sediments, dredged sludge, vegetative debris from channel clearing, demolition waste from the removal of damaged drainage structures, and general construction waste. While these waste streams will be managed as part of project implementation, their generation may contribute to cumulative pressure on existing waste management systems.

  Waste management infrastructure in Monrovia and surrounding areas is already constrained by limited collection coverage, insufficient transport capacity, informal dumping practices, and pressure on existing disposal sites. In this context, the additional waste generated by the Project, particularly during peak construction activities, may interact with existing municipal waste management challenges and temporarily increase pressure on waste collection, transport, and disposal systems.

  If not properly managed, these cumulative pressures could lead to temporary waste accumulation, illegal dumping, localized pollution of soils and surface waters, obstruction of drainage infrastructure, and nuisance impacts such as odors and vermin. These effects could further exacerbate existing environmental pressures in densely populated urban areas and sensitive environments. To address these risks, the Project will implement a Site-specific Waste Management Plan (S-WMP).

- **Cumulative habitat degradation**

  Habitat degradation represents the dominant cumulative pressure on biodiversity in the project area. Key drivers include chronic pollution from solid waste dumping and untreated effluent, altered hydrological regimes, sedimentation, invasive species spread, noise and light disturbance, unregulated sand and clay extraction, and ongoing human disturbance. These pressures interact to reduce habitat quality, simplify ecological structure, and lower the resilience of wetland, estuarine, and coastal ecosystems. Although, on the long-term, the Project will help reduce some sources of degradation—particularly through improved drainage, reduced waste accumulation, and wetland zoning—many degradation drivers originate outside the project's influence, including upstream catchment activities and broader urban development. As a result, cumulative degradation effects will persist despite projectlevel mitigation.

- **Cumulative socio-economic vulnerability**

  Cumulative losses across land access, livelihoods, and social systems may compound over time, increasing the vulnerability of affected and at-risk groups who struggle to adapt to project-induced changes. As these pressures accumulate, households with limited resilience face heightened socio-economic challenges, reduced coping capacity, and greater long-term hardship.

- **Cumulative livelihood vulnerability**

  Cumulative livelihood pressures arising from repeated displacement, past resettlement, restricted access to livelihood areas, and rising living costs may significantly reduce household stability over time. As these stresses compound, affected families face increased vulnerability, declining economic resilience, and a heightened risk of indebtedness.

- **Cumulative pressure on urban services and infrastructure**

  Over time, the combined effects of project activities, population growth, and inmigration to improved areas may place increased pressure on housing, drainage systems, water supply, sanitation, waste management, and other public services. In already dense and underserved neighborhoods, this cumulative pressure may reduce service quality and limit the long-term benefits of infrastructure improvements.

10. Environment and Social Mitigation

10.1. Overview

The Project will be implemented in a manner that ensures environmental protection, social sustainability, and the health and safety of workers and affected communities. The Ministry of Public Works (MPW), through the Project Management Unit (PMU) and in coordination with supervising engineers and contractors, will manage environmental and social risks and impacts in accordance with applicable national legislation and the World Bank Environmental and Social Framework.

Environmental and social risk management for the Project will be operationalized through the Project Environmental and Social Management Plan (ESMP), supported by topic-specific management plans and procedures. These instruments establish the mitigation measures, monitoring requirements, institutional responsibilities, and reporting arrangements necessary to avoid, minimize, mitigate, or compensate for adverse environmental and social impacts associated with the Project.

Given the nature of the LURP, which involves multiple construction contracts in densely populated urban areas, contractors will be required to prepare and implement Contractor Environmental and Social Management Plans (C-ESMPs) consistent with the Project ESMP. The C-ESMPs will be subject to review and approval by the supervising engineer and the PMU prior to commencement of works and will be updated as required to reflect site-specific conditions and construction methodologies.

All environmental and social management instruments will be implemented throughout the construction and operation phases of the Project and will be aligned with the mitigation hierarchy, good international industry practice, and the relevant requirements of the World Bank Environmental and Social Standards.

10.2. Approach

Impacts are classified in Section 9 according to the three main receptor groups (the physical, biological, and socio-economic environments) which may come about through the development and operation of the Project. The focus of impact reduction, mitigation and management can be summarized as follows:

- **Physical environment:** To avoid significant soil erosion and water pollution, to limit noise, dust, gaseous emissions, and other alterations to the landscape and to conserve and protect potable water supplies and air quality.
- **Biological environment:** To protect biodiversity from the potential harmful impacts of the Project and to maintain the integrity of the ecosystem services in the project affected areas.
- **Socio-economic environment:** To minimize the negative and enhance the positive socio-economic impacts on the affected and neighboring communities. Equally, to ensure the health and safety of project staff, contractor employees, and local communities within the immediate operational areas

The hierarchy of options for mitigation used in the impact assessment is explained in detail in Section 9.1. The potential impacts associated with the Project and the mitigation strategies proposed are listed in Section 9.2. In order to keep this document simple and practical, the detailed mitigation measures are not included in this Section but in the ESMPs, which are designed to be immediately usable as self-standing documents. Instead, only the rationale behind mitigation measures is given in Section 10.3.

10.3. Mitigation Measures

10.3.1. Basis of Environmental Mitigation

The potential environmental impacts arising from project activities are described in Section 9. Mitigation of impacts on the physical environment aims to prevent or reduce pollution to soil, water resources, air quality, and ambient noise, and to minimize damage to sensitive receptors, including human communities and biodiversity.

Potential environmental impacts can be:

- **Local**: Affecting areas near project components, such as nearby towns New Kru Town, Duala, St Peter Town, Logan Town, adjacent lands, and immediate watercourses such as local water bodies and wetlands connected to Stockton Creek, the St. Paul River, Mesurado River and Atlantic Ocean outfalls.
- **Regional**: Affecting areas beyond the immediate Project footprint, including Monrovia, the Atlantic Ocean, the Mesurado wetland and the coastal zone of Bushrod Island, particularly areas where urban runoff and tidal influences interact.

Section 6 of the ESIA (Volume III) describes the physical environment in and around the project footprint and highlights the baseline environmental conditions at these locations. Key sensitive receptors are presented in Table 10-1.

Table 10-1 Key environmental sensitive receptors

Sensitive receptor	Description
Surface and groundwater systems	Surface and groundwater systems in Northern Bushrod Island are vulnerable to contamination or hydrological alteration. These include wetlands, drains, and receiving waters connected to Stockton Creek, St. Paul River and its estuary and Atlantic Ocean outfalls, which are intersected by project activities.
Local communities, settlements, and sensitive infrastructures	Communities located near project activities such as New Kru Town, Duala Market, and Logan Town, nearby residential areas, and sensitive receptors such as schools and health facilities, may be affected by temporary changes in water and soil quality, increased noise, vibration, emissions, traffic disruption, and access constraints during the Project.
Sensitive receptor	**Description**
Terrestrial and aquatic ecosystems	Terrestrial and aquatic ecosystems (especially estuarine and wetland areas within the St. Paul wetlands sublocation, are sensitive to changes in flow regimes, sediment loads, and water quality. These systems provide flood buffering and ecological functions that may be temporarily disturbed by construction activities.

Project employees	Project employees working on-site during construction and operation are sensitive to occupational health and safety risks, including exposure to heavy machinery, excavation works, traffic interaction, confined spaces, and extreme weather conditions, and increased noise levels and emissions.

In order to safeguard sensitive environmental receptors and minimize potential negative impacts of the Project, the following key environmental mitigation principles will be applied.

- Ensure **construction methods** adhere to best practices and environmental measures and procedures.
- Incorporate environmental best practice in **project design** to achieve the most resource-efficient and environmentally sound outcomes the Project's lifecycle.
- Ensure that all **project activities** comply with environmental and social guidelines and standards.
- Implement appropriate **erosion control measures** to prevent soil loss and the subsequent deposition of sediment into watercourses.
- **Prevent contamination of water courses** used for domestic or community purposes and maintain compliance with national water quality standards.
- **Rehabilitate all sites disturbed** by construction or operational activities once their use is complete, restoring them to an acceptable condition.
- Implement a robust **environmental monitoring plan** to verify compliance with national standards and confirm the effectiveness of mitigation measures and environmental management practices.

In large projects such as this one, residual environmental impacts will remain despite mitigation. The ESMP specifies mitigation measures to avoid and minimize pollution and other damage, and to restore affected areas (see Section 11).

10.3.2. Basis of Biological Mitigation

The potential biological impacts arising from project activities are described in Section 9. The Project's strategy for managing its biodiversity impacts is fundamentally anchored in the World Bank Environmental and Social Framework (ESF) and aligns with Liberian national environmental requirements and ESIA guidelines. This commitment is operationalized through the application of the mitigation hierarchy prioritizing avoidance, reduction and minimization, followed by restoration and, where necessary, compensation.

Section 7 of the ESIA (Volume III) describes the biodiversity characteristics within the Project footprint, including modified wetlands, mangrove fringes, drainage line aquatic habitats, and the nearshore Atlantic coastal environment. These habitats support a range of flora and fauna that remain ecologically functional despite long term anthropogenic pressure. Key sensitive receptors are presented in Table 10-2.

Table 10-2 Key ecological sensitive receptors

Sensitive receptor	Description
Wetland and mangrove habitats	Modified but ecologically functional marshy wetlands and mangrove patches that provide support to aquatic, semi aqautic and terrestrial fauna, shoreline protection, and natural filtration.
Aquatic systems	The St. Paul River Estuary, Stockton Creek and existing drainage channels connected to wetlands which support ecological connectivity and provide feeding, nursery grounds for aquatic fauna, movement pathways.
Coastal and nearshore habitats	These support intertidal organisms, juvenile marine species, mudflat foragers, and wetland associated birds dependent on the estuarine and nearshore Atlantic zone, including species of concern such as Grey Plover and other migratory shorebirds.

To safeguard sensitive ecological receptors and reduce potential adverse impacts, the Project's strategy for biodiversity mitigation is guided by the sequential application of the mitigation hierarchy, as outlined below.

- **Avoidance of sensitive habitats and functions:** Priority is given to avoiding direct impacts on the most sensitive receptors, particularly mangrove stands, marshy wetland cores, and key ecosystem service areas. This is achieved through spatial controls, buffer zones, no-go areas, and design measures that confine works to existing channel alignments, degraded wetland margins, and previously disturbed areas.
- **Minimisation of disturbance footprint and duration:** Where avoidance is not possible, impacts are minimised by:
  - restricting vegetation clearing and earthworks to the smallest practicable footprint ○ undertaking works progressively and in short, sequential sections ○ limiting the duration of disturbance at any single location
  - preventing unnecessary access, storage, or informal movement within sensitive areas
- **Protection of habitat quality and ecological processes:** Controls on noise, vibration, lighting, and pollution, particularly water and sediment pollution, together with management of temporary flow diversions and channel works, are applied to reduce degradation of habitat quality during construction.
- **Prevention of unnecessary flora and fauna mortality:** Recognising that vegetation clearing can result in direct loss of flora and incidental fauna mortality, mitigation measures emphasise:
  - phased and daylight clearing
  - pre-clearance inspections and fauna relocation where appropriate
  - strict prohibitions on wildlife harm ○ worker awareness, supervision, and enforcement
- **Control of invasive species spread:** Given the presence of invasive flora within drainage channels and wetland edges, invasive species control are a key mitigation priority. Measures focus on preventing the secondary spread of invasive species

through soil movement, vegetation disposal, equipment transfer, and reinstatement activities, thereby avoiding longer-term degradation of less disturbed habitats.

- **Progressive reinstatement and recovery:** Reinstatement measures are applied progressively to stabilise disturbed areas, restore natural drainage and physical structure, and support ecological recovery following construction. Reinstatement prioritises function and stability over aesthetic restoration and is closely linked to erosion control, revegetation, and invasive species prevention measures set out in the ESMP.
- **Protection of ecosystem services and community use:** Mitigation measures addressing ecosystem services are designed to minimise disruption to artisanal fishing and small-scale extractive activities by: ○ providing advance communication ○ maintaining access where practicable
  - limiting the duration and spatial extent of interference ○ ensuring access to grievance mechanisms

The mitigation principles outlined above are implemented through the impact-specific mitigation measures presented in the ESMP, including the Mangrove Protection Procedure, Wildlife Management Procedure, Invasive Species Management Procedure, and Site Reinstatement and Recovery Procedure.

10.3.3. Basis of Social Mitigation

Socio-economic impacts are discussed in Section 9. Mitigation measures aim to avoid, minimize, or mitigatenegative impacts and enhance positive outcomes for affected communities, project workers, and neighboring populations within the Project's social area of influence, as well as in the wider region as affected by the Project. The aim is to safeguard community well-being, protect the health and safety of local populations and project personnel, and promote equitable socio-economic benefits.

Where mitigation measures are effectively applied, project activities are expected to avoid or sufficiently reduce impacts to below significant levels, making additional mitigation or compensation unnecessary. However, where residual impacts remain significant despite these measures, further mitigation or compensation will be implemented to reduce their significance to acceptable levels.

Section 8 of the ESIA (Volume III) describes the baseline socio-economic conditions in the social area of influence. Key sensitive receptors are presented in Table 10-3.

Table 10-3 Key socio-economic sensitive receptors

Sensitive receptor	Description
Flood-affected informal communities	Low-income households in New Kru Town and the St. Paul Wetlands areas experiencing recurrent tidal, fluvial, and pluvial flooding, with limited tenure security and high exposure to construction disturbance.
Host communities near works areas	Communities adjacent to construction zones, potentially affected by displacement, labor influx, traffic, noise, dust, health and safety impacts, service pressure, and social tension.

Vulnerable groups	Individuals or groups at greater risk of adverse impacts or exclusion from project benefits, such as women-headed households, elderly persons, unemployed youth, or people with disabilities.
Livelihood dependent groups	Artisanal fishermen and fishmongers, wetland resource users, petty traders, roadside vendors, and informal service providers whose incomes depend on access to waterways, roads, and public spaces.
Community infrastructure and service users	Users of social amenities such as schools, health centers, water points, and access roads that may be affected by increased pressure from workers, traffic, or construction activities.
Cultural heritage sites	Tangible and intangible cultural resources, including sacred sites or graves that may be disturbed or restricted by project activities.
Project workforce	Employees and contractors who may be exposed to occupational health and safety risks or poor working conditions if not adequately safeguarded.
Local economy and livelihoods	Economic activities (e.g., fishing, petty trading, wetland use) that may be disrupted by restricted access, land take, and economic resettlement

In order to safeguard sensitive socio-economic receptors and minimize potential negative impacts of the Project, the following key socio-economic mitigation principles will be applied.

- **Stakeholder engagement and grievance management** ○ Maintain regular engagement and manage expectations as per the Stakeholder Engagement Plan (SEP).
    - Establish and operate a Grievance Redress Mechanism (GRM) for communities and workers.
- **Land acquisition, resettlement, and livelihoods** ○ Develop and implement a RAP in line with national laws and international standards ensuring consultation, fair compensation, and support during and after physical and economic resettlement.
    - Develop and implement livelihood restoration measures to support affected persons who lose access to land, resources, or sources of income, through appropriate compensation, training, or livelihood support to restore or improve pre-project living standards.
- **Labor and workforce management** ○ Ensure contractors comply with national labor laws and international standards, including written employment contracts, equal opportunity, and a functional worker GRM.
    - Require contractors to implement a Workforce Management Plan to maintain fair labor practices, inclusive hiring, and safe conditions.
    - Enforce Codes of Conduct addressing worker behavior, SEA/SH, and child labor.
    - Establish survivor-centered SEA/SH response and referral pathways in coordination with qualified service providers.
- **Occupational health and safety** ○ Implement an occupational health and safety management system and provide appropriate personal protective equipment to all staff and contractors.
    - Apply measures to prevent and control disease, manage traffic safely, and mitigate impacts from dust, noise, emissions, and vibration exposure.

   - Establish an emergency preparedness and response plan and train workers in its use.
- **Community health, safety, and public services** ◦ Reduce community impacts from worker influx, traffic, dust, noise, and vibration.
   - Avoid inducing unnecessary influx of work seekers to the social area of influence, through controlled recruitment and clear communication.
   - Implement public health measures for disease prevention and control.
- **Economic and employment measures** ◦ Ensure fair, transparent, and locally distributed employment opportunities across the social area of influence.
   - Support the local economy where feasible and avoid generating unsustainable dependencies.

In large projects such as this one, residual socio-economic impacts will remain despite mitigation. The ESMP specifies mitigation measures to avoid and minimize these impacts (see Section 11).

10.3.4. Mitigation of Cross-Cutting Impacts

Some project activities may fall into more than one of the above categories, as they influence two or more environmental components — physical, biological, and socio-economic. These are referred to as cross-cutting impacts, and are described below.

- **Atmospheric emissions:** It is necessary to minimize adverse effects on air quality from engine exhausts, fugitive dust from earthworks, transportation of materials, and other construction or operational sources. Measures will be taken to ensure that operations comply with national air quality standards (gaseous and particulate) and applicable good international practice (e.g. World Bank Group EHS Guidelines).
- **Noise and vibration:** To reduce noise pollution from heavy machinery, vehicle traffic, and construction activities, as well as vibration from continuous equipment operation. Steps will be taken to adhere to national noise limits and international guidelines on noise management, particularly near sensitive receptors such as schools and hospitals.
- **Water quality:** It is necessary to prevent degradation of surface water, groundwater and marine water quality from erosion, sedimentation, and contamination due to spills or poor waste management. Water quality impacts can directly affect aquatic biodiversity, ecosystem services, and human use. All measures will aim to meet national water quality standards and internationally recognized best practice.
- **Solid and liquid waste generated by the Project:** It is necessary to minimize the production and accumulation of solid and liquid waste from construction and operation. Poor waste management can lead to land, water, and marine pollution, posing risks to public health, ecosystems, and visual amenity. The waste management hierarchy—avoidance, minimization, reuse, recycling, recovery, and safe disposal—will be applied to all project activities. Measures will be implemented to prevent illegal

dumping and ensure that all waste is appropriately collected, segregated, treated, and disposed of in compliance with national regulations and international best practice.

- **Hazardous materials:** The safe handling, storage, and disposal of hazardous materials (e.g., fuel, chemicals, lubricants, batteries) are critical to avoid leaks and spills that could contaminate soil, water, and harm wildlife or human health. The project will implement strict pollution prevention measures and emergency response protocols, with a focus on hydrocarbon management and spill containment.

- **Light pollution:** Artificial lighting from construction sites can affect local communities. Measures such as directional lighting, timing controls, and using lowimpact spectra (e.g., amber lighting) will be implemented to minimize disturbance.

- **Land use change and habitat transformation:** The conversion of natural or seminatural landscapes for project infrastructure alters the physical environment through changes in topography, soil structure, hydrology, and biodiversity. These changes may also affect access to natural resources, livelihoods dependent on the land, and potentially cultural heritage sites within the transformed areas. Mitigation focuses on minimizing the project footprint and exploring alternatives that avoid sensitive land types.

11. Environment and Social Management Overview

In accordance with the requirements of the EPA and the World Bank ESF, an Environmental and Social Management Plan (ESMP) is prepared to accompany and support the implementation of this ESIA. The ESMP is presented as a separate, standalone document forming an integral part of the Project's overall environmental and social management system.

The ESMP aims to ensure that all environmental, ecological, social, health, and safety risks and impacts associated with the Project are effectively prevented, mitigated, or otherwise managed throughout the project lifecycle. Specifically, the ESMP:

- Ensures compliance with applicable national legislation, EPA permitting conditions, and relevant World Bank ESSs.

- Safeguards affected communities, project workers, and ecosystems from potential adverse impacts.

- Promotes sustainable project outcomes and continuous environmental and social performance improvement.

The ESMP consolidates all relevant mitigation, monitoring, and management measures identified in the ESIA into a single, practical framework. It defines clear institutional arrangements, roles and responsibilities, monitoring and reporting requirements, capacitybuilding needs, and resource allocations to facilitate effective implementation.

1. Introduction

This document is the Environmental and Social Management Plan (ESMP) for the Liberia Urban Resilience Project (LURP) Interventions in Northern Bushrod Island in Monrovia, Montserrado County, Liberia ("the Project"). The Project is implemented by the Ministry of Public Works (MPW) through its Project Management Unit (PMU) (hereafter referred to as "PMU" or "Client"), with financial support from the World Bank. The ESMP has been developed as a standalone document accompanying the Environmental and Social Impact Assessment (ESIA) prepared by Earthtime Inc. in February 2026 for submission to the Environmental Protection Agency (EPA) of Liberia, for review and if satisfactory, issues the environmental permit. The ESIA and ESMP are also submitted to the World Bank for review, clearance and disclosure before starting works. The ESMP must be implemented throughout the construction and operation phases of the Project.

This ESMP has been developed in compliance with the Environmental Protection and Management Law of Liberia (2003), EPA ESIA Procedural Guidelines (2022), relevant EPA Parameters of Concern (2024), and the World Bank Environmental and Social Framework (ESF), and reflects good international industry practice (GIIP). Its purpose is to translate the ESIA findings into practical, enforceable mitigation, monitoring, and management measures, including responsibilities for the Contractor, Supervision Engineer, PMU and relevant government regulators, schedule, and a budget which would be integrated into procurement and contracts so that the measures are enforceable during construction and operation of the works. The ultimate goal of the ESMP is to avoid, minimize, and manage environmental and social risks and impacts during Project implementation.

1.1. Project Context

Greater Monrovia, and particularly Northern Bushrod Island, is highly vulnerable to recurrent flooding due to its low-lying topography, aging and insufficient drainage infrastructure, unplanned urban expansion, poor solid waste management, and the increasing effects of climate change. Flooding causes significant social, economic, and environmental impacts and is expected to intensify under future climate scenarios. In response, the Government of Liberia is implementing the LURP to enhance flood resilience, improve drainage performance, and reduce community vulnerability.

The LURP targets four flood-prone areas in Greater Monrovia, with this ESMP specifically addressing the Northern Bushrod Island component. Interventions were identified and prioritized through a structured Local Area Resilience Plan (LARP) process that integrated hydrological modelling, flood hazard mapping, environmental and social risk screening, and extensive community consultations. Selection criteria included flood risk reduction effectiveness, environmental and safety considerations, community benefits, implementability, procurement feasibility, and financial constraints.

The Project comprises two main categories of interventions:

- flood risk management infrastructure, including drainage channels, culverts, bridges, and drainage outlets; and

- community upgrading infrastructure, such as footbridges and drainage maintenance facilities.

These structural measures are supported by non-structural ("soft") measures, including zoning and land-use controls in sensitive wetland areas to prevent encroachment.

1.2. Objectives

The objective of this ESMP is to ensure that environmental, social, and health and safety risks associated with the Project are effectively managed during project implementation. It ensures compliance with all applicable regulatory, technical, and institutional requirements, safeguards communities and ecosystems, and supports the achievement of the Project's intended benefits.

This ESMP consolidates all relevant mitigation and monitoring measures into a single, practical document. While some ESMPs may present separate sub-plans (e.g., waste management, traffic, occupational health and safety), in this case, they are integrated for ease of implementation and to avoid gaps between safeguard elements.

The ESMP outlines the E&S risks and impacts, defines specific mitigation actions, assigns institutional responsibilities, establishes implementation timelines, and sets out monitoring requirements for the Project. Its successful execution depends on consistent application, diligent oversight, monitoring, and effective communication among project personnel.

1.3. Scope

This ESMP outlines the environmental, social, and health and safety measures required to manage and mitigate potential environmental and social impacts arising from the Project. The scope of the ESMP covers the construction and operation phases of the Project.

The ESMP will be implemented throughout the Project's lifecycle, ensuring continuous management of environmental and social impacts associated with the Project. The ESMP is structured to be comprehensive yet adaptable, with provisions for periodic review and updates in response to project changes or unforeseen issues.

1.4. Structure of the Report

The ESMP Report has been organized in ten main sections covering all the items listed in the Liberia ESIA Procedural Guidelines (2022), as well as the various pertinent World Bank requirements. The ESMP Report structure is summarized in Table 1-1.

Table 1-1 ESMP report structure

Section	Title	Contents
1	**Introduction**	Provides a brief description of the Project's background, the purpose and scope of the ESMP, and the structure of this report.
2	**Project Description**	Presents an overview of the Project.
3	**Institutional Arrangements**	Describes how the PMU and its contractors should be organized to implement this ESMP. Defines key personnel responsibilities and identifies necessary capacity building and training.

4	**Environmental and Social Mitigation Measures**	Presents the core matrix of the ESMP, detailing required mitigation measures by thematic category, along with responsibilities for implementation and monitoring of implementation.
5	**Environmental and Social Monitoring Plan**	Outlines how environmental, social, and health and safety aspects must be monitored to ensure compliance with relevant standards and regulations.
6	**Adaptive Management**	Describes the process for adjusting mitigation and monitoring measures based on monitoring results, changing project conditions, stakeholder input, and incidents to ensure ongoing ESMP effectiveness.
7	**Environmental and Social Reporting**	Describes the reporting requirements and responsibilities of contractors, independent third parties, and the PMU.
8	**Grievance Redress Mechanism**	Describes the process for receiving, addressing, and tracking complaints or concerns from affected communities and other stakeholders.
9	**Contractor Obligations**	Described the Contractor’s obligations to maintain environmental, social and health and safety standards throughout the Project.
10	**Environmental and Social Action Plan**	Presents a consolidated list of environmental and social actions to be implemented for the Project.
	Appendices	Contains supporting material such as environmental standards and guidelines, as well as guidelines for project-required arrangements and plans.

2. Brief Project Description

The interventions in Northern Bushrod Island under the LURP aim to reduce flood risks and enhance climate resilience through integrated drainage improvements and community upgrading interventions. A summary of the Project's main information is presented in Box 2-1, while Figure 2-1 shows the Project's general location. Detailed project decription is included in the ESIA Volume II, Section 3.

The project description in this ESMP is based on preliminary design information prepared by the Engineering Consultant. The final detailed design will be finalized prior to construction. Any material design changes that may result in different environmental or social impacts will be addressed through updates to the ESMP and associated management measures.

Box 2-1 Project summary sheet

Summary of the LURP Interventions in Northern Bushrod Island
• **Project proponent**: Ministry of Public Works (MPW) - Project Management Unit (PMU) • **Project location**: Northern Bushrod Island, Monrovia, Montserrado County, Liberia • **Project sub-locations**: ○ **Sub-location Atlantic (ATL):** New Kru Town, drainage outfalls to the Atlantic and the St. Paul Estuary ○ **Sub-location St. Paul Wetlands (SPW):** The St. Paul River, including the estuary and associated wetlands located south of the St. Paul River and north of Duala Market, and wetland areas around Caldwell Road and the Bong Mines Railway • **Project type**: Integrated flood risk management and community upgrading works • **Estimated design life**: 25-50 years • **Project phases**: Construction and operation • **Project duration**: ○ **Construction phase:** Approximately 9 months ○ **Operation phase**: 25-50 years **Activities** ○ **Construction phase:** ▪ Clearing of existing drainage infrastructure ▪ Earthworks for the excavation and rehabilitation of existing drainage channels and drains. ▪ Replacement of existing culverts and bridges with upgraded structures to increase hydraulic capacity ▪ Construction of new drainage channels ▪ Construction of drainage outlet structures ▪ Community upgrading interventions (footbridges, landscaping, maintenance facilities) ○ **Operation phase** ▪ Routine operation and maintenance of drainage channels, culverts, outlets, and pathways ▪ Regular inspection, cleaning, and desilting of drainage infrastructure ▪ Monitoring of water levels, drainage performance, and flood behavior ▪ Implementation of flood zoning and awareness measures ▪ Community awareness and capacity-building activities related to drainage maintenance • **Equipment:** Construction equipment including excavators, loaders, trucks, concrete mixers, compactors, lifting equipment, pumps, and small tools • **Materials**: Construction material (mainly concrete, cement, steel, rock, gravel, aggregates, geotextile and sand), fuel and water • **Expected waste:** Organic waste, solid waste (mainly plastic), sediment, demolition and construction waste, hazardous waste • **Employment:** Approximately 100 workers • **Land ownership:** Public and private land

Ministry of Public Works
2026

3. Institutional Arrangements

3.1.1. General arrangement

The overall responsibility for ESMP implementation rests with the PMU within the MPW, which acts as the lead implementing agency and is accountable for ensuring compliance with national regulatory requirements and the World Bank ESF.

The following entities support ESMP implementation:

- **PMU (MPW):** Leads and oversees ESMP implementation, including supervision of contractors, coordination with regulatory authorities, and reporting to the World Bank.
- **Supervising Engineer:** Supports the PMU in supervising the implementation of mitigation measures during construction and ensures that environmental and social requirements are integrated into site-level execution.
- **Contractor(s):** Responsible for the monitoring implementation of mitigation measures as defined in the ESMP.
- **Independent Third Party (ITP) E&S consultant:** Implements the project's E&S monitoring plan.
- **EPA:** Provides regulatory oversight, including environmental permitting and compliance monitoring in accordance with national legislation.
- **Grievance Redress Mechanism (GRM):** The Project will rely on the existing GRM established under the LURP, including its associated grievance committees at community and project levels. The GRM will be used to receive, assess, and resolve complaints related to environmental and social impacts arising from Project activities.

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3.1.2. Responsibilities for ESMP Implementation

This section specifies the responsibilities of the different parties for implementation of the ESMP.

3.1.2.1. Overall Responsibility

The PMU, as project proponent, retains overall responsibility and accountability for implementation of this ESMP and for compliance with:

- National environmental and social regulations
- Conditions of the Environmental Permit
- The World Bank ESF

Notwithstanding delegation of specific tasks to Contractors or Consultants, the PMU remains ultimately responsible for ensuring that mitigation and monitoring measures are implemented effectively.

The PMU shall maintain qualified environmental, social, and OHS personnel to oversee ESMP implementation, conduct regular inspections, and ensure corrective actions are applied when required. As shown in its organigram (Figure 3-1), the PMU has an Environmental Specialist (ES)) and a Social and Gender Specialist (SGS) assisted by a "Grievance Mechanism Officer" (or Community Liaison Officer (CLO). The PMU must recruit an ISO 45001:2018 certified OHS Specialist (OHSS). The inclusion of an OHS Specialist at the PMU level is necessary to ensure independent oversight of occupational health and safety performance and compliance with national requirements and the World Bank ESF. The PMU OHS Specialist provides higherlevel oversight, validation, and escalation of OHS performance, including the review of incidents, systemic risks, and corrective actions across the Project.

The PMU is responsible for instructing, observing, and monitoring its contractors against their C-ESMP and OHS Plan provisions. The PMU should ensure that corrective actions are applied by the Contractors, when necessary.

The PMU is responsible for reporting environmental and social performance to the EPA and the World Bank.

3.1.2.2. Environmental and Social Mitigation

The **Contractor** is responsible for implementing the environmental and social mitigation measures described in this ESMP (Section 4) and for maintaining effective management systems to prevent, minimize, or offset adverse impacts.

Each Contractor must prepare a Contractor's ESMP (C-ESMP), consistent with this ESMP. Each Contractor must also prepare a Contractor's Occupational Health and Safety (OHS) Plan and other plans as stipulated in this ESMP. Both the C-ESMP and OHS Plan must be approved by the PMU. The PMU shall monitor their implementation throughout the Project.

The Contractor must establish an Environmental and Social Management System (ESMS) and recruit an Environmental Officer, an ISO 45001:2018, OHSAS 18001:2007 certified Occupational Health and Safety Officer or other internationally recognized occupational health and safety standards relevant to construction activities, a Social Officer, and a Community Liaison Officer (CLO). These officers will be required to be present full-time at the construction and operation sites during working hours.

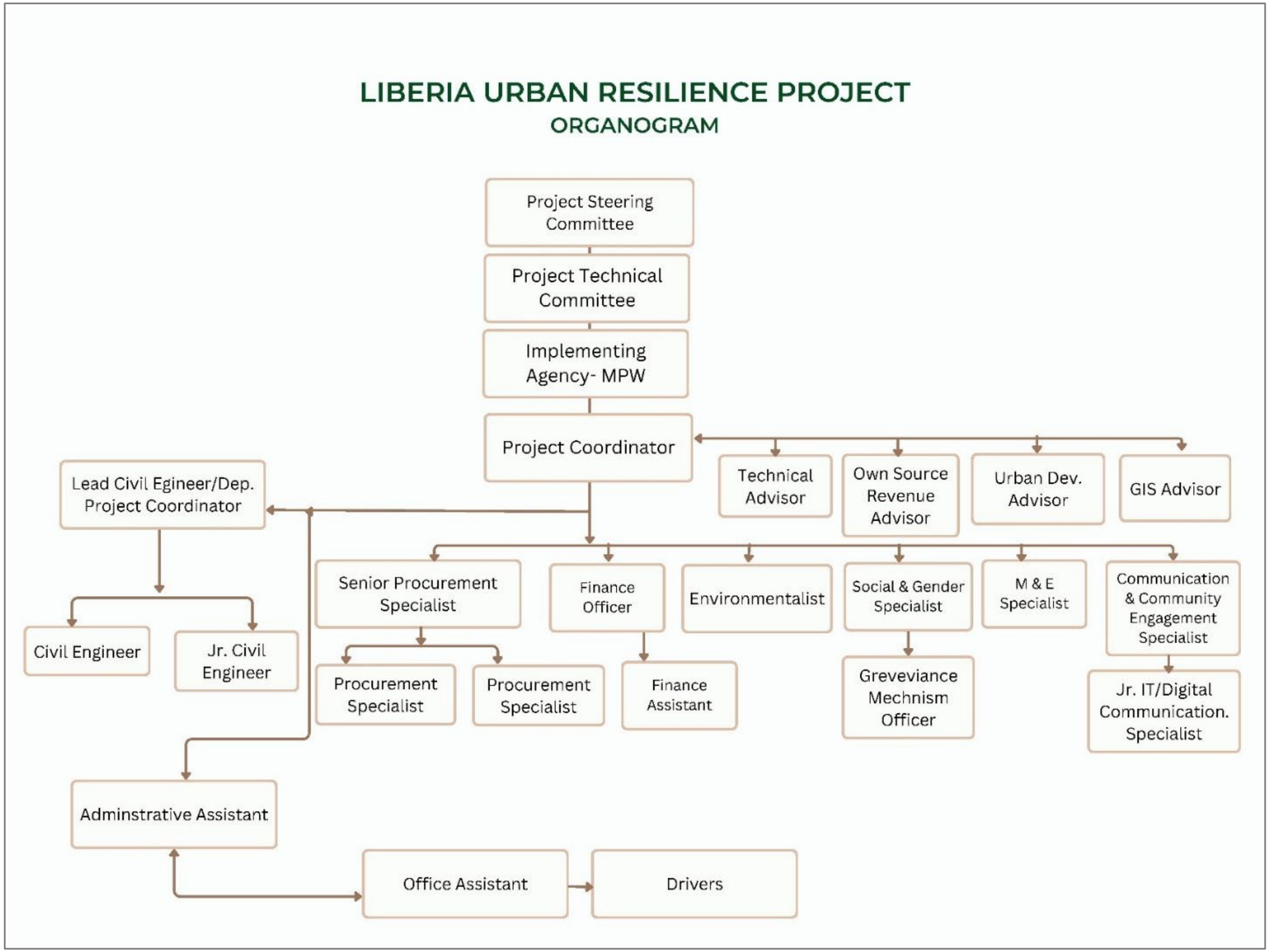

Figure 3-1 PMU organizational chart (source: PMU) 21

3.1.2.3. Environmental and Social Monitoring

Monitoring responsibilities are structured as follows.

3.1.2.3.1. Contractor Responsibilities

During the construction phase, each Contractor shall:

- Conduct routine internal inspections and self-monitoring activities to verify compliance with the requirements of this ESMP and their approved C-ESMP.
- Collect, record, and maintain environmental and social monitoring data relevant to their scope of works, including site inspection records, checklists, incident logs, grievance records, waste tracking documentation, and occupational health and safety compliance records.
- Maintain accurate and auditable records and supporting documentation.
- Provide full access to worksites, personnel, and records to PMU and its consultants for compliance monitoring and verification purposes.
- Submit monthly environmental and social compliance reports to the Supervising Engineer and PMU.

Where multiple contractors are engaged under the Project, each Contractor shall be responsible for monitoring activities within their respective contractual scope.

3.1.2.3.2. Supervising Engineer Responsibilities

The Supervising Engineer shall:

- Oversee all Contractor's activities to confirm compliance with contractual environmental and social requirements.
- Verify Contractor compliance with this ESMP.
- Conduct regular and unannounced inspections to confirm implementation of mitigation measures.
- Issue written non-compliance notices where deficiencies are identified.
- Recommend corrective actions and, where necessary, advise the PMU on suspension of works in cases of serious environmental, social, or OHS breaches.
- Consolidate the contractor's environmental and social performance information in progress reports submitted to the PMU and to the World Bank.

3.1.2.3.3. Independent Third Party

An EPA-certified Independent Third Party (ITP), contracted by the PMU, shall:

Implement the project's Environmental and Social Monitoring Plan set out in Section 5.4, including activities such as environmental sampling and monitoring (water, soil, air, noise, etc.), in collaboration with the PMU.

- Assess compliance with the Project's environmental permit conditions and regulatory requirements.
- Submit findings and recommendations to the PMU and the EPA.

3.1.2.3.4. PMU Responsibilities

The PMU shall:

- Oversee implementation of the mitigation measures.
- Undertake monitoring activities within the Monitoring Program (Section 5.4) across all Project components to ensure Contractor's compliance with this ESMP.
- Ensure that compliance monitoring requirements are incorporated into all Contractor contracts.
- Review reports submitted by Contractors, the Supervising Engineer and the ITP.
- Require timely corrective actions where non-compliance is identified and monitor their effectiveness.
- Ensure environmental and social monitoring reports issued by the ITP are submitted to the EPA.
- Submit required environmental and social performance reports to the World Bank.

3.1.2.4. Responsibilities of Key Staff

This section outlines the roles and responsibilities of the PMU, Supervising Engineer, and Contractor's key staff in implementing this ESMP.

3.1.2.4.1. PMU Project Coordinator

The PMU's Project Coordinator is responsible for overall project implementation and compliance with national regulations and financing partner requirements.

Key responsibilities:

- Represent the PMU in all matters related to environmental and social performance.
- Allocate adequate resources for ESMP implementation.
- Ensure the Contractor's contract includes all ESMP and OHS obligations.
- Review and approve Contractor ESMPs, OHS Plans, and other required management plans.
- Ensure mitigation and corrective measures are implemented and enforced.

Review monitoring reports and ensure timely correction of non-compliance.

- Lead environmental and social compliance reviews.

- Liaise with regulators and financing partners.
- Verify that, upon completion of works, site conditions are consistent with ESMP requirements, approved design specifications, national regulatory standards, and applicable environmental and social commitments, including site reinstatement and closure obligations.

3.1.2.4.2. PMU Environmental Specialist

The PMU ES provides technical oversight of all environmental aspects of ESMP implementation.

Key responsibilities:

- Ensure ESMP environmental requirements are included in Contractor contracts.
- Review Contractor ESMPs, OHS Plans, Emergency Response Plans, and other relevant documents.
- Monitor environmental performance and report to the PMU's Project Coordinator.
- Review the Supervising Engineer's and ITP's reports.
- Direct the Contractor on environmental compliance requirements.
- Communicate environmental issues with regulators and stakeholders.
- Lead environmental compliance reviews.
- Enforce environmental mitigation and corrective actions.
- Review environmental conditions after completion of works.

3.1.2.4.3. PMU Social and Gender Specialist

The PMU Social and Gender Specialist (SGS), supported by the CLO, is responsible for overseeing the implementation of all social and gender-related commitments under the Project.

Key responsibilities:

- Implement the Project's Stakeholder Engagement Plan (SEP)
- Plan and lead community consultations and information campaigns.
- Coordinate with local authorities on land acquisition, compensation, and resettlement matters, including verification of affected assets and PAPs, validation of compensation eligibility and entitlements, and monitoring of RAP implementation and livelihood restoration measures.

Coordinate and monitor the Grievance Redress Mechanism (GRM), including handling of gender-related and sexual exploitation and abuse and sexual harassment (SEA/SH)-sensitive grievances.

- Document GBV/SEA/SH cases and provide guidance on referrals.
- Submit social implementation report.
- Reports incidents/accidents to World Bank.
- Report grievances in gender disaggregated format.
- Inform communities about employment opportunities and promote local hiring (with emphasis on women and vulnerable groups).
- Verify labour information and statistics.
- Conduct age verification to prevent child labor.
- Lead capacity building and training on gender and social issues.
- Ensure ESMP social and gender requirements are included in Contractor contracts.
- Oversee compensation activities and livelihood restoration.
- Review Contractor's social management plans.
- Monitor Contractor's compliance with social mitigation measures and training requirements and report to the PMU Project Coordinator.
- Review the Supervising Engineer's and ITP's reports.
- Direct the Contractor on social compliance requirements.
- Communicate social and gender issues with regulators and stakeholders.
- Lead social compliance reviews and monitor post-construction social conditions.
- Enforce social mitigation and corrective actions.
- Review social conditions after completion of works.

3.1.2.4.4. PMU Occupational Health and Safety Specialist

The PMU OHSS oversees occupational health and safety risks and ensures consistency with applicable standards. **Key responsibilities:**

- Ensure OHS requirements of this ESMP are integrated into Contractor contracts.
- Review the Contractor's OHS Plans and emergency preparedness procedures.
- Monitor OHS compliance and report to the PMU Project Coordinator.
- Review the Supervising Engineer's and ITP's reports.

Direct the Contractor on OHS compliance matters.

- Communicate OHS issues with regulators and stakeholders.
- Lead OHS compliance reviews.

- Enforce OHS mitigation and corrective measures.

3.1.2.4.5. Supervising Engineer

The Supervising Engineer represents the Proponent during design, construction, and operation.

Key responsibilities:

- Verify that Contractor activities meet ESMP requirements.
- Recruit and maintain Environmental, Social and OHS Specialists within their team.
- Review Contractor ESMPs and OHS Plans.
- Continuously monitor the Contractor's compliance with the ESMP and OHS Plan.
- Review contractor's compliance reports.
- Assess site conditions and verify implementation of mitigation measures.

3.1.2.4.6. Contractor Site Manager

The Contractor Site Manager is fully responsible for ESMP and OHS Plan implementation, including the actions of subcontractors.

Key responsibilities:

- Oversee compliance with environmental, social, health, and safety requirements on site.
- Ensure staff understand and implement ESMP mitigation measures and procedures.
- Provide Environmental, Social, and Health and Safety (ESHS) training to all site personnel.
- Prepare and implement emergency response plans.
- Implement local hiring commitments (including gender targets where applicable).
- Maintain a confidential worker grievance mechanism.
- Coordinate with qualified service providers on GBV/SEA-SH investigations.
- Maintain records of ESMP implementation and make them available to the PMU and financing partners.
- Participate in compliance reviews and community consultation sessions.

- Identify ESHS non-compliances and coordinate corrective actions with the PMU.
-
- 3.1.2.4.7. Contractor Environmental Officer

The Contractor EO provides technical support to the Site Manager on all environmental matters.

Key responsibilities:

- Implement environmental control measures from this ESMP and the C-ESMP.
- Communicate environmental requirements to all staff.
- Advise management on environmental compliance issues.
- Plan for spill response and other environmental emergencies.
- Deliver environmental awareness training.
- Conduct internal environmental compliance reviews.
- Verify environmental conditions after completion of works.
- Identify and implement additional environmental mitigation or corrective measures as needed.
- Prepare regular environmental compliance reports for the Contractor Site Manager.
- Support the Supervising Engineer and auditors with monitoring and reporting.

3.1.2.4.8. Contractor Social Officer

The Contractor shall appoint a Social Officer (supported by Community Liaison Officers where appropriate).

Key responsibilities:

- Implement social mitigation measures from this ESMP and the C-ESMP.
- Communicate social requirements and standards to staff.
- Advise management on social compliance issues.
- Support emergency response planning related to community welfare.
- Deliver social awareness and community interaction training.
- Reports incidents/accidents.
- Document GBV/SEA/SH cases and lead in referrals.
- Provide labour information and statistics.
- Keep records and report grievances in gender disaggregated format.
- Submit implementation report (weekly, monthly, quarterly, etc).
- Conduct age verification to prevent child labor.
- Support site-level implementation of the GRM, including receiving, recording, and referring grievances.

- Ensure GBV/SEA/SH grievances are handled confidentially and referred through appropriate channels.
- Raise awareness among workers on GRM procedures and codes of conduct (including SEA/SH prevention).
- Lead social compliance reviews.
- Identify and implement additional social mitigation or corrective measures as needed.
- Prepare regular social compliance reports for the Contractor Site Manager.
- Support the Supervising Engineer and auditors with monitoring and reporting.

3.1.2.4.9. Contractor Community Liaison Officer

The CLO acts as the primary interface between the Contractor and local communities.

Key responsibilities:

- Engage continuously with local communities and facilitate participation.
- Support implementation of the grievance mechanism and employment procedures.
- Keep management informed of community concerns, incidents, and disputes.
- Support compensation and resettlement activities.
- Assist with community-related emergency response and training.
- Participate in social compliance reviews and community meetings.
- Identify additional community support or mitigation measures.
- Prepare reports on community relations for the Site Manager.

3.1.2.4.10. Contractor OHS Officer

The Contractor OHSO supports the Site Manager in ensuring safe working conditions and compliance with OHS standards.

Key responsibilities:

- Implement OHS control measures from this ESMP, the C-ESMP, and the Contractor's OHS Plans. • Communicate OHS requirements to all staff.
- Advise management on OHS compliance and risks.
- Plan for emergency response, accident prevention and other OHS risks.
- Deliver OHS awareness and emergency response training.
- Lead OHS compliance reviews.
- Identify and implement OHS mitigation or corrective actions.

- Prepare regular OHS compliance reports for the Contractor Site Manager.
- Support the Supervising Engineer and auditors with monitoring and reporting.

3.1.3. Capacity Building and Training

The proper implementation of the ESMP is highly dependent on the existing available capacity and awareness of PMU's and the Contractor's staff, the surrounding community, and other concerned stakeholders.

Training workshops are required to increase environmental, biodiversity, social, and OHS awareness of all individuals concerned with the Project and to train and follow-up with the workers who are specifically involved in site operation. The capacity building and training program is presented in Table 3-1.

Table 3-1 Capacity building and training program

Workshop topic	Participants	Frequency	Objectives	Key topics	Training provider	Estimated budget (USD)
Environment	• PMU personnel • Contractor staff • May include local community members	• Before project initiation • Twice yearly during construction and operation • Reinforced during toolbox talks	Ensure appropriate environmental awareness and capacity to implement environmental mitigation measures	• Environmental laws, regulations, and standards • Potential environmental impacts • Sources of environmental impact • Mitigation and management measures and guidelines • Incident reporting • Managing contractor's E&S performance • Sampling techniques and environmental monitoring guidelines • Emergency preparedness and response procedures	• External third party for initial training • Subsequent sessions delivered by PMU ES and Contractor EO	10,000-15,000
Biodiversity	• PMU personnel • Contractor staff • May include local community members	• Before project initiation • Twice yearly during construction and operation • Reinforced during toolbox talks	Ensure appropriate biodiversity awareness and capacity to implement biodiversity mitigation measures	• Biodiversity law in Liberia • Legally protected and threatened species • Sensitive habitats and species, as applicable • Sources of biodiversity impact and mitigation measures • Required on-site and off-site behavior to protect biodiversity • Wildlife management • Invasive species management	• External third party for initial training and biannual workshop • Contractor EO for toolbox talks	10,000-15,000

Workshop topic	Participants	Frequency	Objectives	Key topics	Training provider	Estimated budget (USD)
Social	• PMU personnel • Contractor staff • Local community members	• Before project initiation • Twice yearly during construction and operation • Reinforced during toolbox talks	Ensure appropriate social awareness and capacity to implement social mitigation measures	• Community awareness and engagement • Respect, non-discrimination, cultural sensitivity • GBV and SEA/SH prevention and response • Code of conduct • Grievance redress • Stakeholder Engagement and Information Disclosure • Land Acquisition, Restriction on Land Use and Involuntary Resettlement • Assessment and Management Labour Risks and Working Conditions • Managing Cultural Heritage • Concept and Principles of Grievance Mechanism under ESF • Addressing Complaints on Sexual Exploitation, Abuse and Sexual Harassment in World Bank Financed projects SEA/SH sensitive GM process • Responding to an allegation of SEA/SH • Child labor mitigation and prevention • Community health and safety.	• External third party(ies) for initial training • Subsequent sessions delivered by PMU SGS and Contractor SO	15,000-12,000

OHS and site operation	• PMU on-site personnel • Contractor onsite staff	• Before project initiation • Quarterly during construction and operation • Reinforced during toolbox talks	Equip with knowledge and skills to safely perform site activities and implement OHS mitigation measures	• Workplace hazards and controls • Personal protective equipment requirements • Incident and accident prevention • Emergency preparedness and response • Sources of OHS impacts and mitigation measures • Handling and storage of hazardous materials and waste • Spill contingency procedures	• PMU OHS Specialist • Contractor OHS Officer • External third party as required	10,000-15,000

4. Environmental and Social Mitigation Measures

The environmental and social mitigation and monitoring matrix (Table 4-1) forms the core of the ESMP, as it defines what must be done, by whom, and when. It also specifies who is responsible for monitoring the implementation of mitigation measures, how, and when.

The environmental and social mitigation and monitoring matrix lays out the arrangements for safeguarding the environment and society (including project workers) through the practical mitigation of identified impacts. It is organized under thematic headings, each grouping related impacts identified in the ESIA. This structure ensures that each aspect of environmental and social protection is clearly addressed.

To avoid duplication, each impact is assigned to a single heading—even where impacts overlap. For example, while air emissions primarily affect community receptors, their management is addressed under Heading 4: Air Emissions Management. The full list of thematic mitigation headings is provided in Box 4-1.

The mitigation measures have been developed to meet applicable Liberian standards and regulations, World Bank Environmental and Social Standards (ESSs) and guidelines, as well as relevant GIIP.

The applicable regulatory standards, as well as the detailed procedures supporting GIIP implementation, are presented in Appendix A. The latter includes:

- Formally issued national environmental standards with which the Project must strictly comply. These establish mandatory regulatory limits and compliance requirements for parameters such as air quality, water quality, effluent discharge, noise, vibration, and wildlife protection. Compliance with these standards is a legal obligation.
- Project-specific environmental and social procedures and guidelines developed as part of this ESMP to operationalize mitigation and management measures. These procedures provide practical implementation guidance to the PMU, its Contractors, and supervising entities during construction and operation.

The environmental and social mitigation and monitoring matrix (Table 4-1) references Appendix A where compliance with specific national standards (e.g. national water quality or air quality standards), or project-specific procedures or guidelines (e.g. vegetation clearance guideline, procedure for unexpected cultural sites) is required.

In addition, the matrix references Appendix B where the preparation of specific management plans or arrangements (e.g. Waste Management Plan, Emergency Preparedness and Response Plan) is required. Appendix B defines the minimum scope, content requirements, and compliance criteria for such plans and arrangements. All required plans shall be prepared in accordance with these requirements prior to commencement of the relevant works.

Box 4-1 Thematic categories for mitigation measures

Impact assessment matrix categories
1. General environment management 2. Soil and land resources management 3. Water resources management 4. Air emissions management 5. Noise and vibration management 6. Visual intrusion management 7. Climate change adaptation and resilience 8. Waste management 9. Drainage and stormwater runoff management 10. Traffic and transport management 11. Hazardous materials management 12. Construction materials management 13. Biodiversity management 14. Ecosystem services management 15. Community relations management 16. Livelihood protection and restoration 17. Influx management 18. Cultural heritage management 19. Public health and safety management 20. Labor and working conditions management 21. Occupational health and safety management

Table 4-1 Environmental and social mitigation and monitoring matrix

	Potential impact and cause	Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
1.	**General environment management**							
1.1.	**Temporary environmental disturbance due to site preparation, clearing, and earthworks.**	• Limit site clearance strictly to approved work areas. • Clearly mark approved work boundaries before clearing. • Phase earthworks to minimize the extent of exposed areas at any given time. • Set erosion control measures (silt fences, berms, sediment traps, etc.) where and as necessary prior to the start of activities. • Restore disturbed areas as soon as practicable.	• Contractor Site Manager • Contactor EO	C	ATL-SPW	• Weekly during earthworks	• PMU ES • Supervising Engineer	• Visual inspection
1.2.	**Degradation of local environmental conditions (dust, noise, air quality, vegetation waste) from construction activities.**	• Apply dust suppression measures (e.g. watering). • Maintain machinery and vehicles in good condition. • Restrict noisy activities to daytime hours. • Implement traffic and access management measures including a Traffic and Transport Management Plan. • Properly collect, segregate and dispose of all vegetation waste, generated from site clearing and maintenance activities, in accordance with environmental best practice and invasive species management requirements (Appendix A). • Strictly implement the mitigation measures provided in this matrix in relation to water and soil management, noise and air emission management, and waste and effluent management.	• Contractor Site Manager • Contractor EO	C	ATL-SPW	• Weekly	• PMU ES • Supervising Engineer	• Visual inspection
1.3.	**Accidental environmental damage from fuel spills and improper waste handling.**	• Store fuel and hazardous materials in designated secure, covered and bunded areas. • Implement spill prevention and response procedures. • Segregate and dispose of waste appropriately. • Train workers on spill response and waste handling. • Strictly implement the mitigation measures provided in this matrix in relation to hazardous materials management and waste and effluent management.	• Contractor Site Manager • Contactor EO • Contractor OHSO	C-O	ATL-SPW	• Weekly and after spill incident	• PMU ES • PMU OHSS • Supervising engineer	• Visual inspection • Documentation
1.4.	**Risk of general environmental and social damage due to inadequate implementation of the ESMP, including insufficient supervision and lack of an effective management system.**	• Develop, implement, and maintain an ESMS as per Appendix B. • Ensure all Contractors and personnel are informed of and trained on ESMP requirements prior to and during works. • Deploy qualified environmental, social and health and safety officers on site. • Implement routine inspections, supervision, and compliance monitoring systems • Maintain daily/weekly environmental checklists and supervision logs. • Identify, record, and investigate non-compliance and incidents • Implement corrective and preventive actions in a timely manner • Conduct toolbox talks and refresher trainings on environmental compliance. • Do not allow staff and workers to neglect environmental issues. This may lead to offences under the Environment Protection and Management Law.	• Contractor Site Manager • Contactor EO • Contractor SGO • Contractor CLO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU Project Coordinator • PMU ES • PMU SGS • PMU CLO • Supervising engineer	• Visual inspection • Documentation
1.5.	**Potential non-compliance with national regulations, permit conditions, and World Bank ESF/ESS requirements.**	• Obtain an environmental permit for the project from the EPA as well as all other necessary permits from relevant authorities. • Ensure compliance with permit conditions. • Do not hide any damage or pollution. In the event of an accident, it is better to consult the EPA and agree on a mitigation plan than to risk prosecution under the law. • Align contractor procedures with national environmental regulations and World Bank ESF/ESS standards. • Maintain documentation for audits and regulatory inspections. • Implement the proposed environmental and social monitoring plan, assess the efficiency of the mitigation measures based on results and adapt / add measures as needed to ensure proper environmental management.	• Contractor Site Manager • Contactor EO	C-O	ATL-SPW	• Before the start of works • Quarterly	• PMU Project Coordinator • PMU ES • Supervising Engineer	• Documentation • Review of monitoring plan results

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
1.6.	**Long-term environmental degradation in absence of proper operation and maintenance.**	• Establish and implement an operation and maintenance plan covering at least routine channel desilting, vegetation trimming, and culvert inspection. • Ensure that site supervisors brief all workers at the start of every job, and at the beginning of each week, on the main environmental messages. • Conduct regular toolbox talks on environmental good practices and site-specific risks • Implement a Code of Conduct with environmental obligations for all workers • Carry out routine supervision and inspections to verify compliance with O&M and environmental requirements • Record and address non-compliance incidents, including issuing corrective actions where needed • Maintain training attendance records and supervision logs.	• Contractor Site Manager • Contractor EO • Contractor SGO	O	ATL-SPW	• Monthly	• PMU ES • PMU SGS • Supervising Engineer	• Visual inspection • Documentation • Interview with site workers
2.	**Soil and land resources management**							
2.1.	**Soil erosion and degradation from earthworks, construction, and operation activities.**	• Compliance with erosion control and land rehabilitation good practice (Appendix A). • Minimize vegetation clearance and avoid steep slopes where feasible. • Restrict soil disturbance strictly to areas required for the agreed works. • Clearly demarcate all excavation and disturbance zones to prevent machinery from operating outside designated areas. • Prioritize the use of existing tracks and previously disturbed areas. • Limit the width of access tracks and the size of cleared areas to the minimum necessary. • Do not allow erosion to occur without immediate corrective action. Install erosion and sediment control measures as the first physical activity on site. • Grade new slopes to the lowest practical angle and cut slopes according to material stability. • Regrade and level exposed surfaces promptly after completing works to prevent erosion. • Keep earth piles away from steep slope edges and water courses. • Revegetate all slopes steeper than 10°. • Assess soil and slope stability before undertaking any major excavation. • Inspect surrounding areas to identify unstable sections or potential landslide zones before commencing excavation. • Plan all land-disturbing activities in line with best engineering practices for slope stability and soil protection. • Maintain buffer zones between wetland zones and construction activities to minimize accidental damage. • Apply site-appropriate erosion and landslide prevention techniques, such as slope stabilization, revegetation, drainage control, clearing and improvements, retaining walls, etc. • Stabilize exposed soils using mulching, hydroseeding, or planting of fast-growing nonintrusive vegetation where required. • Avoid vegetation clearing during the rainy season wherever possible. If clearing during the rainy season is unavoidable, rigorously apply drainage management, erosion and sedimentation control measures prior to any clearing operation.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• C: Weekly • O: Quarterly	• PMU ES • Supervising Engineer	• Visual inspection • Documentation

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
2.2.	**Soil contamination from spills and leaks.**	• Design and install appropriate secondary containment systems for all fuel tanks, chemical storage areas, and hazardous material handling zones. • Use drip trays beneath machinery, generators, and fuel transfer points. • Store raw materials on impermeable surfaces equipped with runoff collection or containment systems. • Develop and implement an Emergency Preparedness and Response Plan (EPRP) that includes spill prevention and response measures as per Appendix B. • Provide regular training for workers on spill management, environmental awareness, and proper handling of hazardous materials. • Regularly monitor soil quality to detect deviations from baseline and implement corrective actions promptly.	• Contractor Site Manager • Contractor EO • Contractor OHSO	C-O	ATL-SPW	• Weekly • After spill event	• PMU ES • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Incident reports and monitoring results • Audit
2.3.	**Soil compaction from repeated movement of heavy machinery.**	• Minimize vegetation clearance and restrict soil disturbance to areas required for the agreed works. • Clearly demarcate all permitted machinery movement zones to prevent equipment from crossing beyond designated limits. • Prioritize the use of existing tracks and previously disturbed areas for access and operations. • Limit vehicle and machinery access to sensitive and wet area especially in St. Paul wetland sublocation. • Confine machinery movement to designated roads and access routes. • Avoid unnecessary vehicle traffic on unpaved or vegetated land. • Rip or scarify compacted soil post-construction to restore permeability. • Schedule heavy-vehicle movement during dry periods as far as practicable.	• Contractor Site Manager • Contractor EO	C	ATL-SPW	• Weekly	• PMU ES • Supervising Engineer	• Visual inspection • Documentation
2.4.	**Degradation of soil structure and permeability in wetlands and low-lying areas due to drainage construction.**	• Design the structures and drainages to allow for the retention of the minimum amount of water needed to keep the wetlands active and avoid them drying out. • Minimize excavation footprint in wetlands. • Avoid unnecessary dewatering. • Stabilize soils and restore vegetation after works without using invasive plant species. • Prevent sediment discharge into wetlands. • Contractors shall implement invasive species management measures through the C-ESMP, as applicable (See Appendix A). • Monitor the water levels in the wetland and the performance of the drains to ensure that the wetlands are not drying out.	• Supervising Engineer for design measures • Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Monthly	• PMU ES • Supervising Engineer	• Visual inspection • Water level data.
3.	**Water resources management**							

3.1.	**Water pollution from poor drainage systems, contaminated sediments, and sediment-laden runoff entering watercourses and wetlands during channel excavation and rehabilitation and maintenance works.**	• Install adequately sized culverts and cross-drainage structures wherever natural flows intersect roads or tracks. • Install sediment and erosion control measures (e.g. silt traps, sediment basins, geotextile barriers, check dams, etc.) at all watercourse crossings and along drainage paths. • Design drainage outlets with energy dissipation measures (e.g. drop structures, riprap aprons) to minimize scouring. • Make temporary drains, as necessary, to avoid waterlogging and erosion. These must be adequate for accumulated runoff as well as rainfall. • Discharge drains into well vegetated areas. Provide mini silt collection ponds if drains must discharge straight into water courses. Never allow sediment from bare eroding surfaces to be washed into water courses. • Prevent discharge of untreated runoff, wastewater, or sediment-laden water into wetlands and water bodies. • Rehabilitate disturbed wetland margins and drainage channels. • Maintain vegetation buffers around wetlands to enhance natural filtration and oxygenation. • Implement diversion channels upstream of work areas and where needed prior to the start of works to reduce water inflow. • Minimize in-channel works and avoid unnecessary disturbance of wetland sediment • Schedule high-disturbance activities during the dry season as far as practicable. • Schedule works in stages. Progressively stabilize and rehabilitate disturbed areas immediately after completing work sections (e.g. grading, mulching, grassing). Implement a comprehensive Operation and Maintenance Plan with scheduled inspections, drainage clearing, culvert desilting, and structural integrity assessments. • Conduct regular water quality monitoring, compare against baseline, and implement corrective actions where needed.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Weekly during earthworks • After heavy rainfall events • After completion of site operations	• PMU ES • Supervising Engineer	• Visual inspection • Water quality monitoring and sampling • Documentation

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method

3.2.	**Contamination of surface and groundwater from spills, leaks, and contaminated runoff.**	• Implement all mitigation measures under Waste management, Hazardous materials management, and Construction materials management categories. • Design and install secondary containment for all fuel tanks, chemical storage areas, and hazardous material storage. • Use drip trays during fuel transfers, equipment maintenance, or temporary storage of machinery. • Prohibit storage of fuels, chemicals, or hazardous materials within 100 m of water sources, wetlands and drainage channels. • Store construction materials and any contaminated materials on impermeable surfaces with controlled drainage and spill containment. • Install oil-water separators and ensure routine maintenance to avoid contaminated discharges. • Develop and implement an EPRP that includes spill prevention and response measures as per Appendix B. • Conduct training on environmental awareness, handling of hazardous materials, and spill prevention and management. • Prohibit the disposal of any material into any water body, drains and wetlands. • Establish and enforce borehole protection zones. Ensure that all community water supplies are safeguarded. Confirm the location of local water supplies with the contractor CLO. • Provide alternative clean water supply for communities if project activities impact their water sources. • Relocate equipment away from watercourses at the end of each day and before forecasted heavy rainfall. • Inspect all vehicles, equipment, and storage areas daily for fuel, oil, or chemical leaks. • Implement a comprehensive operation and maintenance Plan with scheduled inspections, drainage clearing, culvert desilting, and structural integrity assessments. • Routinely monitor surface water and groundwater quality upstream and downstream of work areas. • Take immediate corrective action where monitoring indicates non-compliance or potential contamination.	• Contractor Site Manager • Contractor EO • Contractor OHSO • Contactor CLO	C-O	ATL-SPW	• Before the start of works • Monthly inspections • After any incident	• PMU ES • PMU OHSS • PMU CLO • Supervising Engineer	• Visual ality inspection and • Water monitoring sampling • Documentation • Audits
3.3.	**Alteration of natural drainage patterns, hydrological connectivity and wetland water retention characteristics resulting from construction of new channels, drain rehabilitation and Long-term improvement of drainage efficiency**	• Design the structures and drainages to allow for the retention of the minimum amount of water needed to keep the wetlands active and avoid them drying out. • Design drainage and culverts to maintain natural hydrological flows, including wetland connectivity. • Design and install flow and water-level control structures in the drainages (like adjustable weirs, sluice gates etc.) • Avoid over-deepening channels to prevent wetland drying; align with design notes on maintaining levels above minimum wetland water levels. • Design infrastructure to align with natural drainage patterns wherever feasible. • Install appropriately sized culverts and bridges to maintain natural flow volumes and velocities. • Avoid blocking, filling, or diverting streams unless engineered and approved alternatives are in place. • Restore natural drainage lines post-construction. • Prohibit dumping of spoil or fill into natural watercourses. • Conduct periodic inspections during construction and operations to confirm drainage structures are functioning and not obstructed by regularly removing sediment and debris from drains and culverts to prevent blockage. • Monitor the water levels in the wetland and the performance of the drains to ensure that the wetlands are not drying out.	• Supervising Engineer for design aspects • Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly inspections during construction and operations. • After completion of construction	• PMU ES • Supervising Engineer	• Visual inspection • Design verification • Water level data

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
		• Use adaptive management techniques, if evidence of water – level drop is found, including immediate adjustment of the flow control structure, temporal suspension of drainage operation, and revisions and adjustments to the drainage design as needed.						
3.4.	**Depletion of local water resources due to increased abstraction for project (e.g. concrete production, dust suppression, cleaning, domestic use).**	• Confirm the location of all community water sources before abstraction and safeguard their access and quality. • Provide alternative clean water supply for communities if project activities impact their water sources. • Ensure that community water users retain priority access. Abstraction must not reduce supply to locals. • Use non-potable, recycled, harvested rainwater, or treated wastewater for dust suppression where feasible. • Limit abstraction to sustainable rates based on baseline seasonal flow data. • Avoid abstraction from ecologically sensitive and low-flow streams or during dry season. • Implement water-efficient construction practices (recycling wash water, batching optimization). • Monitor water levels and flow rates before, during, and after abstraction periods. • Maintain abstraction records and adjust rates if monitoring indicates stress on water resources.	• Contractor Site Manager • Contractor EO • Contactor CLO	C	ATL-SPW	• Before the start of works • Quarterly review of monitoring results and abstraction rates	• PMU ES • PMU SGS • PMU CLO • Supervising Engineer	• Flow and level monitoring at abstraction points • Water abstraction records • Visual inspection
4.	**Air emissions management**							
4.1.	**Dust emissions from land clearing, excavation, construction activities and vehicle movement.**	• Implement dust suppression measures, especially during the dry season and peak activity periods. • Regularly water exposed surfaces, unpaved roads and work areas, especially during dry and windy conditions. • Wet down stockpiles and cover them when not in active use. • Install windbreaks around stockpiles and loading areas. • Cover trucks transporting friable or dust-emitting materials. • Minimize the area and duration of exposed earthworks; use a phased construction approach. • Limit or suspend activities work in very windy, dry weather. • Retain existing vegetation where possible and promptly re-vegetate disturbed areas. • Enforce strict speed limits on earth tracks and particularly near community boundaries and sensitive receptors. • Establish buffer zones around sensitive receptors. • Schedule high-emission activities outside peak hours near receptors (e.g. when students leave schools). • Coordinate construction schedules to avoid peak traffic hours and school timings. • Optimize logistics to reduce vehicle trips. • Conduct routine dust monitoring and apply corrective measures when thresholds are exceeded.	• Contractor Site Manager • Contactor EO	C-O	ATL-SPW	• Weekly during construction • As needed during windy conditions and after complaints	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Dust monitoring • Interviews with nearby communities • Review of complaints log

4.2.	**Exhaust emissions from machinery, generators, and transport vehicles.**	• Ensure all machinery and vehicles are regularly serviced, maintained according to manufacturer's instructions, and where relevant, comply with air quality emission standards. • Maintain engines in proper working conditions and ensure emission control systems are functional. • Keep engines in proper working condition and fit generators/ancillary equipment with exhaust filters where needed. • Use low-sulfur diesel or cleaner fuel alternatives where feasible. • Limit or suspend activities work in very windy, dry weather. • Prohibit unnecessary idling of vehicles and equipment. • Minimize on-site generator use where grid power is available.	• Contractor Site Manager • Contactor EO	C-O	ATL-SPW	• Monthly checks • As needed during windy conditions and after complaints	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Air quality monitoring • Review of maintenance records and complaints log

Potential impact and cause		**Mitigation measure**	**Responsibility for implementation**	**Phase***	**Sub-location°**	**Monitoring of mitigation measure implementation**		
						Check timing	**Responsibility for checking**	**Assessment method**
		• Optimize logistics to reduce vehicle trips. • Explore and prioritize alternative or renewable energy sources where viable. • Conduct regular air quality monitoring and address exceedances immediately.						
4.3.	**Odor impact from disturbed drains and organic waste during works**	• Avoid prolonged stagnation of excavated drains. • Transport excavated organic material to approved disposal sites immediately. • Schedule drain cleaning works in stages to limit exposure. • Ensure proper housekeeping and daily waste removal to avoid accumulation of decomposing organic waste. • Avoid leaving wet organic material exposed during high-heat hours to reduce odor volatilization. • Provide adequate personal protective equipment (PPE) for site workers. • Response immediately to odor complaints.	• Contractor Site Manager • Contractor EO • Contractor OHSO	C	ATL-SPW	• During drain works • After complaints	• PMU ES • PMU OHSO • Supervising Engineer	• Visual inspection • Interviews with workers and communities • Complaints log
5.	**Noise and vibration management**							
5.1.	**Noise and vibration from construction activities, operation of heavy equipment, and transport.**	• Use low-noise equipment and install silencers or mufflers where feasible. • Minimize site-generated noise to the greatest possible extent. • Maintain all equipment according to the manufacturer's recommendations to prevent excessive noise. • Install permanent or temporary acoustic barriers around generators and other high-noise sources especially near sensitive receptors • Schedule noisy activities to avoid nighttime hours (22:00–06:00) as much as possible. • Establish buffer zones or install noise barriers near sensitive receptors. • Ensure excavators, dumpers, dozers, and other operator-based machinery are fitted with soundproof cabs. • Prohibit anyone from approaching operating machinery without appropriate hearing protection. • Provide ear protection to all workers exposed to noise levels above 70 dB(A). • Enforce speed limits, no-idling rules, and proper vehicle maintenance. • Equip vehicles with noise-dampening systems where applicable. • Use rubber-lined chutes and dampers to reduce impact noise during unloading. • Coordinate construction schedules to avoid peak traffic hours. • Maintain road surfaces to reduce vibration-related noise. • Implement a noise monitoring program with routine measurements. • Operate a community grievance mechanism with rapid response to noise-related complaints.	• Contractor Site Manager • Contractor EO • Contactor CLO • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Weekly during peak construction time	• PMU ES • PMU OHSS • PMU CLO • Supervising Engineer	• Visual inspection • Documentation • Equipment inspection logs • Interviews with workers • Interviews with communities • Noise monitoring results
6.	**Visual intrusion management**							

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
6.1.	**Visual intrusion from vegetation clearance and new linear drainage contrasting with natural landscape.**	• Use earth berms, vegetative buffers, or planted screens (native trees and shrubs and noninvasive species) to soften visual contrasts in sensitive viewpoints. • Select non-reflective, low-glare, and earth-tone materials for structures, poles, fencing, and equipment. • Confine equipment storage, laydown areas, and construction materials to designated locations. • Remove temporary structures, debris, and unused equipment promptly. • Align drainage channels along natural land contours where feasible to reduce visual exposure. • Minimize vegetation clearing and retain natural vegetative buffers where possible.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Quarterly during construction • Bi-annually during operation	• PMU ES • Supervising Engineer	• Visual inspection • Interview with communities
6.2.	**Light pollution, defined as excessive, misdirected, or obtrusive artificial lighting, from nighttime operations and security lighting.**	• Position lighting to avoid direct illumination of water bodies, wildlife corridors, residential areas, and migratory routes. • Install motion sensors and timers to limit lighting to essential periods. • Choose warm-spectrum, low-intensity lighting. • Reduce or avoid nighttime activities whenever possible. • Minimize artificial lighting; use shielded, downward-facing fixtures to reduce glare and light spill. • Use safety lighting that limits visual disturbance, such as red or blinking lights, and consider timers or motion sensors. • Operate a community grievance mechanism with rapid response.	• Contractor Site Manager • Contractor EO • Contractor OHSO • Contractor CLO	C	ATL-SPW	• Quarterly	• PMU ES • PMU OHSS • PMU CLO • Supervising Engineer	• Visual inspection • Grievance logs
6.3.	**Visual degradation from temporary stockpiles, machinery, construction materials, improper waste handling and poor housekeeping practices.**	• Store equipment, materials, and waste in designated, screened areas to avoid clutter. • Screen stockpiles using fencing, tarpaulins, or vegetative barriers where visible to communities. • Remove temporary structures and waste promptly after use. • Coordinate construction activities to avoid worsening visual congestion in markets and dense settlements especially in New Kru town and Duala market area. • Maintain clean, orderly sites with effective waste management practices. • Operate a community grievance mechanism with rapid response.	• Contactor Site Manager • Contractor EO • Contractor CLO	C	ATL-SPW	• Monthly	• PMU ES • PMU CLO • Supervising Engineer	• Visual inspection • Site audits • Community consultation
7.	**Climate change adaptation and resilience**							
7.1.	**Greenhouse gas (GHG) emissions from vehicles, heavy machinery, generators and from routine operation and maintenance activities.**	• Use fuel-efficient and low-emission vehicles, equipment, and generators. • Prioritize low-sulfur diesel and cleaner fuels where feasible. • Prohibit vehicle and equipment idling except for safety-critical operations. • Optimize logistics, routing, and load management to reduce unnecessary trips. • Maintain all machinery, vehicles, and generators according to manufacturer specifications to optimize fuel efficiency and minimize emissions. • Fit generators and ancillary plants with appropriate exhaust filters or emission-reduction devices. • Evaluate and, where feasible, install renewable or hybrid energy. • Establish a GHG inventory and track fuel consumption and emissions annually; set reduction targets aligned with national regulations and GIIP. • Promote awareness among contractors and workers on energy efficiency and emission reduction. • Conduct regular air quality monitoring.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Quarterly review of high emission activities • Annual GHG inventory	• PMU ES • Supervising Engineer	• GHG emissions calculator tools • Fuel logs and equipment specs • Air Quality monitoring

	Potential impact and cause	Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Check timing	Responsibility for checking	Assessment method
7.2.	**Failure of Project infrastructure due to improper operation and maintenance or to extreme climate-related events (e.g., flooding, storms, sea-level rise) leading to increased vulnerability.**	• Design and construct infrastructure (roads, culverts, drainage, stockpiles) using climateresilient standards that account for more intense rainfall, flooding, and storm surges. • Use durable, climate-resilient materials and proven construction methods. • Conduct slope stability assessments and implement reinforced embankments, improved stormwater systems, and erosion control measures. • Integrate climate projections into engineering design and periodically update design criteria as climate information improves. • Protect natural drainage patterns and use natural features (vegetation buffers, wetlands) to slow runoff and absorb excess water. • Implement continuous preventive maintenance for roads, culverts, and drainage structures. • Re-vegetate cleared or disturbed areas promptly to prevent erosion and enhance soil stability. • Implement a comprehensive operation and maintenance Plan with scheduled inspections, drainage clearing, culvert desilting, and structural integrity assessments. • Monitor meteorological parameters (rainfall intensity, storm frequency, tides) and incorporate early warning systems into site operations.	• Supervising Engineer for design aspects • Contractor Site Manager	O	ATL-SPW	• Annually • After major storm events	• PMU Project Coordinator • PMU ES • Supervising Engineer	• Structural condition assessments • Post-storm damage reports • Meteorological parameters
8.	**Waste management**							
8.1.	**Increased waste volume due to failure to recycle or reuse materials.**	• Implement a waste hierarchy: reduce → reuse → recycle → recover → dispose. • Segregate waste at source. • Provide separate, clearly labeled bins for recyclables and non-recyclables. • Train workers on waste minimization and recycling practices. • Require contractors to enforce a strict policy for plastic, packaging, and single-use materials. • Monitor and record waste volumes to track reduction and recycling performance.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
8.2.	**Pollution of soil and water from improper waste handling and disposal.**	• Develop and implement a Project Site-specific Waste Management Plan covering collection, storage, transport, and disposal (see Appendix B). • Prohibit littering, open dumping and burning. • Enforce a clean worksite policy. • Prohibit disposal of any solid or liquid waste into drains, wetlands, rivers, or coastal waters. • Store waste in covered, durable containers placed on impervious surfaces. • Schedule regular waste collection to avoid overflow or scattering. • Dispose of waste only through EPA-authorized collectors and approved facilities. • Maintain waste records (type, quantity, disposal method). • Train workers on waste handling, pollution prevention, and environmental awareness. • Conduct regular inspections of waste storage areas. • Take immediate corrective action in case of improper waste handling or pollution incidents.	• PMU ES (for the SWMP) • Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Soil and water monitoring reports

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
8.3.	**Contamination of water and soil, health and safety risks, and legal penalties due to mismanagement of hazardous waste.**	• Treat hazardous waste as hazardous materials (refer to Hazardous materials management category). • Segregate hazardous waste from general waste at all times. • Store hazardous waste in sealed, labeled, chemical-resistant containers within bunded, weather-protected areas. • Keep incompatible waste types separated. • Ensure only trained personnel handle hazardous waste. • Maintain up-to-date spill response plans and kits at storage and handling points. • Use only EPA-licensed contractors for hazardous waste transport and disposal. • Keep detailed logs of hazardous waste generation, storage, and disposal.	• Contractor Site Manager • Contractor EO • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• PMU ES • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Soil and water monitoring reports
8.4.	**Soil and water contamination from mismanaged domestic wastewater and sludge.**	• Install sealed, watertight septic tanks sized for maximum occupancy. • Locate septic systems ≥30 m away from water sources and outside flood-prone areas. • Pump septic tanks regularly to prevent overflow; maintain a pumping schedule. • Use only EPA-certified contractors for sludge collection and disposal. • Keep records of desludging frequency and contractor permits. • Monitor nearby soil and groundwater to detect early signs of contamination.	• Contractor Site Manager • Contractor EO	C	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Groundwater and soil monitoring reports
8.5.	**Soil and water contamination from mismanaged effluent at vehicle washing stations.**	• Construct engineered wash bays with impermeable flooring, bunding, and drainage systems. • Install sediment traps and oil-water separators before discharge to treatment ponds or approved systems. • Prohibit discharge of untreated wash water into soil or storm drains. • Maintain sediment traps monthly and service oil-water separators at least every 6 months. • Dispose of trapped solids and oily residues through EPA-licensed contractors. • Establish monitoring points downstream to check for contamination.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • Soil and water monitoring reports
8.6.	**Soil and water contamination from improper disposal of chemicals or fuel into site drains.**	• Treat all used chemicals and fuels as hazardous waste. • Prohibit discharge of chemicals or fuel into drains, soil, or water bodies. • Store chemicals and used oils in bunded, impermeable, clearly marked areas. • Install oil-water separators in drainage systems where hydrocarbons may be present. • Maintain spill kits and ensure prompt clean-up and reporting of all spills. • Conduct regular soil and groundwater sampling near storage areas. • Maintain inventory and tracking logs for chemicals and fuels.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• Supervising Engineer • PMU ES	• Visual inspection • Documentation • Groundwater and soil monitoring reports
8.7.	**Soil and water pollution due to discharge of untreated or inadequately treated effluents into the environment.**	• Route all effluents (wash water, wastewater,) through appropriate treatment systems (e.g., septic tanks, oil-water separators, settlement systems). • Maintain treatment systems to ensure proper functioning and adequate capacity. • Conduct regular effluent sampling and laboratory testing to meet EPA discharge limits. • Prohibit any discharge that does not comply with national standards; hold or retreat noncompliant effluent. • Keep detailed records of effluent quality, maintenance, and corrective actions. • Report any exceedances or accidental discharges to the EPA. • Establish dedicated monitoring points at all effluent discharge locations.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • C: Weekly • O: Monthly • After any pollution or spill event	• PMU ES Supervising Engineer	• Visual inspection • Documentation • Interviews with workers • Soil and water monitoring reports • Effluent monitoring reports
9.	**Traffic and transport management**							

9.1.	**Traffic congestion, dust, and accidents from project vehicle movement on public roads.**	• Develop and implement a Traffic and Transport Management Plan (see Appendix B). • Schedule and coordinate vehicle movement to minimize peak-hour traffic and reduce congestion. • Enforce strict speed limits, defensive-driving rules, and safe-driving protocols for all project drivers. • Conduct regular driver training on road safety, fatigue management, and community protection. • Maintain vehicles in good mechanical condition to reduce emissions, and noise. • Install wheel-wash systems and apply dust suppression (e.g., controlled water spraying) where needed, ensuring runoff does not create erosion. • Implement random alcohol and substance testing. • Prohibit dangerous driving and apply disciplinary action for violations. • Maintain ongoing coordination with local police and road authorities on traffic management.	• Contractor Site Manager • Contractor EO • Contractor CLO • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU CLO • PMU OHSS Supervising Engineer	• Visual inspection • Documentation • Breath testing • Air quality monitoring • Interviews with workers
9.2.	**Temporary safety hazards, dust, noise, land access conflicts, local traffic and community mobility disruption due to road diversions.**	• Avoid road diversions unless absolutely necessary; prioritize using existing routes. • When diversions are unavoidable, design them to ensure safe separation between vehicles, pedestrians, and livestock. • Install appropriate signage, lighting, and barriers along temporary routes., • Apply dust suppression and maintain diversion roads in safe, drivable condition. • Engage affected communities early to communicate traffic changes, access limitations, and expected timelines. • Provide alternative safe pedestrian routes where necessary. • Restore and rehabilitate diversion routes after use, ensuring no long-term impacts on land or access.	• Contractor Site Manager • Contractor EO • Contractor CLO • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU CLO • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Air quality monitoring
10.	**Drainage and stormwater runoff management**							
10.1.	**Increased surface runoff and localized flooding due to poor drainage design and increase of impermeable surfaces.**	• Design and construct stormwater drainage systems sized for peak flow conditions. • Use permeable surfaces (gravel shoulders, green swales) where feasible to reduce runoff. • Integrate detention basins and retention ponds to manage peak flows. • Regularly inspect and clear drains and culverts to prevent clogging. • Implement green infrastructure (vegetated channels, buffer strips) to slow and retain runoff.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Monthly during rainy season • After major rainfall events	• PMU ES Supervising Engineer	• Visual inspection • Documentation • Drainage maintenance reports
10.2.	**Sediment loading in nearby water bodies from unprotected earthworks.**	• Stabilize exposed soils using vegetation, erosion control mats, or geotextiles. • Install silt fences, sediment traps, and sedimentation basins around construction areas. • Phase construction to minimize exposed surfaces at any given time. • Maintain buffer strips of vegetation near water bodies. • Prohibit direct discharge of turbid water into water bodies. • Cover soil and material stockpiles; use bunding to channel runoff to treatment areas. • Install check dams or small sediment traps in long or steep channels. • Conduct regular inspections and repair erosion-prone areas promptly. • Maintain cleaning and repair schedules for drainage channels to prevent sediment transport.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Monthly checks • After heavy rainfall events	• PMU ES Supervising Engineer	• Visual inspection • Water quality report
10.3.	**Blockage or overloading of natural waterways from inadequate culverts and drainage.**	• Design culverts and crossings to handle peak flow and climate change scenarios. • Ensure culverts are appropriately sized and spaced to prevent upstream flooding. • Provide overflow or bypass channels in high-flow areas. • Inspect and remove debris or blockages regularly. • Avoid altering natural water flow paths where possible.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Monthly checks • After heavy rainfall events	• PMU ES Supervising Engineer	• Visual inspection • Water quality report

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
10.4.	**Contaminated stormwater runoff from project activities.**	• Segregate stormwater flows to isolate clean and potentially contaminated runoff. • Install oil-water separators at maintenance, fueling, and ore handling areas. • Use bunding, covered storage, and diversion systems to prevent contaminated runoff entering waterways. • Conduct regular inspections and maintenance of runoff treatment systems. • Monitor water quality downstream to detect any contamination early. • Perform regular water quality and flow monitoring. • Immediately investigate the source of any identified downstream contamination and implement corrective measures to stop or reduce pollutant discharge. • Contain and manage contaminated runoff (e.g. diversion, pumping, or treatment) • Notify the PMU and relevant authorities, where required, and implement agreed remediation measures. • Increase monitoring frequency until water quality returns to acceptable levels.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Monthly checks • After heavy rainfall events	• PMU ES Supervising Engineer	• Visual inspection • Water quality report • Flow and level monitoring • Drainage maintenance and inspection records
11.	**Hazardous materials management**							
11.1.	**Incidents, regulatory violations, or safety hazards from inadequate monitoring and documentation of hazardous materials.**	• Develop and maintain a comprehensive hazardous materials inventory, including substance names, quantities, locations, and hazard characteristics. • Implement a hazardous materials tracking system documenting handling, transport, and disposal from source to final destination. • Conduct regular hazard assessments using internationally accepted methods (HAZID, HAZOP, FMEA). • Maintain Material Safety Data Sheets (MSDS) on site for all substances. • Train staff in hazardous materials identification, handling, and regulatory compliance.	• Contractor Site Manager • Contractor EO • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation
11.2.	**Leaks, spills, or fire hazards from inadequate storage conditions.**	• Store hazardous materials in leak-proof, clearly labeled tanks or containers, compliant with international standards. • Place storage on impervious surfaces and under shelter to prevent rain ingress. • Conduct routine integrity testing of tanks, pipes, and fittings. • Maintain storage areas ≥100 m from watercourses and away from high-traffic zones. • Remove hazardous materials from active work areas at the end of each day. • Inspect storage areas regularly for deterioration, leaks, or non-compliance.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES Supervising Engineer	• Visual inspection • Documentation
11.3.	**Leaks or overflows of hazardous materials from inadequate containment systems, especially during heavy rainfall.**	• Provide bunds around hazardous material storage areas with capacity ≥110% of largest tank or 25% of combined volume. • Construct bunds from impervious, chemically resistant materials. • Ensure secondary containment drains to a sump connected to a spill retention area with an oil-water separator. • Regularly clean and inspect containment systems for cracks, blockages, or leaks. • Reconcile tank contents periodically to detect leaks. • Provide secondary containment for refueling areas.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES Supervising Engineer	• Visual inspection • Documentation
11.4.	**Soil and water pollution due to poorly maintained or designed oil-water separators.**	• Design separators for site-specific flow rates and contaminant loads. • Inspect separators regularly and service every 6 months; empty immediately when oil accumulation is significant. • Maintain operational procedures and logs of inspections, cleaning, and maintenance. • Train personnel on proper operation and maintenance. • Dispose of separated oil and sludge through EPA-approved contractors.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES Supervising Engineer	• Visual inspection • Documentation

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation: Check timing	Responsibility for checking	Assessment method
11.5.	**Environmental contamination from uncontrolled discharge of oils, greases, detergents, and sediments during vehicle or equipment washing.**	• Require use of designated washing stations with oil-water separators and sediment traps. • Prohibit washing in or near waterways or unauthorized areas. • Maintain infrastructure to prevent runoff to soil or water.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • Supervising Engineer	• Visual inspection • Documentation
11.6.	**Fires or explosions from improper management of reactive, flammable, or explosive materials.**	• Store flammable materials in dedicated, fire/spill-resistant areas separated from main activities. • Separate incompatible substances with containment barriers. • Keep flammable materials away from ignition sources and label fire hazard areas. • Install fire suppression systems, spark-proof fixtures, flame arrestors, and ventilation. • Provide grounding and lightning protection for tanks and refueling stations. • Train staff in handling flammable materials and fire prevention procedures.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU OHSS Supervising Engineer	• Visual inspection • Documentation
11.7.	**Soil or groundwater contamination from spills during manual or mechanical transfers of hazardous materials, including vehicle refueling operations.**	• Conduct transfers only in designated, contained areas with spill containment measures. • Use dedicated, compatible fittings, pipes, and hoses for each chemical. • Train staff in proper transfer procedures and spill prevention. • Maintain spill kits and clean up spills, even if minor, immediately. Remove contaminated soil or dispose properly if significant. • Install secondary containment (drip trays, bunds) at refueling and maintenance points.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Contractor and subcontractor contract clauses
11.8.	**Human injury and environmental damage from slow or inefficient spill response.**	• Develop and implement an EPRP for hazardous materials incidents (see Appendix B). • Ensure availability of spill kits, fire-fighting equipment, and trained response teams wherever hazardous materials are handled. • Maintain personnel on standby during high-risk operations (refueling, transfers, handling flammables). • Conduct regular spill response drills and training for all personnel. • Include contractual obligations for contractors to follow spill prevention and response procedures.	• Contractor Site Manager • Contractor EO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU ES • PMU OHSS	• Visual inspection • Documentation
12.	**Construction materials management**							

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation: Check timing	Responsibility for checking	Assessment method
12.1.	**Land damage (degradation, loss of soil and cover, reduced productivity) and environmental disturbance (noise, vibration, dust, water pollution) from borrow pits and quarries.**	• Conduct early site identification and assessment of all proposed borrow pits and quarries, including dedicated impact assessments and tailored mitigation measures. • Obtain all necessary permits and approvals from the EPA and other relevant authorities prior to commencing extraction activities. • Provide evidence of environmental compliance from all third-party materials sourcing locations before procurement begins. • Allow adequate time for the consultation, resettlement, and compensation of people whose land is affected, ensuring that all land acquisition follows national regulations and World Bank requirements and the Project Resettlement Action Plan. • Ensure that only the approved borrow pits and quarries are used. • Design and install sediment control measures (e.g., diversion drains, silt fences, sediment traps) to prevent runoff from causing contamination and siltation of water bodies. • Ensure that quarry blasting does not create excessive noise, vibration or air emission disturbance to wildlife and communities. • Maintain borrow pits and quarries in a clean, safe, and environmentally sound condition, with clear signage, controlled access, and housekeeping measures. • Apply proper geotechnical and engineering controls to prevent slope instability, erosion, and unsafe excavation practices. • Rehabilitate all borrow pits and quarries upon completion of extraction, restoring them to a stable, safe, and vegetated state. • Store and manage construction materials safely, using designated, contained stockpile areas on stable and impermeable ground, with appropriate drainage and runoff controls to avoid soil and water contamination.	• Contractor Site Manager • Contractor EO • Contractor SGO • Contractor CLO • Contractor OHSO	C	ATL-SPW	• Before the start of works • Monthly during work • After closure of quarries and borrow pits	• PMU ES • PMU SGS • PMU CLO • PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with communities • Air quality monitoring • Noise and vibration monitoring • Water quality monitoring • Slope stability testing
13.	**Biodiversity management**							
13.1.	**Loss of modified or natural (degraded) habitats due to vegetation clearing and infrastructure development.**	• Implement a Mangrove Protection Procedure as presented in 00. • Establish and maintain at least 10 m no-go buffer zones around mangrove stands, marked with fencing, flagging, or signage to prevent machinery encroachment and unauthorized vegetation clearing. • Minimize vegetation clearing to the smallest footprint possible. • Prohibit the cutting or removal of any mangrove trees.	• Contractor Site Manager, supported by Contractor EO	C	ATL-SPW	• Before the start of works • Bi-weekly during peak construction period, otherwise monthly	• PMU ES • Supervising Engineer	• Visual inspection • Documentation • GPS verification of exclusion buffers

Potential impact and cause	Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
					Check timing	Responsibility for checking	Assessment method

		• Clearly demarcate no-go areas in marshy wetlands before work begins. • Prohibit the cutting or removal of vegetation and all kinds of construction works outside the approved footprint of the project. • Carry out vegetation clearing progressively and only where permanent works are immediately required, to avoid unnecessary expansion of cleared areas. • Where construction requires only temporary clearance, reinstate these areas immediately following works. • Revegetate channel banks using native sedges and grasses to restore habitat structure and promote long-term ecological resilience. • Implement progressive rehabilitation and replanting with native species. • Ensure reinstatement achieves stable ground cover and does not result in further permanent habitat loss. • Use manual labor for vegetation removal near mangrove wetlands to prevent disturbance of native soil-stabilizing sedges. • Ensure environmental supervision during vegetation clearing and earthworks. • Stop works and apply corrective measures immediately if habitat loss exceeds approved limits. • Record cleared areas to confirm that habitat loss remains within assessed boundaries. • Ensure workers are aware of the importance of wetlands and their protection, through training. • Confine beach works to clearly demarcated areas and complete outlet construction as efficiently as practicable to minimize the duration of habitat disturbance. • Regrade and restore temporarily disturbed beach surfaces following construction to reinstate natural beach profiles and sediment conditions. • Apply Site Reinstatement and Recovery Procedure as presented in 0.						
13.2.	**Increased degradation of modified or natural (degraded) habitat quality due to noise, vibration, light, and pollution of water, air and/or soil.**	• Ensure all mitigation measures for noise, vibration, light, water, soil and air pollution are strictly implemented. • Establish and maintain at least 10 m no-go buffer zones around mangrove stands. • Implement Mangrove Protection Procedure as presented in 0. • Clearly demarcate no-go areas in marshy wetlands before works begin. • Avoid intact marshy wetland cores and concentrate on the edges of the mangroves as per the design. • Prevent use of sensitive areas for access, storage, or informal movement. • Conduct major earthworks and dredging during the peak dry season (January–March) to reduce impacts on breeding amphibians, nesting birds, and wet-season runoff affecting aquatic biodiversity. • Schedule high-noise activities during daytime only. • At coastal areas, avoid high-noise activities during low tide to minimize disturbance to foraging shorebirds. • Avoid unnecessary lighting in mangrove and wetland areas to reduce disturbance to nocturnal wildlife. • Restrict construction traffic to designated access routes to prevent trampling or degradation of adjacent habitats. • Provide site induction training to all workers on biodiversity sensitivity of wetlands and estuarine areas. • Monitor adjacent habitats (especially wetlands and mangroves) during construction to confirm no unintended damage occurs.	• Contractor Site Manager, supported by Contractor EO	C	ATL-SPW	• Before the start of works • Monthly during construction	• PMU ES • Supervising Engineer	• Noise, noise, vibration, light, water, soil and air pollution monitoring records • Visual inspection • Documentation • Photographic documentation
13.3.	**Direct loss of flora and fauna from vegetation clearing or removal by workers.**	• Conduct vegetation and channel clearing during daylight hours to allow fauna to move away naturally. • Use phased clearing and dredging to allow wildlife to disperse. • Apply the Wildlife Management Procedure presented in 0.	• Contractor EO • Contractor Site Manager	C	ATL-SPW	• Before the start of works • Monthly during construction	• PMU ES • Supervising Engineer	• Documentation • Visual inspection • Wildlife relocation and incident logs

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
		• Implement a pre-clearance walk-through by trained personnel in wetland-adjacent areas to identify and allow safe escape of fauna (e.g. reptiles, amphibians). • Use phased clearing and dredging to allow wildlife to disperse. • Before clearing and dredging each drainage segment, a qualified environmental officer must sweep the area to relocate slow-moving or vulnerable species (e.g., turtles, pythons) and identify and relocate any active bird nests to a close and safe location. • Prohibit clearing outside approved boundaries. • Prohibit intentional harm, capture, or killing of wildlife by workers. • Suspend works temporarily if protected or sensitive species are encountered and apply wildlife response procedures. • Implement fauna rescue and relocation where applicable. • Include biodiversity protection requirements in site induction training. • Clearly communicate prohibitions on wildlife harm, hunting, fishing, or plant collection. • Apply disciplinary measures in cases of non-compliance. • Monitor vegetation clearing activities to ensure they remain within approved limits. • Record any wildlife incidents or mortalities and implement corrective actions if patterns are observed. • Adjust clearing methods if excessive flora or fauna loss is detected.						• Photographic documentation
13.4.	**Disturbance to hydrological and associated ecological processes due to temporary flow diversions and channel works.**	• Design and install temporary flow diversions to safely convey anticipated flows during the period of works, ensuring continuous upstream–downstream connectivity. • Undertake channel works in short, sequential sections and reinstate flow in completed sections before opening new work areas. • Restrict works and temporary diversions to channel alignments and degraded margins, avoiding marshy wetland cores. • Minimise the length of channel affected at any one time and remove temporary diversion structures promptly once permanent works are completed. • Restore natural flow paths, channel profiles, and bank stability immediately following completion of works. • Apply Site Reinstatement and Recovery Procedure as presented in 0. • Monitor flow conditions during construction and adjust diversion arrangements if unintended ponding, drying, or altered wetland conditions are observed.	• Contractor EO • Contractor Site Manager	C	ATL - SPW	• Before the start of works • Monthly during construction	• PMU ES • Supervising Engineer	• Contractor work plans • Visual inspection • Photographic documentation

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
13.5.	**Spread of invasive species from vegetation clearing and disturbance, movement of trucks, , waste disposal, and/or transport of soil containing invasive species to less disturbed areas.**	• Implement the Invasive Species Management Procedure described in 0. • Limit vegetation clearing and soil disturbance to the minimum area necessary for construction activities. • Avoid unnecessary movement of soil and vegetation material between different parts of the project area. • Treat all vegetation and sediments removed from channels and wetland edges as potentially contaminated with invasive species. • During dredging activities, measures must be taken to avoid fragmenting or dispersing existing invasive flora from the channels to downstream areas. • Prohibit reuse of invasive-contaminated soil or vegetation for backfilling, landscaping, or rehabilitation in less disturbed areas. • Dispose of invasive-contaminated vegetation and sediments only at locations approved by the PMU ES and Supervising Engineer and prohibit disposal in less disturbed or ecologically sensitive areas. • All removed biomass should be securely collected and disposed of on dry land, away from waterways, to prevent re-infestation. • Transport soil and vegetation material in a controlled manner (e.g. covered trucks) to prevent spillage and dispersal of seeds or plant fragments. • Clean machinery and vehicles before moving between work zones, particularly from invaded to less disturbed areas. • Replant disturbed areas with native species only. • Monitor disturbed areas and remove invasive species early. • Include invasive species awareness and control measures in site induction training for all workers.	• Contractor EO • Contractor Site Manager	C	ATL - SPW	• Before equipment mobilization • Bi-weekly during construction	• PMU ES • Supervising Engineer	• Visual inspection of machinery and vehicle • Inspection of stockpiles, disturbed soils, and drainage areas • Photographic documentation • Verification of biomass disposal records
14.	**Ecosystem services management**							
14.1.	**Disruption of artisanal fishing activities and related cultural habits near active construction zones due to construction works and potential associated increased turbidity and sediment mobilization.**	• Communicate channel cleaning and dredging schedules to all potentially affected fishing communities at least two weeks in advance. • Inform fishing communities in advance of planned construction activities, locations, and durations that may temporarily restrict access to fishing areas. • Avoid unnecessary restriction of access to fishing grounds, landing sites, and water-edge areas outside active work zones, and maintain safe access routes where practicable. • Where works temporarily block access, establish alternative temporary locations in consultation with fishermen associations. • Ensure that affected fishermen are aware of and able to use the project grievance mechanism to raise concerns related to access, timing, or impacts on fishing activities.	• Contractor SGO • Contractor CLO	C	ATL-SPW	• Before the start of works • Monthly during construction	• PMU SGS • PMU CLO • Supervising Engineer	• Visual inspection • Documentation • Interviews with fishing groups

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
14.2.	**Interference with small-scale extractive activities (e.g. clay extraction from wetlands)**	• Inform individuals and groups engaged in clay extraction in advance of construction activities, including locations, timing, and expected duration of access restrictions. • Confine construction work to clearly defined zones and avoid active extraction areas where feasible. • Implement works in short, sequential sections to limit the duration of interference at any single extraction location. • Where safe and practicable, maintain alternative access routes to extraction areas outside active work zones. • If excavation work overlaps clay extraction sites, provide advance notice and temporary access alternatives where safe. • Communicate safety to affected people and maintain clear signage near active machinery zones. • Ensure that potentially affected individuals are aware of and able to use the project grievance mechanism to raise concerns related to temporary loss of access or disruption of activities.	• Contractor SGO • Contractor CLO	C	SPW	• Before the start of works • Monthly during construction	• PMU SGS • PMU CLO • Supervising Engineer	• Visual inspection • Documentation • Interviews with involved community members
15.	**Community relations management**							
15.1.	**Damage to land, yards, access paths, and communal spaces due to construction activities, material storage, and movement of machinery**	• Conduct pre-construction condition surveys and clearly demarcate approved work areas, access routes, and material storage zones. • Restrict machinery movement to designated routes and protect vulnerable surfaces; always maintain safe access to homes and communal facilities. • Limit material storage and construction activities to approved areas and avoid use of private yards and communal spaces where feasible. • Reinstate all affected areas to pre-construction condition or better upon completion of works. • Engage affected land users early and disclose project boundaries and timelines clearly. • Maintain continuous dialogue with communities on land access restrictions, work schedules, and reinstatement commitments. • Coordinate with community leaders to prevent unintentional encroachment into community farmland or cultural sites. • Address any residual impacts on land, access, or livelihoods that cannot be fully restored through reinstatement in accordance with the Project Resettlement Action Plan (RAP) and livelihood restoration framework (see Appendix B for more details on RAP). • Disclose the project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU SGS	C	ATL SPW	• Before the start of works • Monthly during construction • When grievances arise	• PMU SGS • PMU Project Coordinator • Supervising Engineer	• Document review (RAP, compensation records) • Visual observation of land boundaries and access routes • Community interviews • GRM logs • Audits
15.2.	**Nuisance impacts from construction activities (including dust, noise, and**	• Implement dust, noise, and vibration control measures as set out in this ESMP. • Limit construction activities to approved working hours.	• Contractor Site Manager • Contractor EO	C	ATL - SPW	• Daily during highnoise activities and	• PMU ES • PMU SGS	• Visual checks for dust, noise sources

	vibration) disrupt daily life, affect community well-being, and intermittently interfere with religious practices, particularly at sensitive receptors such as places of worship, schools, and health centers.	• Communicate work schedules and high-noise or dust-generating activities at least 24 hours in advance through agreed communication channels. • Maintain regular community meetings to gather feedback on nuisance impacts. • Provide contact details (CLO) for immediate reporting of urgent concerns. • Avoid high-noise activities near sensitive receptors, where practicable. • Avoid nighttime disturbances and respect local norms. • Install noise barriers around sacred sites to minimize disturbance and preserve their cultural and spiritual significance. • Provide advance notice to religious and traditional leaders about planned high-noise activities. • Limit or pause works during major religious, cultural or community events. • Monitor noise and vibration levels near religious sites and adjust operations if levels exceed agreed thresholds. • Disclose the Project GRM to the communities.	• Contractor SGO • Contractor CLO			dust-generating activities • Monthly during construction • Immediately when complaints arise	• Supervising Engineer	• Work schedule communication records • Noise/dust monitoring reports • GRM logs and response times • Community interviews
15.3.	**Safety risks to community members from increased road traffic.**	• Prepare and implement a Traffic and Transport Management Plan covering vehicle routes, speeds, scheduling, and pedestrian safety measures (see Appendix B for more details). • Restrict construction traffic to approved routes and times, with enforced speed limits in residential and high-use areas. • Install temporary signage, barriers, crossings, and flag persons near communities, schools, markets, and other sensitive locations. • Conduct driver training and induction on community safety, defensive driving, and zero tolerance for unsafe behavior. • Conduct community road safety awareness campaigns particularly in schools, hospitals, markets, and roadside communities. • Keep communities informed about abnormal load movements or temporary road closures. • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor CLO • Contractor SGO • PMU CLO	C	ATL - SPW	• Before the start of road works • Monthly • Immediately upon road incidents or complaints	• PMU Project Coordinator • Supervising Engineer • PMU SGS	• Visual inspection of signage, pathways, crossings and traffic • Awareness campaign attendance sheets • GRM logs • Community interviews
15.4.	**Damage to or contamination of drinking water supplies from project activities.**	• Communicate preventive measures and monitoring results transparently. • Engage community leaders in identifying early-warning signs of water quality problems. Maintain two-way communication allowing communities to report concerns immediately. • Provide timely alternative water supply if project activities disrupt access or quality. • Implement spill prevention and waste management near water sources. • Document and resolve water-related complaints through the GRM.	• Contractor Site Manager • Contractor EO • Contractor SGO • Contractor CLO	C	ATL - SPW	• Before the start of works near water sources • Monthly • Immediately when complaints arise	• PMU ES • PMU SGS • Supervising Engineer	• Water quality reports • Visual inspections • Community interviews • GRM logs • Alternative water supply delivery records

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
15.5.	**Conflicts or tension due to inadequate consultation or exclusion from benefits.**	• Inform communities before starting activities that may affect shared infrastructure (see Appendix A for more details on community consultation). • Involve community representatives in planning detours, temporary access paths, or service interruptions. • Implement engagement activities in line with the project SEP, ensuring inclusive participation of affected and vulnerable groups. • Commit to repairing any infrastructure damaged by project activities and communicate timelines for restoration. • Implement transparent and fair recruitment processes, with priority given to local communities where feasible. • Communicate clearly the types of project benefits (e.g. employment, procurement opportunities) and eligibility criteria. • Promote inclusion of vulnerable and underrepresented groups in employment and projectrelated opportunities. • Monitor and document distribution of project benefits (e.g. local employment) to identify and address potential exclusion. • Disclose the Project GRM to the communities.	• Contractor SGO • Contractor CLO • PMU CLO	C	ATL - SPW	• Before the start of works • Monthly • Immediately when damage is reported	• PMU SGS • Supervising Engineer	• Visual inspection • Review of contractor reports on reinstatement • GRM logs • Community interviews
15.6.	**Inappropriate or disrespectful worker behavior toward other workers and community members, especially women.**	• The contractor must prepare and implement a Workforce Management Plan, approved by the PMU (see Appendix B for more details). • As part of the Workforce Management Plan, enforce a mandatory Code of Conduct (CoC) for all workers, covering respectful behavior, non-discrimination, and zero tolerance for sexual harassment, SEA, and gender-based violence (GBV) (See Appendix A and Appendix B for more details) • Provide mandatory induction and regular refresher training for workers on acceptable behavior, community interaction, and GBV/SEA prevention, with particular emphasis on respect toward women and vulnerable groups. • Implement clear disciplinary procedures for breaches of the CoC, including sanctions and removal from site where required. • Hold regular meetings with community leaders, women's groups, youth, and vulnerable groups. • Ensure the GRM is widely communicated and culturally appropriate. • Track grievances and share findings and resolutions transparently with communities. • Provide timely feedback to community suggestions and concerns to build trust.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL - SPW	• Before the start of the project • Monthly • When grievances arise	• PMU Project Coordinator • PMU SGS • Supervising Engineer	• Participation records and meeting minutes • GRM log analysis • Stakeholder interviews
15.7.	**Loss of social networks, community ties, and informal support systems for households relocated to new areas or new communities, with associated pressure on housing, services, and livelihood opportunities in host communities.**	• Implement resettlement and livelihood restoration measures in accordance with the approved RAP and livelihood restoration framework, with specific actions to support social cohesion (see Appendix B for more details on RAP). • Where feasible, relocate households in groups to maintain existing social networks and neighborhood ties (see Appendix A and Appendix B for more details on resettlement and RAP). • Provide targeted social support to vulnerable households (e.g., women-headed households, elderly, persons with disabilities) during and after relocation. • Ensure continued access to community services, social infrastructure, and informal support mechanisms following relocation. • Monitor post-relocation social conditions and address emerging issues through the GRM.	• PMU SGS • PMU CLO	C-O	ATL - SPW	• Monthly • Prior to relocation • Monthly, during relocation • When grievances arise	• PMU Project Coordinator	• Review of RAP/livelihood restoration implementation and completion reports • Post-relocation household and community interviews • Monitoring of vulnerable household support measures

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
								• GRM records related to resettlement and social cohesion
16.	**Livelihood protection and restoration**							
16.1.	**Temporary or permanent economic displacement due to loss or restriction of access to livelihood spaces and resources as a result of construction activities and access controls.**	• Avoid and minimize disruption to livelihood spaces through construction phasing, and siting of works, access routes, and material storage areas. • Maintain safe, continuous access to livelihood spaces wherever feasible, including provision of temporary access routes, crossings, or alternative arrangements. • Consult affected livelihood users in advance of works that may restrict access, and provide clear information on timing, duration, and nature of disruptions. • Schedule construction activities to reduce peak livelihood disruption, particularly for timesensitive activities such as fish landings, drying, and roadside trading. • Reinstate affected livelihood spaces promptly following completion of works, restoring access, surfaces, and functionality to pre-construction condition or better, in consultation with users. • Where loss of access is temporary but repeated, prolonged, or permanent, and cannot be adequately mitigated through access management or reinstatement, implement compensation and livelihood restoration measures in accordance with the Project RAP and Livelihood Restoration Plan (LRP), if needed (see Appendix A and Appendix B for more details on resettlement and RAP). • Where feasible, relocate affected households within or close to their original communities to reduce disruption of livelihood networks and social ties. • Ensure displaced households retain or regain access to livelihood resources, services, and markets, including through alternative locations or shared access arrangements where needed. • If needed, include targeted support measures for vulnerable persons within the RAP/LRP, with specific provisions for female-headed households, elderly persons, youth, and persons with disabilities (see Appendix A for more details). • Provide cash assistance, targeted livelihood grants, or enterprise start-up support for vulnerable households whose resilience is reduced by project-related changes. • Ensure continuous stakeholder engagement, disclosure of entitlements, an access to GRM.	• Design Engineer • Contractor Site Manager • PMU SGS • PMU CLO	C-O	ATL - SPW	• Before the start of works • Weekly during construction • Quarterly after compensation • When grievances arise	• PMU Project Coordinator • PMU SGS	• Document review (construction layouts and plans, RAP, compensation records, livelihood assistance records) • Field verification • Photographic documentation • GRM logs • Community meetings and interviews • Audits of livelihood restoration outcomes • Vulnerability assessment records • GRM logs

16.2.	**Physical displacement of households due to permanent land acquisition, resulting in loss of housing, relocation, and disruption of established social and economic systems.**	• Avoid and minimize physical displacement through careful project design, alignment selection, and optimization of footprints, giving priority to technically feasible alternatives that reduce land acquisition and household relocation. • Where displacement is unavoidable, prepare and implement a RAP in compliance with World Bank ESS5 (Check Appendix A and Appendix B for more details on resettlement and RAP) • Ensure compensation for lost housing, structures, and assets at full replacement cost prior to displacement • Ensure timely provision of suitable relocation options, with secure tenure, adequate services, and access to livelihoods, social services, and community facilities. • Restore or improve livelihoods of displaced households through livelihood restoration measures as defined in the RAP/LRP (if needed). • Maintain continuous consultation with displaced households and disclose resettlement timelines, entitlements, and grievance mechanisms. • Disclose the Project GRM to the communities. • Monitor post-resettlement living conditions and livelihood outcomes and implement corrective actions where needed.	• PMU SGS • PMU CLO	C-O	ATL - SPW	• Prior to land acquisition and displacement • During RAP implementation • Quarterly post resettlement • When grievances arise	• PMU Project Coordinator	• RAP records • GRM records • Stakeholder engagement (community consultations, interviews and surveys)
17.	**Influx management**							
17.1.	**Influx of people seeking employment puts pressure on local resources and services, leading to social tensions with host communities.**	• Influx management measures should form part of the Workforce Management Plan, to be prepared and implemented by the contractor (see Appendix B for more details). • Ensure worker have safe and healthy accommodation with adequate services (water, sanitation, lighting, waste management) to reduce pressure on host communities. • Restrict uncontrolled worker settlement within host communities • Conduct continuous engagement with community leaders to monitor and address emerging tensions or concerns related to influx (see Appendix A for more details on community consultation). • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL - SPW	• Monthly during construction • When grievances arise	• PMU SGS • Supervising Engineer	• Workforce registry review • Interviews with community leaders • Monitoring of job distribution records
17.2.	**Social tension — including frustration, feelings of exclusion, and decreased local support for the project — arising from unequal employment opportunities and the failure to prioritize affected communities in hiring.**	• Prioritize local hiring to support community economic benefits. • Establish transparent recruitment procedures and criteria • Communicate job opportunities clearly through multiple channels • Maintain records of local employment to track fairness • Address grievances related to employment through the GRM • Conduct engagement focused on employment expectations and concerns	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL - SPW	• Monthly during construction • When grievances arise	• PMU SGS • Supervising Engineer	• Employment tracking logs • Community feedback on recruitment fairness
17.3.	**Increased social ills (e.g., prostitution, gambling, drinking, substance abuse) due to poor worker behavior.**	• Implement a workers' CoC to guide worker behavior, ensure compliance with labor standards, and promote respectful engagement with local communities (see Appendix A for more details). • Ensure all workers sign and understand the CoC before starting work; provide refresher training throughout the Project.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL - SPW	• Before construction begins • Monthly during construction • When grievances arise	• PMU Project Coordinator • PMU SGS • Supervising Engineer	• Worker interviews • Inspections • Incident reports • Community feedback

Potential impact and cause	Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
					Check timing	Responsibility for checking	Assessment method

		• Train all workers on acceptable behavior, community norms, and consequences for violations. • Prohibit non-company personnel from riding in company vehicles. • Include clear penalties for all CoC violations, including misconduct, unsafe behavior, SEA/SH breaches, and the unauthorized transport of non-company personnel in company vehicles. • Enforce disciplinary actions consistently, such as removal from site or contract termination. • Maintain regular communication with local leaders and communities to identify early warning signs of social tensions or emerging behavioral issues among workers. • Disclose the Project GRM to the communities.						
17.4.	**Risk of child, sexual exploitation and abuse (SEA/SH), GBV, and other forms of labor-related misconduct from inadequate labor management and supervision within the workforce.**	• Enforce strict age verification for all workers. • Conduct regular labor audits of contractors and subcontractors to ensure compliance with child labor and SEA/SH prevention requirements. • Prohibit recruitment of workers through informal brokers, who may exploit vulnerable people. • Ensure no child labor is used in borrow pits and quarries, or by suppliers. • Train workers and supervisors identify and report signs of child labor or women exploitation. • Collaborate with local authorities and NGOs for awareness-raising on child protection, SEA/SH risks, and reporting mechanisms. • Prohibit employment of anyone under the legal minimum working age as defined by World Bank ESS2 and national laws (see Appendix A for more details). • Include a child labor clause in all contracts and procurement processes (see Appendix A for more details). • Disclose the Project GRM to the communities. • Provide grievance channels for reporting suspected child labor incidents.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL-SPW	• Monthly during construction • When grievances arise	• PMU SGS • Supervising Engineer	• GBV training logs • Anonymous reporting mechanism review • Interviews with workers and community members • Monitoring of incident reports • GRM logs
17.5.	**SEA/SH and GBV increase in the affected communities due to the presence and influx of temporary laborers.**	• Require all workers to sign a SEA/SH CoC with clear consequences for non-compliance. • Deliver SEA/SH training for all workers and supervisors. • Establish a confidential, accessible grievance mechanism that allows safe reporting of SEA/SH and GBV cases, including anonymous options. • Provide survivor-centered support pathways, including referrals to local health services, psychosocial support, and legal assistance. • Restrict unnecessary worker movements around schools, markets, and community gathering areas. • Ensure adequate lighting, security, and monitoring in worker accommodations, if established, to reduce SEA/SH risks (see Appendix A for more details). • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL-SPW	• Prior to hiring • Quarterly during construction • Immediately when grievances arise	• PMU Project Coordinator • PMU SGS • Supervising Engineer	• Personnel record review • Site inspections • Anonymous complaint tracking • Interviews with workers and local leaders
17.6.	**Pressure on housing, services, and livelihood opportunities, including increased competition for informal employment and local resources, due to the presence of workers leading to tension with host communities.**	• Prioritize recruitment of local workers to reduce in-migration pressure on housing and services. • Coordinate with local authorities and community leaders to identify areas where pressure on housing, services, or livelihoods is increasing and agree on mitigation actions. • Communicate clearly with host communities regarding the duration of worker presence and demobilization timelines. • Monitor community concerns related to housing availability, service access, and livelihood competition through regular engagement and the GRM.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO • PMU SGS	C	ATL-SPW	• Monthly during construction • When grievances arise	• PMU Project Coordinator • Supervising Engineer	• Review of workforce numbers and accommodation records • Community interviews and meetings with local leaders • GRM logs related to housing, services, and livelihoods

								• Site inspections of worker accommodation facilities

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
17.7.	**Improved living conditions in project areas may attract inmigration, increase population density and placing additional pressure on housing, services, infrastructure, and livelihood opportunities, leading to increased social stress within host communities.**	• Manage community expectations through transparent communication on project benefits, limitations, and eligibility criteria (see Appendix A for more details on community consultation). • Strengthen stakeholder engagement with host communities to identify emerging social stress related to population growth. • Use the GRM to track and respond to grievances related to overcrowding, service access, and livelihood competition.	• PMU SGS • PMU CLO	O	ATL-SPW	• Monthly during construction • When grievances arise	• PMU Project Coordinator • PMU SGS	• Review of community feedback and consultation records • Analysis of GRM trends related to housing, services, and livelihoods • KII with community leaders and local authorities
18.	**Cultural heritage management**							
18.1.	**Loss, disturbance, or restricted access to cultural sites — disturbs or damages sites of historical, spiritual, or cultural significance and limits communities' ability to perform traditional and spiritual practices.**	• Identify, map, and document all cultural heritage sites before works begin. • Avoid cultural sites through design adjustments wherever feasible; if avoidance is impossible, consult affected communities and traditional custodians to agree on appropriate mitigation measures, access arrangements, and culturally acceptable management of impacts. • Implement a Chance Finds Procedure to manage unexpected cultural discoveries and ensure proper preservation of artifacts or sites in coordination with cultural authorities (see Appendix A for more details). • Designate and clearly mark no-go zones around sacred and culturally significant areas. • Ensure continued community access to sites for cultural, spiritual, and traditional practices. • Provide alternative access routes, agreed with by affected communities, where temporary restrictions cannot be avoided. • Engage traditional leaders and elders throughout planning and implementation to guide decisions on protection and access (see Appendix A for more details). • Train all workers on cultural sensitivity and respectful conduct, including prohibited behaviors near sacred sites. • Use construction methods that minimize disturbance and prevent contamination of soil, water, and air in and around culturally sensitive areas. • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO • PMU CLO	C	ATL-SPW	• Prior to clearance • Monthly during construction	• PMU SGS • Supervising Engineer	• Community consultations • Mapping of sacred sites • Site inspection • Documentation of access • Site inspection • Community feedback • Documentation review
19.	**Public health and safety management**							

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
19.1.	**Increased road accidents during construction and operation.**	• Develop and enforce a Traffic Management and Transport Plan for all construction and operational areas (See Appendix B for more details) • Clearly mark and segregate work zones, pedestrian pathways, and vehicle routes. • Implement speed and traffic management measures near work zones and communities. • Require drivers and equipment operators to be trained, licensed, and medically fit. • Provide high-visibility clothing and proper lighting for workers near traffic or moving equipment. • Conduct awareness campaigns for local communities on road safety during project activities. • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO	C	ATL-SPW	• Before the start of works involving traffic • Monthly during construction • When grievances arise	• PMU Project Coordinator • PMU SGS Supervising Engineer	• Contractor Plans • GRM logs • Site inspections • Driver logs • Incident report reviews • Safety program participation tracking
19.2.	**Higher risk of communicable diseases (e.g., sexually transmitted diseases, vectorborne diseases) linked to workforce influx, temporary stagnant water during construction and limited health awareness.**	• Provide health awareness and education campaigns for workers and local communities, including sexually transmitted diseases, HIV, and other infectious diseases. • Ensure adequate medical services and access to healthcare for workers and communities. • Monitor workforce health and implement preventive measures for communicable diseases. • Limit or regulate workforce interactions in ways that reduce disease transmission risk. • Avoid prolonged ponding of water in excavation pits, drainage channels, and work areas through proper drainage and timely backfilling. • Regularly inspect and drain or treat stagnant water bodies, including temporary construction-related water accumulation. • Coordinate with local health authorities, where necessary, to support vector control measures. • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO	C	ATL-SPW	• Prior to workforce mobilization • Quarterly during construction	• PMU SGS • Supervising Engineer	• Health campaign and training records • Feedback from local health partners • GRM logs
19.3.	**Community exposure to hazards from open trenches, inadequate fencing, and unsafe work sites, particularly affecting children.**	• Install secure fencing, barricades, and warning signage around all open trenches, excavations, and active work sites. • Cover, backfill, or plate open trenches where works are temporarily halted, especially near residential areas, schools, and pedestrian routes. • Provide safe, clearly marked pedestrian crossings and alternative access routes where trenches or works interrupt normal movement. • Ensure adequate lighting around work sites and excavations, particularly at night or during low-visibility conditions. • Conduct community awareness activities, with special focus on children and caregivers, to explain construction hazards and restricted areas. • Immediately secure any unsafe conditions identified through inspections, incidents, or community complaints. • Disclose the Project GRM to the communities.	• Contractor Site Manager • Contractor SGO • Contractor CLO	C	ATL-SPW	• Prior to construction • Weekly during active construction • Quarterly during construction	• PMU SGS • Supervising Engineer	• Site inspection • GRM logs • Community engagement • Community feedback
20.	**Labor and working conditions management**							

20.1.	**Local communities are excluded from employment if project opportunities are preferentially given to outsiders.**	• Establish local hiring policies that prioritize qualified local candidates (see Appendix B for more details). • Maintain transparent recruitment procedures and publicly advertise all vacancies.	• Contractor Site Manager • Contractor SGO • Contractor CLO	C	ATL-SPW	• Continuously during recruitment and employment • Quarterly during construction	• PMU SGS • Supervising Engineer	• Employment records • Verification through community feedback and consultations • Review of grievances related to employment practices • Field visits and interviews with hired personnel and local leaders
20.2.	**Increase in vulnerable groups being excluded from employment.**	• Develop inclusive hiring practices to ensure equitable access for vulnerable groups. • Offer training, mentoring, and skills development programs targeted at vulnerable populations. • Monitor workforce composition regularly to ensure fair representation.	• Contractor Site Manager • Contractor SGO • Contractor CLO	C	ATL-SPW	• Continuously during recruitment and employment • Quarterly during construction	• PMU SGS • Supervising Engineer	• Employment records • Community feedback • Contractor workforce reports • Recruitment process audits
20.3.	**Gender inequality and exclusion of women from employment.**	• Ensure women have equal access to employment opportunities. • Recruit at least 30% of labor force from local women, where possible. • Provide safe and supportive facilities for women at work sites (e.g., sanitation, changing rooms). • Conduct awareness campaigns to address workplace discrimination and gender biases.	• Contractor Site Manager • Contractor SGO	C	ATL-SPW	• Continuously during recruitment and employment • Quarterly during construction	• PMU SGS Supervising Engineer	• Workforce genderdisaggregated data • Interviews with female employees • Review of job postings and hiring procedure • Site inspections

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
20.4.	**Lack of access to a fair grievance mechanism for employees.**	• Establish a clear, confidential, and accessible GRM for all employees as part of the Workforce Management Plan (see Appendix B for more details). • Ensure grievances are acknowledged, investigated, and resolved promptly and fairly. • Train staff and workers on how to access and use the grievance system. • Maintain records of grievances and their resolution for accountability. • Provide opportunity for referrals and confidential reporting of grievances • Ensure a non-retaliation policy is enforced, allowing workers to raise grievances without fear of dismissal, discrimination, or other adverse consequences.	• Contractor Site Manager • Contractor SGO	C	ATL-SPW	• Continuously during construction and employment • Monthly reporting • When grievances arise	• PMU Project Coordinator • PMU SGS • Supervising Engineer	• Grievance logs • Interviews with workers • Site audits
20.5.	**Employees face exploitation due to low pay, long hours, and inadequate contracts.**	• Comply with national labor laws regarding wages, working hours, and contracts (see Appendix A for more details). • Provide clear written contracts for all employees, specifying terms of employment, wages, and benefits. • Monitor and enforce fair working hours and ensure overtime is voluntary and compensated. • Conduct periodic audits to ensure labor standards compliance.	• Contractor Site Manager • Contractor SGO	C	ATL-SPW	• C: nces Monthly • When grieva arise	• PMU Project Coordinator • PMU SGS • PMU OHSS • Supervising Engineer	• Contract review • Worker interviews • Site inspections • Audit of payroll and labor condition reports
21.	**Occupational health and safety management**							

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
21.1.	**Occupational injuries resulting from inadequate training, hazard awareness, or supervision.**	• Provide comprehensive OHS orientation for all workers and contractors, including site rules, hazard identification, emergency procedures, and safe work practices. • Conduct routine toolbox talks, daily briefings, and weekly safety meetings. • Provide task-specific training before workers start new assignments, including equipment use, material handling, and hazard controls. • Maintain ongoing refresher and specialty training for all staff, supervisors, and workers with rescue/first aid duties. • Implement a visitor orientation and control system to prevent untrained personnel from entering hazardous areas. • Promote a safety culture where unsafe acts are reported, corrected, and discouraged; ensure supervisors set good examples and enforce compliance.	• Contractor Site Manager • Contractor EO • Contractor OHSO	C-O	ATL-SPW	• Before start of the works • Monthly	• PMU ES • PMU OHSS	• Visual inspection • Documentation • Interviews with workers • Training records
21.2.	**Occupational injuries due to inadequate provision of safety equipment.**	• Provide appropriate Personal Protective Equipment (PPE) suited to each task and ensure correct sizing, fit, and use. • Maintain PPE in good condition; repair or replace damaged or worn equipment immediately. • Require the active use of PPE where hazards exist. • Install machine guards, splash shields, welding screens, and protective barriers on equipment with moving or hazardous parts. • Ensure vehicles and machinery are equipped with safety devices such as backup alarms, mirrors, and lighting.	• Contractor OHSO	C-O	ATL-SPW	• Before start of the works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
21.3.	**Fire, explosion, and electrical hazards caused by poor facility design, inadequate maintenance, or unsafe handling of flammable and reactive materials.**	• Design facilities to meet industrial fire codes; incorporate fire-resistant materials, adequate ventilation, safe electrical systems, and emergency shut-off procedures. • Install and maintain fire detectors, alarms, extinguishers, hydrants, and firefighting equipment. • Calibrate extinguishers annually via the Liberia National Fire and Rescue Service. • Restrict smoking to designated areas. Prohibit smoking near vehicles and flammable materials. • Store flammable, reactive, corrosive, and oxidizing chemicals separately in ventilated areas with secondary containment. • Implement standard operating procedures for explosives handling, blasting, and hazardous materials management; ensure only certified personnel carry out such activities. • Use lockout/tagout procedures for all electrical systems during service and maintenance. • Inspect electrical cords, tools, and wiring routinely. • Establish exclusion zones and "No Approach" rules near high-voltage overhead power lines.	• Contractor Site Manager • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers

21.4.	**Accidents from unsafe work environments, such as inadequate lighting, ventilation, sanitation, access routes, or emergency exits.**	• Provide adequate lighting for all work areas; install emergency lighting that activates during power outages. • Supply sufficient fresh air and maintain mechanical ventilation systems. • Implement proper housekeeping: keep work areas clear of obstacles, clean spills promptly, and dispose of waste regularly. • Maintain safe pedestrian and vehicular routing; install railings, handholds, and covers over openings; restrict unauthorized access to work areas. • Ensure emergency exits are clearly marked, unobstructed, and sufficient in number and capacity. • Provide non-slip flooring and ensure structures are designed to withstand local climatic conditions (heat, humidity, heavy rainfall). • Ensure sanitary toilet facilities are provided, maintained, and kept hygienic. • Prohibit open defecation.	• Contractor OHSO	C-O	ATL-SPW	• Before start of the works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
21.5.	**Traffic and machinery-related injuries due to inadequate segregation of work zones, poor traffic management, and untrained vehicle or equipment operators.**	• Develop and enforce a Traffic Management Plan covering routing, signage, speed limits, and vehicle inspection requirements (see Appendix B). • Segregate workers from traffic using barriers, fencing, detours, lane closures, or controlled access zones. • Require high-visibility clothing and adequate lighting for all personnel working near roads or moving equipment. • Train industrial vehicle and equipment operators. • Require medical surveillance and random alcohol/breath tests for drivers. • Equip machinery with audible alarms, mirrors, and lighting; conduct regular maintenance and safety checks. • Restrict work near rail lines or roads unless traffic can be blocked or controlled. • Use trained human lookouts with whistles where needed. • Report serious work related injuries and fatalities to PMU immediately.	• Contractor Site Manager • Contractor OHSO	C-O	ATL-SPW	• Before start of the works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
21.6.	**Health risks and disease transmission from poor hygiene, inadequate potable water, lack of clean eating areas, or unsanitary living conditions.**	• Provide an adequate supply of potable drinking water that meets water-quality standards. • Maintain water sources and containers in sanitary condition. • Establish clean, designated eating areas separate from work zones. • Provide adequate toilets and washing facilities at all sites, including gender-segregated options where feasible; maintain them in clean working order. • Conduct regular sanitation and hygiene awareness training during toolbox talks. • Encourage personal hygiene practices and provide handwashing facilities with soap and water. • Prevent pest and vector breeding by eliminating standing water and maintaining clean site conditions; install mosquito protection where applicable. • Provide awareness and prevention campaigns for infectious diseases (influenza, malaria, Covid-19, Ebola, HIV, STIs).	• Contractor Site Manager • Contractor OHSO	C-O	ATL-SPW	• Before start of the works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
21.7.	**Injuries are exacerbated due to inadequate emergency response.**	• Develop and implement an EPRP. • Train workers and conduct routine drills for emergency response procedures, including evacuation, fire, medical response, and project shutdown protocols. • Maintain accessible, fully stocked first aid kits, eye-wash stations, and emergency showers near hazardous work areas. • Train all workers in basic first aid; ensure at least two trained responders are present on each site and qualified first-aid support is always available. • Clearly mark emergency exits and ensure they remain unobstructed and visible during power outages. • Establish communication procedures for lone or remote workers, including hourly checkins and means to summon emergency aid. • Provide specialized rescue training and maintain rescue equipment for working at heights, confined spaces, and hazardous environments.	• Contractor Site Manager • Contractor OHSO	C-O	ATL-SPW	• Before the start of works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers

Potential impact and cause		Mitigation measure	Responsibility for implementation	Phase*	Sub-location°	Monitoring of mitigation measure implementation		
						Check timing	Responsibility for checking	Assessment method
21.8.	**Increased OHS hazards for workers operating on or near water bodies including drowning, slips and falls on wet or unstable surfaces, and risks associated with vessel or pontoon instability.**	• Ensure all workers receive task-specific health and safety training for working on or near water bodies. • Provide and require mandatory use of appropriate PPE, including life jackets or buoyancy aids, non-slip footwear, and helmets. • Design, install and maintain pontoons in a way that ensures structural stability, with guardrails, safe access points, and adequate lighting. • Train workers and conduct routine drills for emergency response procedures when working on or near water bodies.	• Contractor OHSO	C	SPW	• Before the start of works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers
21.9.	**Risk of serious injury from encounters with venomous or constrictor snakes and crocodiles, including snakebite envenomation, crushing injuries, severe trauma, or drowning.**	• Ensure the EPRP covers injuries from encounters with venomous or constrictor snakes and crocodiles (Appendix B). • Provide worker training on snake and crocodile hazards. • Maintain vegetation control around work areas to reduce hiding places. • Use PPE such as high boots in high-risk areas. • Implement a buddy system for field activities. • Keep first-aid kits accessible at all times. • Establish clear emergency response plan and evacuation procedures to nearest facility with trauma care and antivenom.	• Contractor OHSO	C	SPW	• Before the start of works • Monthly	• PMU OHSS • Supervising Engineer	• Visual inspection • Documentation • Interviews with workers

** Phases: C = construction; O = operation* *° Sub-locations: ATL = Atlantic; SPW = St Paul Wetlands*

5. Environmental and Social Monitoring Program

The monitoring program is an integral part of the ESMP. It ensures that the legal obligations and the environmental and social safeguards identified as necessary in Section 4 and are all satisfactorily complied with, so as to reduce the impact of the Project on the environment and people.

There are two aspects to the monitoring exercise: compliance monitoring and impact detection monitoring, further described in the subsections below.

5.1. Objectives of the Environmental and Social Monitoring Program

The main objectives of environmental and social monitoring are to:

- Assess the changes in environmental and social conditions.
- Monitor the effective implementation of mitigation measures described in Section 4.
- Indicate potential problems in order to allow prompt implementation of effective corrective measures, so as to minimize the negative impacts generated.

Monitoring will be particularly important where:

- Environmental and social impacts cannot be estimated with suitable certainty.
- The efficiency of mitigation measures is uncertain.
- Impacts on the socio-economic environment are expected, or health and safety issues need to be addressed.

5.2. Compliance Monitoring

The PMU at the MPW is responsible for ensuring compliance of project activities with the mitigation measures, reference standards and guidelines set out in the mitigation and monitoring matrix of this ESMP (Table 4-1). This must be performed continuously throughout the life of the Project.

The PMU's monitoring is applied through:

- Continuously monitoring the implementation of the control and mitigation measures set out in this ESMP.
- Adopting remedial action and further mitigation and control measures when deemed necessary.

- Continuously testing and measuring project compliance with reference standards and guidelines.
- Record keeping of all environmental, social and OHS aspects of the Project. These include, but are not limited to, incident records, maintenance records of generators, equipment and vehicles, quantity and quality records for waste produced and disposed of by the Project, community or employees' complaints records, and internal and external grievance records.

A simple form for incident monitoring is suggested in Table 5-1. It shows the overall trends in performance and allows senior management to determine if the Project's environmental, social and health and safety compliance is improving or degrading.

Table 5-1 Suggested yearly incident monitoring indicator comparison table

Impact category		Number of incidents / 2026											
		Q1			Q2			Q3			Q4		
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1.	General environment management												
2.	Soil and land resources management												
3.	Water resources management												
4.	Air emissions management												
5.	Noise and vibration management												
6.	Visual intrusion management												
7.	Climate change adaptation and resilience												
8.	Waste management												
9.	Drainage and stormwater runoff management												
10.	Traffic and transport management												
11.	Hazardous materials management												
12.	Construction materials management												
13.	Biodiversity management												
14.	Ecosystem services management												
15.	Community relations management												
16.	Livelihood protection and restoration												

17.	Influx management												
18.	Cultural heritage management												
19.	Public health and safety management												
20.	Labor and working conditions management												
21.	Occupational health and safety management												
M = month, Q = quarter													

5.3. Impact Detection Monitoring

Impact detection monitoring includes periodic sampling and audit exercises to assess the impact of the Project's operations on the environment, human health and safety and social aspects, and to ensure progress towards minimizing the negative impacts generated.

When an environmental and/or social impact is spotted, efforts must be made to:

- Identify the most probable cause.
- Verify the proper implementation of the specified mitigation measures.
- Review the capacity of staff to implement mitigation measures effectively.
- Review the effectiveness of environmental management and monitoring measures and propose alternative actions as appropriate.
- Increase the monitoring frequency to assess the effectiveness of remedial measures.
- Verify the proper implementation of good housekeeping practices.

5.4. Environmental and Social Monitoring Plan

The environmental and social monitoring plan (Table 5-2) has been developed to cover both compliance monitoring and impact detection monitoring. It includes details on the monitoring of environmental, social, and health and safety parameters.

The monitoring plan shall be strictly implemented without ignoring any of the details in Table 5-2. The PMU retains overall responsibility for ensuring monitoring is conducted in accordance with regulatory and World Bank requirements. The PMU should hire and collaborate with an ITP consultant to ensure the implementation of the monitoring plan. Quarterly monitoring reports and must be issued by the ITP during construction and the early years of operation, as described in Section 7. During later stages of operation, monitoring reports shall be issued by the ITP on a bi-annual basis, unless increased frequency is required based on monitoring results, incidents, or regulatory requirements. Yearly environmental, social and health and safety audits must be issued by the ITP during construction and operation (or as frequently as specified in the environmental permit obtained from the EPA).

Table 5-2 Environmental and social monitoring program

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Weather data								
Routine monitoring of meteorological parameters	Weather station	• Rain • Wind speed • Wind direction • Humidity • Temperature • Solar radiation • UV index	• 1 station at any location in the Project area.	C-O	Continuous	Data logged at 30minute intervals (Recommended to capture short-term changes; monitoring frequency can be adjusted as needed based on the accuracy required to support project design and implementation.)	PMU, with support from ITP	USD 6,000 per unit
Soil quality								
Routine monitoring for signs of soil contamination and erosion	• Visual inspection • Photographs	• Signs of erosion or landsides • Drainage system conditions • Signs of contamination	• All active construction sites • All drainage corridors • Storage locations for fuel, chemicals and hazardous materials • Septic tank locations, if applicable • Effluent discharge points • Solid waste collection points	C-O	N/A	• Monthly (construction) • Quarterly (operation)	PMU and ITP	Under operational costs
Routine analysis for soil quality	• Sampling and laboratory analysis	As per Appendix C the list can be reduced or expanded depending on the results and change in activities	• 7 selected representative locations covering: ○ Upstream Wetland Area (SPW°) ○ Downstream wetland area (SPW°) ○ SPW° Drainage outfall ○ ATL° Drainage outfalls (2 samples, one at each drainage end) ○ Storage locations for fuel, chemicals and hazardous materials (2 samples)	C-O	N/A	• Quarterly during construction • Biannually during operation	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample (Approx. USD 5,250 per quarter or biannually)
In case of spill, contamination, or complaints	• Sampling and laboratory analysis	As per Appendix C; the list can be reduced or expanded depending on the results and change in activities	To be determined based on location and extent of contamination or complaint	C-O	N/A	To be determined based on contamination extent and severity	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample
Groundwater quality								
Routine monitoring of groundwater quality and level	• Multi parameter InSitu water quality probe	• pH • Conductivity • Turbidity • Oxidation reduction potential • Dissolved oxygen • Temperature • Water level	• At 2 locations, one close to ATL° and one to SPW°. Exact locations can be determined in collaboration with community leaders. Suggestions: ○ ATL°, around Redemption Hospital area ○ SPW°, around, Bong Mine Railway	C-O	Continuous	Data logged at 15minute intervals (Recommended to capture short-term changes; monitoring frequency can be adjusted as needed based on the accuracy required to support project design and implementation.)	PMU, with support from ITP	USD 20,000 per unit

Routine monitoring of groundwater quality	• Sampling and laboratory analysis	As per Appendix C; the list can be reduced or expanded depending on the results and change in activities	• At the same two locations continuously monitored	C-O	N/A	• Quarterly during construction • Biannually during operation	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample (Approx. USD 1,500 per quarter or biannually)

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
In case of spill, leachate contamination or complaints	• Sampling and laboratory analysis	As per Appendix C; the list can be reduced or expanded depending on the results and change in activities	To be determined based on affected wells and extent of contamination or complaint	C	N/A	To be determined based on contamination extent and severity	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample
Surface water quality								
Routine monitoring of surface water quality and level	• Multi parameter InSitu water quality probe	• pH • Conductivity • Turbidity • Oxidation reduction potential • Dissolved oxygen • Temperature • Water level	• At 2 locations: ○ 1 at the outfall of SPW° drainage system ○ 1 at one of the outfalls of ATL° drainage system, the one with the lowest elevation	C-O	Continuous	Data logged at 15minute intervals (Recommended to capture short-term changes; monitoring frequency can be adjusted as needed based on the accuracy required to support project design and implementation.)	PMU, with support from ITP	USD 20,000 per unit
Routine monitoring of water level in the SPW system wetlands	• In-situ level troll • Installation infrastructure (Protective stilling well or PVC pipe)	• Water level (m) • Depth-to-water	• At 2 locations: ○ In the most upstream wetland of the SPW° system ○ In the most downstream wetland of the SPW° system	C-O	Continuous	Data logged at 5minute intervals (Recommended to capture short-term changes; monitoring frequency can be adjusted as needed based on the accuracy required to support project design and implementation.)	PMU, with support from ITP	USD 7,500 per unit
Routine monitoring of water quality	• Sampling and laboratory analysis	As per Appendix C; the list can be reduced or expanded depending on the results and change in activities	• At 4 locations covering: ○ The upstream wetland of the SPW° system ○ The outfall of the SPW° system ○ The outfalls of the ATL° system on both ends (2 samples)	C-O	N/A	• Monthly during construction • Quarterly during operation	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample (Approx USD 3,000 per month or quarter)
In case of spill, contamination, or complaints	• Sampling and laboratory analysis	As per Appendix C; the list can be reduced or expanded depending on the results and change in activities	To be determined based on affected surface water and extent of contamination or complaint	C-O	N/A	To be determined based on contamination extent and severity	ITP, with support from PMU	Cost depends on final number of samples and parameters at approx. USD 750 per sample
Monitoring of water abstraction quantity and rates, if applicable.	• Pump meter • Staff Gauge • Abstraction log sheets	• Daily abstraction volume • Pump operating hours and hour-meter readings • Abstraction rates	At each abstraction point	C	During each abstraction event	Monthly	PMU, with support from ITP	Approx. USD 1,500 per system
Air quality								

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Routine monitoring of dust and gaseous emissions	• Handheld monitor (e.g., Aeroqual S500 with different sensor heads or similar)	• PM10 • PM2.5 • CH_4 • CO • CO_2 • H_2S • NO_2 • O_3 • SO_2 • VOCs	• Selection of active working sites and sensitive receptors (such as nearest community, school, hospital, etc.)	C-O	Ranging between 10 min and 1 hr per parameter based on the shortest standard time available, to enable comparison	• Monthly during construction • At the time of maintenance activities during operation	ITP, with support from PMU	USD 20,000 per system of monitor and sensors
In case of complaints	• Handheld monitor (e.g., Aeroqual S500 with different sensor heads)	• To be determined based on complaint	• To be determined based on complaint	C	To be determined based on complaint	To be determined based on complaint	ITP, with support from PMU	Covered under the same equipment used for routine monitoring.
Noise and vibration								
Routine noise monitoring	• Noise monitoring device	• LAeq • Lamin • Lamax • LCpeak • LAn (LA90, LA50, LA10)	• Selection of active working sites and sensitive receptors (such as nearest community, school, hospital, etc.)	C-O	• Minimum 1 hr in daytime and 1 hr at nighttime (if nighttime works are anticipated)	• Monthly during construction • At the time of maintenance activities during operation	ITP, with support from PMU	USD 20,000 per unit
In case of complaint	• Noise monitoring device	• To be determined based on complaint	• To be determined based on complaint	C-O	• To be determined based on complaint	To be determined based on complaint	ITP, with support from PMU	Covered under the same equipment used for routine monitoring.
Waste								
Solid waste storage	• Visual inspection • Photographs • Inspection checklist	• Container condition • Storage area condition • Leaks, drips, cracks, corrosion, damage • Proper labeling	• Waste storage locations	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation	PMU and ITP	Under operational and supervision cost
Solid waste segregation, generation and disposal	• Visual inspection • Photographs • Documentation	• Segregation and collection practices (correct waste types in correct bins) • Waste generation logs (type and amount, transfer details, disposal destination) • Waste collector's EPA environmental permit	• Waste bins	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation	PMU and ITP	Under operational and supervision cost

Hazardous waste management and disposal	• Visual inspection • Photographs • Inspection checklist • Documentation	• Container condition • Storage area condition (bunding, roofing, impervious surface below, locked area) • Proper labeling • Hazardous waste logs (type of material, physical state, quantity, storage conditions, location on site, transfer details) • Disposal destination	• Hazardous waste storage locations	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation	PMU and ITP	Under operational and supervision cost
Sludge and wastewater	• Visual inspection • Photographs • Documentation	• Tank condition • Signs for leaks • Transfer log to EPA-certified collector	• Septic tanks • Any area generating sludge	C-O	N/A	• Monthly during construction • Bi-annually during operation	PMU and ITP	Under operational and supervision cost

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Handling of hazardous materials								
Storage, handling, and disposal of hazardous materials	• Visual inspection • Photographs • Audit • Review of MSDS • Record-keeping • Staff interviews	• Labeling and segregation • Condition of containers and storage area • Secondary containment • Compatibility of stored materials • Presence of MSDS on site • Use of PPE • Incident and spill reporting • Training and awareness of staff • Records and manifests	• Chemical storage areas • Workshops • Maintenance bays	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation	PMU and ITP	Under operational and supervision cost
Fuel offloading, storage and dispensing	• Visual inspection • Photographs • Documentation • Audit • Staff interviews	• Condition of storage tanks and secondary containment • Integrity of hoses, valves and fittings • Use of drip trays and spill kits • Adherence to fuel handling and transfer procedures • Record of fuel volumes and losses • Compliance with spill prevention and response plan • Condition and accessibility of fire safety equipment • Staff awareness and training records	• Fuel offloading points • Storage tank areas • Fuel dispensing points • Vehicle service areas • Workshops	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation	PMU and ITP	Under operational and supervision cost

Oil-water separators	• Visual inspection • Photographs • Documentation • Audit	• Separator integrity • Accumulated sludge/oil levels • Frequency of maintenance and cleaning • Effluent quality, compliance with discharge criteria • Maintenance logs • Proper disposal of sludge/oil	• Workshops • Vehicle wash areas • Refueling areas	C-O	N/A	• Monthly during construction • Bi-annually during operation	PMU and ITP	Under operational and supervision cost
Biodiversity and ecosystem services								
Mangrove condition and buffer compliance	• Visual inspection • Photographs	• Evidence of cutting • Root damage • Buffer zone fencing/signage • Encroachment into exclusion buffer	SPW° - Mangrove stands and buffer zones adjacent to works	C–O	Daytime	Monthly during construction and during active maintenance activities	PMU and ITP	Under operational costs
Wetland and marshy habitat condition	• Visual inspection • Photo points	• Signs of drying • Prolonged inundation • Physical disturbance	SPW° - Marshy wetlands and wetland margins	C	Daytime	Monthly	PMU and ITP	Under operational costs
Vegetation clearing	• Visual inspection	• Clearing confined to approved footprints • No mangrove removal	All construction sites	C	Daytime	Monthly	PMU and ITP	Under operational costs
Beach habitat condition	• Visual inspection • Photo points	• Extent of beach disturbance • Signs of erosion, scour, or debris accumulation	ATL°- Beach area adjacent to outlet location(s)	C	Daytime	Monthly	PMU and ITP	Under operational costs

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Temporary flow diversion effects on biodiversity	• Visual inspection	• Signs of fauna trapping, wetland stress, or abnormal conditions	Active diversion and work areas	C	Daytime	Monthly	PMU and ITP	Under operational costs
Wildlife encounters and mortality	• Incident log • Worker observation	• Fauna injury, mortality, or repeated disturbance	Active construction zones	C	Daytime	Continuous; incidents logged as they occur	PMU and ITP	Under operational costs
Invasive species spread	• Visual inspection • Photographs	• New invasive growth outside known invaded areas	Disturbed areas, reinstated zones, disposal sites	C-O	Daytime	Monthly during construction and during active maintenance activities	PMU and ITP	Under operational costs
Rehabilitation of disturbed habitats	• Visual inspection • Photographs	• Stabilization and vegetation recovery	Rehabilitated channel margins	C- early O	Daytime	Monthly until stabilized	PMU and ITP	Under operational costs
Access to ecosystemservice areas (fishing, clay extraction)	• Site observation • Grievance review	• Unplanned or prolonged loss of access • Grievances	• ATL-SPW°: Fishing areas and landing sites close to works • SPW°: Wetland margins	C-O	Daytime	Monthly during construction and during active maintenance activities	PMU and ITP	Under operational costs
Disposal of vegetation and sediments	• Document review • Site inspection where feasible	• Disposal at approved sites only; no dumping in sensitive habitats	Approved disposal sites (if accessible)	C-O	Daytime	Monthly during construction and during active maintenance activities	PMU and ITP	Under operational costs

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Social performance and community relations								
Stakeholder engagement, grievance redress, and community relations	• Documentation (stakeholder engagement matrix and grievance records) • Photographs • Interviews with communities	• Frequency and quality of community engagement activities • Number and type of grievances received • Time taken to resolve grievances • Recurrence of similar complaints • Community satisfaction with engagement and resolution process • Inclusivity of stakeholder groups • Accuracy and completeness of stakeholder engagement records • Evidence of feedback integration into project activities	• Affected communities: ○ Central New Kru Town ○ Colonel West ○ Duala Market ○ Fundaye ○ Lagoon ○ Supermarket Community ○ Popo Beach ○ Trowin ○ Bong Mines Bridge ○ Caldwell Road ○ Crab Hole ○ Gbandi Town ○ Island Clinic ○ King Peter Town ○ Momboe Town ○ Whea Town ○ Tweh Town ○ Zuma Town	C	N/A	• Monthly • Continuous for logging GRM data	PMU, with support from ITP	Under operational costs
Community health and safety	• Documentation (medical reports, accident reports, GRM) • Interviews with communities and health workers • Audit	• Frequency and severity of reported health incidents • Types and causes of community accidents • Effectiveness of emergency response and first aid • Uninterrupted community access to health facilities through construction scheduling and advance community notification • Trends in health-related grievances and community complaints • Implementation of community safety awareness programs • Staff and contractor compliance with health and safety protocols	• Affected communities: ○ Central New Kru Town ○ Colonel West ○ Duala Market ○ Fundaye ○ Lagoon ○ Supermarket Community ○ Popo Beach ○ Trowin ○ Bong Mines Bridge ○ Caldwell Road ○ Crab Hole ○ Gbandi Town ○ Island Clinic ○ King Peter Town ○ Momboe Town ○ Whea Town ○ Tweh Town ○ Zuma Town	C	N/A	Quarterly	ITP, with support from PMU	Under operational costs

Influx management	• Visual inspection • Photographs • Interviews with workers and communities • Grievance records	• Influx size (number, origin, and duration of stay of incoming workers) • Worker behavior in surrounding communities (e.g., compliance with Code of Conduct) • Conditions and appropriateness of worker accommodation by the Contractor, if any (overcrowding, hygiene, segregation from host community) • Grievances or complaints related to worker influx and social interactions • Community perceptions of security and pressure on local services due to influx	• Affected communities: ○ Central New Kru Town ○ Colonel West ○ Duala Market ○ Fundaye ○ Lagoon ○ Supermarket Community ○ Popo Beach ○ Trowin ○ Bong Mines Bridge ○ Caldwell Road ○ Crab Hole ○ Gbandi Town ○ Island Clinic ○ King Peter Town ○ Momboe Town ○ Whea Town ○ Tweh Town ○ Zuma Town • Project site	C	N/A	Monthly	ITP and PMU	Under operational costs
Resettlement and livelihood restoration implementation	• Review of RAP implementation reports • GRM records • Audit / verification • Other methods as stipulated in the RAP (if applicable)	• Status of compensation and resettlement support payments (completed / pending) • Timeliness of payments • Progress of livelihood restoration activities • Number of PAPs engaged in livelihood programs • Status of vulnerable household support • Trends in resettlement-related grievances	• Affected communities / resettlement sites (as defined in RAP)	C-O	N/A	Quarterly (or aligned with RAP reporting)	PMU, with support from other entities as defined in RAP	Under RAP implementation budget

Monitoring activity	Equipment or method	Parameter	Location	Phase*	Duration and time of day	Frequency	Responsibility	Cost (USD)
Employee rights								

Labor and working conditions	• Visual inspection • Photographs • Documentation (contracts, internal grievances) • Interviews with workers and communities	• Employment conditions (contract clarity, wage compliance, hours, benefits) • Working conditions (safety, sanitation, breaks, PPE availability) • Protection of women's rights and prevention of sexual and GBV through the enforcement of the worker's code of conduct and the workers' grievance redress and GBV/SH mechanisms • Availability and awareness of grievance mechanisms among workers • Inclusion of women, youth, and vulnerable groups in the workforce • Prevention of child labor in accordance with national labor laws and ESS2 • Record of internal grievances and resolution status • Workers' perception of fairness and respect in the workplace	• Affected communities: ○ Central New Kru Town ○ Colonel West ○ Duala Market ○ Fundaye ○ Lagoon ○ Supermarket Community ○ Popo Beach ○ Trowin ○ Bong Mines Bridge ○ Caldwell Road ○ Crab Hole ○ Gbandi Town ○ Island Clinic ○ King Peter Town ○ Momboe Town ○ Whea Town ○ Tweh Town ○ Zuma Town • Project site	C	N/A	Monthly	ITP and PMU	Under operational costs
Occupational health and safety								
Safety inspection, testing, and calibration	• Visual inspection • Photographs • Functionality testing • Inspection checklists • Calibration records	• Safety features • PPE effectiveness • Equipment condition • Presence and condition of first aid kits • Presence, visibility and legibility of safety signs and instructions • Availability and proximity of firefighting equipment	All project sites, including vehicles	C-O	N/A	• Monthly during construction • At the time of maintenance activities during operation • Calibration per manufacturer's recommendation	ITP and PMU	Under operational cost
Surveillance of workers' health	• Medical exams and checkups • Health records	• Health status • Workplace exposure indicators	All project sites	C-O	N/A	• Pre-employment • Annually • As needed	ITP and PMU	Under operational cost
Training	• Attendance sheets • Training records	• Training frequency, attendance, and curriculum • Drills and exercises	All project sites	C-O	N/A	• At start of employment • Bi-annually for drills and exercises	ITP and PMU	Under operational cost

Accident and disease monitoring	• Reporting and recording systems • Incident forms and logs • First aid and emergency response records	• Rates of accidents and fatalities • Rates of occupational injuries, near misses, and dangerous occurrences • Diseases	All project sites	C-O	N/A	• Immediate reporting • Monthly / quarterly analysis	ITP and PMU	Under operational cost
** Phases: C = construction; O = operation*	*° Sub-locations: ATL = Atlantic; SPW = St Paul Wetlands*							

5.5. Review and Update of the Environmental and Social Monitoring Program

The environmental and social monitoring program will need to be periodically revised and updated to ensure that monitoring parameters, frequency, and methods remain relevant and effective in identifying environmental and social trends and verifying compliance.

Revisions to the monitoring program will be triggered by various factors, as described in Box 5-1.

Box 5-1 Revising and updating the environmental and social monitoring program

When to revise and update the environmental and social monitoring program

- **Regulatory and compliance-driven updates** ○ **Changes in laws or regulations**: When environmental or social monitoring requirements are updated by national authorities, international lenders (e.g., World Bank), or industry standards.
  - **Permit or license modifications**: When regulatory agencies impose new monitoring obligations as part of permit conditions.
  - **Non-compliance issues**: If audits or inspections reveal monitoring gaps or weaknesses in data collection.
- **Project changes and expansions** ○ **Change in project design or scope**: If the project expands, modifies activities, or introduces new infrastructure that could alter environmental and social impacts.
  - **New environmental or social risks**: If previously unidentified risks emerge.
  - **Geographic expansion**: If the Project extends into new areas.
- **Monitoring data and performance findings** ○ **Ineffectiveness of existing mitigation measures**: If monitoring results indicate that current mitigation strategies are not achieving intended outcomes.
  - **Environmental exceedances**: If pollution, emissions, or discharges exceed regulatory limits or projectspecific thresholds.
  - **Significant environmental or social incidents**: If significant spills, accidents, worker injuries, community conflicts, or biodiversity impacts occur.
  - **Community or stakeholder feedback**: If grievances, complaints, or engagement findings suggest that current monitoring does not capture key issues.
- **Operational and management changes** ○ **Organizational reforms in the Project**: If restructuring, changes in management, contractors, or shifts in responsibility impact monitoring processes.
  - **Changes in operational procedures**: If updates to standard operating procedures affect environmental or social risks.
  - **Improved monitoring technologies**: If advancements in sensors, remote sensing, or field methodologies can enhance monitoring accuracy.
  - **Lessons learned from similar projects**: If best practices from other projects highlight better monitoring approaches.
- **Scheduled and periodic updates** ○ **After a year of monitoring**: after covering both a dry and a rainy season to capture seasonal variations. ○ **Regular review cycle**: As part of a scheduled annual program update to ensure continued effectiveness.
  - **End of project phase or closure**: If transitioning to a new phase, decommissioning, or post-closure environmental and social commitments.

6. Adaptive Management

Adaptive management is a structured and iterative approach to decision-making that allows for flexibility and continuous improvement in the face of uncertainty. It enables project teams to adjust environmental and social management measures based on monitoring results, feedback, and changing site conditions. This principle is central to the ESMP and ensures that mitigation and monitoring measures remain effective, relevant, and compliant throughout the project lifecycle.

6.1. Objectives

The objectives of adaptive management are to:

- Ensure that environmental and social mitigation measures remain effective across changing conditions (e.g., traffic volume, seasonal variation, community dynamics, operational changes).
- Respond promptly and effectively to new or unforeseen impacts, such as exceedances of monitoring thresholds, near-miss incidents, or stakeholder grievances.
- Support continuous improvement through evidence-based updates to management procedures and mitigation strategies.
- Maintain compliance with applicable national regulations and World Bank ESSs.

6.2. Key Components

The key components of adaptive management are described below.

- **Monitoring-informed decision-making**

Project performance will be continuously monitored against the mitigation and monitoring measures outlined in the ESMP. When performance indicators exceed thresholds or when community complaints arise, corrective and preventive actions will be implemented, and relevant management procedures will be updated.

- **Periodic review and update**

This ESMP will be reviewed and updated to reflect lessons learned, operational changes, and feedback from stakeholders and monitoring programs. Updates will occur:

  - Annually, as part of routine performance review
  - Following major operational or design changes (See Sections 6.3 and 6.4)
  - After incidents, accidents, or cases of non-compliance
  - In response to stakeholder grievances or external audit findings
  - Following emergency drills
  - In response to new legal requirements or monitoring results

All revisions will be documented, dated, and tracked through version control, and communicated to relevant personnel, contractors and sub- contractors.

- **Stakeholder feedback integration**

Feedback from affected communities, workers, contractors, and monitoring teams will be systematically reviewed and incorporated into management updates. Stakeholder engagement outcomes, grievances, and consultation feedback will be used to refine mitigation and monitoring approaches.

- **Flexibility and contingency planning**

The ESMP will be updated to accommodate changes in baseline conditions. If new environmental or social risks emerge, the management approach will be reassessed, mitigation measures revised, and resources reallocated as necessary to maintain compliance and effectiveness.

- **Institutional capacity**

The PMU will ensure that all personnel responsible for ESMP implementation, including contractors and sub-contractors, are trained in adaptive management principles. The Environmental, Social, and OHS Specialists will oversee the review process and recommend adjustments to management plans and procedures. Training and awareness sessions will be conducted periodically—or following major ESMP revisions—to ensure that all staff understand and apply adaptive management practices in their daily work.

6.3. Management of Design Changes

This ESMP is based on the preliminary design information available at the time of its preparation. As the Project progresses to the detailed design stage, refinements to alignments, footprints, construction methods, drainage structures, ancillary facilities, or sequencing of works may occur.

All proposed design modifications shall be screened by the PMU ES, SGS and OHSS prior to implementation to determine whether the change may:

- Expand the project footprint
- Increase land acquisition or affect additional households
- Result in additional vegetation clearance
- Introduce new ancillary facilities (e.g., laydown areas, borrow sites, disposal sites)
- Alter traffic management arrangements
- Generate new or increased environmental, social or OHS impacts

Where screening determines that a modification may result in new or materially increased impacts, the ESMP and any relevant instruments (including the RAP) shall be updated accordingly prior to implementation.

Where required, revised instruments will be submitted to the EPA and/or the World Bank for review and clearance in accordance with applicable regulatory and ESF requirements.

No design change with material environmental or social implications shall be implemented until appropriate assessment, mitigation updates, and approvals are completed.

6.4. MANAGEMENT OF OPERATIONAL ARRANGEMENTS AND CHANGES

At the time of ESMP preparation, certain aspects of long-term operation and maintenance arrangements (including institutional responsibilities, maintenance frequency, equipment deployment, waste handling logistics, etc) are still under refinement.

Prior to commencement of operations, the PMU ES, SGS and OHSS shall confirm the operational model and conduct a screening to assess whether the finalized operational arrangements introduce any new or materially different environmental, social, health, or safety risks compared to those assessed in this ESMP.

Where operational procedures differ from those assumed during the ESIA phase, the ESMP and relevant operational management procedures shall be updated.

If screening identifies new or increased impacts, additional mitigation measures shall be developed and implemented prior to the start of operations. Where required, updated instruments will be submitted to the EPA and/or the World Bank for review and clearance.

No operational activities shall commence without confirmation that environmental and social management measures are adequate for the finalized operational arrangements.

7. Environmental and Social Reporting

7.1. Environmental and Social Reporting by the Contractor

The Contractor will prepare monthly environmental and social compliance reports. These reports will be submitted to the Supervising Engineer for review and then to PMU and World Bank for final review and approval.

The compliance reports shall demonstrate compliance with all applicable environmental and social requirements, including full implementation of the mitigation measures set out in this ESMP, the Contractor's C-ESMP, and any other relevant project instruments and contractual obligations. Each report shall include, at a minimum:

- A summary of environmental and social performance during the reporting period
- Status of implementation of all ESMP mitigation measures
- Records of incidents, accidents, grievances, non-compliances, and corrective actions taken
- Photographic evidence and supporting documentation, as appropriate
- Planned corrective and preventive actions for the subsequent reporting period

7.2. Environmental and Social Reporting by the Independent Third Party

An ITP Consultant who holds an Environmental Evaluator license from the EPA will prepare environmental and social monitoring reports on a quarterly basis during construction and early operation (first 3 years) and bi-annually during later operation (after 3 years), unless increased frequency is required based on monitoring results, incidents, or regulatory requirements. These reports will present monitoring results, evaluate the effectiveness of mitigation measures, and recommend improvements. After review and approval by the PMU, the ITP will submit these reports to the EPA.

Furthermore, an integrated ESHS Audit will be carried out by an ITP consultant annually (or as frequently as specified in the environmental permit obtained from EPA). This audit will consolidate monitoring findings and assess the adequacy of environmental and social controls. Once approved by the PMU, the ITP will submit the audit report to the EPA.

7.3. Environmental and Social Reporting by the Supervising Engineer

The Supervising Engineer shall prepare and submit monthly progress reports to the PMU. These reports shall incorporate the monthly environmental and social compliance reports submitted by the Contractor, together with the Supervising Engineer's review, verification, and assessment of the Contractor's environmental and social performance.

The Supervising Engineer's report shall document findings from site inspections, compliance verification activities, identified non-conformities, and the status of corrective actions, and shall provide an overall assessment of environmental and social performance during the reporting period.

7.4. Environmental and Social Reporting by the PMU

A consolidated summary of the Supervising Engineer's monthly progress reports and the ITP's environmental and social monitoring reports and audits will be submitted to the World Bank every six months, as part of regular progress reporting.

In cases of complaints, non-compliance, incidents, accidents, or exceedances of applicable national or international standards, the PMU shall issue formal notifications to the Contractor requiring immediate corrective action within specified timeframes. Where non-compliance is deemed serious, repeated, or poses significant environmental, social, health, or safety risks, the PMU may, upon recommendation of the Supervising Engineer or ITP, require suspension of the relevant activities until satisfactory remedial measures have been implemented.

The PMU shall immediately notify the EPA and other relevant national authorities, as well as the World Bank of any significant environmental or social incidents or accidents.

8. Grievance Redress Mechanism

A GRM is established to ensure that both internal and external grievances are addressed in a timely, transparent, and culturally appropriate manner, in line with World Bank ESS requirements. The GRM provides a structured process for receiving, documenting, assessing, reporting, and resolving grievances or complaints from individuals or groups affected by or interested in the project. For additional details on the GRM, refer to Appendix D.

Key features of the GRM include:

- Multiple accessible channels for lodging grievances, including hotlines, email, social media platforms and physical submission points.
- Procedures for managing grievances that can be resolved directly and those requiring referral to third parties or official agencies.
- Clear documentation and tracking of all grievances through a grievance register or matrix.
- Awareness-raising to ensure communities understand how to access the GRM, with no cost, barriers, or risk of retaliation.
- Integration into contractors' Workforce Management Plans, with training on GRM procedures provided to all staff and contractors.

The GRM ensures equitable access for all, including women, men, and vulnerable groups such as persons with disabilities. Specific provisions include:

- Confidential handling of grievances related to Gender-Based Violence (GBV), and SEA/SH.
- Referral pathways linking GBV survivors to local support services, including health, psychosocial, and legal assistance.
- Zero tolerance for retaliation or victimization of individuals submitting complaints.
- Designation of female GRM focal points for gender-sensitive complaints.
- Training for GRM staff on survivor-centered, gender-sensitive grievance handling.
- Community awareness initiatives, especially for women, on reporting procedures, rights, and available support, delivered in relevant local languages (e.g., Mano, Gio, English, and simple Liberian English).
- Collection of gender-disaggregated grievance data to track trends and ensure proper resolution.
- GBV-related grievances to be referred to specialized service providers in accordance with national protocols.

9. Contractor Obligations

All contractors and sub-contractors engaged for project activities are required to comply with the following obligations to ensure that ESHS standards are maintained throughout the project lifecycle.

- **Legal and regulatory compliance:** Adhere to all applicable national laws, permits, and World Bank ESSs, and good international industry practice.
- **Environmental and ecological protection:** Minimize impacts on land, water, air, and biodiversity; manage waste responsibly; and implement site-specific ESMP mitigation measures.
- **Community engagement:** Respect local communities, address grievances promptly, and manage risks related to social issues and workforce influx.
- **Health and safety:** Ensure the health and safety of personnel and local communities through proper training, personal protective equipment (PPE), and emergency procedures.
- **Monitoring and reporting:** Maintain records of ESHS performance, report incidents promptly, and implement corrective actions.

The clauses to be included in contractor contractual agreements are presented in Appendix E.

10. Environmental and Social Action Plan and Budget

The main environmental and social actions that must be implemented and documents that must be developed by the PMU and its Contractor are listed in Table 10-1, along with the responsible entity and the approximate budget required. Unless specified otherwise, the cost included covers the lifetime of the Project, i.e. assumes 9 months of construction, and 25 years of operation.

The costs presented are indicative and based on current assumptions. Actual costs will depend on contractor methodologies, procurement processes, and market conditions. Funding for ESMP implementation will be secured through a combination of PMU project budget allocations, contractor obligations embedded within works contracts, and supervising engineer and third-party monitoring contracts. A contingency allowance of 10% of the ESMPrelated budget shall be maintained to address unforeseen environmental and social management needs.

The PMU must ensure that these actions are completed or in place before work can begin.

Table 10-1 Environmental and social action plan

No.	Item	Responsibility	Approximate cost (USD)
Before construction activities begin			
1.	Recruit ISO 45001:2018 certified OHS Specialist	PMU	Under PMU operational costs
2.	Contractor's ESMP (C-ESMP)	Contractor	Under contractor operational cost

3.	Workforce Management Plan	Contractor	Under contractor operational cost
4.	Project Site-specific Waste Management Plan (S-WMP)	PMU	Procured
5.	Traffic and Transport Management Plan	Contractor	Under contractor operational cost
6.	Occupational Health and Safety (OHS) Plan	Contractor	Under contractor operational cost
7.	Emergency Preparedness and Response Plan (EPRP)	Contractor	Under contractor operational cost
8.	Resettlement Action Plan (RAP) (standalone report)	PMU	Procured
9.	Livelihood Restoration Plan (if required under RAP)	PMU	To be decided under RAP
10.	Vulnerable People's Plan (if required under RAP)	PMU	To be decided under RAP
11.	Internal Grievance Redress Mechanism (GRM)	Contractor	Under contractor operational cost
12.	Contractor Workers Code of Conduct	Contractor	Under contractor operational cost
13.	Environmental Permit	PMU	To be decided by the EPA
14.	Recruit ITP Consultant	PMU	Under costs for rows no. 15, 16, 17, 20, 21, 22
No.	**Item**	**Responsibility**	**Approximate cost (USD)**
Throughout the Project (construction and operation phases)			
15.	Monitoring equipment cost – initial set-up (includes 4 multiparameter water monitoring probes, 2 water level probes, 1 noise level meter, 1 handheld gas monitoring device, 1 weather station and 1 pump flow meter system; does not include cost of calibration, sensor or equipment replacement)	ITP	142,500
16.	Regular environmental sampling for soil and water quality (does not cover contingency cost in case of spill or complaint) - construction and early operation (first 3 years)	ITP	63,000 / year
17.	Regular environmental sampling for soil and water quality (does not cover contingency cost in case of spill or complaint) - operation (beyond 3 years)	ITP	25,500 / year
18.	Monthly environmental and social compliance reports	Contractor	Under contractor operational cost
19.	Monthly environmental and social progress reports	Supervising Engineer	Under Supervising Engineer operational cost
20.	Quarterly environmental and social monitoring reports - construction and early operation (first 3 years)	ITP	15,000 / quarter
21.	Bi-annual environmental and social monitoring reports - operation (beyond 3 years)	ITP	15,000 / 6 months

22.	Yearly environmental, social, and health and safety audit	ITP	50,000 / year
23.	Bi-annual progress reports to World Bank	PMU	Under PMU operational cost
24.	Capacity building	PMU	45,000-65,000
Contingency			
25.	ESMP contingency allowance	PMU	10% of total budget

A summary of estimated PMU budget for the construction phase (9 months) is provided in Table 10-2. For the operation phase, an estimate budget is given for the first year of operation in Table 10-3.

Table 10-2: Estimated budget for PMU during 9 months of construction

Category	Calculation basis	Estimated budget (USD)
Capacity building	See Section 3.1.3	**65,000**
Environmental monitoring and periodic audits		
Environmental monitoring equipment	*Lump sum*	*142,500*
Environmental sampling	*9 sampling events for soil @ 5, 250 USD/ event + 9 sampling events for groundwater @ 1500 USD/event + 9 sampling events for surface water @ 3000 USD/event*	*87,750*
Monitoring reports	*3 reports @ 15,000 USD/report*	*45,000*
Audits	*1 report @ 50,000 USD/report*	*50,000*
Environmental monitoring and periodic audits total		**325,250**
Total		**390,250**
Contingency	10% of total cost	**39,025**
Total including contingency	Total + Contingency	**429,275**

Table 10-3: Estimated budget for PMU during the first year of operation

Category	Calculation basis	Estimated yearly budget (USD)
Environmental sampling	*2 sampling events for soil @ 5, 250 USD/ event + 2 sampling events for groundwater @ 1500 USD/event + 4 sampling events for surface water @ 3000 USD/event*	*25,500*
Monitoring reports	*4 reports/year during first 2 years 2 reports per year beyond 2 years @ 15,000 USD/report*	*60,000*

Audits	*1 report @ 50,000 USD/report*	*50,000*
Total		**135,500**
Contingency	10% of total cost	**13,550**
Total including contingency	Total + Contingency	**149,050***
** This sum is expected to decrease by about 20% after few years of operation*		

Appendix A. Environmental and Social Standards and Guidelines

Appendix B. Guidelines for Project-Required Arrangements and Plans

B.1 Guidelines for Environmental Plans and Arrangements

B.1.1 Environmental and Social Management System B.1.2 Siting, Management and Closure of Borrow Pits and Quarries B.1.3 Borrow Pit and Quarry Closure Plan B.1.4 Waste Management Plan

B.2 Guidelines for Social Plans and Arrangements

B.2.1 Resettlement Action Plan B.2.2 Workforce Management Plan

B.3 Guidelines for Health and Safety Plans and Arrangements

B.3.1 Occupational Health and Safety Plan B.3.2 Emergency Preparedness and Response Plan B.3.3 Traffic and Transport Management Plan

Appendix C. Monitoring Program Parameters

Appendix D. Project Grievance Redress Mechanism

Appendix E. Contractor Clauses

E.1 General Environmental and Social Compliance

E.2 Contractor Environmental and Social Management System

E.3 Mandatory Contractor Plans

E.4 Environmental Protection

E.5 Vegetation Clearing and Biodiversity Protection

E.6 Labor and Working Conditions

E.7 Occupational Health and Safety

E.8 Community Health, Safety, and Traffic

E.9 SEA/SH Prevention

E.10 Stakeholder Engagement and Grievance Redress

E.11 Cultural Heritage and Chance Finds

E.12 Monitoring, Reporting, and Access

E.13 Non-Compliance and Corrective Actions

E.14 Completion and Site Reinstatement