Environmental and Social Impact Assessment for Hybrid Wastewater Treatment System in Juba City

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South Sudan Urban Water Corporation

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South Sudan Urban Water Corporation

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Abbreviations and Acronyms

AfDB	African Development Bank
AOI	Area of Influence
BOD	Biological Oxygen Demand
C&D	Construction and Demolition
CWIS	Citywide inclusive sanitation
CMP	Contractor Management Plan
CO	Complaint Owner
COD	Chemical Oxygen Demand
CPA	Comprehensive Peace Agreement
DPR	Detail Project Report
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ESMP	Environmental and Social Management Plan
ERM	Environmental Resources Management
ERP	Emergency Preparedness and Response Plan
ESIA	Environment and Social Impact Assessment
E&S	Environment and Social
ESAP	Environmental and Social Action Plan
ESDD	Environment and Social Due Diligence
FC	Fecal Count
FS	Fecal Sludge
FSTP	Fecal sludge treatment Plant
GBV	Gender based Violence
GoSS	Government of South Sudan
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HH	Household
HSE	Health safety and environment
IFC	International Finance Corporation
ISS	Integrated Safeguards System
JCC	Juba City Council
JICA	Japan International Cooperation Agency
LS	Lifting station

LMP	Labour Management Plan
MLD	Million Liter per day
MOEF	Ministry of Environment and Forestry
MLHUD	Ministry of Land, Housing and Urban Development
MWRI	Ministry of Water Resources and Irrigation
MPS	Main pumping station
NEMA	National Environmental Management Authority
NOS	No objection Certificate
OD	Open Defecation
OHS	Occupational Health and safety
O&M	Operation and Maintenance
OS	Operation standard
PAP	Project Affected Person
PMP	Pollution Management Plan
PMU	Project Management Unit
PPP	Public Private Partnership
PS	Pumping Station
RAP	Resettlement Action Plan
QHSE	Quality, Health, Safety and Environment
ROW	Right of way
SBR	Sequential Batch Reactor
SEP	Stakeholder Engagement Plan
SOP	Standard Operating Procedure
SR	Safeguarding requirements
SS	Suspended solids
STP	Sewerage Treatment Plant
SSUWC	South Sudan Urban Water Corporation
SUWASA	South Sudan Sustainable Water and Sanitation in Africa (Project)
WW	Wastewater
WWTP	Wastewater Treatment Plant
ToR	Terms of Reference
TDS	Total Dissolved Solids
TS / TSS	Total Solids / Total Suspended Solids

Glossary

Aerobic A biological decomposition process in the presence of oxygen
Anaerobic A biological decomposition process in the absence of oxygen
Anaerobic Digestion A series of biological processes in which microorganisms break down biodegradablematerial in the absence of oxygen
Biodegradable Organic material or waste that is degraded or chemically dissolved by bacteria or otherliving organisms.
Biogas Gas containing mostly methane generated when wastes decompose anaerobically
Baseline: A description of the biophysical and socio-economic state of the environment at a given time, prior to development of a particular project.
Biodiversity: The variety of life on earth.
Composting Controlled aerobic biological decomposition of organic matter, such as food scraps andplant matter, and other organic waste into humus, a soil-like material
Contamination: Pollution.
Environment: The combination of elements whose complex interrelationships make up the settings, surroundings and conditions of life of the individual and society as they are or are felt.
Environmental and Social Management Plan: A comprehensive plan for the implementation of mitigation measures prescribed in the environmental and social impact assessment.
Faecal Sludge Management Comprises collection transportation, treatment and disposal of the liquid and solid material removed from septic tanks or pit latrines thus contributing significantly to breaking the chain of disease transmission and creation of a healthier environment
Fauna: The total animal population in a given area.
Flora: The total vegetation assemblage in a given area.
Habitat: Terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the nonliving environment.
Impact: The consequence of an action or activity on the human or natural environment. Impacts may be positive, negative or neutral.
Magnitude: The size or degree of a predicted impact.
Mitigation: Prescribed actions taken to prevent, avoid, reduce or minimize the impacts, or potential adverse effects, of a project
Onsite system Excreta removal facility where excreta is collected at the site
Offsite system Excreta removal facility where excreta is carried away through water to conventionalwastewater treatment system
Sanitation Refers to the provision of facilities and services for the safe disposal of human urine and faeces.

Sewerage system A system for the collection, treatment, and final disposal of sewage/wastewater. It includesthe sewer lines with manholes and pumps that convey sewage to the treatment plant, the treatment plant for treating sewage and the final disposal system of the treated wastewater and sludge.
Sewage The off-site water-carried waste (human faeces, urine and sullage), in solution or suspension
Septage The liquid and solid material removed from septic tanks or pit latrines
Sullage the liquid waste form from household sinks, showers, and baths
Utility The organization that provides services that is consumed by the public. In this case it is the set of services provided by the utility to collect, treat and final disposal of sewage
Wastewater System Comprises storage, collection, transportation, treatment, and disposal of domestic humanwaste (human urine and faeces and sullage) to avoid environmental degradation and aesthetic nuisance

EXECUTIVE SUMMARY

This is an Environmental and Social Impact Assessment (ESIA) study report for the proposed integrated (hybrid) wastewater management project in Juba City, South Sudan.

The objective of the ESIA study is to evaluate the environmental and social impacts of the proposed project, including mitigation and management measures in line with the national laws and regulations of South Sudan as well as the requirements laid out in the Integrated Safeguards System (ISS) of the African Development Bank to facilitate preparation of the Project Specific ESIA, Stakeholder Engagement Plan (SEP) and Pollution Management Plan (PMP) that will guide mainstreaming of environmental and social safeguards during the implementation of the project. This report contains only the ESIA itself, while the SEP and PMP are prepared and presented as standalone reports (plans).

Overview of the Project

The project seeks to address the waste management of Juba city by design of upgrading and expansion of wastewater management project(s), which integrate waterborne sanitation infrastructure with fecal sludge (FS) management systems (both pumpable and non-pumpable fecal sludge). The aim is to reach at least 80% safe disposal of fecal sludge and sewer 10% of the residents in Juba city.

South Sudan's capital city is Juba and is divided into three blocks, Juba Town, Kator, and Munuki. The city has an executive director for each block. Sanitation standards in Juba City are improving at the household level as Juba's population grows and its urban area develops. 86% of households' sanitation is mechanically emptied with vacuum trucks in 2022 versus 40% in 2013. However, technically it is only 68% of the facilities that are waterborne. The lowest-income households however can't afford FS emptying. The current sanitation crisis in Juba poses several interconnected challenges, including the (only) existing FS treatment plant at Rokwe (Roton) being overloaded due to insufficient capacity and poor management, and the effluent discharged into the surrounding environment and ultimately the White Nile being substandard.

The project is designed to be implemented in three phases over 15 years with the first phase treating fecal sludge (only) with a volume of 320 m3/day. Subsequent Phases 2 and 3 of the project are designed with a piped wastewater system and combined improved wastewater and sludge treatment, each phase designed with an added capacity treating 19,000 m3. At the end of Phase 3 the total treated volume is 38,320 m3/day.

Assessment of the environmental and social impacts is a prerequisite for implementing developmental projects both by the Ministry of Environment and Forestry (MoEF) and the African Development Bank (AfDB). Accordingly, this study has been prepared for performing an Environmental and Social Impact Assessment (ESIA), following Terms of Reference (TOR) prepared by funding institutions, aiming at providing a detailed analysis of the anticipated environmental and social safeguard issues associated with the Rokwe (Roton) Fecal Sludge Treatment Plant (FSTP) extension/upgrading project and full scale Wastewater Treatment Plant (WWTP) project, i.e. the hybrid wastewater treatment system. Furthermore, the ESIA outlines the environmental management and monitoring plan to be implemented during the construction and operation of the project.

The AfDB Integrated Safeguards System (ISS) updated their safeguards in 2023, which now includes 10 environmental and social operational safeguards (OS) that should be considered in its financed projects. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process.

The ESIA includes the identification and assessment of potential impacts due to the construction and operation of the different components of the project in accordance with the AfDB ISS. It also includes

proposed mitigation and monitoring measures to avoid and control/minimize the impacts of the identified negative impacts.

Brief description of the Project and the project site

The project is a hybrid wastewater treatment plant (WWTP) designed for 15 years period but with the anticipation of implementing it in phases, and the phases for the implementation as detailed above is in three sub-phases and will be further detailed as well in the preliminary engineering design. The sewage treatment plant is conceptually designed to handle sewage flow of 38,000 m3/day, while the faecal sludge plant is sized to treat 320 m3/day. Two treatment sites were initially proposed as options during the feasibility study phase, but the clearly most viable option was concluded to be an expansion and upgrade of the existing treatment plant for (presently only) fecal sludge. There were however 4 options considered at Rokwe for the more detailed preliminary design of the upgraded WWTP. For further details please refer to final Feasibility Study Report, December 2023, and final Preliminary Engineering Design Report, April 2024.

An overview of the current state of sanitation systems in Juba is provided (section 2.2) highlighting the reliance on on-site systems, the collection and transportation logistics of fecal sludge, and the current treatment facilities' capabilities and constraints. Among other key factors the following is highlighted:

- Human Excreta Removal System is primarily an on-site system with 68% of households having a waterborne sanitation system.
- The remaining 32% use non-waterborne sanitation, mainly unlined pit latrines or neighbourhood toilets.
- Vacuum trucks collect and transport fecal sludge (FS) and septage to the Rokwe treatment facility.
- The Rokwe Wastewater Lagoon, financed by the World Bank, includes an inlet chamber, channel, anaerobic pond, and facultative pond. It is located 8 km from central Juba, designed for 3,300 m^3/day with potential expansion to 6,800 - 9,500 m^3/day.

The two treatment ponds are reportedly 4 m (anaerobic) and 3 m (facultative) deep, respectively, and are full of sludge. A wastewater effluent analysis conducted in 2014 shoved the effluent quality was "poor" and content was very high in BOD and COD not only at the outlet of the anaerobic pond but even 1 km and 2 km downstream the plant.

Water sampling conducted in conjunction with this ESIA study was taken in April 2024 and clearly underlines the detrimental insufficient treatment process currently in operation, and the discharge of highly polluted effluent from Rokwe WWTP. In summary:

- The discharge does NOT meet standards in regard to parameters such as Total Dissolved Solids (TDS), phosphates, Colour and COD.
- The processes / current operation is clearly insufficient or malfunctioning, among others it is noted that there is high apparent turbidity (flow) and colour.
- High nutrient levels, as per measurements.
- Very high Chemical Oxygen Demand (COD). This suggest that the ponds and WWTP is "overloaded" with organic matter.
- All-together, the effluent/discharge is a case of "non-compliance" with standards, as per both national and normal international standards.

There is no final disposal or recycling/reuse of treated sludge at Rokwe at present.

Major issues and constraints: While the Rokwe WWTP operates at present within its capacity (in principle), it does not produce the quality of effluent that would be expected as it is not at present a properly maintained and operated facility. A short-circuiting of the influent wastewater is obvious and consequently limited blending is done with the lagoon wastewater, but rather large quantities

flow out almost untreated. The current lagoon system operation state is of primary concern.

Sub-phase 1 of the project: The preliminary engineering design for the FS treatment is prepared until the design Year 2041. It includes the layout of the treatment plant facility after conducting topographical survey of the area, a preliminary design for a receiving tank, the design and sizing of the multi-disc screw presses, including concrete plinths for screw press placement, the design and sizing of feed pumps, design of buffer tanks, the design of waste stabilization ponds, including the rehabilitation of the existing ponds, and the design of the auxiliary buildings.

Sub-phase 2 of the project: The preliminary design of the sewage management system is designed for the design Year 2036. It includes the sewage network system and the sewage treatment plant. The preliminary design includes the topographical survey of the sewer routes, the hydraulic analysis and sizing of the sewer pipes, the preparation of the sewer network layout as well as presenting the layout and profile for the trunk/transmission main from the pumping station to the sewage treatment plant. It also includes sizing of pumps and the preliminary design of the pumping stations. In regards to the Sewage Treatment Plant, the Consultant has calculated the sizing, preparation of the layout and of the preliminary engineering design and structural analysis of all the components of the sewage treatment plan, which include screening, preliminary and secondary clarification units, trickling filter and disinfection and sludge stabilization units.

Sub-phase 3 of the project (until 2041): The preliminary engineering design work carried out and the remaining tasks required to bring it to realization during Sub-phase 3 are like those outlined in Sub-phase 2 above, with the only distinction being the timing of their implementation.

Establishment of a Project Management Unit (PMU): Further to above more technical aspects, the project entails as a key planning aspect/proposal that a PMU be established in South Sudan Urban Water Corporation (SSUWC) to fulfil the administration, management and supervisory responsibilities of the project at the time of implementation. This will, among others, require the assignment or recruitment of professionals. The PMU will have the responsibility of implementing the project in compliance with the procurement, financial management and safeguards procedures of the African Development Bank (AfDB).

The project is located in Roton, Luri Block, Juba County, Central Equatoria State. It's within the existing facility at coordinates 4°54'00" N 31°36'16" E. The land is already acquired and owned by the government and the available area is approximately 200,000 m^2 or 20 Ha. It's at an elevation of 461m above sea level and it's located where there is limited settlements in the immediate vicinity of the facility, although it is noted there are some small factories, office buildings and residential located on the access road to the WWTP – construction of such buildings have increased recently (after the access road was established). Further, it should be noted that a few inhabitants (local community members) have expressed a desire to settle near the facility.

The facility is more than 500 meters away from any designated (and observed) wetlands, and approximately 1 km away from Roton Lake. Importantly, it is noted the effluent outflow does not directly lead to the wetland or the lake, but rather downhill into a waterway (stream) that directly flows into the White Nile. The site thus has a slight slope of 6% to the east toward a small stream where the current wastewater from the treatment plant is flowing into (which leads to the White Nile).

Two options were considered in the Draft Preliminary Engineering Design Phase for sewerage network. The first option involved pumping all the sewage into one pumping station and conveying it to the WWTP. The second option considered collecting (pumping) the sewage using two pumping stations. The first pumping station will pump the wastewater within its gravity catchment to the second pumping station and the second pumping station will convey all the sewage within its own gravity catchment area and sewage from the first pumping station to the WWTP. Within the scope of the Draft Preliminary Design Report, both options were compared, and the results were presented in

a workshop. It was decided during the final workshop to go with option 2 as the maximum depth for pipe cover is less and both the pump stations are within the city jurisdiction and can be physically located on government land.

The type of surface soil at the WWTP is sandy loam and sandy clay and potentially suitable for both farming and other economic activities. Some agricultural crops are currently being grown within the actual facility by informal farmers, mainly for subsistence purposes. This issue has been thoroughly investigated and conclusion is that the proposed project will not lead to any physical or economic displacement aspects for the involved farmers. This is further outlined in section below on "Potential Social Impacts".

In summary, the option prioritised and chosen, as per approved feasibility study and preliminary engineering design, involves treatment of both sewage and faecal sludge at Rokwe (Roton) site using drying bed for FS and Trickling filter for Sewage. Most essentially, both faecal sludge and sewage will be treated at the existing treatment plant site at Rokwe (Roton). Rokwe's rehabilitated and modified treatment plant will be used to treat faecal sludge along with drying beds and ponds for treating leachates. Trickling filters will be used to treat sewage that is conveyed by sewers (pipeline system). For technical descriptions and detailed outline of all elements in below FS and WW treatment system, reference is made to the approved preliminary engineering design report, April 2024.

The activities for the Project can be divided into two (2) phases, namely: a) Construction; and b) Operations and maintenance. The key project activities during these two phases of the Project have been summarized below.

Construction Phase: The construction activity will involve construction of anaerobic pond, trickling filter facility and laying of gravity sewer line and raising main and construction Treatment Facility. The construction work will include excavation, pilling, backfilling etc. Construction work shall also encompass desilting of the existing gravity sewer lines. Replacement and installation of pumps along with electrical works (i.e. wiring, cable dressing, installation of electrical panels etc.) shall also be carried out during construction phase. The length, diameter, and depth and the of the gravity pipes and the number of manholes for the first stage shall be done. Laying of gravity pipes and the number of manholes shall be done for the second stage

Operation and Maintenance Phase: During Operation and Maintenance the sewage water from Rokwe treated at the new WWTP will follow prescribed standards generally used in East Africa (in Uganda and Kenya). Biogas and sludge will be generated from the treatment of sewerage water. Biogas can be utilised in the bio-gas plant for power generation whereas the dry sludge cakes can be utilised for composting after dewatering of the sludge, though this aspect has not been considered in scope of work for O&M contractor as per Concession Agreement. The treated water will comply with effluent discharge standards set by East African standards and shall be discharged into a water system (stream) leading to the White Nile 2-3 km downslope from the treatment plant.

Sludge handling for pond system: The pond systems are not producing any regular sludge to be removed. Sludge are basically almost completely digested in the ponds and only after an interval of several years would it need to be removed. No sludge handling system are foreseen in this solution.

Sludge handling for trickling filter: The total sludge production from the Trickling filter system are estimated to 8,914 kg TSS/day (say 9,000 kg TSS/day) with a DS% of 1.0%. The following proposal are made for handling of sludge: Pre-dewatering of sludge: Digestion of Sludge Dewatering of sludge and Disposal of sludge. When sludge are digested mesophilic in a digester, the sludge are hygienized and can be applied as agricultural fertilizer if it does not contain hazardous components (heavy metals etc.).It is recommended that there are made a quality test of FS that can reveal if the digested sludge can be used as a fertilizer.

Biogas/energy potential: Biogas production rate = 0.4 m3 biogas/kg TS: = 3,600 m3/day; Methane: = 65 %; Heating value of biogas: = 22,400 kJ/m3 Total energy yield: = 80,640 MJ/day; and Potential CHP

electric power: = 300 kW.

Institutional and legal framework

The Government of the Republic of South Sudan is dedicated to advancing sustainable development and integrating environmental protection measures into all development projects. The government therefore has several policies, laws, and regulations aimed at mainstreaming environmental management practices. ESIAs are conducted as standard to assess the potential positive and negative impacts of proposed projects and any project proponents are required to adhere to the provisions outlined in various policies designed to uphold a clean, healthy, and sustainable environment. Key policies and legislation include:

- Southern Sudan Water Policy of 2007: The policy is the guiding principle of managing water resources in the country. The overall objective of the policy is to ensure efficient development and management of urban water supply and sanitation.
- WASH Strategic Framework: Establishes a legal framework for the management of the water sector.
- The National Occupational Safety and Health Policy, 2022: This policy is particularly relevant for the OHS of the Project. Especially the construction crews and subsequently, the maintenance personnel. The policy will also have relevance in mitigation measures that protect the public from health and safety impacts because of project construction and subsequent operation and maintenance activities.
- Interim National Constitution of South Sudan & Transitional National Constitution of South Sudan, 2011: The WWTP will abide by the articles within the constitution through obtaining a certificate and operate within the guidelines to secure a safe environment for all.
- Environment Bill 2023: An Environmental and Protection Management Bill was drafted in 2013, but never formally approved in Parliament. A revised Environment Bill is drafted in 2023 and currently awaits to be passed into law by Parliament. The fundamental goal of the environment Bill is to ensure the protection, conservation and sustainable use of the natural resources of South Sudan, without compromising future generations. The Ministry responsible for Environment through an environmental protection agency will require a systematic environmental impact assessment, audits, monitoring and evaluation of all development projects to mitigate adverse impacts and enhance environmental benefits. Establishment of the WWTP/FSTP falls in the category of projects that require an ESIA. The Environment Bill will when passed into law guide direct all issues relating to environment matters for the Project.
- Southern Sudan Land Act, 2009: The Act stipulates, among others, the rights of the citizens in regards to compensation modalities if people are relocated from the land they have been using. The Land Act further classifies land as (a) communal, (b) public, or (c) private land. A Land Policy is still under development and it will include some amendments to the Land Act. The project will only take place on government land, and the sewer lines will be put within the right of way. It will be confirmed that the location of the pumping stations are in fact on government land. If not, then proper compensation in accordance with national legislation and AfDB safeguards must be completed.
- Initial National Communication, 2018: Under South Sudanese national circumstances NCs are important for predicting, monitoring and evaluating a Party's contribution to attaining the objectives of the UNFCCC and also for reducing the impacts of adverse effects of climate change on its people and economy. The contractor of the WWTP, supervised by SSUWC, will be able to mitigate impacts of pollutants from the WWTP.

Institutional Framework:

The Ministry of Water Resource and Irrigation, Water, Sanitation & Hygiene (WASH) Sector Strategic Framework of August 2011 proposes in urban contexts where UWC operates, that it gets the mandate

to manage urban sanitation (including sewerage systems) as well. Alternatively, in areas where UWC is not operating, the mandate for sewage collection and disposal (from septic tanks and solid waste) will be with State Government Ministries responsible for housing and town planning or the Local Government (municipalities).

The Ministry of Water Resource and Irrigation, Water, Sanitation & Hygiene (WASH) Sector Strategic Framework that was prepared in August 2011 proposed that UWC be mandated to manage urban sanitation (including sewerage systems as well). Where UWC is not operating, the State Government Ministry responsible for housing and town planning or the Local Government (municipalities) will be responsible for sewage collection and disposal (from septic tanks and solid waste).

Currently four ministries at national level namely Ministry of Water Resources and Irrigation, Ministry of Land, Housing and Urban Development, and Ministry of Health (MoH), Ministry of Environment and Forestry, and the City Council/County (Local Government), two at Central Equatoria State level, Juba County and Juba City Council have a role in Juba urban sanitation. South Sudan Urban Water Corporation (SSUWC) is indirectly involved.

The Ministry of Water Resources and Irrigation (MWRI) was formed with the mandates for safeguarding and conserving fresh water systems; carrying out and supervising hydrological studies, flood control works, irrigation and hydropower developments and water storage facilities.

South Sudan Urban Water Corporation (SSUWC) established by a Decree in 2007 and by Presidential Order Act in 2011, is mandated for the production of safe drinking water and capable distribution network and sale, to any customer according to the agreements, contracts, tariffs and the conditions of supply. The Corporation is headed by a Managing Director and has a Board of Directors which is chaired by the Minister of Water Resources and Irrigation.

Operating under MWRI, the South Sudan Urban Water Corporation (SSUWC) holds the official designation as the urban waterworks entity for South Sudan. It is entrusted with the responsibility of delivering water supply services to the urban population of South Sudan. The legal framework and governance structure of SSUWC are established by the "SSUWC Provisional Order, 2011". However, in this order water supply services has been covered only and wastewater services has not been yet included.

African Development Bank (AfDB) Safeguard Policies: All projects funded by AfDB must follow their environmental and social safeguards. AfDB updated their Integrated Safeguards Statement in 2023 which now lists 10 Operational Safeguards (OS) relating to the identification and assessment of E&S risks and impacts. By following these OS, it is possible to minimize, mitigate and avoid adverse impacts on people and the environment. From unintentional harm, as well as sustainably reducing poverty and increasing prosperity for the benefit of the environment and communities.

Multilateral Environmental Agreements/Treaties: South Sudan has made considerable efforts to participate in multilateral environmental agreements (MEAs) and has also joined global efforts to address environmental issues by becoming a Party in 2014 to the following three Rio Conventions: the United Nations Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC). Article 12.5 of the UNFCCC states that Parties that are LDCs, such as South Sudan, may make their initial communication at their discretion.

Major and moderate Potential Impacts and Mitigation Measures

The impacts have been identified based on the information presently available from the project proposal on the Project and been informed through stakeholder consultations with government

officials, local community members, reconnaissance visit and broad assessment of the area. The potential environmental and social impacts have been assessed for each phase and all stages of the Project – including construction (and pre-construction) and operational and to the extent possible as well potential de-commission.

The potential impacts were identified through a systematic process whereby the activities (both planned and unplanned) linked with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors. A comprehensive interaction matrix was used to enable a methodical identification of the potential interactions each Project activity may have on the range of resources or receptors within the Area of Influence of the Project.

As per project schedule and plans it was noted that the project includes elements of de-commissioning (of old treatment system and structures at the WWTP) and simultaneous construction phase, i.e. these overlap each other. In such cases, assessment of environmental and social impacts and mitigation measures have been combined in the assessment and "total" impact has been considered.

As summarised below, the proposed project activities in many cases have an potential and in many case indeed a likely positive or negative impact on the surrounding environment via interaction(s) and effect etc. on environmental resources or receptors. These impacts chiefly fall in the following overall categories:

Visual Aesthetics & Nuisance: Overall impact for the construction phase is ***Moderate*** and for operation phase ***Minor***. *Mitigation Measures include:*

- All the construction activities will be restricted within the designated site.
- Use of covered trucks, tippers or dumper, if not, then contractor has to make sure that materials are not moved without putting a cover on them.
- On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility.
- Quick disposal of Sludge from existing structures and de-silt material from sewer network.

Residual Impact: Considering the implementation of above-mentioned mitigations measures the significance of residual impact is assessed as **Minor**.

Ambient Air Quality and Odour: During the construction phase the potential impact on air quality is assessed to be **Minor** with effective mitigation measures stated below.

- The construction materials waste will to the extent possible not be exposed to the open environment and it will be stored logically according to the prevailing wind. Further efforts will be made to maintain the stockpile against a wall or have "obstruction structures" in place so that it works as a windbreak and fugitive emissions during strong winds can be avoided;
- Hazardous or Non-hazardous waste generated from construction activities at the site will not be burned on site, but should be disposed properly and safely;
- All loading and unloading activities to be carried out as close as possible to the storage facilities;
- Proper handling of materials to ensure minimal emission of dust. Trucks used for transportation of material during site preparation will be provided with impervious sheeting.

Odour Impacts: During construction impacts are expected to be short term and impact magnitude will be **negligible to minor** in nature. In subsequent operation/implementation phases impact may be more noticeable. Nuisance odour generated from sewage and wastewater treatment plants impairs ambient air quality and represents a growing social and public health issue that is increasingly a cause for public discomfort and complaints. Biological treatment and stabilization processes, which are widely applied for upgraded sewage treatment, reduce the nutrient concentration in waste water, thus minimizing environmental impact (as also proposed in this

Project). However, when anaerobic conditions are reached during microbial decomposition of organic matter present in sewage (food, animal scums, organic compounds, sludge etc.), unpleasant odours are naturally generated. Key anticipated emission sources of odour from the proposed WWTP include several potential sources of odour due to mass transfer and organic reaction leading to formation of odourous substances from aerated grit separator and activated sludge treatment section etc. As per the Project proposal design these structures are to be "closed" and odour generated within the structures will generally not spread outside if structures are well maintained and operated as intended. Hence, it is considered that impact will be negligible in this regard. However, sources where new odorants form, i.e., primary/secondary sedimentation, thickening tanks and similar structures in the upgraded WWTP are considered major sources of odour and hence they are considered for odour impact estimation.

In addition, other sources of odour include potential smell and leakage from sewage lines and not least from the two pumping stations. However, if properly designed, constructed, maintained and operated – the impact should be **negligible or minor**. *Mitigation Measures include:*

- Developing an ambient monitoring plan and stack monitoring schedule;
- Using low Sulphur content diesel for Diesel Generator sets;
- Keeping the storage areas under moist conditions to prevent dust formation;
- To ensure compliance with the air emission criteria for flue gas stacks, the following measures will be implemented during operations:
    - The use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels will be undertaken for PM10, NOx, SO2, CO and O2;
    - PM2.5 and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the natural gas fuel.
- The stack will be provided with safe access to sampling points for CEM.

Noise Quality: The potential impact on noise quality may arise out of the following: Machineries and Equipment; Vehicular traffic and Back-up generator. The upgrading of WWTP and the wastewater system, not least the sewage pipelines and pumping stations, will produce significant noise. The cumulative level of noise generated during the construction phase could be in excess of 80 dB(A) at peak times, although this would only be for short intervals. Since the activities are for shorter duration the magnitude of impact is expected to be **Moderate** in nature. *Mitigation Measures include*:

- Effective noise management protocols implemented wherever applicable during construction and operating phases of the life of this project. Besides this protocol measures, construction work will be limited to day time periods;
- Switching off unnecessary or idle equipment's;
- Fitting of noise mufflers to mobile equipment's;
- Advertise operations (construction) well in advance and work during day hours;
- and Preventive maintenance of equipment to minimize noise emissions.

During operation phase noise will be generated from pumps and air compressor having noise range of 60-90dB in the immediate vicinity and for administrative building noise generated could potentially be in the range of 60-70dBm. All together impact is assessed to be **moderate** – but it is important to note that impact will be considerable less outside the WWTP (where impact can be expected to be minor). *Mitigation Measures include:*

- High-quality pump installations will be arranged within the territory of the treatment plant. Much less noise is generated from pumps which are made of stainless steel or cast iron, as example, and this may be considered during detailed design (Low-cost pumps, which are made of thin steel

sheets, produce more noise);
- During the installation of pumps, noise-insulating material such as foam plastic can be used as far as possible;
- Pumps will be arranged on vibration isolation platforms, for which thick rubber sheets can be used;
- Equip all personnel with proper protective equipment. Since, the cumulative noise level at Site is in the 60-90dB range, as best practice the workers must be provided with personal protective equipment such as ear muffs to reduce exposure to high noise level.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality is assessed as **Medium** inside the WWTP and the pumping stations**,** but **minor** outside.

Drainage Impacts: The potential impact scenarios will have negligible impact on the drainage due to buffer carrying capacity of 7000 Million Liters per Day (MLD). *Mitigation Measure is primarily:*

- Develop a storm water drainage system as best management practice on site.

Surface Water Quality: No adverse impact on surface water quality is envisaged during construction phase. However, contamination of limited areas of surface water bodies during the construction phase is possible in the following cases:

- Oil spill in case of violating the rules of "proper" storage or the rules of construction equipment and vehicles maintenance;
- In case of contaminated water discharge during the earth works;
- In case of discharging vehicles or equipment, wash down water;
- In case of improper management of construction waste;
- In case of improper management of sludge and storm waters, etc.

Mitigation Measures include:

- Providing spill kits near oil and grease storage.
- Using a secondary container during transfer of oils, grease etc.
- The drainage system at site is to be provided with sedimentation.
- Tank and oily-water separator in place to prevent contaminants, especially oil and grease, from being carried off by surface runoff.

In regard to the operation phase, the objective of the proposed project activity is among others aimed at creating environmental improvement in terms of reducing pollution load to receiving water bodies (streams), and ultimately the White Nile, by installation and operation of WWTP and linked sewerage infrastructure. As the WWTP facility has a relatively flat topography in parts, while in other parts a sloping profile, some negative impact during operation phase on surface water *could materialise* – but would only do so if facility is improperly operated or there is malfunctioning of WWTP equipment, or in case of severe flood events resulting to draining of storm water during heavy rains or causing overflowing of adjacent ponds existing nearby the WWTP facility.

Another potential negative impact, potentially quite severe, is overflow/malfunctioning of the sewage pipeline system including pumping stations. This could be caused by accidents (pipeline exposed and punctured for instance), or poor maintenance etc. Impact can potential locally be ***severe*** from such events, but all other things equal probably ***not large in extent***.

Mitigation Measures include:

- Provide emergency measures for potential sewage overflows from sewer systems, or pumping

stations, including intervention troughs along the affected main surface drains that are likely to receive overflowing sewage. Similar collection trough could also be provided downstream the treatment plants (these measures should be considered further in final design) ;
- Draw up a monitoring schedule for the treated sewage quality. This should constitute an important component of the sewage treatment disposal (sampling at pre-designated locations of the treatment plants and submitting to the laboratory for analysis). Key water pollutants to monitor for would include organic matter, settable solids and nutrient residuals.

Ground Water Quality: There will be no groundwater extraction during project life-cycle, as per design. Potential sources of impact for ground water contamination are minor oil and grease spillage, during maintenance of construction machinery, repair of pumps and compressors during operational phase. A ***potential major impact*** is however groundwater contamination from exposed groundwater sources during construction, and subsequent operation, of the actual pipelines and sewage piped system. The preliminary design team has been very much aware of this element, and in fact changed certain important project elements to minimize the likelihood of this potential negative impact materializing. There is no mitigation available other than planning/designing appropriately, and thus avoiding any potential negative impact – on the other hand it is a known aspect of sewage pipeline systems and with proper assessment and final design it can be addressed adequately.

Soil Quality: Construction waste may contain hazardous as well as non-hazardous waste. However, soil quality impacts will be localized within the project site or in a dump site. The significance of potential impact, without mitigation measures in place, on soil quality is assessed as ***Minor***. *Mitigation Measures include:*

- Manage spills of contaminants on soil using standard engineering practices;
- Impervious storage area, especially for fuel & lubricant, chemical, hazardous waste etc.;
- Municipal solid waste generated from the labour camp and construction site will be transferred to the disposal site in consultation with the local municipality;
- Fuel, chemical and lubricant will be stored in paved storage areas.

In the operational phase, potential impact on soil quality can arise due to activity at the WWTP, or pumping stations, or even at other sites where the pipeline is maintained or expanded etc. The planned activities with both storage and disposal of treated fecal sludge and biogas scrubber sludge, which have high organic content, has potential risk elements, but normally will have *positive impact* by increasing the fertility of soils if distributed as manure – as dried sludge are often used and considered a very valuable bio fertilizer. However, worth noting is that the quality and contents etc. of the resulting treated sludge material should be monitored frequently. The only case that will heavily impact the soil quality of the WWTP and surrounding environment (or other projects sites) negatively is overflow of WWTP system/equipment due to malfunctioning, mis-management or flood situation, this could have impact downslope or downstream from the WWTP if significant amounts pf untreated or only partially treated material is released accidentally or by weather induced events.

Overall negative impact for the operational phase is estimated to be negligible as the impact scale is low, sensitivity of receptor is low resulting in **magnitude of impact to be negligible**. Yet, the above considerations on risks are important notes, and the mitigation measures highlighted below are highly relevant despite this overall assessment. *Mitigation Measures:* The following mitigation measures will be implemented:

- Ensure proper spill control and management at site (all project sites);
- Monitor and detect any contamination on soil & ground water (all project sites);;
- Good housekeeping to prevent spillage and runoff from site;
- Ensure the disposal of waste into designated storage and disposal area;
- Closely monitor contents of treated sludge, especially if used for manuring of farm fields.

Residual Impact: Considering the implementation of above-mentioned mitigation measures, significance of impact on soil quality during operation phase of the Project is assessed as **Negligible.**

Other potential environmental and pollution related impacts: Although not identified as *likely negative impacts* it must be recognized that there are other forms of pollutants or pollution effects that can materialise in the project. These include: (i) Nitrogen-phosphorous rich compounds, occurring in the treated wastewater or in the treated sludge; Pathogenic organisms etc. in the treated wastewater or in the treated sludge; and, Potential negative impact/pollution from inorganic chemicals, micro-plastics, radioactive substances, synthetic organic chemicals etc. None of these are expected to constitute significant negative pollution effect (impact is minor or negligible).

Potential Social Impacts:
There are potential impacts both for the construction and operation phase of the project. These include:

- Potential loss of livelihoods for informal farmers at Rokwe
- Restricted access during pipe laying
- Occupational health and safety
- Spread of diseases
- Traffic safety
- Gender issues.

Potential loos of livelihood: The main potential impact investigated thoroughly in the ESIA is the potential loss of livelihoods for informal farmers due to the restricted access to Rokwe WWTP, see below. The project is however not expected to lead to any land acquisition since both the WWTP, pumping stations and pipe network will be built on government land and within the right of way (RoW).

Parts of the WWTP area where there currently is no sewage treatment or other activities are being used by informal famers growing agricultural, mainly for subsistence purposes. This issue has been thoroughly investigated with many visits, workshops and discussions with official stakeholders and the informal farmers themselves and conclusion is that the proposed project will not lead to any physical or economic displacement aspects for the involved farmers. It has been agreed that the Government of South Sudan through its representatives and the farmers will establish an Memorandum of Understanding on the use of (still) vacant land within the facility with permission and coordination with the facility management. The facility thus has expansive land that can be utilized by the community for their subsistence oriented farming. Additionally, it was agreed that the use of the raw water from the oxidation ponds, which has happened in some cases hitherto, to cease with immediate effect until the quality of the effluent is of the required standard. The nearby swamp water is of good quality for irrigation and can be utilized instead for farming activities should this be warranted.

The government will further be required to issue a public notice for any claimant to the proposed project site area or part of it to lay claim before the project commences. This is to be done through issuance of notices through radios, publishing in local dailies and erect notice on site for the recommended national timelines. Further, farmers should be allowed to harvest their seasonal and temporary farming (crops) before reallocation to other parts of the area. Naturally, any area for firstly construction, subsequently sewage treatment, is to be properly marked and fenced off and no access should be granted to the actually WWTP site in the future for unauthorised people.

Communication and close consultation should continue with the project affected people (PAP) at Rokwe (and elsewhere). Immediate *Mitigation Measures* are*:*

- Liaise with the relevant Government agencies to establish the PAPs (farmers on site) likely to be affected by the expansion and improvement of the WWTP i.e. their number, crop grown, and location.
- The Government of South Sudan through its representatives and the farmers to get into an official MOU on the use of the vacant land within the facility that they are currently majorly using it for subsistence farming under the permission of the facility management.
- The process should be in conformation to AfDB OS 5 - Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement which state that the people should not be left badly off from the project activities.
- The farmers should immediately cease their use of the effluent from the ponds as they are untreated and pose a health hazard to human health. Analysis of the effluent indicates high levels exceeding the recommended standards. The swamp nearby water can be utilized for the irrigation purposes if needed.
- Ensure that the PAPs can harvest their last crops before any new fencing/marking of the future WWTP area and construction starts.
- Identify all PAPs before the cut-off date.
- Establish a community liaison officer who is responsible for having continuous engagement with the PAPs and who will respond to any questions and collect grievances.

The government should ensure Land ownership evidence: I.e. submit/issue the Rokwe (Roton) WWTP land ownership document to avoid future land ownership tussles. Further, a public notice should be issues for any claimant to the proposed project site area or part of it to lay claim before the project commences. This is to be done through issuance of notices through radios, publishing in local dailies and erect notice on site for the recommended national timelines.

Residual impact: By implementing the mitigation measures it is assessed that the PAPs will retain their livelihoods to the same level or better. The impact magnitude with mitigation efforts is thus assessed to be **negligible.**

Temporary loss of income: All the sewage lines will be laid along the sides or in the middle of the roads. The proposed project will lead to temporary access disruption during construction**.** The disruption will be caused by the excavation work, vehicular movement for transportation of construction materials for carrying out construction materials, especially along narrow and congested areas**.** No new land acquisition will be required for undertaking the proposed work**.** All replacement and renovation work will be undertaken along the existing Right of Way principle (RoW)**.** The access disruption may lead to temporary loss of income for some businesses along the network, if customers decide to not go to the store due to restricted access and increased congestion due to construction. However, it is assessed that these impacts will be **minor** since the shops still will be accessible, even if somewhat inconvenienced. Further, the pipe laying will be done in 100 meter sections, and each section is estimated to take 1 week. This must be carefully monitored to ensure that the construction do not take unreasonable long time or restricts the access for customers to enter the shops. If so is the case, it will be needed to issue compensation due to temporary loss of livelihood unless other is agreed with the shop owners. There must be a clear grievance redress mechanism in place so PAPs easily can contact the project and raise complaints. *Mitigation Measures include:*

- The contractor should inform all the stakeholders well in advance (at least 15 days) before the start of the construction work;
- Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.
- Easily understandable grievance redress mechanism, where the Project is responsive and answering grievances in a timely manner.

- Establish a community liaison officer who is responsible for engaging with communities and PAPs
- Mitigation measures will be part of the contract agreement for the work Contractor and will be implemented through it, with careful monitoring by the client.

Residual impact: Considering the implementation of above-mentioned mitigation measures, the residual impact disturbance to local businesses and street vendor is assessed to be **minor or negligible**.

Road Traffic Impacts: During the construction phase some negative impact can be expected with heavy vehicles along the road and disturbance for local residents who are using the road in their day to day activities. There will also be increased traffic in Juba city centre in phase 2 and 3 of the project when the sewage network is put down. This will cause disruption to traffic movement, which may disturb local residents, especially during peak hours. These impacts are all considered limited in scope and duration and the potential impact on road and traffic due to operational traffic is assessed to be **minor**.
Mitigation Measures:

- Trucks are not loaded beyond their load carrying capacity.
- Impose speed limit for vehicles moving in and out of WWTP complex by put display signs and hazards associated with speeding and rash driving.
- Sewage truck drivers must follow a company code of conduct which includes safe driving.
- Since majority of the roads in the project area are narrow, there will be some traffic congestion, hence alternate traffic routing may be adopted in consultation with concerned traffic police authorities. In case alternative traffic routes are not available, traffic management measures will be adopted.
- Traffic dislocations also have some adverse impact on trade and commerce, hence works at business and market area must be completed in a phased manner and in consultation with the local stakeholders.
- Careful consideration should be taken to minimize congestion and negative impacts at schools and hospitals.

Gender Aspects: There is a need to promote gender equality in all aspects of the project. Women's roles in construction are mainly confined to supply of unskilled labour and selling food to the construction workers. As civil construction work will take place at the proposed WWTP site and the sewer lines, the participation of women in the construction workforce should be ensured to reduce gender disparity and enhance gender mainstreaming. Female workers should also be encouraged to apply and be hired for the operation of the WWTP. Special efforts and *Mitigation Measures:*

- Ensure the implementation of a Gender Action Plan (GAP) for the project.
- Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work.
- SSUWC to ensure that the company level policy on Prevention of Sexual Harassment (POSH) in the Workplace is also extended to the project level. HR Policy should have provisions on gender based violence.
- Trainings on sexual harassment, gender-based violence and social protection benefits to all employees.
- Ensure availability of gender sensitive facilities such as toilets and resting areas.
- Women to be encouraged to participate in public meetings, discussions and consultations.
- Contractor is encouraged to develop CSR Projects which include initiatives around the following aspects: improving the health conditions of women in the project area, or improving access to education for girls in the project area through school donations and provision of scholarships.
- Women to be made aware of the Grievance Redress Mechanism (GRM)
- The Grievance Redress Committee should comprise of at least two women.

Stakeholder Engagement and Consultations

It is a prerequisite, for all category 2 AfDB funded projects, that project affected groups be consulted It is also necessary that individuals, groups and entities with a stake in any proposed project not only be informed but equally consulted for their views as regards likely impacts and any other concerns pertaining to the proposed project. At the same time, South Sudan laws and regulations such as the draft Environmental Bill and Environmental Impact Assessment Regulations and Guidelines also emphasise the importance of stakeholder participation in development projects.

The developer shall, in undertaking the environmental and social impact study, carry out consultations with relevant stakeholders, communities likely to be affected by the project and the public. On consultation and participation, the borrower or client is responsible for conducting and providing evidence of meaningful consultation (i.e., consultation that is free, prior and informed) with communities likely to be affected by environmental and social impacts, and with local stakeholders, and also for ensuring broad community support.

The developer (in this case SSUWC) is responsible for ensuring the satisfaction of broad community support. The Bank requires that stakeholder engagement starts at an early stage during project preparation and that it shall continue throughout the project process. The results of such engagement should be adequately reflected in project design, as well as in the preparation of project documentation. In all cases, consultation should be carried out after, or in conjunction with, the release of environmental and social information. Once all stakeholders have been identified, the developer shall develop (further consolidate) and implement a Stakeholder Engagement Plan (SEP) that is proportionate to the project risks, impacts and development stage, and that is tailored to the characteristics and interests of the affected communities. The advantage of having a SEP is that it provides a formal commitment, defines responsibilities, and ensures that adequate funds are made available to carry out the program of consultation. A SEP typically describes measures to allow the effective consultation and participation of all affected communities, a description of any consultations that have already taken place, and a definition of the reporting procedures. A SEP is prepared as a separate stand-alone document. The project also has a Grievance Redress Mechanism, and it details the procedures for managing complaints and grievances.

During the entire project process it is important that stakeholders are informed of plans and activities. Information disclosure refers to the provision of relevant and adequate project information to enable stakeholders understand inherent risks, impacts and opportunities of the proposed project. In the context of this project, stakeholder consultations aim to:

i) Generating a good understanding of the proposed project.
ii) Understanding and characterizing the potential environmental, socio-economic and health impacts of the project.
iii) Understanding local expectations throughout the project lifecycle.
iv) Developing effective mitigation measures and management plans.
v) Optimizing local benefits that can be delivered through the project.

Stakeholder Identification and Analysis: Public participation was encouraged throughout the process of the ESIA study. Stakeholder engagement was conducted for meaningful consultation with affected communities, local stakeholders, and also to ensure broad community support. The ESIA identified and consulted different stakeholders as listed below. The stakeholders include but are not limited to:

- Ministries at the National level
- Juba city council leaders
- State leaders
- Payam leaders and village chiefs

- Community leaders
- Affected communities living around Rokwe WWTP
- Some affected communities living along the sewer line
- South Sudan Urban water Corporation.

Stakeholder consultations were carried out to obtain views and concerns about the proposed project, and for the identification of the most suitable approaches for implementation of the proposed project.

Key stakeholders were identified and engaged during the process of conducting the ESIA Study, and these included the Local community of Rokwe, Luri Block, Juba City Council Technical Planning Committee, Local Leaders, Departments and Ministry of Environment and Forestry, Ministry of Water and Irrigation, and South Sudan Urban Water Corporation.

The Consultant team has held engagement meetings with the affected communities to update them about the project, and its possible positive and negative impacts. They were assured that AfDB's safeguards will be followed and mitigation measure for negative impacts will be set in place. Furthermore, questions raised by the potential PAPs were answered.

Different methods of engagement were used ranging from individual interviews to controlled small groups, and focus group discussions. Phone calls have also been used, especially to key people to follow up on issues.

Activities included:

- Engagement meetings with the affected communities to update them about the project. The meeting covered general information and potential positive and negative impacts.
- The communities were assured that mitigation measures for the negative impacts will be established and compensation will be given if there are any impacts on structures, land and communal property resources, environment in according with AfDB safeguards. The questions raised by the potentially affected people were answered.
- Through consultations, the team was able to identify the vulnerable groups of people who would need special or extra support.

Stakeholder consultations revealed that the project is generally perceived positively by the stakeholders since it has clear environmental and social benefits with improved sanitation. There are however some negative impacts that will need to be addressed for sound environmental and social management. The expected benefits that were highlighted include employment opportunities, development of the area, and infrastructural development, improved health, safer environment, and improvement in sanitation.

Environment and Social Management Plan (ESMP)

A comprehensive ESMP is prepared (see below) outlining the potential adverse impacts, mitigation measures, monitoring and management responsibilities during construction and operation phases of the Project. The purpose of the ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designed to mitigate potentially adverse impacts, are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place;
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Projects.

An ***environmental monitoring programme*** has also been devised and incorporated as an elaborate plan in table format with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project area.

The ESIA Study also incorporates a comprehensive ***Alternative Analysis,*** a ***Grievance Redress Mechanism*** outline as well as various annexes. Furthermore, key standalone documents (plans) have been prepared, namely: a ***Stakeholder Engagement Plan (SEP)*** and a ***Pollution Management Plan (PMP)***.

Overall conclusion and recommendation:

The ESIA study extensively analysed potential positive and negative impacts of the project. The process found that the project upon completion shall significantly improve sanitary and livelihood conditions in Juba City and will have a very positive impact on the environment – if well designed (final design), constructed and properly implemented and operated. More concretely, the improved sludge collection and treatment (Phase 1) and subsequent Phase 2 and 3 of the project with piped wastewater system and combined improved wastewater and sludge treatment incrementality will have positive social and environment impact.

However, there are specific stakeholders that will be affected negatively, and whose livelihood needs to be maintained/restored. Furthermore, the project will have (short term) negative impacts emanating from construction activities.

Management plans have been prepared to address and mitigate the severity of the negative impacts, and as well to increase/upscale identified positive impacts. It is recommended to initiate a close and regular monitoring of environmental impact and potential key pollution elements from both treated sludge and wastewater generated at the treatment plant, designed and scaled (up) for each stage/phase of the project. This is also addressed in a standalone Pollution Management Plan (PMP) which is prepared for the Project.

It is recommended to involve all key stakeholders further during the final design phase and further clarify and consolidate mitigation plans and actions – with immediate action required for finalising Memorandum of Understanding and ensure reallocation of the farmers presently conducting "informal" farming at Rokwe (Roton) Treatment Plant. Importantly, this is also addressed in the standalone produced Stakeholder Engagement Plan (SEP). It is recommended indeed to closely involve all stakeholders throughout every stages of preparation, construction and implementation phases of the project to ensure, among others, that socio-cultural impacts are minimized. In addition, local labour should be considered for unskilled labour during construction, and adequate information on negative impacts (social, environment or otherwise) associated with construction and subsequent project stages should be disseminated to the public.

Therefore, with recommended management plans the project is recommended for approval as it will result in substantial sanitary, health, social and environment benefits for the people of Juba City and surrounding areas.

Environmental and Social Management Plan (on following pages):

Issue	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsible for Mitigation	Mitigation Cost (USD)*
Environmental Issues Associated with Site Construction Phase						
Drainage	Soil stripping and limited cutting, filling and levelling activities to make the site topography suitable for setting up of the WWTP.	Surface runoff from the construction site may contain eroded earth, sand, aggregate, spilled oil, lubricant, paint residues etc., however the potential to reach drainage channel near and affecting the water quality.	Minor (Negative)	Develop appropriate storm water drainage and flood water management plan	SSUWC Contractor O&M Supervisor	30,000 * * NB! All below figures in this column are estimates
Visual and Aesthetics	Grading and cleaning of land. Storage and disposal of demolition waste Storage and disposal of sludge/silt from decommissioned structure	Loss of topsoil producing an offensive odour and visual impact	Minor (Negative)	Stacking of soil heaps and sludge/silt to be done away from settlements with provision of covers so that odour and fugitive emissions are restricted. All construction activities will be restricted to the designated site upon completion of work. All temporary structures, surplus materials and wastes will be removed from the site and disposed of at a designated facility.	Contractor O&M Supervisor	15,000
Visual and Aesthetics	On-Site storage of excavated and construction materials; On-Site storage of construction waste;	Disposal of MSW in open area around the site can create odour nuisance.	Minor (Negative)	Provision of storage facility for construction materials within the site; Provision of temporary storage of wastes and collection will also be made at the site Sections excavated for pipeline route will be barricaded with tin sheets; Stacking of sections of pipeline to be done	Contractor O&M Supervisor	15,000

	Off-Site disposal of construction waste; Earth work along the sewer pipeline route; De-silting of sewer pipelines; On-Site storage and Off- Site disposal of silt/sludge from sewer pipeline; and Renovation work at linked facilities.			away from settlements with provision of wedges to ensure that rolling or movement of pipeline do not pose risks to passers-by; All the construction activities will be restricted within the designated site; On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility; Construction and municipal solid waste temporarily stored at the site will be transported to the designated disposal facility at regular intervals;		
Soil Quality	Site clearing and preparation	Soil compaction	Minor (Negative)	Demarcation of routes for movement of heavy vehicles; Stripping and placing soils when dry, and not when wet	Contractor O&M Supervisor	6,000
Soil Quality	Fuelling and operation of heavy machinery and transport vehicles	Soil contamination through spills and leaks	Minor (Negative)	Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals; Storage areas for oil, fuel and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel or chemicals from contaminating soils, water or groundwater; Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks; and Installation of oil/water separators to treat surface run-off from bounded areas prior to discharge to the storm water system.	Contractor O&M Supervisor	6,000
Soil Quality	Storage and handling of chemicals	Soil contamination through spills and leaks	Minor (Negative)	Designated storage area with proper area arrangements	Contractor O&M Supervisor	6,000

Soil Quality	Storage, handling and disposal of construction waste	Soil contamination	Minor (Negative)	Design processes to prevent/ minimize quantities of wastes generated and hazards associated with the waste generated; Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period; Segregate hazardous and non- hazardous waste and provide appropriate containers for the waste types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odour nuisance); Store wastes in closed containers away from direct sunlight, wind and rain; Ensure storage area has an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; Dispose of waste by authorised vendor.	Contractor O&M Supervisor	6,000
Soil quality	Generation of sanitary effluent	Soil contamination	Minor (Negative)	Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce; Septic tank and soak pit will be provided to treat domestic waste water. The Waste Management Plant (including C&D waste as well as liquid waste) should also contain aspects of adequate storage, disposal, transportation route, training and record keeping for different categories of waste i.e. hazardous waste, solid waste, e-waste, bio-medical waste, municipal solid waste and chemical waste.	Contractor O&M Supervisor	6,000
Surface Water Quality	Erosion from excavation, levelling,	Increased sediment content of surface water	Minor (Negative)	Provision of channels, earth bunds or sand bag barriers on site to direct storm water to silt removal facilities; Protection of stockpiles by plastic sheeting to ensure that		7,500

	filling and other activities			they are suitably secured against the wind at the end of each working day if rain is forecasted; Appropriate surface drainage will be designed and provided where necessary; Drainage systems, erosion control and silt removal facilities will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly; Any temporarily diverted drainage will be reinstated to its original condition when the construction work has finished or when the temporary diversion is no longer required; Temporary and permanent drainage pipes and culverts will be provided to facilitate runoff discharge. These will be designed for the controlled release of storm flows.		
Surface Water Quality	Fuelling and operation of heavy machinery and transport vehicles	Contamination of surface water	Minor (Negative)	Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor; Any oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal; Any surplus wastewater from the concrete batching plant will be treated to comply with discharge standards before it is discharged to waters	Contractor O&M Supervisor	7,500
Surface Water Quality	Storage and handling of chemicals	Contamination of surface water	Minor (Negative)	Designated storage area with proper boundary	Contractor O&M Supervisor	7,500

Surface Water Quality	Generation of sanitary effluent from on-site labour accommodation.	Contamination of surface water by sanitary effluent generated from on-site labour accommodation.	Minor (Negative)	Provide sanitation facilities for worker accommodations	Contractor O&M Supervisor	7,500
Ground Water	Fueling and operation of heavy machinery and transport vehicles	Contamination of groundwater	Minor (Negative)	Proper SOP has to be followed during such kind of activity	Contractor O&M Supervisor	30,000
Air Quality	Operation of heavy machinery and transport vehicles	Exhaust Emissions	Minor (Negative)	Minimise movement of construction vehicles and enforce a speed limit around the construction site; Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM_{10} and SO_2; Where available use low Sulphur diesel (LSD) in HGVs and diesel powered equipment in collaboration with best management practices; Implement best practice procedures to control vehicle / equipment air emissions (such as turning off equipment when not in use); Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts should be serviced/ replaced.	Contractor O&M Supervisor	15,000
Air Quality	C&D waste management and Sludge Handling	Dust	Minor (Negative)	As far as possible, locate the concrete batching plant away from sensitive receptors; Implementation of a periodic watering and sprinkling regime in particular during the dry season, at least two times during the day;	Contractor. O&M Supervisor.	15,000

				Minimise the height from which fill materials are unloaded during site backfilling as far as possible. Where possible, this should be below the height of the hoarding around the Project site boundary; During construction, the approach road will be regularly maintained to keep it clean, free from mud and slurry. The approach road will be properly shaped and compacted by rolling to an even and uniform surface to receive pavement.		
Noise	Heavy machinery operations for construction works	Increase in ambient noise levels	Minor (Negative)	Normal working hours of the contractor will be between 06:00 and 21:00 hours from Monday to Sunday. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria at nearby sensitive receptors; Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; Low noise equipment should be used as far as practicable; The number of equipment operating simultaneously should be reduced as far as practicable; Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby sensitive receptors as far as practicable; Acoustic enclosure should be erected around DG sets and other stationary noise generating equipment	Contractor. O&M Supervisor.	30,000
Occupational Health and Safety	General construction activities	Health and safety of construction workforce	Moderate (Negative)	The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety	Contractor	30,000

				arrangements; Measures will be implemented to reduce the likelihood and consequence of the following hazards: falling from height; falling into water; entanglement with machinery; tripping over permanent obstacles or temporary obstructions; slipping on greasy oily walkways; falling objects; contact with dangerous substances; electric shock; variable weather conditions; lifting excessive weights; A Permit to Enter system will be established to ensure that only authorised persons gain entry to the site; All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; All workers will be properly informed, consulted and trained on health and safety issues; Personal Protective Equipment (PPE) shall be worn at all times on the Site. If women will be working in the hazard prone areas, then the contractor needs to ensure proper outfit and PPEs. Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order; All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; All scaffolding will be erected and inspected in conformity with the relevant laws and the appropriate records maintained by the Contractor; Safety hoops or cages will be provided for ladders with a height		

				in excess of two meters; When there is a risk of drowning lifejackets shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel is present during work; The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress.		
Community Health and Safety	Influx of construction workers	Increased prevalence of disease	Minor (negative)	Barriers will be provided to prevent ingress of persons into the construction site and also to protect the public from exposure to hazards associated with the construction activities; Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes; Undertaking health awareness and education initiatives among workers; Avoiding collection of stagnant water;	Contractor	15,000
Community Health and Safety	Road transportation	Traffic safety	Minor (Negative)	Road safety awareness building for residents living along the transportation route.	Contractor	10,000
Social Issues Associated with Site Construction Phase						
Loss of access to farmland in WWTP	The WWTP will become a closed facility and not allow informal farming (where some farmers are doing it now).	If not addressed, loss of livelihood	Negligible (after action plan implemented)	Prepare Memorandum of Understanding ; reallocate farmers – in this regard ensure they have as minimum same or better land available for their farming ; Land ownership evidence prepared and submitted/issued ; Issue a public notice for any claimant to the proposed project site area or part of to lay claim before the project commences.	SSUWC	20,000

Access Disruption	Repair and Laying of new sewer line.	Access disruption for both residential, commercial and business operation during excavation work for laying of new rising mains, replacement and construction work.	Minor (Negative)	Inform all the stakeholders well in advance (at least 15 days) before the start of the construction work to enable shop owners to stock up and remain unaffected if goods vehicles are unable to reach them during construction; Provision of wooden planks to ensure pedestrian access, signage with project details and contact details for grievance redress and proper traffic management; Providing assistance to mobile vendors if any present during construction, to shift nearby locations if any; The contractor should provide proper barricading and signage or notices to indicate the ongoing work. In case by-lanes towards the residential areas/shops are located from the replacement stretches; Contractor to provide proper barricading and temporary alternate route for people to access their houses/shops; Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.	Contractor	20,000
Livelihood Restoration Plan for Affected Persons	Repair and Laying of new sewer line.	Temporary loss of Income: Road side vendors, kiosk and shops operating their business near the project *could* face temporary livelihood / income loss during the laying of new sewer line, rising main and replacement along the RoW.	Minor	Two options exists depending on the severity and situation on site: (1) One-time compensation will be paid for the temporary income loss as per the entitlements detailed out in the Livelihood Restoration Framework (LRF); A Livelihood Restoration Plan will be prepared for the Affected Persons. For the purpose of the Livelihood Restoration Plan (LRP) and identifying the PAHs, primary socio-economic data will be collected for the PAHs. The primary data comprised of quantitative and qualitative data collected via a range of tools and data	Contractor	30,000

				gathering techniques. The primary data will be collected through the following method: *Inventory of losses*: An inventory of all structures and immovable assets, livelihood loss to be impacted for each PAH will be conducted during the LRP preparation. (2) No compensation will be paid – unless there are very special circumstances. The logic behind this is that no compensation reportedly has been paid during the very recent water supply pipeline establishment in almost the exact area of Juba town as will be covered under this Project. It has been assessed and decided that the disturbance for the water project – like can be expected for the sewage project – is very short term and has very limited economic consequences. There are as well options for avoiding undue disturbance or livelihood/economic detrimental impact, e.g. laying the pipes under the actual road or at the other side of the road. Regardless of which option above ultimately is chosen, the contractor should ensure that construction work to take place during off-peak business hour and during the night to avoid major disruption. Further, the Contractor during construction should ensure that structure near the RoW are minimally affected and excavation should be carried out to a possible extend to avoid any damages to residential and commercial structure. Finally, if any destruction of structures takes place, the structures should be re-established to same or better level immediately after the pipeline work is finished.		

Migrant Workers & Labourers	Inflow of Migrant labourers & workers expected during construction phase of the project	Potential conflict with local community; Health risks due to spread of communicable diseases and sexually transmitted diseases Issue of Sanitation and hygiene	Minor (Negative)	Provide adequate facilities to the workers and labourers such as properly constructed and well-ventilated labour camps, clean and hygienic sanitation facilities, cooking areas etc. to minimize the health-related impacts; Separate toilet and bathing facilities for men and women; Creating awareness about local tradition and culture among outside migrant and encouraging respect for same; Conducting awareness programme about sexually transmitted diseases among the migrant workers, labourers and for community around project site; Proper disposal of wastes generated from the camp and construction activity to maintain general hygiene in the area;	Contractor SSUWC Ministry of Labour	30,000
Gender Empowerment including Employment of Women	Civil construction during the construction phase of the project.	The civil construction work to be taken place at the WWTP can provide employment opportunities	Moderate (Negative)	Ensure the implementation of the Gender Action Plan (GAP) for the for women residing in the project area; Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment; Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements; Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise of 50% women.		30,000
Environmental Issues Associated with Site Operation Phase						
Visual and Aesthetic	Physical presence of the WWTP;	Visual and Odour	Minor (Negative)	Appropriate shading of lights to prevent scattering; Tree plantation and odour Monitoring	Contractor	9,000

	Illumination from the WWTP facility; Operation and storage of sludge increasing odour					
Surface and ground water quality	Oil spills from oil tanks	Impact on soil and ground water environment Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Moderate (Negative)	The secondary containment structures such as berms, dykes, or walls that could hold up to 110 % of the primary containment volume will be made of firm and impervious material at diesel and lubricating oil storage areas; SOPs will be prepared to manage any oil spills, leaks seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis;Empty drums will be sent for reuse or for recycling in line with relevant guidelines; At all oil and diesel storage tank locations, emergency spill kits will be provided for the operating personnel to use. Operating personnel will be trained to use such kits and dispose of them as part of hazardous waste;	Contractor	5,000
Surface and ground water quality	Oily water-runoff	Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Moderate (Negative)	Oily water runoff collected in the oil handling & storage area and oil filled motors and pump bases will be collected in different sump and taken to a common oily waste water sump; The oily wastewater and storm runoff collected from specific areas mentioned above will be treated using an oil water separator; and Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be transferred to waste water chamber	Contractor	5,000

Surface and ground water quality	Spills of fuel, oil and chemicals	Impact on soil and ground water environment; Occupational health and safety hazard; Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Minor (Negative)	Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation; All chemicals will be stored in primary containers that have in-built secondary containment of capacity that is at least 110% of primary containment.	Contractor	5,000
Surface and ground water quality	Discharge of domestic wastewater Non-oily site or storm water runoff	Impact on river Water and channel water quality; Impact on water quality	Minor (Negative)	The sewage from the entire plant area will be collected and treated in septic tank/soak pit No untreated sewage will be directly discharged into water or disposed of on land through the project life cycle; National and AfDB Guidelines before discharge; and In order to monitor WWTP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of WWTP.	Contractor	5,000
Air Quality	Stack emissions	Impact on ambient air quality ; GHG emissions		Comply with the Emission guidelines for Combustion engines in given by CPC. Monitor ambient air quality in and around the Project site as per the Environment Monitoring Program formulated for the Project which will comply with National Regulatory requirements.	Contractor Juba city council	9,000
Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	Noise monitoring along with health check-up on a regular interval	Contractor	4,500

Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	All noise generating units would be acoustically enclosed; Use of rubber padding underneath high noise and vibration generating machines; Personnel working onsite in high noise generating areas will use ear plugs /ear muffs;	Contractor	4,500
Community Health and Safety	Plant operations	Impact on community assets such as water due to water intake and cooking water discharge. Increased vehicular traffic in the region Exposure to site accidents and incidents Project Security	Minor (Negative)	Comply with the Community health and safety guidelines presented in Sections	Contractor	9,000
Occupational Health and Safety	Project operation phase	Risk of accident and fatality to worker	Minor (Negative)	On job training for the workers shall be carried out; Work permit system shall be followed; PPEs to be provided and use of PPEs shall be encouraged; SOPs to be developed for operation and maintenance of the project site.	Contractor	9,000
Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor (Negative)	Awareness campaign among the community residing adjacent to the road Maintaining healthy relationship with community through CSR activity	Contractor	4,500
Social Issues Associated with Site Operation						

Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor	Awareness campaign among the community residing adjacent to the Site. Maintaining healthy relationship with community through CSR activity	Contractor	4,500
Social Issues Throughout Project Cycle						
Grievances Redress	Entire Project Cycle	Health and safety risk, Non- payment of wages for workers Community Grievances Compensation and Resettlement	Minor	Awareness on the Grievance redress Mechanism Training on the process and GRM procedures	Contractor	9,000
Consultation and Information Disclosure	Entire Project Cycle	Project Impacts and potential influence of stakeholders on the projects	Minor	Sharing of Emergency Preparedness procedures with workers and community. Sharing of monitoring reports for E&S compliance Continuous engagement with stakeholders	Contractor	9,000
Total *estimated* cost of the ESMP						**459500**

1. INTRODUCTION

1.1 General Background

As Juba's population grows and its urban area develops, sanitation standards are being upgraded at the household level at the same time. As compared to the 2013 South Sudan Sustainable Water and Sanitation in Africa (SUWASA) sanitation survey, where only 40% of the households (in the 3 blocks, Juba City, and outside) had sanitation that could be mechanically emptied with a vacuum truck, the latest Japan International Cooperation Agency (JICA) survey from 2022 found that this percentage had increased to about 86% in the project area (3 blocks Juba City). Despite more households paying for Fecal Sludge (FS) emptying services, the current sanitation crisis still poses several interconnected challenges in Juba, including but not limited to: The FS treatment plant in Rokwe (Roton)[1] is overloaded, due to insufficient size and poor management with regards to ring-fencing the revenue to use for expansion and proper Operation and Maintenance (O&M); The effluent from the FS treatment discharged into the Nile is substandard, and there is no reuse of treated FS, as the FS dumped into the Rokwe ponds is not removed; The centralized Fecal Sludge Treatment Plant (FSTP) at Rokwe results in long haulage distances and many vacuum trucks passing through the city centre; and the price for the FS emptying service is high, excluding a number of users in low-income households.

In Juba City, 68% of households have waterborne sanitation, 86% pay for mechanical FS emptying service, and 31% live in low-income housing. The remaining Blocks outside Juba City have waterborne household sanitation facilities, but 42% have non-waterborne sanitation (mainly unlined pit latrines with an unknown interface). Only four households out of 422 interviewed practice Open Defecation (OD), and these are new arrivals. Different low-cost sanitation models are available to low-income households, however, the willingness and ability to invest in improved sanitation may be challenged in low-income housing.

A feasibility study conducted in 2023 documented how low-income areas in Juba city have poor sanitation, including a high number of users, poor quality slab/floor on the pit, inadequate design, insufficient capacity/volume of the pit, and low availability of mechanical FS emptying without the risk of collapse.

1.2 Intro – Project Conceptualization and Overall Design

In April 2023, South Sudan Urban Water Corporation (SSUWC) and the main Consultant, NIRAS A/S (Denmark), entered into a Consultant's Services Contract for the "Feasibility Studies and Preliminary Engineering Design of a Hybrid Wastewater Management System in Juba City'' for a period of 12-month with the support of Swedfund International AB. The objective of the Feasibility Study and the Preliminary Engineering Design was to develop a 'bankable' integrated (hybrid) wastewater management project, comprising both sewerage (water-borne sanitation) infrastructure and fecal sludge (FS) management systems. This should include both pumpable and non-pumpable FS from septic tanks, lined and unlined pit latrines.

The key outcomes to achieve at the completion of the consultancy assignment as per the Terms of

[1] The treatment plant is often referred to as "Roton", but this might cause confusion among local communities as "Roton" commonly refers to a lake, Roton Lake, so the village community Nyaying initially thought that the treatment plant would be located literally in the lake. This has been clarified with them, but nevertheless it may be prudent to refer to "Rokwe (Roton) Treatment plant" to avoid any further confusion. This is generally applied in this report.

Reference (ToR) were:

- Outcome 1.1.: Confirmed solutions for implementation of the hybrid wastewater system and
- faecal sludge plant;
- Outcome 1.2: Increased proportion of collected faecal sludge to be safely treated for reuse/disposal to reach 80% volume-wise; and
- Outcome 1.3: Increased proportion of likely sewered population in Juba to reach 10%.

Further, the activities for project preparation has included: (i) Conducting feasibility studies and developing alternatives solutions for the identified wastewater (WW) problems; Defining appropriate locations for one or more WW treatment plants; Carrying out preliminary engineering design of the selected option; and, Assessing the environmental and social impact.

Concurrently, after conducting the inception period and validating the Inception Report's findings, a comprehensive Feasibility Study was carried out. This included a citywide inclusive sanitation (CWIS) assessment that thoroughly explored comprehensive sanitation solutions across the entire service chain (see Figure 1). The study area concerned Juba City (Juba, Munuki and Kator Blocks) which covers about 50km2 area out of the 330km2 area of the greater Juba metropolitan area. The examination of the various aspects of the sanitation service chain lead to following important assessments:

- Regarding capture and containment, the feasibility phase CWIS assessment and survey showed that most households, i.e. 86% (as per the JICA survey), reportedly have containment from which FS is removed mechanically using vacuum trucks. The CWIS assessment survey showed that low income housing with a high density was found in only a few, small areas in the three Blocks.
- Possibly because the original Juba City is so old, gentrification has forced low-income households to move outside the three Blocks. Though small in numbers, these low-income households use low quality shared pit latrines without proper seal. Annex B of the Feasibility Study report outlines both on-site and off-site sustainable solutions that may be explored and considered particularly for this category of households.
- There seems to be enough vacuum trucks of bigger size of 8m3 and above for emptying and transporting domestic and non-domestic faecal sludge. However, these vacuum trucks are not small enough to access the narrow roads of the unplanned areas. In order to be inclusive of all, it was therefore proposed to address this need by using 3-wheel small vehicles mounted with vacuum pumps and tank. Up to 6 of these vehicles should be sufficient for the design year 2041.

In addition, the feasibility study and the preliminary engineering design included a sewerage system for the entire Juba Block and part of Munuki and Kator to transport sewage from domestic and non-domestic sources to the final discharge point of the sewerage system in Rokwe (Roton) Sewage/WWTP. As it is impossible to convey the wastewater to Rokwe (Roton) only by gravity, the wastewater collected by gravity in the city will be pumped to Rokwe from the lower points in the city area. The preliminary engineering design for the piped sewerage system proposed two options during the draft preliminary design phase:

1. Option 1 involved collecting all the sewage in one location and from one pumping station conveying (pumping) it to the WWTP.
2. Option 2 considered collecting the sewage using two pumping stations. The first pumping station will pump the wastewater within its gravity catchment to the second pumping station and the second pumping station will convey all the sewage within its own gravity catchment area and sewage from the first pumping station to the WWTP.

The main sewer lines and preliminary design for option 1 was presented during the early phase(s) of the consulting process, while the design for option 2 was presented in the final stages, and this option, option 2 with two pumping stations, is the ultimately chosen and prioritised option, while the other option (option 1 above) can be considered as an alternative option in the context of this ESIA.

The preliminary engineering design for the selected alternative treatment option was prepared for the treatment and final disposal of both the faecal sludge and sewage. This included siting and preparation of layouts, sizing and preliminary design and preparation of drawings for the treatment plants for both the FS and sewage treatment.

1.3 ESIA Study – Purpose and process

Terms of Reference (summary ToR is included in Annex 1) and contract were prepared for onboarding a qualified Environmental and Social Safeguards Consultant team (Annex 2). Immediately after this was finalised in January 2024 the team mobilised to carry out on-site field work which has continued up to end of April 2024. The work is designed to, most fundamentally, prepare an Environmental and Social Impact Assessment (ESIA), Stakeholder Engagement Plan (SEP) and Pollution Management Plan (PMP) for the proposed integrated wastewater system in Juba city.

The objective of the ESIA study is to evaluate the environmental and social impacts of the proposed project, including mitigation and management measures in line with the national laws and regulations as well as the requirements laid out in the Integrated Safeguards System (ISS) of the African Development Bank to facilitate preparation of the Project Specific ESIA, SEP and PMP that will guide mainstreaming of environmental and social safeguards during the implementation of the project.

The feasibility study carried out in 2023 (final version December 2023), and preliminary design consultancy (draft February 2024, final version April 2024) for the hybrid wastewater management system, guides and forms the starting point for the preparation of an ESIA, Stakeholder Engagement Plan (SEP) and Pollution Management Plan (PMP) aimed at screening and assessing the proposed project interventions against adverse environmental and social impacts and recommending, where necessary, appropriate mitigation and enhancement measures, and course of action for implementation. The specific purpose of the SEP (a standalone document) is to ensure that all the relevant stakeholders are identified, adequately and meaningfully informed, consulted, and their perspectives are considered throughout the project lifecycle. The PMP (another standalone document) is a comprehensive strategy and plan developed to identify, assess, and control pollution in order to minimize environmental impacts and includes a set of measures and actions aimed at preventing, mitigating, or managing pollution in various forms, such as air, water, soil, and noise pollution from the project. In conducting the assignment, the Consultant has consulted widely with all stakeholders identified and worked closely with the environmental and social focal persons at the South Sudan Urban Water Corporation (SSUWC), the Department of Housing (MLHUD) and other members of the project implementation unit to consult, consolidate and transfer all relevant knowledge required.

1.4 Scope of Work

As the part of the overall scope of work, initially, the ESIA study team has assessed the environmental and social baseline of the project's study area and assessing impacts associated with the proposed project activities, covering the following points:

- Review of existing ESIA/ ESMP reports for WWTP area;
- Conducting environmental and social baseline assessment based on secondary information and environmental primary data collection through monitoring of environmental parameters in the study area and social primary data collection through socio-economic sample survey;
- Conducting environmental and social impact studies for WWTP project in accordance with AfDB OS, covering the following issues and risks:
  - The location and impacts on sensitive receptors including residential houses, schools, health care facilities, aged care facilities, ecological sensitive habitats etc.;
  - Monitoring of the receiving environment, including water quantity and quality;
  - Noise, vibration, air quality and odor impacts (including airborne pathogens) during construction and operation, in comparison to national and international standards;

- Assessment of the terrestrial and aquatic ecology of the site, surrounds and receiving environment, including presence of Modified Habitat, Natural Habitat, and/or Critical Habitat, protected areas, protected or endangered species or habitats;
- Study proposed solid and hazardous wastes management practice, including waste management during construction, volumes of sludge to be produced, processing, recycling and reuse of treated wastewater and bio solids, storage and/or disposal;
- Assess flood risk and draw up mitigation measures focusing on design and operation, including impacts of heavy rainfall events and climate change, as well as discharges from the WWTPs, Pumping Stations (PSs) or trunk sewers in such events;
- Prepare plan for protection of workers and community health and safety during construction and operation, including construction camps, traffic management, hazardous substances, solid waste and effluent discharge.
- Identify any impacts on physical cultural resources and heritage sites;
- Assess the social impacts of the Project, undertake focus groups and key informant interviews to validate predictions in the social impact section of the existing Environment and Social Management Framework reports;

- Provide the process and outcomes of meaningful consultation with Project Affected Peoples (PAPs) and concerned stakeholders, how concerns have been addressed, and how engagement will continue during construction and operation.
- Formulate mitigation measures and actions, where impacts and risks cannot be avoided or prevented and prepare an Environmental and Social Management Plan (ESMP) for the project. Also include a Stakeholder Engagement Plan (SEP), and Pollution Management Plan (PMP)

Furthermore, an Environmental and Social Management Plan (ESMP), and monitoring plan, has been prepared charted out with feasible control technologies, embedded controls and mitigation measures for implementation by the Client to minimize adverse impacts of proposed activities such as:

- Pollution control measures proposed to meet the emission, effluent and noise standards etc.;
- Solid/hazardous waste management practices;
- Mitigations on Occupational health and including an occupational health surveillance programme.
- Mitigations for management of social impacts through mitigation measure at community level;
- Mitigation measures and management plans for implementation with defined timelines and responsibilities;
- Organisation required for implementation of management program during construction and operation phases of the Project;
- Monitoring and reporting mechanism both for regulatory compliance as well as internal assurance within the Client organisation;
- Environmental quality monitoring programme during construction phase and operational phase will be provided;
- Emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.

1.5 Approach and Methodology of ESIA

The ESIA has been undertaken following a systematic process that predicts and evaluates the impacts on aspects of the physical, biological, social/socio-economic and cultural environment of the surrounding due to project activity. It also identifies measures that need to be taken to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. No formal approach or methodology is yet established legally and thus required to be used in South Sudan for ESIAs, but the chosen ESIA methodology follows the generally established and accepted practices in-country, which builds solidly on commonly used standards and

practices in East Africa (in Kenya among other countries). The overall impact assessment approach and methodology is illustrated in ***Figure 1.1***.

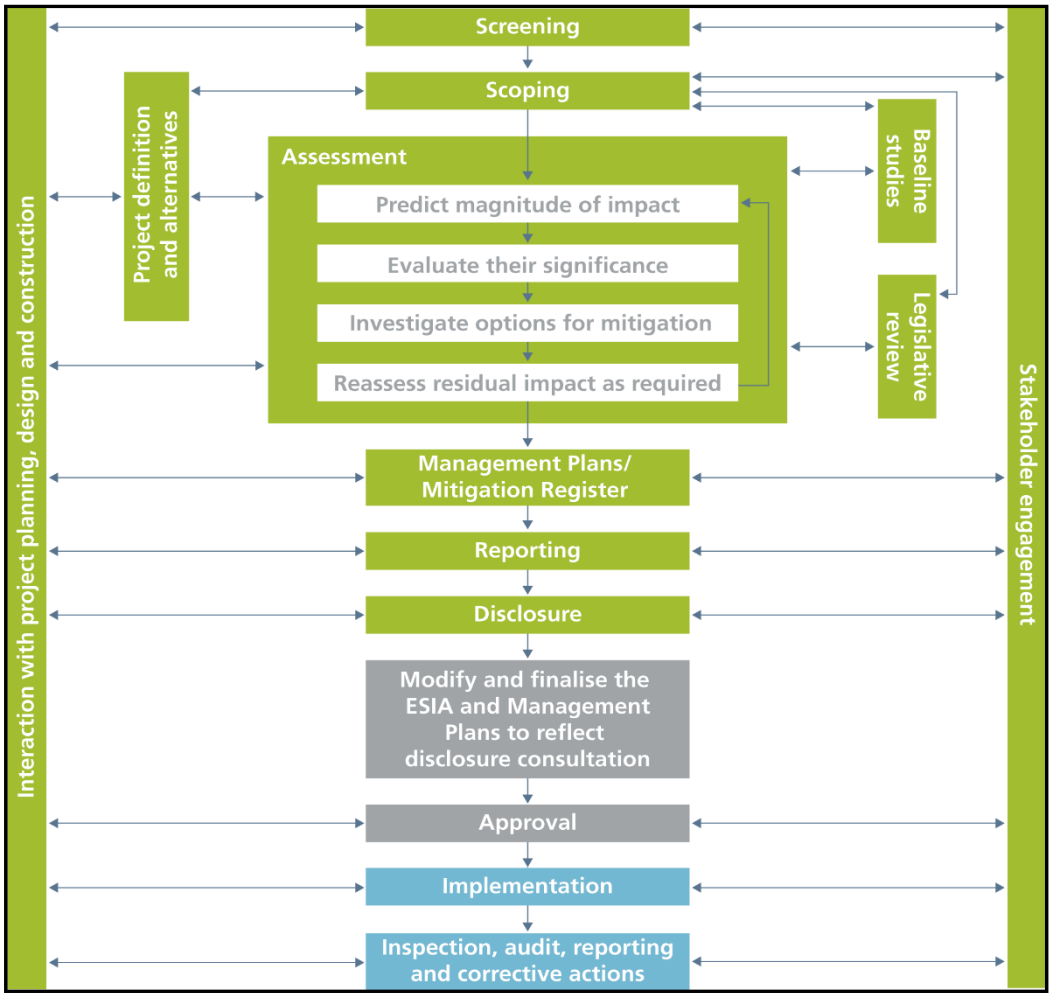


Figure 1: ESIA methodology

1.6 Risk Categorization

The AfDB has three Environmental and Social (E&S) risk classifications: high risk (Category 1), moderate risk (Category 2) or low risk (Category 3). The categorization considers the nature and impacts of E&S risks and impacts as well as all context specific matters such as sector and geographical setting. No formal system (risk categorization) is currently formalised for South Sudan, but in practice the same categorization is followed (Category 1, 2 and 3 ; high risk, moderate risk and low risk respectively).

In October 2023, the project finalized an environmental and social screening which reviewed E&S risks, potential impacts and magnitude of risks. It was assessed that there are negative impacts, but they are few in number, site-specific, largely reversible, and readily addressed through mitigation measures. Hence, the proposed project was categorized as Category 2 project as per AfDB OS (2023).

Importantly to note, environmental impacts will largely be positive since the fecal sludge and wastewater will be treated before being any discharge. There are still negative environmental impacts, which however can be managed with proper mitigation measures. In regards to social aspects, the project is not expected to trigger any physical displacements of homes. Initially, it was considered if the project would lead to permanent loss of livelihoods for a small group of informal farmers who use the land inside the WWTP at Rokwe (Roton), but a solution has been found and there will be no permanent loss of livelihood in the project, please refer to elaborations on this issue in subsequent

chapters where details are provided and mitigation measures presented. The project will also lead to temporary loss of livelihood due to laying the new pipeline network which will cause temporary income loss for road side vendors, kiosks, carts and shops along the sewer lines during the construction phase – however this impact can be mitigated considerably or in many cases avoided with design (where and how pipes are laid into the ground) and a communicative and participatory approach.

1.7 Limitations

All assessments are conducted based on the information and documents available at the time of conducting the ESIA study. Initially, there has been some delay and restrictions in regard to access to the Rokwe WWTP for physical sampling, observational studies and stakeholder consultations and engagement. This was ultimately resolved with cooperation and support by key stakeholders, not least the timely intervention by SSUWC. Thus, eventually, it was possible to gather the required environmental and social data at this specific critical site. Several key visits, data collection and community stakeholder workshop with key informants and people affected by the Project at the WWTP area was undertaken in April, May and June 2024. Stakeholder meetings and discussions were held right up to the deadline for producing the ESIA Study with both stakeholders at the WWTP, its immediate surrounding, stakeholders and the proposed pumping stations sites - and elsewhere in Juba city and the whole project area.

2. PROJECT DESCRIPTION

2.1 Introduction to Project

The project is a hybrid wastewater treatment plant (WWTP) designed for 15 years period but with the anticipation of implementing it in phases, and the phases for the implementation as detailed above is in three sub-phases and will be further detailed as well in the preliminary engineering design. The sewage treatment plant is conceptually designed to handle sewage flow of 38,000 m^3/day, while the faecal sludge plant is sized to treat 320 m^3/day. Two treatment sites were initially proposed as options during the feasibility study phase, but the clearly most viable option was concluded to be an expansion and upgrade of the existing treatment plant for (presently only) fecal sludge. There were however 4 options considered at Rokwe for the more detailed preliminary design of the upgraded WWTP. For further details please refer to final Feasibility Study Report, December 2023, and final Preliminary Engineering Design Report, April 2024.

2.2 Inventory of existing wastewater system and its constraints

Human excreta removal system: The existing human excreta removal system is on-site system with coverage as noted above with 68% of households having waterborne sanitation system. The remaining 32% are likely to have non-waterborne sanitation (mainly unlined pit latrines with an unclear interface, or a few HHs (Households) using neighbourhood toilet). From the 422 people interviewed by JICA in 2022 household survey, 4 households out of 422 interviewed practice Open Defecation (OD), or 1% in Juba. This means that in the expansion areas, OD is likely to persist at a low level, but this can change from household to household as new habitation is established.

Fecal sludge collection system: High percentage of FS and Septage from HHs and institutions in Juba is collected and transported by vacuum trucks to the treatment facility at Rokwe. FS encountered in Juba can be defined by age, water content (%), Total Solids (TS), and BOD (Biochemical Oxygen Demand):

- WW collected frequently from holding tanks (fresh FS, high water (liquid) content, low TS, low BOD); and
- Fecal sludge from pit latrines or septage from septic tanks with a soak-away (older FS, less water (liquid) content, medium TS, medium BOD).

A large volume of sewage is generated from hotels, institutions, and apartment blocks in Juba. This WW that are collected from large producing institutions is fresh FS/WW with a high-water content (the WW is mixed FS and sullage), low TS, low BOD compared to the FS from HHs. These institutions mostly have private boreholes, independent of the public water supply system, and their wastes fill their septic tanks frequently. As a result, these tanks are serving as merely holding tanks until large-size vacuum trucks empty them and bring them to Rokwe (Roton) FSTP for treatment. Hence, WW from these big WW producers is collected and transported to Rokwe via large vacuum trucks of 15 m3 or above.

On the other hand, waste that is collected from households had generally stayed in the septic tank or latrine pit for a longer time and is thus septage that has undergone some stabilization and in situ transformation from original stage. Vacuum trucks of size 8 to 10 m3 are mostly serving households. The very small type of vacuum trucks of 3-5 m3 that could better serve households at low-income areas are not common in Juba, yet at least.

How much faecal sludge and sewage from holding tanks is transported to Rokwe remains unknown. Privately owned vacuum trucks transport faecal sludge from a relatively large number of households to the Rokwe FSTP for treatment. Emptying prices range from 70 to 100 USD per 20 m3 depending on the haulage distance to Rokwe and the truck owner. Prices include unloading fees of 30 USD per 20 m3.

2.2.1 Fecal sludge treatment system and disposal

A waste stabilization pond for the Faecal Sludge Treatment Plant Site that includes an inlet chamber, channel, anaerobic pond and facultative pond is financed by the World Bank. This treatment plant, which is also known as Rokwe (Roton) Wastewater Lagoon is located approximately eight kilometres away from central Juba town in Nyaying Village, North Juba. It was designed for a capacity of 3,300 m3 /day, but with land available for a full capacity of between 6,800 and 9,500 m3 /day (as per initial estimates and present technology and approaches).

Figure 2: Existing Faecal Sludge treatment plant at Rokwe (Roton)

The two treatment ponds are reportedly 4 m (anaerobic) and 3 m (facultative) deep, respectively, and are full of sludge. The last known wastewater effluent analysis (prior to the present ESIA study) was conducted in 2015. According to the assessment done by USAID, SUWASA (reported February 2015 the effluent quality in fact high in BOD and COD not only at the outlet of the anaerobic pond but even 1 km and 2 km downstream the plant of the samples taken in 2014 (Table 1).

Sampling taken in connection with this ESIA Study in April 2024 is included as Table 2 below. The full details of this sampling is included as Annex 3. Table 2 further includes effluent standards as for parameters where they are defined in Sudan or Uganda.

All samples show that Rokwe's FS treatment produces poorly treated effluent for discharge into the surrounding environment, and ultimately into the White Nile which receives by far the majority of the effluent.

Table 1: Data on Wastewater Quality – March and July 2014

Parameters	Influent (receiving area)	Anaerobic lagoon effluent	Facultative lagoon effluent	1 km downstream from discharge	2km downstream from discharge
Sample event: March 2014					
BOD	365	328	216	270	264
COD	912	820	653	674	660
Sample event: July 2014					

BOD	384	466	184	664	1668
COD	712	1165	460	1668	458

Table *2*: Data on Wastewater Quality – April 2024

Sampling date: 22nd of April 2024 **Analysis date:** 24th to 26th of April 2024

Parameter	Units	Wastewater sources-Sample ID				NEMA Effl stds *	Sudanese Guidelines for Discharge
		1	2	3	4		
pH		5.9	6.4	6.4	6.5	6.0-8.0	6.0-9.0
EC	µS/cm	2940	3250	3420	3420	ns	
TDS	mg/l	1460	1620	1700	1700	1200	
Temperature	ºC	31.8	32.0	32.1	21.1	ns	
Apparent Colour	PtCo	2255	2160	2270	1263		
Turbidity	NTU	352	358	333	220		
Nitrates	mg/l	23	15	25	12	20	30
Total Phosphorus	mg/l	15.2	13.5	14.5	14.8	10	
Sulphates	mg/l	6.0	10.5	7.2	3.2	500	
Total Suspended solids (TTS)	mg/l	317	311	290	260		
Chromium	mg/l	0.015	n.d	n.d	n.d	1	
Lead	mg/l	0.1	0.04	0.11	0.03	0.1	0.5
Chemical Oxygen Demand	mg/l	1080	1383	1080	300	100	

* Uganda National Effluent discharge standards, 1999-values for heavy metals are for total concentrations; ns - not specified; nd - not detected; detection limit for Cadmium, Copper, Lead and Zinc is 0.001mg/l.

Sources (location of sampling):

1. Wastewater influent to ponds
2. Anaerobic Pond effluent wastewater
3. Facultative Pond effluent wastewater
4. Facultative Pond effluent entering waterway onwards to River Nile (or used in irrigation)

Figure 3: Existing Anaerobic Pond at Rokwe (Roton)

Figure 4: Existing Facultative Pond at Rokwe (Roton)

Figure 5: Existing effluent from the facultative pond

As mentioned above, water sampling conducted in conjunction with this ESIA study was taken in April 2024 and clearly underlines the detrimental insufficient treatment process currently in operation, and the discharge of highly polluted effluent from Rokwe WWTP. The full data is provided in Annex 3 to the report, but in summary:

- The discharge does NOT meet standards (see Table 2) in regard to parameters such as Total Dissolved Solids (TDS), phosphates, Colour and COD.
- The processes / current operation is clearly insufficient or malfunctioning, among others it is noted that there is high apparent turbidity (flow) and colour.
- High nutrient levels, as per measurements.
- Very high Chemical Oxygen Demand (COD). This suggest that the ponds and EETP is "overloaded" with organic matter.
- Al together, the effluent/discharge is a case of "non-compliance" with standards, as per both national and normal international standards.

There is no final disposal or recycling/reuse of treated FS at Rokwe at present.

Major issues and constraints

While the Rokwe WWTP operates at present within its capacity (in principle), it does not produce the quality of effluent that would be expected as it is not at present a properly maintained and operated facility. A short-circuiting of the influent wastewater is obvious and consequently limited blending is done with the lagoon wastewater, but rather large quantities flow out almost untreated. It is also evident that one of the causes for the short circuiting is the accumulation of sludge which has an adverse effect on performance both in the anaerobic and especially in the facultative ponds. This means that the current lagoon system operation state is of primary concern. In fact, the situation is becoming worse with time - the desludging of the ponds until a new one is constructed is therefore a crucial step that need to be taken to improve the effectiveness of the system.

2.3 Further consideration and overview of Project Phases

Sub-phase 1 of the project:

The preliminary engineering design for the FS treatment is prepared until the design Year 2041. It includes the layout of the treatment plant facility after conducting topographical survey of the area, a preliminary design for a receiving tank, the design and sizing of the multi-disc screw presses, including concrete plinths for screw press placement, the design and sizing of feed pumps, design of buffer tanks, the design of waste stabilization ponds, including the rehabilitation of the existing ponds, and the design of the auxiliary buildings.

The implementation of the this sub-phase 1 of the project will include the following:

- The preparation of the detail designs for all the civil infrastructures, including detail design drawing preparation. This also includes sizing and designing the flow channels from one unit of treatment to the other unit; as well as designing the access roads.
- The preparation of bidding documents for the construction of civil works and for the supply and installation of the electro-mechanical parts which include multidisc screw press, sludge feeding pumps and laboratory equipment's.
- The construction of the civil works and supply and installation of the electro-mechanical units.

Sub-phase 2 of the project:

The preliminary design of the sewage management system is designed for the design Year 2036. It includes the sewage network system and the sewage treatment plant. The preliminary design includes the topographical survey of the sewer routes, the hydraulic analysis and sizing of the sewer pipes, the preparation of the sewer network layout as well as presenting the layout and profile for the trunk/transmission main from the pumping station to the sewage treatment plant. It also includes

sizing of pumps and the preliminary design of the pumping stations. In regards to the Sewage Treatment Plant, the Consultant has calculated the sizing, preparation of the layout and of the preliminary engineering design and structural analysis of all the components of the sewage treatment plan, which include screening, preliminary and secondary clarification units, trickling filter and disinfection and sludge stabilization units.

The implementation of the this Sub-phase 2 of the project will include, among others, the following:

- Updating the design data and bases. Given that Sub-phase 2 implementation is anticipated to take place five years from now, at least that is the initial time line anticipated, the design integrates and take provisions into the project that account for potential shifts related to population growth, urban development, technological advancements, and regulatory changes. This should be consolidated however, and especially concerning the sewer network system updates may be required that involve revising hydraulic design data, which could impact pipe sizes and pump sizing – although substantial alterations to the network layout are not expected.
- Similarly, with regard to sewage treatment, if significant changes in flow occur, it is advisable to assess the treatment plant's capacity for the new flow and adjust sizing as necessary.
- Further to the updates of the preliminary design based on the new design data and bases, the detail design for the sewer network will include the design of each sewer pipes, manholes and pumps with precision. Likewise, the detailed design for the sewage treatment plant includes drilling of more boreholes for the geotechnical investigation, the review of the structural analysis and the preparation of drawings for all the civil infrastructures; flow channel design which ensures efficient flow distribution and detail design drawings preparation; electro-mechanical design of the electrical and mechanical units.
- Construction of the civil works and supply and installation of the electro-mechanical units.
- Capacity building component is also an important consideration and should be an integrated aspect/scope of the project.

Sub-phase 3 of the project:
The preliminary engineering design work carried out and the remaining tasks required to bring it to realization during Sub-phase 3 are like those outlined in Sub-phase 2 above, with the only distinction being the timing of their implementation.

Establishment of a Project Management Unit (PMU):

Further to above more technical aspects, the project entails as a key planning aspect/proposal that a PMU be established in SSUWC to fulfil the administration, management and supervisory responsibilities of the project at the time of implementation. This will, among others, require the assignment or recruitment of professionals. The PMU will have the responsibility of implementing the project in compliance with the procurement, financial management and safeguards procedures of the African Development Bank (AfDB).

The ESIA study takes notes of all above plans and considerations. They are further considered in regard to assessment and planning, among others for the assessment of risks, and also for outline of ESMP where it indeed is a fundamental assumption that a PMU be established and increased capacity be secured for operation and monitoring (also of environmental and social issues).

2.4 Project WWTP Facility Location

The project is located in Roton, Luri Block, Juba County, Central Equatoria State It's within the existing facility at coordinates 4°54'00" N 31°36'16" E. The land already acquired by the government. The available area is 200,000 m^2 or 20 Ha. There is furthermore (presumably) an additional land area available for expansion around the existing Rokwe treatment plant, but this is not required/planned for in the Project. It's at an elevation of 461m above sea level and it's located where there is no settlements in the immediate vicinity of the facility. The nearest buildings not directly related to the WWTP facility are some small factories and office buildings a few hundred meters away on the access

road to the WWTP – and it is noted that construction of such buildings have increased recently (after the access road was established). The facility is 500 meters away from any designated (and observed) wetlands, and approximately 1 km away from Roton Lake - and importantly to note, the effluent outflow does not directly lead to the wetland or the lake, but rather downhill into a waterway (stream) that directly flows into the White Nile. The site has a slight slope of 6% to the east toward a small stream where the current wastewater from the treatment plant is flowing into (which leads to the White Nile).

The current site and structure (and also the area designated to be the future treatment plant area) is further illustrated below. The existing facility consists of the following process units with approximate volumes:

- Reception tank. Approximately 5 x 5 meter
- Coarse screen
- Anaerobic pond – estimated area is 2,500 m2 and average depth is 4 meters. Total of 10,000 m3
- Facultative pond – area 27,000 m2. The estimated depth is between 2.5 and 3 meters. Total of 67,500-81,000 m3.
- Discharge well
- To the west of the ponds are the reception facilities and small buildings for registration and for the staff.

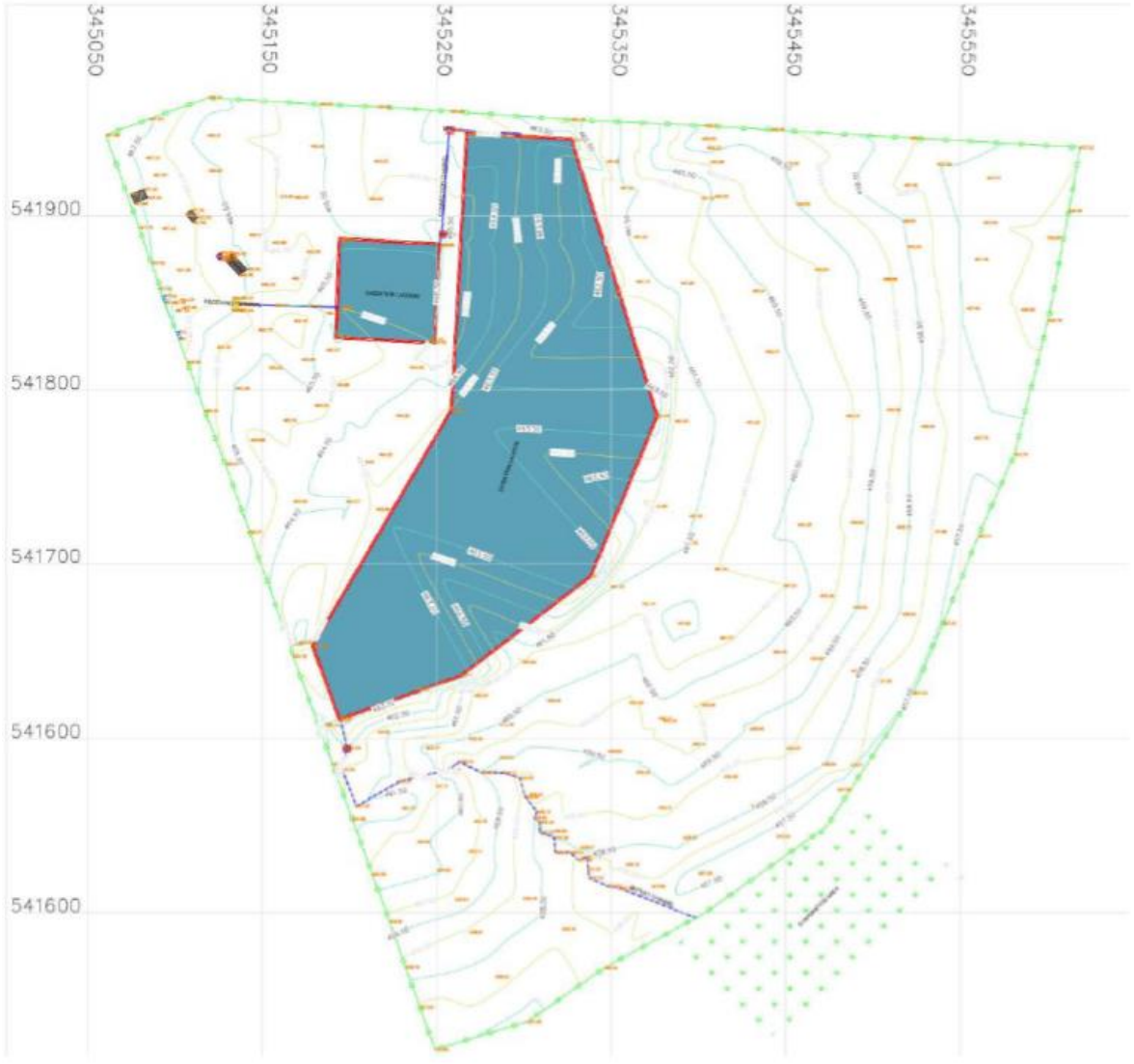


Figure 6: Project area (the full designated site of the wastewater treatment facility at Rokwe)

2.5 Outline of Sewer System and Pumping Stations

Two options were considered in the Draft Preliminary Engineering Design Phase for sewerage network. The first option involved pumping all the sewage into one pumping station and conveying it to the WWTP. The second option considered collecting the sewage using two pumping stations. The first pumping station will pump the wastewater within its gravity catchment to the second pumping station and the second pumping station will convey all the sewage within its own gravity catchment area and sewage from the first pumping station to the WWTP.

The two options are shown in figures below, pumping station(s) indicated with “PS/PUMPS”:

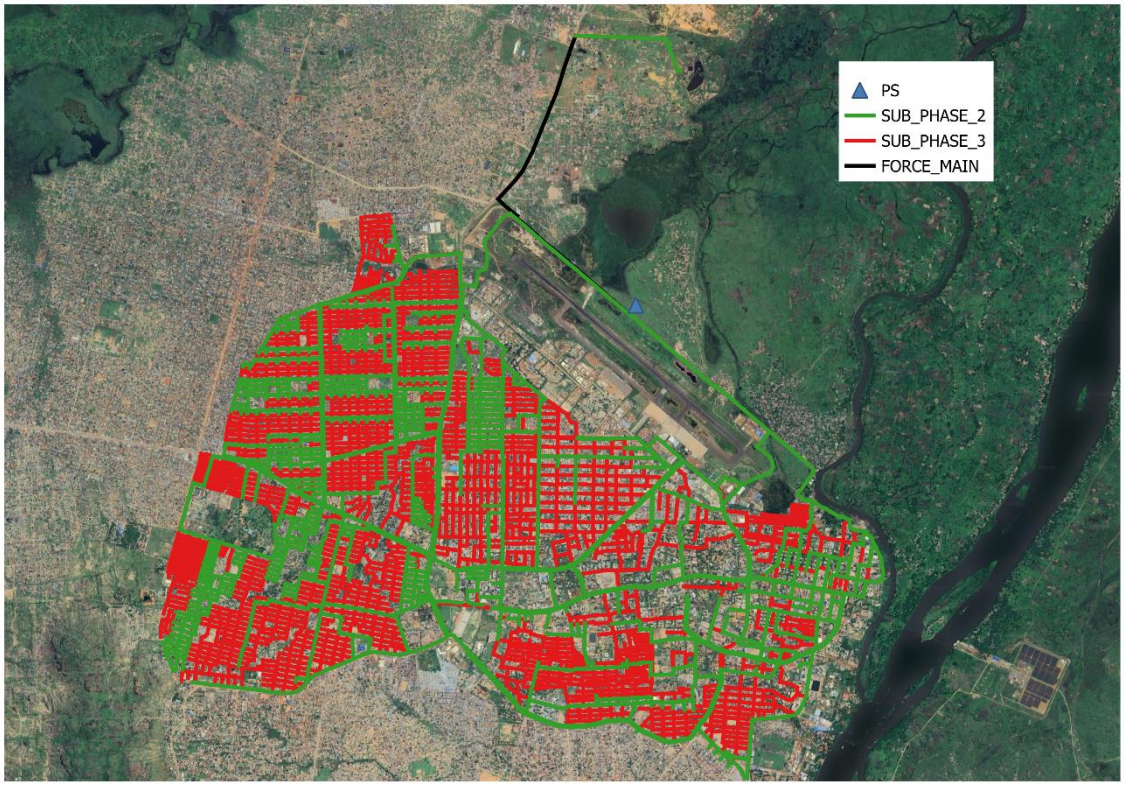


Figure 7: Sewerage Network Design Option 1

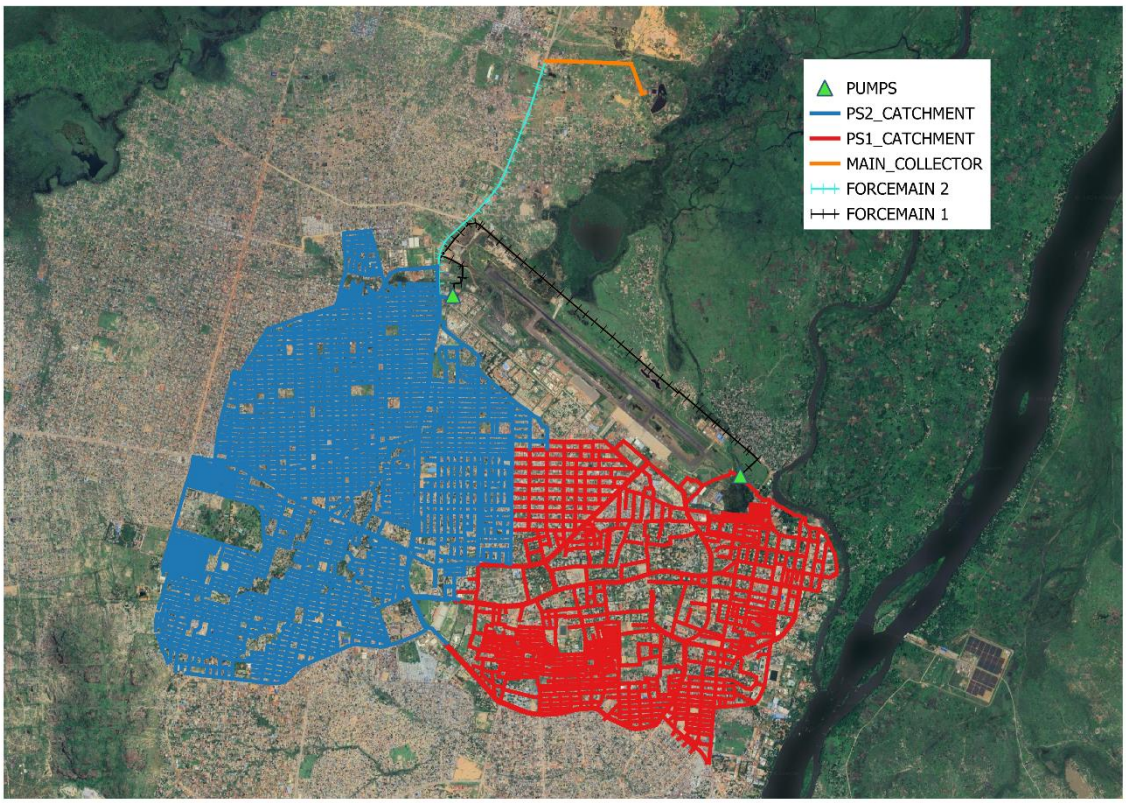


Figure 8: Sewerage Network Design Option 2

Within the scope of the Draft Preliminary Design Report, both options were compared, and the results were presented in the workshop. It was decided during the final workshop to go with option 2 as the maximum depth for pipe cover is less and both the pump stations are within the city jurisdiction.

2.6 Environmental Setting - Overview

Rokwe WWTP is located where there is only limited settlements, in the vicinity, although some expansion of mainly small business, offices and household settlements is noted. These are all established/constructed in the last 15 years and mostly along the (improved) access road leading to the WWTP facility. Altogether, there is limited settlements, and have been very much aware that there is a designated and established WWTP. A further note is that some (local community members) have expressed a desire to settle near the facility in the future, even very close to.

Figure 9: Existing settlements in proximity to the WWTP

(small building in the foreground on first picture is not an actual settlement in the WWTP area but a part of the WWTP facility). The second picture included a settlement very close to the fence, but outside the facility.

The wastewater treatment plant is more than 500 meters away from any designated wetlands and as well from lake Roton. However, effluent could in principle flow to some wetland areas downslope from the WWTP if run off not "controlled". At present the discharge/effluent flows firstly to an existing stream and subsequently to the White Nile 3 km away instead.

The type of surface soil is sandy loam and sandy clay. Some agricultural crops are growing within the facility by informal farmers. This will be further analysed in subsequent sections.

Figure below: The overflow of wastewater from current operations flow downslope from the treatment plant through a small channel (reinforced within the treatment plant area), essentially untreated and thus released into the natural waterways (streams) downslope and ultimately into the White Nile.

Figure 10: Discharge point

2.7 Project Components

The design as well as a design period for sizing the septage and wastewater treatment plants and deciding the number of collection and transportation equipment is assumed to be 15 years up to Year 41. The construction of the units is expected to be phased. While designing the sewer system, flow for the Year 2051 will be checked to see if it is economical to either use one large diameter pipe suitable for the final planning horizon 2051, or multiple smaller diameter pipes installed at various intermediate planning horizon/s say 2041.

The Sewage Treatment Plant shall include the following unit operations, including all inter-connecting pipework, valving, instrumentation, and necessary control system:

- Inlet pump station
- Coarse screening
- Fine Screens
- Grit removal
- Primary sedimentation tanks, incl. scraper bridge, scum boards, effluent weirs
- Trickling filters including filter material and associated recirculation pump station.
- Secondary settling tanks and sludge return pump station, incl. scum collection and transport to inlet works.
- Sludge dewatering, incl. polymer system
- Anaerobic tank for co- stabilization of sludge from primary and secondary sedimentation tank incl. mixing units , gas collector and gas flare
- Sludge disposal area, incl. screening and grit storage,
- UV Disinfection

Faecal Sludge System Design Scope

The Faecal Sludge System shall include the following unit operations, including all inter-connecting pipework, valving, and instrumentation:

- Volume Control System (Weight/flow)
- Inlet structure
- Coarse Screening
- Fine Screening
- FS Dewatering units (Option)
- Anaerobic Ponds
- Facultative Ponds
- Maturation Ponds
- Effluent Station

Auxiliary Components

Combined for the two treatment lines are the following elements:

- Buildings and associated mechanical and electrical equipment, including building for power supply, incl. associate electrical switchboards and control system, incl. associate electrical switchboards and Motor Control Panels.
- Building for Sludge dewatering and Mechanical and electrical workshop, incl. maintenance equipment.
- Storage area for dewatered and stabilized sludge .
- Administration and Operations building, incl. SCADA system,
- Staff service building,
- Laboratory and associated equipment.

The proposed design life for major components of the wastewater management system is set out in Table 2.

Table 3: Design life for major components

Component	Year
Mechanical truck-mounted tank	20 years
Civil works of the treatment plants	40 years
Mechanical Equipment of the treatment plants	15 years

2.8 Technical options

The successful implementation of proposed measures heavily relies on tailoring technologies and management concepts to suit local conditions. The proposed measures must be accepted by the SSUWC, the city administration, and the population in order to be effective. In order to operate and expand the proposed system, SSUWC must have the necessary financial, technical, and human resources. Human excreta removal systems can either be onsite or offsite.

On-site disposal system: On-site disposal is a system where waste is disposed (septic tanks, aqua privies and latrines) just at a site of production without moving elsewhere. Collected excreta sludges or septages consisting both liquid and solid material from these septic tanks, pour flush, aqua privies and latrines require removal from time to time, transportation or collection, treatment and the environmentally safe disposal of septage.

Off-site disposal system: Offsite system is a system that consists of sewer lines for carrying household, commercial, institutional and where economically and technically feasible industrial level created wastewaters into a central treatment plant site, where the wastewater is being treated prior to its disposal to a water body or used for land application. The on-site and off-site potential solutions that have been considered is summarized in the table below

Table 4: Sanitation typology and options

Wastewater management options at point of generation **1. Human Excreta Removal Options** • Toilet with private or communal septic tank • Toilet with Aqua Privy VIP latrine • Compost latrine • Bio-gas **2. Sullage Removal Options at point of generation** Faecal Sludge Management at the Municipal/Utilitylevel Faecal Sludge Collection Options • Manual • Mechanical **3. Faecal Sludge Final Treatment Options** • Pre-Treatment by Screening • Sludge drying bed and ponds for the leachate • Waste stabilization pond	**1. Liquid waste management options at point of generation** **2 Sewage Collection System** **3 Sewage Treatment Options** **3.1 Waste Stabilization Ponds** **3.2Trickling Filter** **3.3 Oxidation ditch**

2.9 Establishment of design criteria for both FS and Sullage collection

Septage collection: Currently it is reported that 86% of the households use vacuum trucks for emptying their excreta pits. Although the outcome in the ToR for faecal collection is 80%, the Consultant proposes full coverage for means of emptying latrines and septic tanks for Munuki and Kator Blocks except gravity sewer collection system for old Juba town and those in small areas of Munuki and Kator that are in the same catchment. As to human excreta from the institutions, commercial centres and industries 100% collection is again targeted in Munuki and Kator Block.

Sullage Collection: With respect to sullage: waste from sinks, showers, and baths, are expected to be managed at household level; in most cases where there is piped house connection by disposing it to septic tanks. Hotels and restaurants in the non-sewered areas however may use mostly use soak away pits.

Manhole design criteria: Manholes shall be made of concrete as shown on below figure, without step irons. Manholes will be installed on sewer pipelines at all changes of the vertical or horizontal alignment at intervals not exceeding lengths (as per figure below) in straight line for sewer lines.

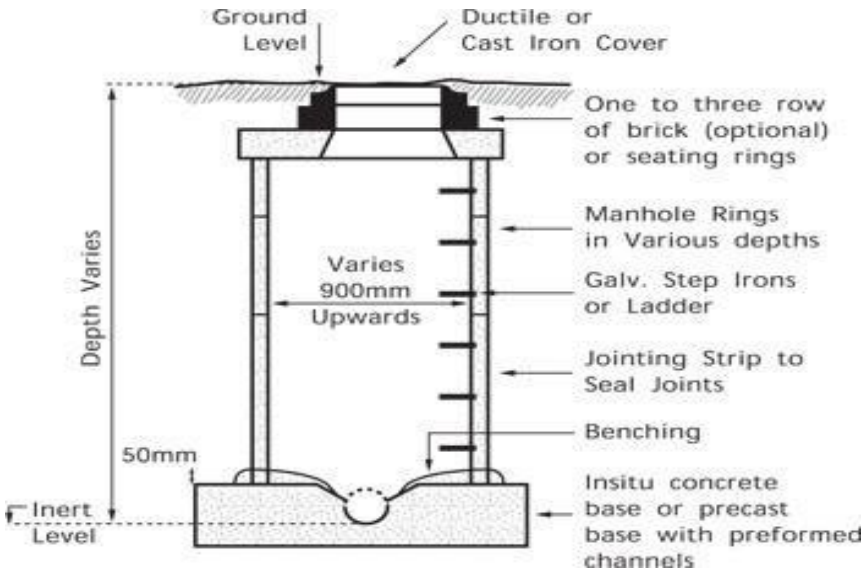


Figure 11: Typical Precast Concrete Manhole

Manholes shall be delivered and installed on site as pre-cast concrete sections. Sewers and manholes must be made watertight and upon completion should leaks be discovered when the manholes are tested, they must be sealed with hydraulic cement.

Connections to the manhole shall be performed by a coupling O-ring around the pipe cast into the concrete base of the manhole that is suitable for HDPE pipes to provide a water tight manhole. A flexible pipe connector coupling shall be installed within 300 mm of manhole exterior in any areas of less than optimum soils conditions. Steps shall not be provided in the manholes. Portable aluminium ladders shall be provided for accessing the interior of manholes.

The following design criteria/requirements shall be applied for the manholes:

Concrete shall be 30 MPa minimum strength; Sulphide resistant cement shall be used; Traffic loading in accordance with DIN 1072 Maximum depth ≤ 5 m.

Manhole covers shall be either ductile iron or cast iron, black bitumen coated. Concrete bricks will be allowed for levelling of the manhole casting. Lock-type or pressure-type manhole covers shall be used on manholes located in areas subject to flooding. Manhole covers shall be in accordance with the relevant provisions of DIN EN 124 where:

- Class D400kN covers will be used in roads, hard shoulders and parking areas.
- Class B125kN will be used in pedestrian walkways areas and comparable locations.
- All manhole covers shall be 62.5 cm diameter clear opening,
- Cover shall be tight fitting on frames so as not to vibrate under passing traffic

2.10 Pump Station design criteria

Submersible pumps shall be used for the lift and pumping stations. For small-medium sized lift stations, a simple circular chamber is proposed. Benching will be provided to direct sewage solids to the pump(s). The main pumping stations (North and South) will be provided with a back-up diesel generator electrical system

The civil structures are designed for 2041 flows; however, it will be considered that the pumping equipment to be initially procured under project implementation are designed to meet 2031 flows. The corresponding wet wells, piping system and force mains shall also be designed for 2041 flows.

2.11 Establishment of design criteria for treatment and final safe disposal/reuse

The effluent quality is based on the water body into which the effluent will be discharged. As South Sudan does not have a valid discharge criterion, in this design, the Consultant proposes to adopt the National Environmental Management Authority (NEMA) effluent standards as the East African standards shown below (standards used in Kenya and Uganda among others).

Table 5: Effluent Standard for Discharging to the environment

Parameter	Unit	Allowable limits for Pollutant Substance
pH	`	6.5 – 8.5
Biological Oxygen Demand BOD5 (5 days at 20 C)	mg/L	< 30
Chemical Oxygen Demand COD *	mg/L	< 50
Total Suspended Solids *	mg/L	< 30
Total Dissolved Solids *	mg/L	< 1200
Ammonia (NH4) + Nitrate (NO_3) + Nitrite N02	mg/L	< 100
Max E. Coli	mg/L	Nil/100
Total Coliform	mg/L	1000/100

Source: NEMA, Kenya Gazette supplement No 68 - Sixth Schedule

Marked with a * is parameters where the recent water samples taken in April 2024 of discharged effluents do NOT meet the East African standards – please also refer to Annex 3 and Table 2.

2.12 Criteria for primary treatment design

Design criteria for primary treatment options where required is detailed in the table below.

Table 6: Design criteria for primary treatment options

Process Unit	Primary treatment
Influent Tank	• Rectangular concrete tank • Min. retention time of 3 min. (peak flow) • Bottom level as high as possible due to optimization of start hydraulic head.
Coarse Screen	• Installed at entrance to Inlet tank. • Cleaning depth 90 – 100 mm. • Manual cleaned • Space between bars: 20 mm
Fine Screen	• Installed in the Influent tank • Cleaning depth 90 – 100 mm. • Automatic cleaned • Space between bars: 5 mm

Primary Clarification	• Circular concrete tanks. • Design basic: peak flow • Hydraulic retention time: 2.5 hour • Overflow rate: 30 m^3/m^2*day (average flow) • Weir loading: 60 m^3/m * day (average flow) • Underflow concentration (sludge concentration): 4% • Side water depth: 3.50 meter • Suspended Solid removal: 50%. • BOD and COD removal: 30%

2.13 Criteria for waste stabilization ponds design

Waste stabilization ponds (WSP) are designed based on retention times and loading rates determined by the average influent flow rate and sewage quality. The net evaporation rate and the mean temperature of the coolest month are also essential parameters to consider during the design process. These design criteria, recommendations for pond depth and slope, etc., have been compiled from various international publications on wastewater treatment.

2.14 WSP Components and Effluent Standards

Anaerobic: - A pond where sewage is digested anaerobically.

Facultative: - A pond where both anaerobic and aerobic digestion of the sewage takes place.

Maturation: - A pond primarily responsible for pathogen removal by various mechanisms including UV disinfection. Effluent standards for South Sudan are not available. NEMA standards are of the design criteria are used. The BOD_5 removal rates used for the design are shown below:

Table 7: Anticipated BOD5 and Coliform Percentage Reductions

Type of Pond System	**BOD5 Removal Rate(%)**			**Coliform Removal Rate (%)**		
	12^0C	20^0C	25^0C	12^0C	20^0C	25^0C
Anaerobic, 3 x facultative and 3 x maturation	94	95	95+	99.95	99.996	99.99999

World Bank: Design and Operation of Waste Stabilization Ponds in Warm Climates of Developing Countries

2.15 Criteria for oxidation ditch design

This is a modified activated sludge process operated in extended aeration process. The bases for the design of oxidation ditch is primarily the load, that is the quantity and the strength of the waste which has to be purified. Oxidation ditches achieve 95% removal of both Biological Oxygen Demand (BOD) and Suspended Solids. Design criteria for oxidation ditch is shown below.

Table 8: Design criteria for oxidation ditch

Process Unit	**Oxidation Ditch System**

Oxidation Ditch	• Hydraulic Retention Time. Min. 15 hours • MLSS concentration. 4 kg MLSS/m3 • F/M ratio: 0.2-0.5 kg BOD_5/kg MLSS/day • Depth of tanks: 3 meter • Width of channels: 4-5 meter • Influent Feed Location: Influent and return activated sludge feed to theaeration tank should be located just upstream of an aerator to afford immediate mixing with mixed liquor in the channel • Effluent Removal Location: Effluent from the aeration channel shall beupstream of an aerator and far enough upstream from the injection of the influent and return activated sludge to prevent short-circuiting.
Secondary Clarification	• Circular concrete tanks. • Design basic: Peak flow and average flow • Overflow rate: 20 m^3/m^2*day (average flow) • Weir loading: 50 m^3/m * day (average flow) • Underflow concentration (sludge concentration): 1-1.5% • Side water depth: 3.50 meter • Effluent SS: 20 mg/l
Effluent Tank	• Concrete construction following secondary clarifier • Main function. To collect cleaned water from secondary clarifier step forflow measurement and sampling of water probes
Disinfection (if required)	• Complete facilities for disinfection of cleaned waste water to be included if needed • Disinfection method. Chlorination or alternative UV/Ozon (only with lowSS)
Sludge Storage Tank (secondary sludge)	• Circular concrete tanks. • Design basic: storage of 3 days sludge production • Include 2 pcs. (one + one stand-by) of dry installed pump for feedingsludge thickener • Capacity of pump: adjusted for feeding of sludge thickener for 7hours/day and 5 days/week
Sludge Gravity Thickener	• Circular or rectangular concrete tanks. • Depth. 4 meters • Design basis: Mass loading • SS loading: 60 kg/m3 * day • Underflow concentration (sludge out): 4-6%
Process Unit	**Oxidation Ditch System**
Sludge Dewatering Unit	• Sludge source: Digested sludge • Type of dewatering unit: Belt filter press or Filter Screw Press. • Filtrate solids content: 100 mg/l • Cake solid content. 18-20 % • Polymer station for preparation from dry polymer and with dosing of 1%solution

Sludge Digester (if required)	• Circular concrete tank • Temperature: raw waste water = 20 dg C; digester: 35 dg C • Heating: waste heat from CHP • Heat exchanger: external between influent sludge and CHP waste heat • Percent volatile solids degraded: 50-60 % • Influent Concentration of SS to digester: 10 % • Concentration of SS in Digester: 6 % • Detention time in digester: min. 20 days • Pump installation for feeding sludge from primary and secondary sludgestorage tank
Technical Building	• The building to include the following: • Electrical room for panels • Control room • Laboratory • Work-shop • Stock room for spare parts • Toilet facilities • Rest/eating facilities
Other Civil Structures	• All necessary wells
Piping:	• Process water: HDPE • Biogas pipes: HDPE
Instrumentation & Control	• Flow at inlet/outlet • pH at inlet/outlet • Temperature at inlet/outlet • Temperature at digester • Oxygen in aeration tank • pH at digester • Gas flow at digester • PLC control
Land Preparation & Landscaping and infra structure	• Existing pump station to be removed or closed down • All vegetation, trees, and roots to be removed on the land and land to beprepared for construction. • New soil to be supplied when needed and excess soil to be removed. • After finished construction the land must be landscaped including grass. • Roads to be established where needed. • Fences around the whole area to be established

2.16 Criteria for trickling filter system design

The Trickling Filter process is based on the biological oxidation of pollutants contained in the wastewater. The media in the Trickling Filter provides a surface for the growth of bacteria and other micro-organisms that feed on the organic pollutants in the wastewater, and then uses oxygen in the air to convert these into harmless by-products.

Trickling Filters can provide biological treatment of wastewater to reduce Biological Oxygen Demand

(BOD) and Chemical Oxygen Demand (COD) in carbonaceous systems, BOD and ammonia in combined carbonaceous and nitrifying systems and nitrifying liters to reduce ammonia.

Originally built using rock or stone media, Trickling Filters have proved simple to run, reliable, energy efficient and able to achieve successful treatment. The modern version of Trickling Filters uses the structured plastic cross-ow media.

Trickling filter system may be constructed as single unit, or multiple units connected in parallel or in series. They can also be arranged in a flexible way that is open for various flow schemes. Trickling filters are sensitive to high content of suspended solids (SS). SS with after time block the trickling system. Furthermore, SS is not digested during the way down the trickling filters, Therefore a primary sedimentation tank together with screens is required to remove SS prior to the trickling filter.A typical trickling filter system will be as shown below:

Table 9: Typical trickling filter specifications

Process Unit	Trickling Filter System
Trickling filter system in series	
First Trickling Filter	• High-loaded. 0.8 kg BOD/ m3 x day • Circular concrete tanks. • Media: Plastic or stone • Specific Surface Area: min. 60 m^2/m^3 • Plastic pre-fabricated • Size of stone. 50 mm (25-75 mm) • Underdrain material: Plastic or concrete • rotating arm (distributor arm) is provided to evenly distribute sewage over thesurface. Motor driven or by head power. • Air to be provided through under-drainage system from ventilation of filter.
Second Trickling Filter	• Low-loaded. 0.20-0.25 kg BOD/ m3 x day • Circular concrete tanks. • Media: Stone • Specific Surface Area: min. 60 $m^2/m3$ • Plastic pre-fabricated • Size of stone. 50 mm (25-75 mm) • Underdrain material: Plastic or concrete • rotating arm (distributor arm) is provided to evenly distribute sewage over thesurface. Motor driven or by head power. • Air to be provided through under-drainage system from ventilation of filter.
Secondary Clarification	• Circular concrete tanks. • Design basic: Peak flow and average flow • Overflow rate: 20 m^3/m^2*day (average flow) • Weir loading: 50 m^3/m * day (average flow) • Underflow concentration (sludge concentration): 1-1.5% • Side water depth: 3.50 meter • Effluent SS: 20 mg/l

Recirculation Tank	• Concrete construction following the 2nd Stage Trickling filter • 2 pcs of submerged pumps for recirculation of discharged water to 1st stage trickling filter. Capacity each. 1-3 x average flow.
Effluent Tank	• Concrete construction following secondary clarifier • Main function. To collect cleaned water from secondary clarifier step for flowmeasurement and sampling of water probes
Disinfection (ifrequired)	• Complete facilities for disinfection of cleaned waste water to be included ifneeded • Disinfection method. Chlorination or alternative UV/Ozon (only with low SS)
Process Unit	**Trickling Filter System**
Sludge Storage Tank (Primary sludge)	• Circular concrete tanks. • Design basic: storage of 3 days sludge production • Include connection for vehicle pump.
Sludge Storage Tank(secondary sludge)	• Circular concrete tanks. • Design basic: storage of 3 days sludge production • Include 2 pcs. (one + one stand-by) of dry installed pump for feeding sludgethickener • Capacity of pump: adjusted for feeding of sludge thickener for 7 hours/day and5 days/week
Sludge GravityThickener	• Circular or rectangular concrete tanks. • Depth. 4 meters • Design basis: Mass loading • SS loading: 60 kg/m3 * day • Underflow concentration (sludge out): 4-6%
Sludge Dewatering Unit	• Sludge source: Digested sludge • Type of dewatering unit: Belt filter press or Filter Screw Press. • Filtrate solids content: 100 mg/l • Cake solid content. 18-20 % • Polymer station for preparation from dry polymer and with dosing of 1%solution

Sludge Digester (ifrequired)	• Circular concrete tank • Temperature: raw waste water = 20 dg C; digester: 35 dg C • Heating: waste heat from CHP • Heat exchanger: external between influent sludge and CHP waste heat • Percent volatile solids degraded: 50-60 % • Influent Concentration of SS to digester: 10 % • Concentration of SS in Digester: 6 % • Detention time in digester: min. 20 days • Pump installation for feeding sludge from primary and secondary sludge storagetank
Technical Building	• The building to include the following: • Electrical room for panels • Control room • Laboratory • Work-shop • Stock room for spare parts • Toilet facilities • Rest/eating facilities
Process Unit	**Trickling Filter System**
Other Civil Structures	• All necessary wells
Piping:	• Process water: HDPE • Biogas pipes: HDPE
Instrumentation &Control	• Flow at inlet/outlet • pH at inlet/outlet • Temperature at inlet/outlet • Temperature at digester • pH at digester • Gas flow at digester • PLC control
Land Preparation & Landscaping and infrastructure	• Existing pump station to be removed or closed down • All vegetation, trees, and roots to be removed on the land and land to beprepared for construction. • New soil to be supplied when needed and excess soil to be removed. • After finished construction the land must be landscaped including grass. • Roads to be established where needed. • Fences around the whole area to be established

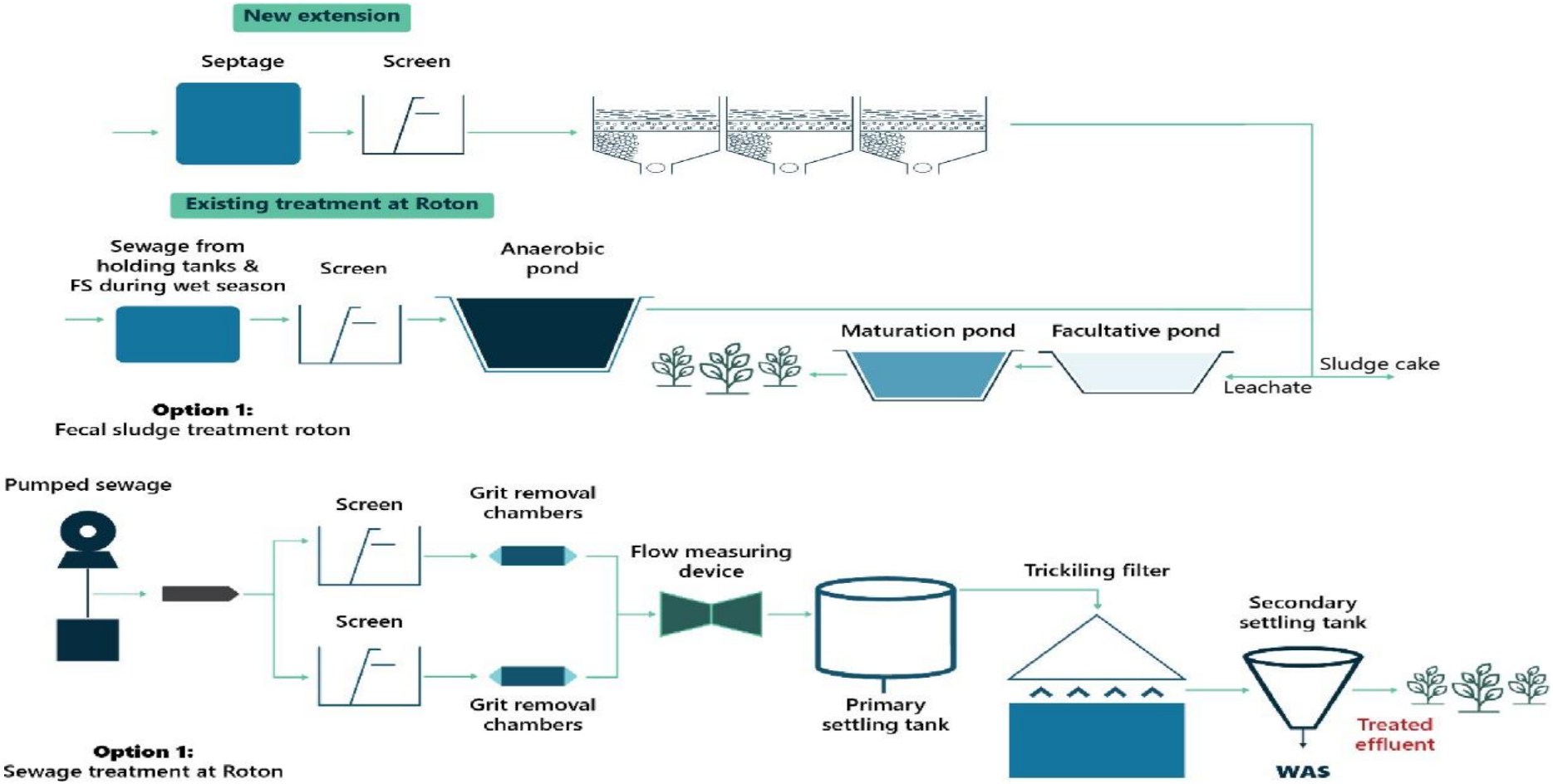
2.17 Faecal Sludge and Wastewater Treatment Prioritised Option (Project proposal)

The option prioritised and chosen, as per approved preliminary design, involves treatment of both sewage and faecal sludge at Rokwe (Roton) site using drying bed for FS and Trickling filter for Sewage as shown in the flow diagram below.

Most essentially, both faecal sludge and sewage will be treated at the existing treatment plant site at Rokwe (Roton). Rokwe's rehabilitated and modified treatment plant will be used to treat faecal sludge along with drying beds and ponds for treating leachates. Trickling filters will be used to treat sewage that is conveyed by sewers (pipeline system). The figure below shows this treatment plant prioritised project solution.

For technical descriptions and detailed outline of all elements in below FS and WW treatment system, reference is made to the approved preliminary engineering design report, April 2024.

Figure 12*:* Treatment plant for chosen Project Option



2.18 Main Project Activities

The activities for the Project can be divided into two (2) phases, namely: a) Construction; and b) Operations and maintenance. The key project activities, and associated environmental aspects, during these two phases of the Project have been summarized below.

Construction Phase:

The construction activity will involve construction of anaerobic pond, trickling filter facility and laying of gravity sewer line and raising main and construction Treatment Facility. The construction work will include excavation, pilling, backfilling etc. Construction work shall also encompass desilting of the existing gravity sewer lines. Replacement and installation of pumps along with electrical works (i.e. wiring, cable dressing, installation of electrical panels etc.) shall also be carried out during construction phase. The length, diameter, and depth and the of the gravity pipes and the number of manholes for the firststage shall be done. Laying of gravity pipes and the number of manholes shall be done for the second stage

Operation and Maintenance Phase:

During Operation and Maintenance the sewage water from Rokwe treated at the new WWTP will follow prescribed standards generally used in East Africa (in Uganda and Kenya). Biogas and sludge will be generated from the treatment of sewerage water. Biogas will be utilised in the bio-gas plant for power generation whereas the dry sludge cakes can be utilised for composting after dewatering of the sludge, though this aspect has not been considered in scope of work for O&M contractor as per Concession Agreement. The treated water will comply with effluent discharge standards set by East African standards and shall be discharged into a water system (stream) leading to the White Nile 2-3 km downslope from the treatment plant.

Sludge handling for pond system:

The pond systems are not producing any regular sludge to be removed. Sludge are basically almost completely digested in the ponds and only after interval of years it needs to be removed. No sludge handling system are foreseen in this solution.

Sludge handling for trickling filter:

The total sludge production from the Trickling filter system are estimated to 8,914 kg TSS/day (say 9,000 kg TSS/day) with a DS% of 1.0%. The following proposal are made for handling of sludge: Pre-dewatering of sludge: Digestion of Sludge Dewatering of sludge and Disposal of sludge.

When sludge are digested mesophilic in a digester, the sludge are hygienized and can be applied as agricultural fertilizer if it does not contain hazardous components (heavy metals etc.).It is recommended that there are made a quality test of FS that can reveal if the digested sludge can be used as afertilizer.

Biogas/energy potential:

- Biogas production rate = 0.4 m3 biogas/kgTS: = 3,600 m^3/day
- Methane: = 65 %
- Heating value of biogas: = 22,400 kJ/m3Total energy yield: = 80,640 MJ/day
- Potential CHP electric power: = 300 kW

3. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 Relevant National Policies

The Government of the Republic of South Sudan is dedicated to advancing sustainable development and integrating environmental protection measures into all development projects. The government therefore has several policies, laws, and regulations aimed at mainstreaming environmental management practices.

ESIAs are conducted to assess the potential positive and negative impacts of proposed projects. The aim is to capitalize on the positive impacts while implementing measures to mitigate the negative ones. Consequently, project proponents are required to adhere to the provisions outlined in various policies designed to uphold a clean, healthy, and sustainable environment. This ensures that development initiatives are carried out in a manner that minimizes adverse effects and promotes long-term environmental sustainability.

Since achieving independence in 2011, the Government of the Republic of South Sudan has implemented a new constitution, along with policies and legislation concerning environmental and social standards. While some laws from the pre-independence time still persist, efforts are underway to draft additional legislation for enhanced sustainable socio-economic development. Several existing and developing policies, laws and regulations are relevant for this project, which will be elaborated upon in this chapter.

3.1.1 Southern Sudan Water Policy of 2007

The formulation of Southern Sudan's water policy of 2007 was done through participation and wide consultation, including representation from of political, technical, managerial and other key stakeholders. The water policy presents a shared vision for water sector development and water management led by the Ministry of Water Resources and Irrigation (MWRI). It reflects broad consensus on the basic objectives and principles related to water management and services. It also, represents an important first step towards the establishment of a regulatory framework for utilization and management of water resource; in addition to effective delivery of water services. The Government is committed to ensuring rapidly growing urban populations benefit from access to safe, affordable and reliable water supply and sanitation services.

Relevance to the project: *The policy is the guiding principle of managing water resources in the country. The overall objective of the policy is to ensure efficient development and management of urban water supply and sanitation.*

3.1.2 WASH Strategic Framework

In 2011, the Government adopted the water, sanitation and hygiene strategic framework. The strategy has been crafted to transfer the water policy into actions and aims at serving a road map towards attaining the objectives of the policy. A key element of the framework dwells on speeding up rehabilitation and construction of water supply and sanitation schemes to ensure universal access of services to the people of South Sudan. It recognizes the challenges pertaining to institutional fragmentation in the water sector and calls for streamlining responsibilities of all relevant institutions. The strategic framework recommends the formulation of a Water Council to provide advisory services at the highest level as well as a Water Supply and Sanitation Regulatory Board to develop and enforce regulations for the water supply and sanitation services. Whilst these initial steps are commendable, it is critical for the sector to formulate a Water Legislation (Act).

Relevance to the project*: Establishes a legal framework for the management of the water sector*

3.1.3 The National Occupational Safety and Health Policy, 2022

The key goal of this policy is to ensure the safety, health, and well-being of workers in the workplace. The policy will also minimize work-related hazards and the occurrence of work-related accidents, deaths, and diseases. Therefore, the roles and responsibilities of the key stakeholders will be clearly articulated to ensure a practical implementation of the policy with clear direction for its administration. It will provide an assurance that the stakeholders will be held accountable for their work and responsibilities.

Relevance to the project: *This policy is particularly relevant for the OHS of the Project. Especially the construction crews and subsequently, the maintenance personnel. The policy will also have relevance in mitigation measures that protect the public from health and safety impacts because of project construction and subsequent operation and maintenance activities.*

3.2 National Legislation and Regulations

3.2.1. Interim National Constitution of South Sudan & Transitional National Constitution of South Sudan, 2011

Following the CPA, South Sudan adopted an interim constitution that became the supreme law of the new nation. The constitution emphasizes on environment issues as key milestone to protecting the environment. The environment must be protected for present and future generations through appropriate legislative action and other measures. Furthermore, it is of utmost importance to prevent pollution, prevent ecological degradation, promote conservation, secure ecological sustainable development and use natural resources while promoting rational economic and social development. In regards to lands, it is noted that the State shall manage issues related to land leases, utilization of land in towns and rural planning, agricultural lands within the state boundaries and land tenure.

Relevance to the project*: The WWTP will abide by the articles within the constitution through obtaining a certificate and operate within the guidelines to secure a safe environment for all.*

3.2.2 Environment Bill 2023

An Environmental and Protection Management Bill was drafted in 2013, but never formally approved in Parliament. A revised Environment Bill is drafted in 2023 and currently awaits to be passed into law by Parliament. The fundamental goal of the environment Bill is to ensure the protection, conservation and sustainable use of the natural resources of South Sudan, without compromising future generations. The Ministry responsible for Environment through an environmental protection agency will require a systematic environmental impact assessment, audits, monitoring and evaluation of all development projects to mitigate adverse impacts and enhance environmental benefits.

Relevancy to the project*: Establishment of the WWTP/FSTP falls in the category of projects that require an ESIA. The Environment Bill will when passed into law guide direct all issues relating to environment matters for the Project.*

3.2.3 Southern Sudan Land Act, 2009

The Act stipulates the rights of the citizens in regards to compensation modalities if people are relocated from the land they have been using. According to Sections 74, 75 and 77 of the Land Act, “expropriation of land for public interests should be based on the consultation process with the communities, negotiation and agreements endorsed by the impacted community and individuals evidenced by a written protocol between the individual or traditional authorities and their communities and signed by the local government and traditional authority”.

The Land Act classifies land as (a) communal, (b) public, or (c) private land. Only South Sudanese citizens can own land, but foreigners can lease land. The document defines rights and restrictions of land users and owners. The Land Commission supervises the application of the Land Act and its institutional set-up at the different administrative levels is elaborated in the Act. The Act prescribes ESIA for investment projects, but there are no elaborate provisions for land use planning such as land use categories or planning and allocation procedures. A Land Policy is still under development and it will include some amendments to the Land Act.

***Relevance to the project**: The project will only take place on government land, and the sewer lines will be put within the right of way. It will be confirmed that the location of the pumping stations are in fact on government land. If not, then proper compensation in accordance with national legislation and AfDB safeguards must be completed.*

3.2.4 Initial National Communication, 2018

This communication represents the commitment of the Government to address global warming and climate change, along with the strong belief that all countries must make an effort to greatly reduce greenhouse gas (GHG) emissions in order to avoid the impacts of climate change. As a developing country that is highly vulnerable to the impacts of climate change, South Sudan believes that the issue can be addressed through developing and implementing sustainable development initiatives that promote strong, clean and climate-resilient economic growth. It is crucial that South Sudan learns to adapt to the impacts of climate change and should focus on strengthening the capacity of its institutional and human resources for this purpose.

***Relevance the project**: Under South Sudanese national circumstances NCs are important for predicting, monitoring and evaluating a Party's contribution to attaining the objectives of the UNFCCC and also for reducing the impacts of adverse effects of climate change on its people and economy. The contractor of the WWTP, supervised by SSUWC, will be able to mitigate impacts of pollutants from the WWTP.*

3.3 Institutional Framework

3.3.1 Institutional Framework for Wastewater Management

The Ministry of Water Resource and Irrigation, Water, Sanitation & Hygiene (WASH) Sector Strategic Framework of August 2011 proposes in urban contexts where UWC operates, that it gets the mandate to manage urban sanitation (including sewerage systems) as well. Alternatively, in areas where UWC is not operating, the mandate for sewage collection and disposal (from septic tanks and solid waste) will be with State Government Ministries responsible for housing and town planning or the Local Government (municipalities).

The Ministry of Water Resource and Irrigation, Water, Sanitation & Hygiene (WASH) Sector Strategic Framework that was prepared in August 2011 proposed that UWC be mandated to manage urban sanitation (including sewerage systems as well). Where UWC is not operating, the State Government Ministry responsible for housing and town planning or the Local Government (municipalities) will be responsible for sewage collection and disposal (from septic tanks and solid waste).

Currently four ministries at national level namely Ministry of Water Resources and Irrigation, Ministry of Land, Housing and Urban Development, and Ministry of Health (MoH), Ministry of Environment and Forestry, and the City Council/County (Local Government), two at Central Equatoria State level, Juba County and Juba City Council have a role in Juba urban sanitation. South Sudan Urban Water Corporation (SSUWC) is indirectly involved.

Ministry of Water Resources and Irrigation

The Ministry of Water Resources and Irrigation (MWRI) was formed with the mandates for safeguarding and conserving fresh water systems; carrying out and supervising hydrological studies, flood control works, irrigation and hydropower developments and water storage facilities.

The organization scheme for the ministry is provided in the figure below. Southern Sudan Urban Water Corporation (SSUWC) is administrated directly under the Minister.

South Sudan Urban Water Corporation

South Sudan Urban Water Corporation (SSUWC) established by a Decree in 2007 and by Presidential Order Act in 2011, is mandated for the production of safe drinking water and capable distribution network and sale, to any customer according to the agreements, contracts, tariffs and the conditions of supply. The Corporation is headed by a Managing Director and has a Board of Directors which is chaired by the Minister of Water Resources and Irrigation. The main function of the SSUWC is production.

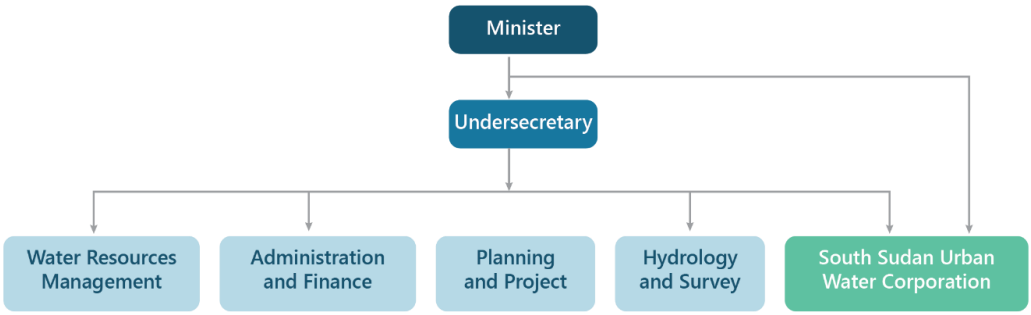


Figure 13: Organization Chart of MoWRI

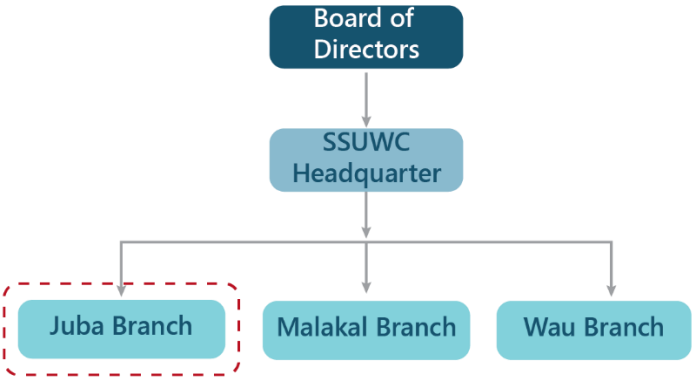


Figure 14: Organization chart of SSUWC showing the Juba Station

Operating under MWRI, the South Sudan Urban Water Corporation (SSUWC) holds the official designation as the urban waterworks entity for South Sudan. It is entrusted with the responsibility of delivering water supply services to the urban population of South Sudan. The legal framework and governance structure of SSUWC are established by the "SSUWC Provisional Order, 2011". However, in this order water supply services has been covered only and wastewater services has not been yet included.

State Minister of Land, Housing and Urban Development

One of MLHUP's key function is providing or ensuring that households in urban areas have access to appropriate sewerage disposal and treatment schemes. The state directorate of Ministry of Land and Housing and Urban development in Juba has been involved in a number of key activities to date, including the rehabilitation of Kololo and Hai Amarat's oxidation ponds for ministerial housing, the

construction of the Rokwe (Roton) Wastewater Lagoon in Juba town, and the construction of three ablution blocks.

Six sewage vacuum tanks were given to the three Blocks of Juba, Munuki, and Kator, as well as the Rokwe Lagoon, which was given to the Commissioner of Juba County, Department of Public Health in Central Equatorial State.

Ministry of Environment and Forestry
In 2010, the Ministry of Environment and Forestry was established to protect the environment. One of the ministry's Waste Management departments is responsible for preparing and enforcing environmental guidelines, and its ESIA team for executing Environmental Impact Assessment Studies, controlling waste management, conducting inspections, and providing technical assistance and advice to developers. However the lack of an environmental law hampers the ministry's operations, although a draft bill on environmental management has been prepared.

Organization of Sanitation at Juba County Level
Even though Juba County is not directly responsible for Juba city sanitation, it is currently partnering with the City Council since Rokwe Wastewater Lagoon is located in one of the Blocks under the county administration. During the construction of the lagoon, the entire area was governed by Juba County as Juba City Council had not been established yet. The county therefore manages the wastewater lagoons at Rokwe, including its day-to-day operation, fecal sludge disposal fees, and administers the account into which these fees are deposited. Private vacuum truck owners are also registered, licensed and regulated by the County.

Organization of Sanitation at Juba City Council Level
The Juba City Council is divided into three blocks (Juba, Munuki, Kator) and 55 bomas (quarters). A mayor heads the Juba City Council, which represents the State Governor before the Legislative Council. A mayor organizes the executive institutions of the city to carry out their duties diligently, implements policies and bylaws passed by the legislature, introduces legislation to the legislative council and signs it into law, mobilizes and organizes the public in order to provide effective services, and coordinates activities with government.

Ministry of Labour, Public Service and Human Resource Development
The Ministry of Labour was established in October 2005. The Ministry of Labour of the Republic of South Sudan is responsible for overseeing labour market for its citizens and the right to employment.

Ministry of Housing, Physical Planning and Environment
The Ministry is the lead agency for planning and developing projects in the infrastructure sector as well as the mobilization of resources and designing of project implementation and supervision.

Central Equatorial State
The Government's Policy of decentralization has devolved a number of central Government functions to local Governments. Some of these functions include the enactment of environment related byelaws such as those related to matters of the environment.

3.4 African Development Bank (AfDB) Safeguard Policies

All projects funded by AfDB must follow their environmental and social safeguards. AfDB updated their Integrated Safeguards Statement in 2023 which now lists 10 Operational Safeguards (OS) relating to the identification and assessment of E&S risks and impacts. By following these OS, it is possible to minimize, mitigate and avoid adverse impacts on people and the environment. From unintentional

harm, as well as sustainably reducing poverty and increasing prosperity for the benefit of the environment and communities. The AfDB OS are listed in the table below along with a description of their applicability to the project.

Table 10: AfDB's Operational Safeguards

Operational safeguards	Rationale
OS1: Assessment and Management of Environmental and Social Risks and Impacts	This safeguard governs the environmental and social assessment process which sets out responsibilities for assessing, managing, and monitoring E&S risks and impacts, and provides an opportunity for stakeholder engagement, as well as considerations to how impacts can be mitigated. Measures shall also be in place so vulnerable people are not impacted disproportionally. The potential environmental and social risks will be described and mitigated through this ESIA and ESMP.
OS2: Labour and Working Conditions	This OS describes the requirements concerning workers' conditions, rights and protection from abuse or exploitation. The project must ensure that worker's rights are protected, people are treated fairly in a non-discriminatory way, no child labour or forced labour, and workers must have a safe work place and receive appropriate personal protective equipment (PPE). The Project may prepare Labor Management Procedures (LMP) to supplement the ESMP. The LMP shall apply to all project workers whether fulltime, part-time, temporary or seasonal. During Implementation of project activities, the respective Contractors shall prepare Occupational Health and Safety Plans (OHS) and the Community Health Management Plans to manage associated risks.
OS3: Resource Efficiency and Pollution Prevention and Management	This safeguard covers the impacts of pollution, waste, and resource efficiency. Pollution, emissions and generation of waste will be minimized. There will be prevention and control measures consistent with national legislation and standards, applicable international conventions, and internationally recognized standards and good practice. The water quality will be monitored and a Pollution Management Plan will be developed for the WWTP. The contractor during construction will also be responsible for having a waste management plan in place.
OS4: Community Health, Safety and Security	OS4 ensures that project affected communities' health, safety, and security risks to and impacts are considered. This includes risks related to traffic, road safety, diseases, influx of workers, exposure to hazardous materials, and how communities shall respond to emergencies.

	Consideration shall be taken to road safety, and increased traffic of sewage trucks before the pipeline network is in place. Overall, it is expected that the community health will improve with the upgraded WWTP and the extended sewage pipe network.
OS5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	This safeguard includes temporary and permanent physical displacement (relocation, loss of residential land or loss of shelter) and economic displacement (loss of land, assets or access to land or assets, leading to loss of income sources or other means of livelihood). It recognizes the adverse impacts of land acquisition, restrictions on land access or land use, and loss of property/assets, and the need for appropriate compensation. The proposed project will not lead to physical displacement. However, there are informal farmers at Rokwe WWTP who will lose access to at least specific parts of the site (where the new WWTP will be constructed) – however they can be reallocated to other parts. The project is also assessed to have temporary economic displacement on businesses and street vendors while laying the sewer pipes. One section of pipe laying is however only assessed to take about one week.
OS6: Habitat and Biodiversity Conservation and Sustainable Management of Living Natural Resources	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements. The project is not expected to pose any danger to the conservation of biodiversity and sustainable management of living resources. The upgraded WWTP will treat the water before discharge which will improve the water quality. The project is also implementing a pollution management plan (PMP) to avoid any contamination.
OS7: Vulnerable Groups	This ensures that special consideration is taken to individuals or groups who are less resilient to risks and adverse impacts. Depending on the specific context of the project and its area of influence, vulnerable groups may include, among others, female-headed households, the landless, the elderly, youth and children, persons with disabilities, groups who are marginalized on the basis of ethnicity, religion, language, sexual orientation, and gender identity, and highly vulnerable rural minorities (HVRM), including groups referred to as indigenous peoples in some contexts. To adopt a gender-responsive approach to the management of E&S impacts. There must be meaningful consultations with vulnerable groups that allows for effective participation.
OS8: Cultural Heritage	The term 'cultural heritage' includes tangible and intangible heritage, which may be recognized and valued at a local, regional, national or global level. Tangible cultural heritage includes movable or immovable objects, sites, structures, groups of structures, and

	natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Intangible cultural heritage includes practices, knowledge, skills, and cultural spaces that communities and groups recognize as part of their cultural heritage. The sewage network will most likely pass buildings of religious or cultural importance, however, it will not have any impact except from noise during construction.
OS9: Financial Intermediaries	OS9 is not applicable for this project since it details the E&S conditions for financing partners (i.e. financial intermediaries, or Fis), which is not a part of relevant in this project.
OS10: Stakeholder Engagement and Information Disclosure.	Stakeholder engagement is an inclusive process conducted throughout the project life cycle. Stakeholders refers to individuals or groups who are/risk being impacted by the project or have an interest in the operation of the project. The project must conduct inclusive stakeholder engagement with affected parties and disclose information about the project and its process. Particular attention must be given to the informal farmers at Rokwe WWTP.

3.5 Multilateral Environmental Agreements/Treaties

The new nation has made considerable efforts to participate in multilateral environmental agreements (MEAs) and has also joined global efforts to address environmental issues by becoming a Party in 2014 to the following three Rio Conventions: the United Nations Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC). Article 12.5 of the UNFCCC states that Parties that are LDCs, such as South Sudan, may make their initial communication at their discretion[2].

There are a number of Multilateral Environmental Agreements (MEA's) that are relevant to the proposed WWTP project reviewed in detail (table).

Table 11: Multilateral Environmental Agreements

Multilateral Environmental Agreements	**Key areas of application**
United Nations Framework Convention on Climate Change (UNFCC)	The ultimate objective of both treaties is to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system. *The proposed WWTP/FSTP project should ensure all activities*

[2] Government of south Sudan -Initial National Communication to the United Nations Framework Convention on Climate Change,2018

	and development plans are undertaken in line with the provisions of the Convention aimed at stabilizing greenhouse gas concentrations in the atmosphere.
Rio Declaration on Environment and Development	The Rio Declaration on Environment and Development, often shortened to Rio Declaration, was a short document produced at the 1992 United Nations "Conference on Environment and Development" (UNCED), informally known as the Earth Summit. The declaration aimed at establishing a new and equitable global partnership through the creation of new levels of co-operation among States, key sectors of societies and people, working towards international agreements which respect the interests of all and protect the integrity of the global environmental and developmental system, recognizing the integral and interdependent nature of the Earth, our home. The Rio Declaration consisted of 27 principles intended to guide countries in future sustainable development. It was signed by over 170 countries. Principle 17 of the Rio Declaration provides key relevance to the proposed project; the principle denotes that environmental impact assessment as a national instrument shall be undertaken for proposed activities that are likely to have a significant impact on the environment and are subject to a decision of a competent national authority.
Ramsar Convention,1971	The Convention on Wetlands, called the Ramsar Convention, is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources The convention entered into force in South Sudan on 10 October 2013. South Sudan currently has 1 site designated as Wetlands of International Importance (Ramsar Sites)[3], with a surface area of 5,700,000 hectares. The Sudd includes National Park and game reserves. One of the largest tropical wetlands in the world, located in South Sudan in the lower reaches of Bahr el Jebel, a section of the White Nile (far away from Juba and the project site however).
Sustainable Development Goals (SDGs)	The Sustainable Development Goals (SDGs) are a new, universal set of goals, targets and indicators that UN member states will be expected to use to frame their agendas and political policies over the next 15 years. The SDGs include 17

[3]A Ramsar site is a wetland site designated of international importance under the Ramsar Convention. The Sudd is a Ramsar site in South Sudan.

	Sustainable Development Goals and 169 targets. In specific, the project will help significantly in the realization of a number of Sustainable Development Goals including SDG 1 (No poverty) SDG 2 (Zero Hunger) and SDG 8 (Productive employment and economic growth) by opening new employment opportunities in the area. The project will also support SDG 13 (Climate action) by reducing GHG emission.
African Unions Agenda 2063	Agenda 2063, rooted in Pan Africanism and African Renaissance, provides a robust framework for addressing past injustices and the realisation of the 21st Century as the African Century. As a blueprint and master plan for transforming Africa into the global powerhouse of the future this strategic framework aims to deliver on its goal for inclusive and sustainable development and is a concrete manifestation of the pan-African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance. Among others, the relevance relate to a long-term perspective (50 year development trajectory envisioned).

4. ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 Introduction

The environmental and socio-economic baseline data were collected and compiled from primary and secondary sources. Data collection was conducted between from February to mid-June 2024, which included collection of primary data on the physical environment, biological environment and socio-economic environment. This followed after the environmental screening process conducted in 2023.

Secondary data was also collected from different government departments, local bodies, literature review, surveys etc. The study has also used publicly available information, among others the 2011 Census of South Sudan, the South Sudan Sustainable Water and Sanitation in Africa (SUWASA) Project survey from 2015 and JICA's household survey from 2022.

4.2 Area of Influence and Study Area

The Area of Influence (AOI) of the Project comprises of the Rokwe WWTP, the two pumping stations, their surrounding area, and the sewage pipe network in Juba Town, Munuki and Kator. The AOI with respect to the environmental and social resources was considered based on the following reach of impacts:

- Air Quality: Gaseous pollutants e.g. NO_x, SO_2 (and fine particulate matter), PM_{10} and $PM_{2.5}$ – typically up to 1 km from projects site during construction and operational phase.
- Noise: Noise impact area is defined as the area over which an increase in noise levels due to the project can be detected – typically 500 m from project site.
- Water: Groundwater may be contaminated through leaching of pollutants from the project site (depending on the geology) – groundwater impact will be within 1 km of the project footprint as the velocity is very slow almost imperceptible
- Flora and Fauna (Terrestrial and Aquatic): The project area is a part of urban environmental setting. However, the WWTP is located by Roton lake and a wetland area where the discharge is released and thereafter flowing to the Nile – the area of influence will be within 1 km.
- Socio-economic: The direct impact of the upgrading of the WWTP and laying down the sewage network – impact area is limited to the Rokwe WWTP, 100m around the pumping stations, and 5-10m from the sewage pipelines.

Based on the above the AOI, the environmental and social study area is limited to 1 km from the WWTP, 100m around the pumping station, and 50m for the sewage pipelines. Laying of pipelines will be a localized activity on the side of the roads, within the right of way. The proposed pipeline work is expected to cover 25 m per day. Hence, the work is temporary for a particular place since it will be done in 100m sections. One section is expected to take up to one week.

4.3 Approach and Methodology

The approach and methodology adopted for collection of baseline data on Physical, Biological and Socio-economic environment are discussed below:

a) The methodology followed for baseline data collection on Physical Environment are given below:

- Review of existing reports, focus on any with relevance for environment or social aspects, of the WWTP/FSTP facility. The relevant data are incorporated in this report.

- Selection of primary data collection location as per scope of work discussed in previous sections.
- Primary monitoring of key environmental parameters like air, noise, soil, sediment, surface water, ground water and traffic.
- Information about geology, hydrology, prevailing natural hazards like floods, earthquakes etc. have been collected from literature reviews and authenticated information made available by government departments.

b) The methodology followed for baseline data collection on Biological Environment are given below:

- Review of secondary data.
- Primary survey data collection by the Consultant.

c) The methodology followed for baseline data collection on Socio-economic Environment are given below:

- Review and collection of Secondary data including the Census data.
- Primary data collection through consultation and field work on site.

4.4 Physical Environment

4.4.1 Topography

The Topography is an important consideration when planning a WWTP/FSTP site. Topography refers to theshape and features of the land, including its elevation, slope, and contours.

The topography of a construction site can affect the construction process, and subsequently the operation and maintenance, for instance in regard to the long-term stability of the structure(s) built on the site. For example, if the site is located on a slope, it may require additional excavation and grading to create a level surface for WWTP/FSTP.

4.4.2 Geology

The stratigraphic classification and outline of the general geology around Tokiman Paleochannel. Tokiman Paleochannel and its surrounding area can be tectonically and geologically divided into two zones that consist of the alluvial deposits and the undifferentiated basement complex. The alluvial deposit, unconformably overlying the undifferentiated basement complex, is extensively distributed in the area. The undifferentiated basement complex consists of metamorphic and intrusive rocks of various grades of metamorphism (please also refer to annex 4 summarising geodetic survey done).

4.4.3 Climate and Meteorology

The climate in the project area is average tropical wet and dry/savanna type, with alternating dry/wet seasons but pronounced wet season. According to the Holdridge life zones system of bioclimatic classification Juba is situated in or near the subtropical dry forest biome.

Precipitation: The average annual rainfall is in average 130 mm per month, but is very unevenly distributed, with peak rain in the period May to November. Correspondingly, the average relative humidity is highest in the same months. The rainfall distribution per month, and other key climate related data, is illustrated in figure below:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Oct	Dec	Year
Record high °C (°F)	41.92 (107.46)	42.92 (109.26)	42.92 (109.26)	41.92 (107.46)	39.92 (103.86)	37.93 (100.27)	39.92 (103.86)	38.93 (102.07)	39.92 (103.86)	40.92 (105.66)	38.93 (102.07)	39.92 (103.86)	42.92 (109.26)
Average high °C (°F)	36.99 (98.58)	38.22 (100.8)	37.28 (99.1)	35.54 (95.97)	33.09 (91.56)	31.72 (89.1)	30.92 (87.66)	31.34 (88.41)	32.07 (89.73)	32.65 (90.77)	33.7 (92.66)	35.65 (96.17)	34.1 (93.38)
Daily mean °C (°F)	31.61 (88.9)	32.98 (91.36)	32.61 (90.7)	30.68 (87.22)	28.76 (83.77)	27.42 (81.36)	26.62 (79.92)	26.94 (80.49)	27.54 (81.57)	28.23 (82.81)	29.29 (84.72)	30.94 (87.69)	29.46 (85.03)
Average low °C (°F)	23.44 (74.19)	25.2 (77.36)	26.07 (78.93)	24.6 (76.28)	22.68 (72.82)	21.43 (70.57)	20.6 (69.08)	20.58 (69.04)	20.91 (69.64)	21.83 (71.29)	22.85 (73.13)	23.68 (74.62)	22.83 (73.09)
Record low °C (°F)	15.97 (60.75)	17.97 (64.35)	20.96 (69.73)	20.96 (69.73)	18.96 (66.13)	17.97 (64.35)	14.97 (58.95)	17.97 (64.35)	17.97 (64.35)	17.97 (64.35)	19.96 (67.93)	18.96 (66.13)	14.97 (58.95)
Average precipitation mm (inches)	5.27 (0.21)	26.52 (1.04)	54.46 (2.14)	92.71 (3.65)	206.59 (8.13)	221.6 (8.72)	212.48 (8.37)	232.03 (9.14)	201.16 (7.92)	201.64 (7.94)	90.3 (3.56)	15.26 (0.6)	130.0 (5.12)
Average precipitation days (≥ 1.0 mm)	1.45	5.08	10.07	16.15	23.23	24.95	26.59	27.22	23.51	22.32	12.8	3.72	16.42
Average relative humidity (%)	26.56	28.04	38.73	53.26	67.3	72.1	75.11	75.51	72.5	68.12	55.83	35.97	55.75
Mean monthly sunshine hours	10.47	11.48	11.77	12.33	12.41	12.23	12.2	12.21	11.01	10.96	11.27	11.12	11.62

Figure 15: Temperature and Precipitation (mm) in Juba.
Source: https://weatherandclimate.com/south-sudan/central-equatoria/juba#t3

Temperature: The annual mean temperature is just below 30°C. The lowest monthly average temperatures are in June, July and August while the hottest months are January, February and March. However, the monthly differences in temperature are relatively limited and South Sudan (Juba) has a fairly uniform temperature regime. Even mean sunshine hours are fairly even throughout they year.

4.4.4 Ambient Air Quality

Air monitoring (baseline) was conducted in April 2024 at the proposed project site Rokwe (Roton), at other main intended project sites (the pumping stations) and two other ad hoc chosen sites. All the gas monitors (PM2.5, PM10, CH4, CO2, SO2, NOx, and H2S air monitors) were deployed at the site for about an hour. All the gas monitors (HAT200 for PM2.5 & PM10, HI-KP810 for CO2, and HI-KP826 for CH4, SO2, H2S, NOx) were field tested prior to commencement of the study.

Hence, altogether the existing Ambient air quality has been assessed for five ambient air quality sites within the proposed project area. Accordingly, the average ambient air quality (AAQ) in the project area for PM2.5 was 10 µg/m3, PM10 was 25 µg/m3, CO2 was 450 ppm and for SO2, NOx, H2S and CH4 were in normal range of 0.0 ppm. There were minimal varioatio between sites for these parameters.

In conclusion, the project area of influence exhibits moderate air quality and moderate air quality index. The major emission sources within the study area are assumed to be vehicular emission from the roads. Further, the major sources of air emissions due to the proposed project activity includes fugitive dust generation from construction activity, vehicular emission due to vehicle movement and emissions from FSTP sets during construction phase, and biogas flaring during operational phase (this will be further analysed in Chapter 5).

4.4.5 Noise Quality

To establish a baseline, noise monitoring was carried out at various locations in the intended project area, including the WWTP and the planned locations for the pumping stations to identify the impact due to the existing sources on the surroundings in the study area. Accordingly, the noise level in the proposed project site ranged between 55 - 64 db in general at peak noise levels. The peak levels were (only) reached when there was incoming landing and takeoff of flights at Juba international airport and when exhauster trucks carrying fecal sludge occurred.

Noise pollution will be generated using construction equipment such as movement of graders and trucks that affects local communities at the adjacent areas. This risk is low, compared to technologies such as construction of noise shields to reduce the potential for noise to reach these communities if an impact occurs. The noise will predominantly relate to the construction through the construction of the WWTP/FSTP, which will have very limited temporal scales and therefore small impact (see also Chapter 5 for further elaborations) . The baseline data of these areas will help to estimate the possible effects of extra load during construction will have on the ambient noise quality of the area.

4.4.6 Site geology and hydrogeology

Geology and hydrogeology are important considerations when planning a WWTP/FSTP site. Hydrogeology is the study of groundwater and its movement through soil and rock. It is essential to understand the hydrogeological conditions of a site before construction begins, as it can affect the stability of the structure built on it. Geological conditions can also affect the construction process. For example, if the site is located on a slope, it mayrequire additional excavation and grading to create a level surface for construction.

To determine the hydrogeological and geological conditions of a site, several activities will be performed on-site during the preliminary design study phase, including drilling and installation of observation wells, piezometric level survey, hydraulic conductivity test, and groundwater sampling.

The hydrogeological component is intended to determine basic geological and hydrogeological conditions, including the geological description of existing soils and bedrock, the depth of the water table, the groundwater flow direction and hydraulic gradient, and the hydraulic conductivity or permeability of existing soils and bedrock.

4.4.7 Soil types and permeability

Soil permeability is the quality of a soil enabling it to transmit air or water through the soil pores. The permeabilityof the least permeable horizon should be estimated because this becomes the most limiting horizon for water andair movement and root penetration. The soil permeability classes are slow, moderate, and rapid. Slow permeability < 0.6 inches of water move through the soil per hour. Slow permeability includes textures of silty clay, clay and sandy clay and soils with massive subsoils. Moderate permeability 0.6–6.0 inches of water move through the soil per hour. Moderate permeability includes textures of silt loam, loam, sandy clay loam, silty clay loam and sandy loam. Please also refer to annex 4 summarising geodetic survey done.

4.4.8 Natural hazards

South Sudan is vulnerable to number of natural disasters, the most common being weather related such as floods, drought, heat waves, disease outbreaks and earthquake, to mention only but a few. All these hazards aggravated by climate change have increased in recent years in terms of intensity, frequency and complexity leaving behind them trails of several destruction of infrastructures, human misery and loss of livelihoods[4]. South Sudan is exceptionally vulnerable to weather related natural hazards which demands diverse participation and coordination from different relevant ministries. According to the Climate Vulnerability Index 2017, South Sudan ranked amongst five worst performing to tackle the impact of climate change in the world. UNESCO Juba office is working with Ministry of Humanitarian Affairs and Disaster Management, Ministry of Water Resources and Irrigation, Ministry of Environment and Forestry and Department of Meteorology among others to support inter-ministerial information-sharing and coordination on mainstreaming disaster risk management.

The implementation of the activity include, knowledge generation, building technical and institutional capacity as well as advocacy to enhance collective awareness and response to natural hazards.

Consultations with stakeholders in the study area indicate that area around the WWTP facility has not recently experienced any flooding situation although the area experience water-logging situation during heavy rainfall. In case of heavy rainfall the area faces temporary water-logging which lasts for maximum 3 to 4 hours duration.

4.4.7 Drainage

Drainage is also an important consideration for construction sites. Poor drainage can lead to erosion, flooding, and other problems that can affect the stability of the structure built on it. To address these issues, it is essential to design an effective drainage system that can manage stormwater runoff and prevent erosion. The following are some best practices for managing drainage at a construction site:

Minimize soil disturbance: Soil disturbance can increase erosion and sedimentation. Minimizing soil disturbance can help preserve the natural drainage patterns of the site.

Use natural drainage features: Natural drainage features such as swales, ditches, and retention ponds can help manage stormwater runoff and prevent erosion

[4] *https://www.preventionweb.net ›* Building capacity in disaster risks in South Sudan Source(s): United Nations Educational, Scientific and Cultural Organization - South Sudan

Install erosion control measures: Erosion control measures such as silt fences, sediment basins, and straw bales canhelp prevent sediment from entering nearby waterways.

Design an effective drainage system: An effective drainage system should be designed to manage stormwater runoff and prevent erosion. This may include installing gutters, downspouts, catch basins, and other features.

4.4.8 Vegetation and land use

Vegetation and land use can play a significant role in the construction process. Vegetation can be used to control erosion on construction sites, which is a critical issue. The four primary factors that determine the potential for erosion are soil type, vegetative cover, topography, and climate. Vegetative cover is the biggest factor in this balance; anything that disturbs it tends to accelerate erosion. Accelerated erosion is most often caused by a disturbance or alteration of the landscape, such as floods, earthquakes, or construction activities. The typical construction site can erode at a rate as high as 100 to 500 tons/acre/year.

Likewise, potential erosion may start or be accelerated if a water flow or water regime is altered, such as potentially in the case of the proposed project when the water effluent/discharge amounts significantly increase – particularly in Phase 2 and 3.

Preserving natural or existing vegetation at any construction site where vegetation exists in the predevelopment condition can be particularly beneficial for floodplains, wetlands, perennial and intermittent streams, environmentally sensitive areas, steep slopes, and other areas where vegetation is important.

Figure 16: Vegetation around the treatment plant
(mostly temporary farming or degraded land is observed)

There is no natural forests in the entire study area. There is however various pockets of relatively degraded wetland area(s), mostly directly adjacent to the White Nile, sometimes the wetland area is referred to as Roton wetland. As mentioned, the (wetland) area has been encroached for crop production. There is also a relatively sizeable lake (Lake Roton) lightly more than 1 km to the Southwest of the WWTP area, however located so there should be no discharge to the lake as the water will rather flow via waterways (streams) downslope in the other direction of the lake east-southeast and eventually into the White Nile.

The vegetation in the area shows profusion presence of trees, shrubs, herbs and grasslands (as per observations). With the urbanization and advent of guns any wild animals have been annihilated, and been replaced by domestic animals such as goats, sheep and cattle. These animals have become important sources of income to the community in the area.

4.4.9 Fauna and biodiversity

The diversity of fauna (native population of mammals, birds, reptiles and amphibian) species recorded in the modified habitat was low in regard to absolute numbers and in variety. Yet, a number of birds, reptiles and mammals *may* occur within the project area, most especially in the discharge area to the east and south of the actual treatment plant site. A full account of these species that may occur in this or other project areas is provided in Annex 5.

There are no IUCN red listed flora in the project area and there are no key biodiversity areas (KBAs) within 50 kms radius of the WWTP site.

4.5 Socio-economic Environment

4.5.1 Population and Demographics

Juba county comprises of sixteen suburbs. This project involves three of these suburbs, namely Juba Town, Kator, and Munuki. The last census was done in 2008, where these three areas had over 36,000 households and over 230,000 residents. Due to lack of recent data, the present population has been estimated based on anticipated growth from the census 2008. In order to project the current population, exponential growth method is used to project the population.

Pn = Pb(1+r)^n

where:

P = Population

b = base year (2008)

r = Rate of population increase

n = Number of years passed since base year

Given the absence of recent data, this analysis utilizes the 2008 census data, employing a population growth rate (r) of 3%[5] to project the demographic trends until 2051. Assuming a constant growth rate, it is estimated that the combined population of three blocks (Juba, Kator, and Munuki) stood at 361,000 in 2023, with projections indicating a rise to 619,000 by 2041.

Table 12 below shows the projected population with a 3% growth rate.

Table 12: Projected population growth in Juba.

Block	Projected population in Year							
	2008	2023	2026	2031	2036	2041	2046	2051
Kator	64,130	100,576	110,048	127,858	148,550	172,590	200,521	232,972
Juba Town	82,346	129,144	141,306	164,174	190,743	221,612	257,476	299,144
Munuki	83,719	131,298	143,663	166,913	193,925	225,309	261,772	304,136

[5] This rate, derived from the difference between 1983 and 2008 censuses, is assumed to be uniform across South Sudan.

Total	230,195	361,018	395,017	458,945	533,218	619,511	719,769	836,252

According to the UN population projections, the population in Juba is anticipated to nearly double its current size, reaching 761,000 individuals by 2035[6]. This suggests that the projected population figure is conservative. Therefore, the project has adopted a phased approach to help mitigate the uncertainties associated with time.

Table 13, Table 14, and Table 15 provide gender disaggregated data for the population of the three Blocks of Juba Town, Kator, and Munuki, respectively. Juba Town, with a total of 82,346 people (in 2008), has a total of 18 bomas with Dresses line Boma (8043 people) being the most populous. Kator Block has 64,130 people from four bomas, with Kator Centre being the most populous. Lastly, Munuki has 83,719 people from its 13 bomas, making it the most populous of the three Blocks.

Table 13: Urban settlement population, Juba Town Block, 2008

Boma	Male	Female	Total
Dresses Line	4423	3620	8043
Hai Buluk	2429	1599	4028
Hai Cinema	1159	833	1992
Hai Commercial	3163	2677	5840
Hai Gabat	2567	1969	4536
Hai Malakal	3572	2207	5779
Hai Mayo	1219	1042	2261
Hai Neem	604	489	1093
Hai Neggily	247	154	401
Hai Nyakama	1010	544	1554
Hai Orselim	1949	1461	3410
Hai Soura	2282	1308	3590
Hai Zendia	2768	2392	5160
Juba Nabari	1271	1054	2325
Juba Quarter Council	1310	378	1688
MTC	2946	2462	5408
Nimra Talata	2002	1223	3225
Tompping	13826	8187	22013
Total	**48747**	**33599**	**82346**

[6] Juba Strategic Plan, United Nations Human Settlements Programme (UN-Habitat) 2023

Table 14: Urban settlement area and population, Kator Block, 2008

Boma	Male	Female	Total
Atlabara	11331	9235	20566
Kator Center	14064	12072	26136
Konyo Konyo	976	584	1560
Lologo	8602	7266	15868
Total	**34973**	**29157**	**64130**

Table 15: Urban Settlement area and population, Munuki Block, 2008

Boma	Male	Female	Total
Dar-Salam	1863	1758	3621
Dar-salam Jebel	2944	2503	5447
Hai Kwuit	6706	5525	12231
Hai Muna	2211	2028	4239
Hai Seminary	4310	3968	8278
Munuki Block A	2771	2171	4942
Munuki Block B	4330	3587	7917
Munuki Block C	4360	3427	7787
Munuki Island	784	690	1474
Nyokuron East	3125	2566	5691
Nyokuron North	4331	3295	7626
Nyokuron South	3748	3296	7044
Nyokuron West	4224	3198	7422
Total	**45707**	**38012**	**83719**

4.5.2 Urban expansion

A comparison has been made between the original graphic showing the urban expansion of Juba between 2002 and 2012, and the most recent updates in urban boundaries from 2021 (from OpenStreetMap 2021) and 2023 (from the latest Google Earth image).

The figure included below shows the updated map for "Juba City" urban expansion, based on the updated data from OpenStreetMap (2021) and the actual urban boundary of Greater Juba Metropolitan Area from the Google Earth satellite image 2023.05.05. From 2021 including Gumbo, East of the Nile. The map shows the city expansion by following the color code: 2002 White, 2007 Yellow, 2012 Red, 2021 Purple, 2023 Blue. Green boundary is the project area.

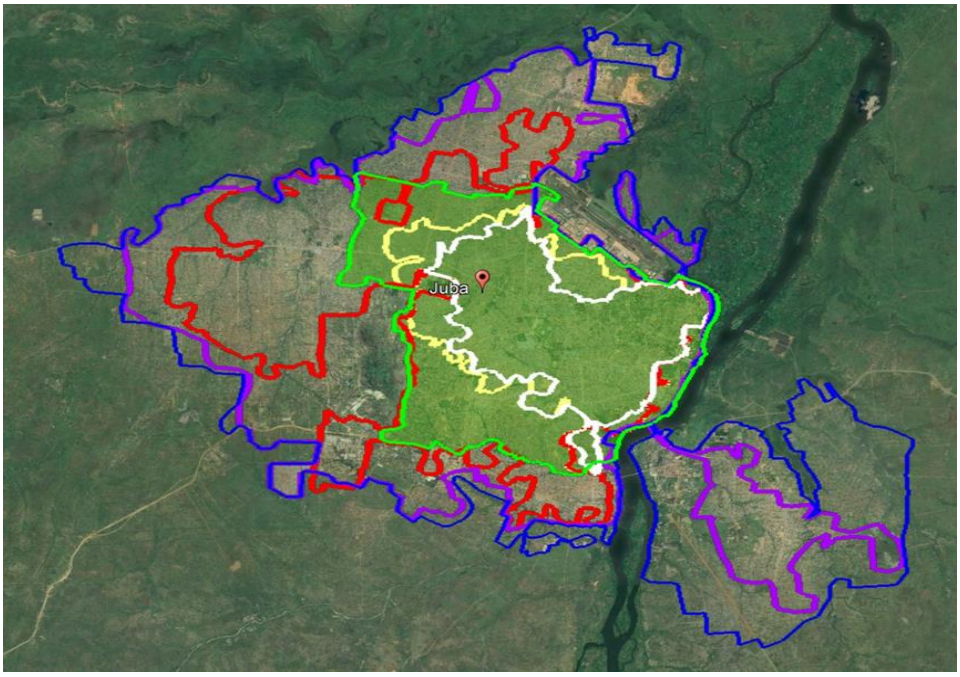


Figure 17: Updated map for Juba City urban expansion, from 2002 to 2023.

Table 16 shows the evolution of the conglomerated urbanized areas for Juba (8 Payams), measured from 2002 to 2023 and projected to 2050 - with projection for 2050 using 2.3 to 2.9% annual growth rate in the conglomerated urbanized area, estimated from the data up to 2023. It is noted that the annual growth rate % refer to the conglomerated urbanized area, not the population growth. A higher population growth rate is expected when urban development shifts from low density to higher density, e.g. multistorey buildings.

Table 16: Measured (2002-2023) and Projected (2050) Urbanized Area of Juba

Year	Measured area, km2	Trend 2002-2023	Annual Growth %
2002	20,9		6,0%
2007	28		20,0%
2012	70,4		5,0%
2021	109		17,0%
2023	150		2,4%
2030		177	2,9%
2040		236	2,3%
2050		295	

4.5.3 Household size

Table 17 displays the average household sizes across the three locations, as recorded in the 2008 census. At that time, the average household comprised 6 individuals across all three locations combined, while Juba Town specifically had an average of 7 members per household. Considering the projected population growth outlined earlier, the total number of households is expected to rise, even though there may not be a corresponding increase in household size.

Table 17: Household and Population, 2008

Block	County	HH	Pop.	HH Size
Kator	Juba	11,018	64,130	6
Juba Town	Juba	11,753	82,346	7
Munuki	Juba	13,404	83,719	6
Total		**36,175**	**230,195**	**6**

JICA's HH survey conducted in 2022 revealed an average household size of 13 individuals, which is notably large. This large HH size is due to households reporting the presence of extended family members and security personnel as a part of the HH. Moreover, observations made during the Consultant's study assessment in low income areas in Juba Town, Munuki and Kator in August 2023, indicated a common scenario where multiple tenants or extended families resided on the same premises. These premises, often enclosed within a fenced plot with multiple housing units and a single gate, were considered as one household despite accommodating multiple families. In such settings, all inhabitants shared the same sanitation facilities, leading to the technical classification of each premises as a single household. Particularly, low-income areas are characterized by a high density of people sharing a single poorly constructed sanitation facility or making use of public sanitation.

4.5.4 Type of housing

Housing is an important indicator of a HHs income level since investments often is made in the home once income increases. The most recent information on housing is the JICA 2022 survey. The result of the 422 HH interview performed by JICA is presented in the Table 18 below, demonstrating that the most common housing is built of concrete blocks. The poorer types of houses are the traditional or Tukul, and the tin shacks, while the higher quality and improved housing are the ones made of concrete and bricks.

Table 18: Dwelling unit (JICA 2022)

House Type	Count	Percentage (%)
Traditional (Tukul)	86	20.4
Tin shack (Self-help)	67	15.9
Concrete blocks	172	40.8
Brick masonry	94	22.3
Container house	3	0.7
Total	**422**	**100**

4.5.5 Economic activity

The predominant economic activity in South Sudan revolves around agriculture and subsistence farming. Approximately two-thirds of the South Sudanese workforce is engaged in agricultural activities, as reported by the World Bank in 2017. Additionally, a significant proportion (83 percent) of

households identify agriculture as their primary source of livelihood. This underscores the crucial role that agriculture plays in sustaining livelihoods and supporting the economy of South Sudan.

Table 19: Economic Activity in urban setting, 2008 census

Source of livelihood	Percent
Subsistence crop farming	49.9%
Subsistence animal husbandry	4.7%
Wages and salaries	23.0%
Owned business enterprise	14.8%
Property income	2.2%
Remittances	2.5%
Pension	0.9%
Humanitarian aid	1.8%
Total	**100.0%**

The census from 2008 shows that subsistence farming/animal husbandry also is extensive among the urban population (>50%). It is however likely that the reliance on agriculture has significantly reduced since 2008. This is supported by the result of JICA's HH survey (2022), which shows that salaried employees (59%) is the most common employment among the surveyed head of households. 10% of the household heads reported to be unemployed.

The JICA study revealed that respondents in general were hesitant to respond to questions concerning their income. However, the result shows that the average monthly income was SSP 538,014 (USD 1,251). In regards to expenditure, it was reported that education was the highest expenditure.

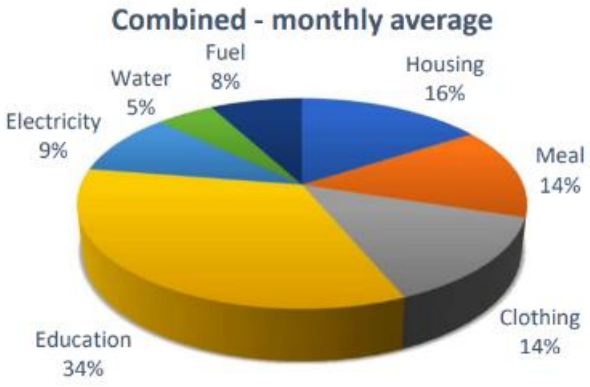


Figure 18: Average HH expenditure (JICA, 2022)

4.5.6 Literacy levels and education

Literacy among people aged 6 and above in the Central Equatorial State was 39% in 2010. In urban areas this figure was 52%[7]. Literacy among people aged 15 and above in the Central Equatorial State was 44% , and in the urban areas this rate increased to 53%.

Education in Juba faces several challenges, but efforts have been made to improve the condition and level of education. Some key points regarding the education system are:

1. Infrastructure and Facilities: Many schools in Juba and across South Sudan lack adequate infrastructure and facilities. Classrooms are often overcrowded, with a shortage of basic amenities such as desks, chairs, and textbooks. Additionally, the quality of school buildings and facilities can vary widely.
2. Access to Education: While efforts have been made to improve access to education, particularly since South Sudan gained independence in 2011, significant challenges remain. Factors such as poverty, distance to schools, and cultural barriers can prevent some children, particularly girls, from accessing education.
3. Quality of Education: The quality of education in Juba and South Sudan as a whole can be variable. Teacher training and qualifications may be inconsistent, and there may be a lack of resources for teaching and learning. Additionally, the ongoing conflict in the country has disrupted education for many children, leading to gaps in learning and educational attainment.
4. Language of Instruction: South Sudan is a linguistically diverse country, with many different languages spoken. The language of instruction in schools can vary depending on the region and the ethnic composition of the student population. Efforts have been made to promote multilingual education, but challenges remain in ensuring that all students have access to education in a language they understand.
5. Higher Education: Juba hosts several universities and higher education institutions, including the University of Juba, which is the largest and oldest university in South Sudan. However, higher education faces its own set of challenges, including funding constraints, limited infrastructure, and a shortage of qualified faculties.

4.5.7 Religious Composition

The majority of South Sudanese, including Juba population, are Christians, with various denominations represented. This includes Catholicism, Protestantism, and other Christian faiths. Christianity was introduced to the region primarily by missionaries during the colonial period and has since become the dominant religion.

Many South Sudanese also adhere to traditional African religions, which vary among different ethnic groups. These religions often involve beliefs in ancestral spirits, nature spirits, and various rituals and ceremonies.

While Islam is not as widespread in South Sudan as in some other African countries, there is a significant Muslim population, particularly in certain regions of the country (not in Juba however). Islam was historically introduced to the region through trade and intermarriage with Arab traders.

It is important to note that religious identity in South Sudan is often intertwined with ethnic identity, as different ethnic groups may have different religious practices and beliefs. Additionally, there is religious

[7] Statistical Yearbook for Southern Sudan 2010 Southern Sudan Centre for Census, Statistics and Evaluation

diversity within each major religion, with various Christian faiths and interpretations of Islam represented among the population.

4.5.8 Household sanitation

In the three blocks of Juba City, 68% of households have waterborne sanitation, 86% of those households pay for mechanical FS emptying service, and 31% live in low-income housing (traditional tukul or tin shack). The remaining 32% are likely to have non-waterborne sanitation (mainly unlined pit latrines with an unclear interface, or a few HHs using neighborhood toilet).

Many households in the three blocks use waterborne sanitation and pay for mechanical FS emptying, according to the JICA 2022 survey. Average resident prioritizes waterborne sanitation, and the number of sanitation facilities that can mechanically empty has increased from 40% in 2013 to 86% in 2022.

Table 20: household sanitation (JICA 2022)

Data from 2022 (% of total interviews in respective areas) Area	**% HHs registered with Waterborne sanitation**	**% HHs registered as using FS collection by vacuum car**	**Actual HHs indicating payment for FS emptying**
3 Blocks	63%	39%	86%
5 Payams	50%	33%	59%
All 8 Payam Blocks	58%	37%	69%

4.5.9 Solid waste management

Despite significant efforts exerted by the City Council, the issue of solid waste remains pervasive throughout Juba, with some waste unfortunately being disposed of in the Nile under the cover of night. In response to this pressing concern, the Juba City Council, in partnership with JICA, initiated a Solid Waste Management Plan in 2022. The objective of this plan is to implement a sustainable solid waste management system, with the overarching goal of enhancing the city's sanitary conditions and fostering a cleaner environment through the provision of sustainable waste management services.[8].

[8] https://www.jica.go.jp/Resource/south_sudan/english/office/topics/fh2q4d000000rbey-att/221122_04.pdf

5. IMPACT ASSESSMENT AND MITIGATION MEASURES

5.1 Introduction

This section identifies and assesses the potential impacts to the physical, biological and socioeconomic environment that can be expected from the proposed project. The impacts due to the Project activities have been identified and assessed. Impacts are identified and predicted based on the analysis of the information collected from the Project site information and Baseline information, respectively. as outlined in earlier sections.

5.2 Impact Assessment Methodology and Approach

The identification of likely impacts during construction and operation phases has been carried out based on understanding of activities and their consequent impacts on various environmental and socio-economic resources or receptors. Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP). The principal impact assessment (IA) steps are summarized and comprise:

- **Impact prediction**: to determine what could potentially happen to resources or receptors as a consequence of the Project and its linked activities;
- **Impact evaluation**: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Mitigation and enhancement**: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts;
- **Residual impact evaluation**: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures

5.3 Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the project and its linked activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the Project and the baseline environment are identified. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques. The nature and types of impacts that has been addressed in this ESIA is defined below.

Table 21: Nature & Type of Impacts Considered for Impact Assessment

▪ **Negative**: when impact is considered to represent adverse change from the baseline or introduced a new undesirable factor;
▪ **Positive or beneficial**: when impact is considered to represent improvement to baseline or introduced a new desirable factor;
▪ **Direct**: impacts that result from a direct interaction between the project and a resource / receptor;
▪ **Indirect**: impacts that follow on (indirectly) from the direct interactions between the project and its environment – as a result of *subsequent* interactions within the

environment; and
▪ **Induced**: impacts that result from other activities (which are not part of the project), but still happen as a consequence of the project.

5.4 Evaluation of Impacts

Evaluation of significance of an impact is assessed by ascertaining a) magnitude and b) sensitivity / vulnerability / importance of resource or receptor likely to be impacted as defined in the following description:

a) Determining Magnitude of an Impact

Magnitude, i.e. severity of an impact or degree of change caused by a project activity is a function of interaction characteristics of Scale, Extent and Duration. The criteria that have been evolved for each of these key elements resulting in degree of change with corresponding ranking/level of impacts (low, medium and high) on the environmental component are presented in the following table below.

Table 22: Impact Prediction Criteria

Impact Elements	Criteria	Ranking
Scale: Degree of damage that may be caused to the environmental components concerned	▪ **Irreversible damage to natural environment** and/or likely difficult or may not to revert back to earlier stage with mitigation; ▪ **Major changes in comparison to baseline conditions** and / or likely to regularly or continually exceed the standard;	**High**
	▪ **Reversible damage to natural environment** but likely to easily revert back to earlier stage with mitigation; ▪ Perceptible change from baseline conditions but **well within acceptable norms**.	**Medium**
	▪ Effect is **within the normal range** of natural variation; ▪ **No perceptible or readily measurable change** from baseline conditions;	**Low**
Extent: Spatial or geographical extent of impact due to a project and related activities	▪ Project site and the entire study area i.e. beyond Project influence area.	**National**
	▪ Project site & its surroundings (2.0 km from Project components	**Regional**
	▪ Project site & its immediate vicinity (0.5 km from Project components	**Local**

Duration: Temporal scale of the impact in terms of how long it is expected to last	▪ Spread beyond the lifecycle of the project	**Long Term**
	▪ Spread across several phases of the project lifecycle	**Medium Term**
	▪ Only during particular activities or phase of the project lifecycle	**Short Term**

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. The magnitude combines the impact characteristics of Extent, Duration and Scale and is a multiplicative factor of these three criteria set. Based on the above understanding magnitude of impact is assessed as per the table below.

Table 23: Assessing Magnitude of Impact

Scale	Extent	Duration	Magnitude
Low	Local	Short Term	Negligible
Low	Regional	Short Term	Small
Low	Local	Medium term	
Medium	Local	Short Term	
Low	National	Short Term	
Low	Local	Long term	
High	Local	Short Term	
Low	Regional	Medium term	
Medium	Regional	Short Term	
Medium	Local	Medium term	
Low	National	Medium term	Medium
Medium	National	Short Term	
Low	Regional	Long term	
High	Regional	Short Term	
Medium	Local	Long term	
High	Local	Medium term	
Medium	Regional	Medium term	
Low	National	Long term	
High	National	Short Term	
High	Local	Long term	
Medium	National	Medium term	Large
Medium	Regional	Long term	
High	Regional	Medium term	
Medium	National	Long term	

High	National	Medium term	
High	Regional	Long term	
High	**National**	**Long term**	

Determining Sensitivity/ Importance/ Vulnerability of Receptor:

In addition to ascertaining magnitude of impact, the other principal step necessary to assign significance for an impact is to define the sensitivity, vulnerability and/or importance of the impacted resources/receptor. There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource/ receptor, which may be physical, biological, cultural or human as per the following understanding:

- Where the resource is physical (for example, fresh water body) its quality, sensitivity to change and importance (on a local, regional, national importance) are considered;
- Where the resources/ receptor is biological or cultural (for example, sea turtle habitat and nesting site), its importance (for example local, regional or national importance) and its sensitivity to the specific type of impact are considered;
- Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Definition as per below ***Table*** has been adopted to determine sensitivity/ importance/ vulnerability of environmental resources or receptor.

Table 24: Sensitivity/Importance/ Vulnerability Criteria

Sensitivity	**Contributing Criteria**
High	• Existing physical environment quality is already under stress; • Ecologically sensitive/ protected area, provides habitat for globally protected species; • Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the project. • Human receptors/ vulnerable community are located within the project footprint and directly affected by the project • Resource exclusive for community use
Medium	• Existing physical environment quality shows some sign of stress; which is sensitive to change in quality or physical disturbance; • Natural habitat provides habitat for wildlife, which are protected under National regulations; • Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the project; • Human receptors/ vulnerable community are located adjacent the project site and likely to be affected by the project; • Alternative resource available with community.

Low	• Existing physical environment quality is good; • Modified habitat provides habitat for common species; • Human receptors are located away and are not likely to be affected due to the project related activities

Evaluating Significance of Impacts

Based on interaction of magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor likely to be impacted, the significance of impact is assigned for each impact using the matrix shown in the following table.

Table 25: Impact significance matrix model

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

Context of Impact Significance

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable(ALARP)This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted. An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

5.5 Identification of mitigation and enhancement measures

Once the significance of an impact is assessed, the next step is to evaluate appropriate mitigation and

enhancement measures are warranted. In this ESIA, the following ***Mitigation Hierarchy*** has been adopted:

- (1) Avoid or Reduce at Source: avoiding or reducing at source through the design of the project;
- (2) Abate on Site: add something to the design to abate the impact;
- (3) Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site;
- (4) Repair or Remedy: some impacts involve unavoidable damage to a resource and these impacts can be addressed through repair, restoration or reinstatement measures;
- (5) Compensate in kind, compensate through other means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the linked Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation and enhancement measures are declared, the next step in impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

5.6 Management and monitoring

The final stage in the impact assessment process is to define the management and monitoring measures that are needed to identify whether: a) impacts or their linked Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

Environmental Management Plan summarizes all actions (including mitigation/enhancement and compensatory measures) which the Project Proponent has committed to executing with respect to environmental/social/ health performance for the Project, is also included as part of the ESIA report. The Plan also includes monitoring measures to assess performance of the actions.

5.7 Assessment of environmental and social impacts and Mitigation Measures

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) linked with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors.

The interaction matrix enables a methodical identification of the potential interactions each Project activity may have on the range of resources/ receptors within the Area of Influence i.e. the study area for the Project.

As per project schedule and plans it was noted that the project includes elements of de-commissioning (of old treatment system and structures at the WWTP) and simultaneous construction phase, i.e. these overlap each other. In such cases, assessment of environmental and social impacts and mitigation measures have been combined in the following assessment and matrix.

Table 26: Overall Impact Matrix

Project Activities	Environmental Resources											Ecological Resources				Social resources								
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora	Aquatic Fauna	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Physical Displacement	Land Use (Economic	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health &
I. Construction Phase																								
Mobilization and Operation of earthmoving equipment																								
Land preparation (cleaning and grading)																								
Land excavation																								
De-watering of excavated area																								
On-site handling and storage of excavated material																								
On-site handling and storage of construction waste																								
Off-site disposal of construction waste including concrete residue																								
Installation of WWTP /FSTP structures																								
Installation of electro-mechanical																								

equipment																								
Operation of DG sets (standby)																								
Use of water for construction activities																								
Wastewater generated during construction activities																								
Vehicular Movement *(*RMC Trucks, raw material unloading vehicles, waste disposal trucks etc.*)*																								

Project Activities	Environmental Resources											Ecological Resources				Social resources								
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora	Aquatic Fauna	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Physical Displacement	Land Use (Economic	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health &
II *(a). Activities at Linked Sewage Infrastructures*																								
Land preparation for sewer pipeline renovation (clearing and grabbing)	■			■	■						■					■		■			■			
Mobilization and operation of earthmoving equipment for sewer pipeline renovation																■					■			
Desilting of sewer pipelines	■				■	■										■		■			■			■
Laying of New sewer pipelines	■			■	■						■					■	■	■			■			■
On-Site storage and handling of silt/sludge	■					■					■					■								■
Off-Site disposal of silt/sludge	■		■				■		■	■						■								■
Dismantling of Electro-Mechanical equipment at linked facilities (MPS, LS structures, etc.)	■															■								■
Renovation of linked facilities (installation of electro-mechanical	■											■				■								■

structures)																								
On-Site handling and Storage of waste generated at linked facilities. (Hazardous and Non-Hazardous)																								
Off-Site disposal of waste generated at linked facilities.(Hazardous and Non- Hazardous)																								

Project Activities	Environmental Resources											Ecological Resources				Social resources								
	Visual Aesthetics & Odour Nuisance	Land Use	Soil Quality	Air Quality	Ambient Noise	Topography & Drainage	Surface water	Surface water quality	Ground water resource	Ground water quality	Traffic (road)	Terrestrial Flora & Fauna	Aquatic Flora	Aquatic Fauna	Migratory Route/ Corridor	Job & economic opportunity	Livelihood Loss	Social & Cultural Structures	Physical Displacement	Land Use (Economic	Access Disruption	Cultural Resources	Community Health & Safety	Occupational health &
II. Operation Phase																								
WWTP/FSTP operation																								
On-Site handling and storage of Bio-Solids																								
Off-Site disposal of Bio-Solids																								
Biogas flaring and flue gas venting (from Biogas engine).																								
Handling and Storage of Chlorine																								
Hazardous and Non-Hazardous Waste Storage, Handling and Disposal at WWTP/FSTP																								
Hazardous and Non-Hazardous. Waste Storage, Handling and Disposal etc																								
Diesel Generator Set operation (standby)																								

5.8 Potential Environmental Impacts

As per Impact Identification Matrix for Rokwe WWTP/FSTP Option 1 and Linked Facilities (**refer to matrix as per Table above)** the proposed project activities in many cases have an potential and in many case indeed a likely impact on the surrounding environment via interaction(s) and effect etc. on environmental resources or receptors. These impacts chiefly fall in the following overall categories:

- Visual Aesthetics & Nuisance
- Ambient Air quality & Odour
- Soil Quality
- Ambient Noise
- Drainage
- Surface Water
- Ground Water

Detailed impacts linked to each of these have been further assessed and analysed, and respective mitigation measures have been proposed, further in the subsequent sections.

5.8.1 Visual and Aesthetics

Construction Phase

The proposed facility shall be developed by clearing shrubs and elephant grass present over the sludge drying bed within the WWTP complex. During this phase multiple activities will be undertaken within the WWTP complex, starting from cleaning and grading of land which is mostly covered with grass and shrubs, mobilization of construction equipment, land excavation and piling for making base foundation, etc. Waste generated from these activities will have to be stored within the WWTP complex temporarily till they are disposed or reutilized for backfilling purpose. They will be stacked at designated place. Continuous stacking builds heaps of these waste along with temporary labour camps which are not soothing for human eye or residents of nearby area. This may have a detrimental effect on the perceived beauty of the place. Potential impacts on the receptors may be medium to high as the WWTP is in direct line of vision for the receptors. Thus, overall impact for this phase is ***Moderate***.

Mitigation Measures: The mitigation measures to minimize the above-mentioned impacts are as follows:

- All the construction activities will be restricted within the designated site.
- Use of covered trucks, tippers or dumper, if not, then contractor has to make sure that materials are not moved without putting a cover on them.
- On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility.
- Quick disposal of Sludge from existing structures and de-silt material from sewer network.

Impact Significance	**Visual and Aesthetics Impacts during Construction Phase**		
Impact Nature	Negative	Positive	Neutral
Impact Type	Direct	Indirect	Induced

Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Minor***			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered ***Minor.***			

Residual Impact: Considering the implementation of above-mentioned mitigations measures the significance of residual impact is assessed as **Minor**.

Operational Phase

Presence of newly built WWTP/FSTP will have a positive effect, as new structures will be constructed, painted, labelled and new internal road will be built improving the overall aesthetic of WWTP complex.

- All the construction activities will be restricted within the designated site
- Use of covered trucks, tippers or dumper, if not, then the contractor has to make sure that materials are not moved without putting a cover on them.
- On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility.
- Quick disposal of Sludge from existing structures and de-silt material from sewer network.

Impact Significance	**Visual and Aesthetics Impacts during Operational Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High

Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Minor***			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large

Residual Impact: Considering the implementation of above-mentioned mitigations measures the significance of residual impact is assessed as **Minor**.

5.8.2 Ambient Air Quality and Odour

Air Quality

Construction Phase: During this phase major source of potential impact on ambient air quality is, among others, fugitive dust emissions from storage and handling of construction waste. During normal conditions these fugitive dust emissions are likely to spread within a range of maximum 100 -150 m radially, only during windy condition radial spread of fugitive emission will increase to 200-250 m and affecting receptors within ~250- 300 meters from WWTP site. Altogether, fugitive emissions within the influence area of WWTP from construction phase of WWTP impacting the receptor will be **minor**.

Another set of activities affecting ambient air quality is vehicular emissions due to movement of trucks carrying construction material and mobilization of construction. Estimated movement of trucks per day for delivering construction material and removal of construction waste are 10 (trucks per day), but it may on occasion be more.

All activities during construction phase will be carried using grid connection. Portable Diesel Generator (DG) set(s) will presumably only be used in case of emergency as back source of electricity. Stack emissions from these portable DG sets and vehicular emissions have HC, NOx, PM and CO. Additional load from construction phase will have negligible incremental impacts on the air quality of the surroundings.

Anticipated impact scenarios mentioned above will be short-term and will exist during construction activities only. As a result, they pose medium risk and they are reversible in nature. The potential impact on air quality is assessed to be **Minor** with effective mitigation measures stated below.

Mitigation Measures*:* The proposed mitigation measures are as follows:

- The construction materials waste will not be stored in the direction, or exposed, of prevailing wind. Further efforts will be made to maintain the stockpile against a wall or have “obstruction structures” in place so that it works as a windbreak and fugitive emissions during strong winds can be avoided;
- Hazardous or Non-hazardous waste generated from construction activities at the site will not be burned on site, but should be disposed properly and safely;
- All loading and unloading activities to be carried out as close as possible to the storage facilities;
- Proper handling of materials to ensure minimal emission of dust. Trucks used for transportation of material during site preparation will be provided with impervious sheeting.

Operation Phase: Biogas will be generated during the operation phase which may partially require to be flared under certain circumstances resulting in flare combustion products. In addition, WWTP of the proposed configuration are expected to emit Bio-aerosols (which may include microorganisms such as viruses, pathogenic bacteria, and fungi) during operations phase and may pose a health risk to WWTP workers and neighbouring communities, but if well operated and maintained impact should

be minor. The *Mitigation / Control Measures* include;

- Sprinkler systems/water bowsers will be used to suppress the fugitive dust emission during construction phase.
- Biogas-scrubber(s) will be used to remove the hydrogen sulphide (H2S) traces present in the biogas generated during anaerobic digestion process.
- Appropriate flaring system should be installed to ensure efficient combustion of Bio-gas through flaring burners
- The quantification of health risks from bio-aerosols is difficult to predict and can be better characterised through monitoring (in terms of colony-forming units per unit volume of air (CFU/m3)) when the WWTP commences operations.

Odour Impacts

During construction phase only source of odour that can be envisaged (apart from the sludge and material in the treatment plant itself) is solid waste generated from labour camp and waste collected in grit chambers etc. Duration of impact from above aspects are short term and impact magnitude will be **negligible to minor** in nature.

Odour nuisance along the sewer line will have potential impact on residents, shops and markets due to temporary storage of de-silted material/solid waste from grit screen along the roadside. Duration of temporary storage may be up to 48hrs maximum which is comparatively short, hence the impact will be Minor. Receptors of Rokwe and other areas as well will encounter odour nuisance during construction, but since the duration of this phase is short term all considered, the impact magnitude is assessed to be **Minor**.

Mitigation Measures: The mitigation measures to minimize the above-mentioned impacts are as follows:

- All the construction and activities will be restricted within the designated site.
- Use of covered trucks, tippers or dumper, if not, the contractor/authorities has to make sure that materials are not moved without putting a cover on them.
- On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility.
- Quick disposal of Sludge/de-silt material from sewer network.

Nuisance odour generated from sewage and wastewater treatment plants impairs ambient air quality and represents a growing social and public health issue that is increasingly a cause for public discomfort and complaints. Biological treatment and stabilization processes, which are widely applied for upgraded sewage treatment, reduce the nutrient concentration in waste water, thus minimizing environmental impact (as also proposed in this Project). However, when anaerobic conditions are reached during microbial decomposition of organic matter present in sewage (food, animal scums, organic compounds, sludge etc.), unpleasant odours are naturally generated. From the chemical nature point of view, the main contributor of such odours are gases like Hydrogen Sulphide as well as Volatile Organic Compounds (VOCs) resulting from anaerobic decomposition of organic matter with Sulphur and Nitrogen content. Other by-products of such decomposition process may comprise of highly odorous compounds like mercaptans, organic sulphur substances and amines.

Key anticipated emission sources of odour from the proposed WWTP include several potential

sources of odour due to mass transfer and organic reaction leading to formation of odourous substances from aerated grit separator and activated sludge treatment section etc. As per the Project proposal design these structures are to be "closed" and odour generated within the structures will generally not spread outside if structures are well maintained and operated as intended. Hence, these have not been considered while estimating odour impacts (impact will be negligible). However, sources where new odorants form, i.e., primary/secondary sedimentation, thickening tanks and similar structures in the upgraded WWTP are considered major sources of odour and hence they are considered for odour impact estimation.

In addition, other sources of odour include potential smell and leakage from sewage lines and not least from the two pumping stations. However, if properly designed, constructed, maintained and operated – the impact should be **negligible or minor**.

In order to assess an incremental increase of odour levels consequent adverse impacts in the immediate neighborhood of the WWTP site, and outline mitigation measures, a dispersion modelling approach has been adopted. It needs to be noted here that there is no ambient odour level standard that are specified by regulations in South Sudan.

Mitigation Measures:

- Developing an ambient monitoring plan and stack monitoring schedule.
- Using low Sulphur content diesel for Diesel Generator sets.
- Keeping the storage areas under moist conditions to prevent dust formation.
- To ensure compliance with the air emission criteria for flue gas stacks, the following measures will be implemented during operations:
    - The use of continuous emission monitoring (CEM) equipment for the measurement of air emission levels will be undertaken for PM10, NOx, SO2, CO and O2;
    - PM2.5 and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the natural gas fuel.
- The stack will be provided with safe access to sampling points for CEM.

5.8.3 Noise Quality

Construction Phase: The potential impact on noise quality may arise out of the following: Machineries and Equipment; Vehicular traffic and Back-up generator.

Impact Assessment:

The construction of WWTP, and as well the sewage pipelines and pumping stations, will produce significant noise. The cumulative level of noise generated during this phase could be in excess of 80 dB(A) at peak times, although this would only be for short intervals. The intensity of noise from sources such as i.e. backhoe, Front loader, Generator, tractors, dozers and concrete vibrators generally will exceed 55 dB by the time it reaches to the receptors outside the WWTP. Since the activities are for shorter duration hence the magnitude of impact is **Moderate** in nature.

Mitigation Measures: Effective noise management protocols would be implemented wherever applicable during construction and operating phases of the life of this project. Besides this protocol measures, construction work will be limited to day time periods, thus avoiding the night time which is the most noise sensitive, and should be advertised well in advance. The following measures should be treated as a part of the project proposal which include:

- Switching off unnecessary or idle equipment's;
- Fitting of noise mufflers to mobile equipment's;

- Advertise operations (construction) well in advance and work during day hours;
- and Preventive maintenance of equipment to minimize noise emissions.

Operational Phase: During daily operations of WWTP, noise will be generated from pumps and air compressor having noise range of 60-90dB in the immediate vicinity and for administrative building noise generated could potentially be in the range of 60-70dBm. All together impact is assessed to be **moderate** – but it is important to note that impact will be considerable less outside the WWTP (impact can be expected to be minor).

Mitigation Measures:

- High-quality pump installations will be arranged within the territory of the treatment plant. Much less noise is generated from pumps which are made of stainless steel or cast iron, as example, and this may be considered during detailed design (Low-cost pumps, which are made of thin steel sheets, produce more noise);
- During the installation of pumps, noise-insulating material such as foam plastic can be used as far as possible;
- Pumps will be arranged on vibration isolation platforms, for which thick rubber sheets can be used;
- Equip all personnel with proper protective equipment.

Since, the cumulative noise level at Site is more than 85 dB, as best practice the workers must be provided with personal protective equipment such as ear muffs to reduce exposure to high noise level.

Impact Significance	**Impact due noise generation during operational phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered ***Moderate***			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Medium.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of residual impact on ambient air quality during construction phase is assessed as **Medium.**

5.8.4 Drainage Impacts

During project life-cycle potential scenarios impacting the surrounding drainage system are, firstly, storm water entering into WWTP complex through broken boundary. Secondly, flood scenario developed due to heavy rainfall. Lastly, (planned) daily operation of WWTP resulting in discharge of treated wastewater. Under all scenarios discussed above, discharge will happen into drainage channel connected through sewer line due to natural slope. The potential impact scenarios as discussed above will also have negligible impact on the drainage due to buffer carrying capacity of 7000 Million Liters per Day (MLD).

Mitigation Measure:

- Develop a storm water drainage system as best management practice on site.

Impact Significance	**Impact on Drainage**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above-mentioned mitigation measures, the significance of residual impact on Drainage impacts during construction phase is assessed as **Negligible.**

5.8.5 Surface Water Quality

Construction Phase: No adverse impact on surface water quality is envisaged as no or very limited discharge into surface water is proposed during construction phase and all proposed phase activities will happen within the WWTP complex.

Impact Source: Contamination of surface water bodies during the construction phase is possible in the following cases:

- Oil spill in case of violating the rules of "proper" storage or the rules of construction equipment and vehicles maintenance;
- In case of contaminated water discharge during the earth works;
- In case of discharging vehicles or equipment, wash down water;
- In case of improper management of construction waste;
- In case of improper management of sludge and storm waters, etc.

Mitigation Measures:

- Providing spill kits near oil and grease storage.
- Using a secondary container during transfer of oils, grease etc.
- The drainage system at site is to be provided with sedimentation.
- Tank and oily-water separator in place to prevent contaminants, especially oil and grease, from being carried off by surface runoff.

Operational Phase: The objective of the proposed project activity is among others aimed at creating environmental improvement in terms of reducing pollution load to receiving water bodies (streams), and ultimately the White Nile, by installation and operation of WWTP and linked sewerage infrastructure.

As the WWTP facility has a relatively flat topography in parts, while in other parts a sloping profile, some negative impact during operation phase on surface water *could materialise* – but would only do so if facility is improperly operated or there is malfunctioning of WWTP equipment, or in case of severe flood events resulting to draining of storm water during heavy rains or causing overflowing of adjacent ponds existing nearby WWTP facility.

Another potential negative impact, potentially quite severe, is overflow/malfunctioning of the sewage pipeline system including pumping stations. This could be caused by accidents (pipeline exposed and punctured for instance), or poor maintenance etc. Impact can potential locally be ***severe*** from such events, but all other things equal probably ***not large in extent***.

Mitigation Measures:

- Provide emergency measures for potential sewage overflows from sewer systems, or pumping stations, including intervention troughs along the affected main surface drains that are likely to receive overflowing sewage. Similar collection trough could also be provided downstream the treatment plants (these measures should be considered further in final design) ;
- Draw up a monitoring schedule for the treated sewage quality. This should constitute an important component of the sewage treatment disposal (sampling at pre-designated locations of the treatment plants and submitting to the laboratory for analysis). Key water pollutants to monitor for would include organic matter, settable solids and nutrient residuals.

5.8.6 Ground Water Quality

There will be no groundwater extraction during project life-cycle, as per design. All water during construction will be sourced through water tankers (collecting water from the White Nile, or the SSUWC facilities) and during operation phase water will sourced from SSUWC supply. Hence there will no direct impact on ground water resource.

Potential sources of impact for ground water contamination are minor oil and grease spillage, during

maintenance of construction machinery, repair of pumps and compressors during operational phase.

A ***potential major impact*** is however groundwater contamination from exposed groundwater sources during construction (or subsequent operation) of the actual pipelines and sewage piped system. The preliminary design team has been very much aware of this element, and in fact changed certain important project elements to minimize the likelihood of this potential negative impact materializing. There is no mitigation available other than planning/designing appropriately, and thus avoiding any potential negative impact – on the other hand it is a known aspect of sewage pipeline systems and with proper assessment and final design it can be addressed.

5.8.7 Soil Quality

Construction Phase: Construction waste may contain hazardous as well as non-hazardous waste. These wastes must be segregated at source or else any leakages or spills viz. grease and lube oil from motors and gearboxes, heavy metals from circuit boards and electrical panels etc. will contaminate the soil within the facility as well as at the disposal ground. However, these impacts are temporary, limited only to WWTP site and in most cases reversible in nature.

Fuels, lubricant, paints, etc. should be stored at designated paved areas – and if this is done the contamination of soil can happen only due to accidental spillage of fuel, lubricants and paints from storage areas and during transfer of fuels and chemicals. However, in case of a spill, the restoration of top soil is usually difficult and a time taking activity.

The above-mentioned soil quality impacts will be localized within the project site or in the immediate vicinity. The significance of potential impact, without mitigation measures in place, on soil quality is assessed as ***Minor***.

Mitigation Measures:

- Manage spills of contaminants on soil using standard engineering practices;
- Impervious storage area, especially for fuel & lubricant, chemical, hazardous waste etc.;
- Municipal solid waste generated from the labour camp and construction site will be transferred to the disposal site in consultation with the local municipality;
- Fuel, chemical and lubricant will be stored in paved storage areas.

Impact Significance	**Impact on Soil Quality during Construction Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			

Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Minor.**			

Residual Impact: Considering the implementation of above mentioned mitigation measures, the significance of impact on soil quality is assessed as ***Minor.***

Operational Phase: Potential impact on soil quality can arise due to activity at the WWTP, or pumping stations, or even at other sites where the pipeline is maintained or expanded etc. One potential impact/risk is accidental spillage of fuel (especially is diesel generator is used), various maintenance activity & lubricant (for gears, motors and air compressor unit) from storage facility or from transport with vehicles. These activities could lead to contamination of soil(s), however chances of spreading of contaminated soil to receptor surrounding is negligible for operations within the actual WWTP complex.

Furthermore, the planned activities with both storage and disposal of treated fecal sludge and biogas scrubber sludge, which have high organic content, has potential risk elements, but normally will have *positive impact* by increasing the fertility of soils if distributed as manure as dried sludge are mostly used and considered very valuable as bio fertilizers. However, worth noting is that the quality and contents etc. of the resulting treated sludge material should be monitored frequently – this is an important additional note.

A potential situation that could heavily impact the soil quality of the WWTP and surrounding environment (or other projects sites) is overflow of WWTP system/equipment due to malfunctioning, mis-management or flood situation, this could have impact downslope or downstream from the WWTP if significant amounts pf untreated or only partially material is released accidentally or by weather induced events.

Solid Waste Generation*:* During operation phase, periodic maintenance of the sewer line will generate de-silted sludge. De-watered sludge will be generated due to treatment of sewage water.

The project does not currently include the option to use the dry sludge as manure/fertilizer and the ESIA team has assessed it as such – however it is recommended this be investigated further as the dry sudge could be a valuable resource. The current plan includes that all non-hazardous solid wastes generated will be stored temporarily at respective location and then disposed to designated landfill sites assigned by Juba City Council (JCC) Authorities. The Control Measures include;

- Contract with SSUWC approved vendor for disposal of hazardous waste;
- Disposal of solid waste through municipal waste collection trucks;
- Dry sludge will be disposed to landfill site as designated by the Juba City Council within a radius of 10 km from the relevant Site

Hazardous Waste*:* activities may result in the potential for generation of small quantities of petroleum-based wastes, such as used oil including lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. Quantity of the used oil generation due to periodic maintenance of the equipment during the WWTP operational phase will be estimated at a later stage after equipment finalization. The Control Measures include:

- Making arrangement for proper segregation, storage and disposal of such wastes;
- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids;
- Using impervious surfaces for refueling areas and other fluid transfer areas;
- Providing portable spill containment and clean-up equipment on site and training in the equipment deployment; and
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills.

Overall negative impact for the operational phase is estimated to be negligible as the impact scale is low, sensitivity of receptor is low resulting in **magnitude of impact to be negligible**. Yet, the above considerations on risks are important notes, and the mitigation measures highlighted below are highly relevant despite this overall assessment.

Mitigation Measures: The following mitigation measures will be implemented:

- Ensure proper spill control and management at site (all project sites);
- Monitor and detect any contamination on soil & ground water (all project sites);;
- Good housekeeping to prevent spillage and runoff from site;
- Ensure the disposal of waste into designated storage and disposal area;
- Closely monitor contents of treated sludge, especially if used for manuring of farm fields.

Impact Significance	**Potential Impact on Soil Quality during Operational Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Negligible**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above-mentioned mitigation measures,

significance of impact on soil quality during operation phase of the Project is assessed as **Negligible.**

Other potential environmental and pollution related impacts: Although not identified as *likely negative impacts* it must be recognized that there are other forms of pollutants or pollution effects that can materialise in the project. These include: (i) Nitrogen-phosphorous rich compounds, occurring in the treated wastewater or in the treated sludge; Pathogenic organisms etc. in the treated wastewater or in the treated sludge; and, Potential negative impact/pollution from inorganic chemicals, micro-plastics, radioactive substances, synthetic organic chemicals etc. None of these are expected to constitute significant negative pollution effect (impact is minor or negligible).

5.9 Potential Social Impacts

There are potential impacts both for the construction and operation phase of the project. These include:

- Potential loss of livelihoods for informal farmers at Rokwe
- Restricted access during pipe laying
- Occupational health and safety
- Spread of diseases
- Traffic safety
- Gender issues.

The main potential impact identified related to the informal farmers' at Rokwe due to the restricted access in the new WWTP. The project is however not expected to lead to any land acquisition since both the WWTP, pumping stations and pipe network will be built on government land and within the right of way (RoW). This chapter will further describe the potential impacts and mitigation measures to ensure that adverse impacts are minimized.

5.9.1 Potential permanent loss of livelihood

The main potential impact investigated thoroughly in the ESIA is the potential loss of livelihoods for informal farmers due to the restricted access to Rokwe WWTP. Parts of the WWTP area where there currently is no sewage treatment or other activities are being used by informal famers growing agricultural, mainly for subsistence purposes. This issue has been thoroughly investigated with many visits, workshops and discussions with official stakeholders and the informal farmers themselves and conclusion is that the proposed project will not lead to any physical or economic displacement aspects for the involved farmers. It has been agreed that the Government of South Sudan through its representatives and the farmers will establish an Memorandum of Understanding on the use of (still) vacant land within the facility with permission and coordination with the facility management. The facility thus has expansive land that can be utilized by the community for their subsistence oriented farming. Additionally, it was agreed that the use of the raw water from the oxidation ponds, which has happened in some cases hitherto, to cease with immediate effect until the quality of the effluent is of the required standard. The nearby swamp water is of good quality for irrigation and can be utilized instead for farming activities should this be warranted.

The government will further be required to issue a public notice for any claimant to the proposed project site area or part of it to lay claim before the project commences. This is to be done through issuance of notices through radios, publishing in local dailies and erect notice on site for the recommended national timelines. Further, farmers should be allowed to harvest their seasonal and temporary farming (crops) before reallocation to other parts of the area. Naturally, any area for firstly construction, subsequently sewage treatment, is to be properly marked and fenced off and no access should be granted to the actually WWTP site in the future for unauthorised people.

Communication and close consultation should continue with the project affected people (PAP) at

Rokwe (and elsewhere). Immediate *Mitigation Measures* are:

- Liaise with the relevant Government agencies to establish the PAPs (farmers on site) likely to be affected by the expansion and improvement of the WWTP i.e. their number, crop grown, and location.
- The Government of South Sudan through its representatives and the farmers to get into an official MOU on the use of the vacant land within the facility that they are currently majorly using it for subsistence farming under the permission of the facility management.
- The process should be in conformation to AfDB OS 5 - Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement which state that the people should not be left badly off from the project activities.
- The farmers should immediately cease their use of the effluent from the ponds as they are untreated and pose a health hazard to human health. Analysis of the effluent indicates high levels exceeding the recommended standards. The swamp nearby water can be utilized for the irrigation purposes if needed.
- Ensure that the PAPs can harvest their last crops before any new fencing/marking of the future WWTP area and construction starts.
- Identify all PAPs before the cut-off date.
- Establish a community liaison officer who is responsible for having continuous engagement with the PAPs and who will respond to any questions and collect grievances.

The government should ensure Land ownership evidence: I.e. submit/issue the Rokwe (Roton) WWTP land ownership document to avoid future land ownership tussles. Further, a public notice should be issues for any claimant to the proposed project site area or part of it to lay claim before the project commences. This is to be done through issuance of notices through radios, publishing in local dailies and erect notice on site for the recommended national timelines.

Residual impact: By implementing the mitigation measures it is assessed that the PAPs will retain their livelihoods to the same level or better. The impact magnitude with mitigation efforts is thus assessed to be **negligible.**

Impact Significance	**Impact on informal farmers**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate** (with no mitigation)			

Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible**			

5.9.2 Temporary loss of income

Construction Phase

All the sewage lines will be laid along the sides or in the middle of the roads. The proposed project will lead temporary access disruption during construction**.** The disruption will be caused by the excavation work, vehicular movement for transportation of construction materials for carrying out construction materials, especially along narrow and congested areas**.** No new land acquisition will be required for undertaking the proposed work**.** All replacement and renovation work will be undertaken along the existing RoW**.**

The access disruption may lead to temporary loss of income for some businesses along the network, if customers decide to not go to the store due to restricted access and increased congestion due to construction. However, it is assessed that these impacts will be limited since the shops still will be accessible to enter. The pipe laying will be done in 100 meter sections, and each section is estimated to take 1 week.

This must be carefully monitored to ensure that the construction do not take unreasonable long time or restricts the access for customers to enter the shops. If so is the case, it will be needed to issue compensation due to temporary loss of livelihood unless other is agreed with the shop owners. There must be a clear grievance redress mechanism in place so PAPs easily can contact the project and raise complaints.

During the inventory of losses at the detailed design phase, shall look into the exact expected impacts to see whether any business will be unable to operate due to the construction and therefore be entitled to compensation. This compensation should be based on the business' average income per day.

There are also mobile vendors with small stalls along the streets. It is assessed that these street vendors easily can move to another area, and that this shall be assisted by local authorities who will find a comparable alternative location and help with the transfer of the stalls.

Mitigation Measures:

- The contractor should inform all the stakeholders well in advance (at least 15 days) before the start of the construction work;
- Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.
- Easily understandable grievance redress mechanism, where the Project is responsive and answering grievances in a timely manner.
- Establish a community liaison officer who is responsible for engaging with communities and PAPs

- Mitigation measures will be part of the contract agreement for the work Contractor and will be implemented through it, with careful monitoring by the client.

Impact	Temporary loss of income			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Within the RoW of the existing government roads within which the sewer pipelines will be laid.			
Frequency	During the construction phase			
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Moderate**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations)	Significance of impact is considered **Minor**			

Residual impact: Considering the implementation of above-mentioned mitigation measures, the residual impact disturbance to local businesses and street vendor is assessed to be minor.

5.9.3 Road Traffic Impacts

Construction phase: To understand the baseline condition and traffic influx, monitoring was undertaken of the roads which will predominantly be used during the construction phase for trucks, tippers, and other heavy machinery that will be mobilized. There will be about 10-15 PCU/day carrying construction material, disposal of construction waste and transportation of plant machineries and raw materials for the upgrading of the WWTP.

Movement of heavy vehicles along the road has a potential to cause accidents and safety hazards. It may also disturb local residents who are using the road in their day to day activities.

There will also be increased traffic in phase 2 of the project when the sewage network is put down. This will cause disruption to traffic movement, which may disturb local residents, especially during peak hours. This may also impact the community during for example medical emergencies.

The potential impact on road and traffic due to operational traffic is assessed to be minor.

Operational phase: The first phase of the project will still be reliant on sewage trucks transferring

fecal sludge and sewage to the WWTP since the sewage network will be built in the second phase of the project. This may lead to an increased number of sewage trucks and subsequently increased traffic until the sewage network is up and running. The sewage trucks drivers might in the long run risk losing their jobs when the sewage network is functioning. However, this is assessed being a minor risk since there are still large parts of the city which will not be covered by the sewage network and the city keeps expanding with urbanization.

Mitigation Measures:

- Trucks are not loaded beyond their load carrying capacity.
- Impose speed limit for vehicles moving in and out of WWTP complex by put display signs and hazards associated with speeding and rash driving.
- Sewage truck drivers must follow a company code of conduct which includes safe driving.
- Since majority of the roads in the project area are narrow, there will be some traffic congestion, hence alternate traffic routing may be adopted in consultation with concerned traffic police authorities**.** In case alternative traffic routes are not available, traffic management measures will be adopted**.**
- Traffic dislocations also have some adverse impact on trade and commerce, hence works at business and market area must be completed in a phased manner and in consultation with the local stakeholders.
- Careful consideration should be taken to minimize congestion and negative impacts at schools and hospitals.

Impact Significance	**Impact on Road Traffic**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Small.**			

5.9.4 Community, Health and Safety

Construction phase: Experience shows that because of its nature and scale, the project can be expected to have a limited interaction with the local community and as a result will have minimal impact on the safety and health of local communities. During the construction stage, there will be construction workers at the WWTP and along the pipe network. The construction workers are expected to come from different socio-cultural settings compared to the residential settlement around the project area. In the case that hygienic conditions are not maintained at the project site, there may be issues with vector borne and other diseases in the immediate vicinity. Therefore a sanitation plan should be made by the Contractor. Unless proper sensitization of neighboring communities is undertaken and appropriate safeguards are adopted, there is a possibility for increase in sexually transmitted diseases, though the possibility appears quite remote.

The site clearing activities and construction activities (involving fill materials, brick and concreting work) would result in emissions of dust and noise, discharge of sanitary wastewater and waste generation during a short phase and has a potential to contribute to additional nuisance levels for the community and households located immediately adjacent to the WWTP. However, with very few people living near the site, no significant impacts are expected to the communities in the area. Although there is public concern over the potential health effects associated with the exposure to noise, odour and fugitive emissions from the WWTP, there is no empirical data that demonstrates adverse health impacts from typical WWTP projects. Considering good construction practices and planned embedded measures for mitigating these impacts, the overall significance of community health and safety impacts can be rated to be minor.

There is a possibility for accidents during the excavation and road opening activities when laying the pipelines. Accidental damage could potentially happen to water pipelines or electricity poles along pipelines. This could lead to temporary disruption or damage of water supply and electricity supply, which would impact the community as well as leading to expensive repair costs. The likelihood of such an accident is considered small but the impact could potentially be significant.

A positive impact for the local community during construction will be the increased job opportunities for in construction. Street vendors will also benefit from increased income by selling food and other products to the construction workers.

Operation phase: Operation is expected to have major positive impacts for the community and residents of Juba. Many households, businesses and others will be connected to the sewage system, which will greatly improve sanitation conditions.

Importantly, it should be noted that the WWTP will become a closed facility (also enforced as such as per plans, not allowing people to bypass fence or guards). This is among others important due to safety reasons since accidents can occur with machinery, tools and children could fall into the ponds.

5.9.5 Spread of Infectious Diseases

Construction and Operation Phase

The project is not expected to lead to extensive influx labour. However, a large influx of workers may impact public health as it could lead to an increase in the prevalence of diseases, including HIV/AIDS.

To address the impacts associated with the spread of infectious diseases, the following mitigation measures have been proposed.

Mitigation Measures

- Health screening of workers.

- Undertaking health awareness among the local community.
- Training programs on HIV/AIDS and other communicable diseases, etc.
- providing the local community of an understanding of the project activities and the possible health and safety risks associated with the same.
- Implementation of on-site vector control measures.

5.9.6 Occupational Health and Safety

Construction Phase: Construction has several occupational health and safety issues including waste handling and storage, material handling and storage; welding and gas cutting activities, use of earth moving equipment, installation of electrical equipment, and installation of other units for the WWTP. All these activities hazard prone and involve significant risks for the people working on it. If these risks and hazards are not monitored or controlled then they may lead to fatal incidents. The receptors are mainly construction workers and people residing nearby. However, the impact scale is low and it will take place during a short duration.

During the construction phase, Personal Protective Equipment (PPE) such as protective footwear and protective goggles, welder's protective eye-shields shall be provided to workers who are engaged in welding works, earplugs shall be provided to workers exposed to loud noise such as workers working in crushing, compaction, or concrete mixing operation. The overall impact with considering the embedded control systems is minor.

Mitigation Measures:

- Setting up a H&S committee for the site;
- Designated H&S personal for daily activities;
- Following all SOPs listed in SSUWC H&S policy and procedures;
- The workers will also be provided all necessary safety appliances (PPE) such as helmets, safety belts, life lines, earplugs, mask, respiratory apparatus etc.
- The Contractor must ensure that the workers are covered by medical insurance in case any accidents or injuries happen at the workplace.
- A well-maintained first aid kit including an adequate supply of sterilized dressing materials and appliances will be made available.
- Only the working staff and authorised personnel will only be allowed inside the WWTP premises.
- Drinking water facility will be made available. Also, adequate ablutions and change facilities to promote appropriate occupational health and safety (OHS) will be provided.
- The O&M and contractor for the project will have to have a formalised Occupational Health, Safety and Environmental Policy endorsed by the Managing Director. This policy will be applicable throughout the concession period.
- Accidents and near misses will be monitored and recorded by the Contractor.

Impact Significance	**Impacts on Occupational, Health and Safety during Construction Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Negligible.**			

Residual Impact: Considering the implementation of above-mentioned mitigation measures, the significance of residual impact on Occupational, Health and Safety during construction phase is assessed as ***Negligible.***

Operational Phase: During operation a number of activities i.e. regular maintenance of WWTP equipment resulting in discharge of lube oils and grease, change over chlorine tonners, sample collection for quality analysis, planned shutdown of WWTP for cleaning purpose, handling and storage of sludge from sludge digester etc. All of these activities pose potential health and safety risk for employees involved during these activities as well as to the environment.

For hazardous and non-hazardous waste generated during maintenance, waste generated during activities may contaminate the soil due presence of harmful chemicals. Waste from cleaning activity may contain pathogen in them which pose risk to health of employees and receptors within the vicinity of WWTP causing vector borne diseases. Due to embedded control measures impact from above mentioned activities is estimated to be minor.

Mitigation measure:

- Appointment of site-specific Health and Safety Officer;
- Formation of a Health and Safety Committee for developing and implementing plans and procedures.
- Manuals regrading Operations and Maintenance (O&M) procedures will be developed and maintained to ensure optimal environmental and social management of the activity.

- The workers involved in O&M will be trained to operate the plant and also trained in the environmental and social management requirements of the plant.

Impact Significance	**Impact on Occupational Health and Safety Operational Phase**			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low	Medium		High
Impact Magnitude	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium		High
Impact Significance (Without Mitigations)	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			
Impact Magnitude (With Mitigations)	Negligible	Small	Medium	Large
Impact Significance (With Mitigations) i.e. Residual Impact	Significance of impact is considered **Minor.**			

Residual Impact: Considering the implementation of above-mentioned mitigation measures, the significance of the residual impact on Occupational Health and Safety during the operation phase is assessed as minor.

5.9.7 Influx of Labour, Child Labour and Conflict with Local people

Construction Phase: During the construction period, labour will be required for construction work for WWTP, and for pipe laying and excavation work. There could be a considerably number of personnel (man power) engaged during intense construction phase(s), possibly in excess of 100 at peak times. This includes unskilled, semi-skilled and skilled workers. The project is however not expected to lead to substantial influx labour since it is located in the capital city with a large labour force available. It is however possible with migrant workers and workers from different ethnicities due to the continuing urbanization with increasing numbers moving to the city.

Influx of labour could potentially lead to conflict with local people residing near the project site due to cultural differences. This can take place especially during the excavation and work on the pipelines. The construction of the WWTP will be within closed premises and no labour camp is at the current state anticipated. No child labour will be accepted under the labour laws, and the Contractor is responsible for ensuring that no children are accepted into the workforce.

This impact is limited to the construction phase, and measures shall be in place such as proper orientation to workers on gender and cultural sensitivity and prior information to communities before construction starts. Therefore the impact is evaluated to be of minor significance.

Mitigation Measures*:*

- Information disclosure and consultations with the local community prior to the start of the construction.
- Migrant labours would be provided training on local culture and traditions through daily tool box talks.
- Local community to be made aware of the grievance redress mechanism.
- Establish a Community Liaison Officer to be the first point of contact for the community.
- If migrant labour is used, and a work camp must be established - the Contractor will be responsible for providing adequate accommodation facilities for the labourers.

The Contractor is required to develop labour management procedures and mitigation measures before the start of works and monitor and update the labour management plan as necessary during the course of the project.

5.9.8 Gender Aspects

The number of women participating in the workforce is generally low, since the majority of women usually are engaged in unpaid domestic work. A review of the workforce at the WWTP and connected facilities reveals that all the workers are male workers. As a result, there is a need to promote gender equality in all aspects of the project. Women's roles in construction are mainly confined to supply of unskilled labour and selling food to the construction workers. As civil construction work will take place at the proposed WWTP site and the sewer lines, the participation of women in the construction workforce should be ensured to reduce gender disparity and enhance gender mainstreaming. Female workers should also be encouraged to apply and be hired for the operation of the WWTP.

Mitigation Measures:

- Ensure the implementation of a Gender Action Plan (GAP) for the project.
- Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work.
- SSUWC to ensure that the company level policy on Prevention of Sexual Harassment (POSH) in the Workplace is also extended to the project level. HR Policy should have provisions on gender based violence.
- Trainings on sexual harassment, gender-based violence and social protection benefits to all employees.
- Ensure availability of gender sensitive facilities such as toilets and resting areas.
- Women to be encouraged to participate in public meetings, discussions and consultations.
- Contractor is encouraged to develop CSR Projects which include initiatives around the following aspects: improving the health conditions of women in the project area, or improving access to education for girls in the project area through school donations and provision of scholarships.
- Women to be made aware of the Grievance Redress Mechanism (GRM)
- The Grievance Redress Committee should comprise of at least two women.

6. ALTERNATIVE ANALYSIS

Analysis of alternatives involves a thorough study of the possible future conditions in the project study area of the possible future conditions in the project area in response to a set of alternatives without the project or status quo condition.

6.1 Project Rationale

The proposed project activity will involve building a new hybrid wastewater treatment plant (WWTP/FSTP) at the existing WWTP. Limited environmental impacts are expected during construction. Little air, water and noise pollution is expected from the proposed construction activities; however, these are localized impacts and can be minimized with proper construction schedule and precautionary approach.

Since the project is in an existing treatment plant, there are no National Parks/Sanctuaries within 10 km radius and There are no Historical places/places of tourist importance within 10 km radius. However, two alternate sites were selected and the options were considered. Using the geotechnical evaluation criteria, the following suitable treatment plants sites were proposed during the feasibility study phase in 2023 based on effectiveness and efficiency.

6.2 Proposed WWTP Site 1

- It's within the existing facility at coordinates 4°54'00" N 31°36'16" E.
- The land already acquired by thegovernment. The available area is 200,000 m^2 or 20 Ha. There is area available for expansion around the existing Rokwe treatment plant.
- It's at an acceptable elevation of 461m above sea level.
- It's located where there is no much settlements except some few inhabitants that went to settle near the facility.
- It's 500 mts away from the wetlands.
- The site has a slight slope of 6% to the east toward a small stream where the current wastewater from thetreatment plant is flowing into.
- The type of surface soil is sandy loam and sandy clay.
- Some agricultural crops were grown temporarily within the facility. The owners of the crops would leave thearea if prompted

Figure 19: The location of the suitable site is enclosed in a yellow polygon

6.3 Proposed WWTP Site 2

- It's located at 4°52'50" N 31°36'05" E (approximately 500 meters east of the airport, 1,5 km south of present Rokwe WWTP, close to Nyaying village), but there is scattered settlement at the North end of the site.
- The available area is 32,000 m^2 or 3.2 Ha. The area is limited by the surrounding wetlands and the scattered settlement.
- It's at an elevation of 459m above sea level which is suitable for gravity flow of wastewater.
- It's at a flat terrain.

Figure 20: The location of the potentially suitable site is enclosed in a yellow rectangle

6.4 Comparisons between the two options (Proposed WWTP Site 1 & 2)

Table 27: Comparisons between the two options (Proposed WWTP Site 1 & 2)

Proposed WWTP Site 1	Proposed WWTP Site 2
The site is in the existing treatment plant site. It's already owned by the government.	The land requires community approach to give out land. That means SSUWC needs to buy land which would take longer to materialize.
There is an area available for expansion around the facility.	The area is limited by the surrounding wetlands and the scattered community.
The site location is far from settlements but few people encroaching near the facility.	There are scattered settlements at the North-east of the site.
The site is accessible by road	The site is accessible by road (with some improvements required)

Therefore, it was concluded in the Feasibility Study that the WWTP Option 1 is the best choice for the treatment plant site because it's already owned by the government and has adequate space for the required expansion (treatment plant) unlike the WWTP Option 2 which isn't yet acquired and also surrounded by wetlands.

The ESIA study full concurs with this conclusion. The chosen option is much preferred from both environmental and social aspects.

6.5 Alternative Treatment Plant Technology

Comparative statement of Proposed Faecal Sludge and Wastewater Treatment Options are highlighted below (this is synthesized from the preliminary engineering design report, April 2024, where options are discussed thoroughly, also in regard to environmental aspects):

Option 1: Treatment of both sewage and faecal sludge at Rokwe site using drying bed for FS and Trickling filter for Sewage. In this case, faecal sludge and sewage will be treated at the existing treatment plant at Rokwe. Rokwe's rehabilitated and modified treatment plant will be used to treat faecal sludge along with drying beds and ponds for treating leachates. Trickling filters will be used to treat sewage that isconveyed by sewers and from hotel holding tanks.

Option 2: Treatment of faecal sludge using dry bed at Rokwe site and sewage using trickling filter at site near by the airport It uses the same treatment process as Option 1, but different sites are used to treat faecal sludge (Rokwe) and sewage (near by the airport).

Option 3: For Option 3 is a combined waste stabilization pond treatment both for faecal sludge and sewage at Rokwe site

Option 4: Treatment of faecal sludge using dry bed at Rokwe site and sewage using oxidation ditch at site near by the airport .In this case, faecal sludge and sewage will be treated at the existing treatment plant at Rokwe similar to option 1. Rokwe's rehabilitated and modified treatment plant will be used to treat faecal sludge along with drying beds and ponds for treating leachates while Oxidation ditch will be used to treat sewage that is conveyed by sewers and from hotel holding tanks.

Table 28: Environmental comparisons of WWTP – main treatment options

TP	Merits	Demerits
Conventional Activated Sludge Technology Process (ASP)	▪ Land requirement is less compared to others ▪ Reduced flies and odour nuisance ▪ Better control possible	▪ High Capital cost ▪ High Power requirements ▪ Skilled labour is required for O & M.
Cyclic Activated Sludge (CAS)	▪ External clarifiers, sludge scrappers, recycle pumps not required. ▪ Well settle able sludge flocks. ▪ Control in time enables flexibility by adapting times for nitrification, Denitrification, ▪ Biological phosphorous removal, sedimentation, depending on influent characteristics. ▪ Easy & compact construction. ▪ No moving mechanical parts ▪ Less head loss	▪ Extensive piping and valves/gates required. ▪ Higher maintenance skill required
Trickling filter	▪ Capacity to handle shock loads ▪ Dependable performance ▪ Minimum supervision. ▪ Lesser land requirement in comparison with other conventional systems.	▪ Capital costs and power requirements are high. ▪ Mosquito and odour nuisance is high. ▪ Equipment is prone to heavy corrosion

6.6 No Project Alternative

By doing nothing, it may mean that Juba City remains at the worrying sewer coverage status, while the current Rokwe WTP would be over stressed causing environmental impacts. This shows that doing

nothing will not only continue worsening the local sanitation challenges but also environmental problems as pollution loading from Rokwe WWTP increases.

Establishment of new WWTP/FSTP will have positive environmental impacts. It is unlikely that it will pollute the air, the soil, or contaminate the aquifers in the area. However, if the proposed WWTP is not established, the wastewater of many areas of Munuki, Kator and Jebel from the septic tanks and the sewerage collection system will continue discharging raw sewage into the nature and this will exert negative effects on the local environment and continue to create health problems. The No Action Alternative would see the continued release of untreated sewage into nearby available area, exacerbating the deterioration of soil and water quality. This is due to the acceleration load of organic and inorganic substances, which are streaming to the Nile river and groundwater with the increasing wastewater flow.

The existing living environmental problems will become more sever and may inhibit economic and social development of the area in the medium and long term such as:

- Degradation of the environment and reverse negative developments;
- Depletion of the aquifer;
- Dramatic decrease of both quantity and quality of the groundwater;
- Degradation of the white Nile river water, bathing quality and biodiversity; and
- Degradation of health situation and increase of water related diseases due to poor sanitation system.

6.7 Pumping station location - and Nyaying community land

The original option was for the sewage network to only have one pumping stations. This pumping station was planned to be located near Nyaying village, which is just north of the airport. The pumping station and the sewer line along the northern fence of the airport would pass community land. The red circle in the map below represents thelocation of Nyaying village, the yellow line is the sewer line and the blue square is the pumping station.

Figure 21: Map of the area around Nyaying community

At first the pipeline would follow the road to the village which is covered by the right of way. Thereafter, the pipes leave the main road and follows what is currently a path. The black triangle on the map in figure above represents where the pipe leaves the main road. The path is accessible by car up until the pumping station. It was noted by SSUWC, that there are plans to construct a road. It is necessary to look into these plans (if the option eventually would be chosen), since it would be good to coordinate work and lay the pipes at the same time.

The proposed sewer line goes along the northern airport fence, and will either run outside the airport (outside the fence) where there currently is no road, or along an existing dirt road along the northern/eastern airport fence and within the airport's premises. The impacts on Nyaying community could thus be minimised by putting the sewer line under the existing road within the airport fence.

The Nyaying community was consulted and expressed great reluctance to having the pumping station on their community land, or alternatively on private land within the vicinity of their village. Since this option would lead have negative impacts on the Nyaying community, it has been recommended to continue with another option where government land is available for the pumping station.

In addition, environmental concerns made the first option less favorable than what is now the Project proposal as the design would require to be laid deep into the ground, up to 6 meters. Potentially the piped system would be reaching groundwater level close to the pumping station where there is wetland relatively close by and the pipes would have to be laid very deep into the ground (as there is only one pumping station). The option chosen now secures that pipes nowhere will be aid deeper than 3 meters (as per preliminary design).

7. STAKEHOLDER ENGAGEMENT AND PUBLIC DISCLOSURE

7.1 Introduction

A stakeholder is defined as an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project. A Stakeholder Analysis is the process of categorising identified stakeholder groups according to their impact on the project and the impact the project will have on them. This information is then used to assess the manner in which the interests of the stakeholders or the project's impact on them should be addressed in the project development plan or its operation.

It is a prerequisite, for all category 2 AfDB funded projects, that project affected groups be consulted It is also necessary that individuals, groups and entities with a stake in any proposed project not only be informed but equally consulted for their views as regards likely impacts and any other concerns pertaining to the proposed project. At the same time, South Sudan laws and regulations such as the draft Environmental Bill (2013) and the Environmental Impact Assessment Regulations and Guidelines also emphasise the importance of stakeholder participation in development projects.

The developer shall, in undertaking the environmental and social impact study, carry out consultations with relevant stakeholders, communities likely to be affected by the project and the public. On consultation and participation, the borrower or client is responsible for conducting and providing evidence of meaningful consultation (i.e., consultation that is free, prior and informed) with communities likely to be affected by environmental and social impacts, and with local stakeholders, and also for ensuring broad community support.[9]

Consultation is based on stakeholder analysis and is preceded by disclosure of adequate project information and environmental and social information to ensure that participants are fully informed. It begins at an early stage during project preparation and continues as needed. It is conducted in a timely manner in the context of key project preparation steps, in an appropriate language, and in an accessible place. The results of the consultation are adequately reflected in the project design and in the project documentation.

AfDB's Environmental and Social Policy and OS10 states that the borrower or client shall be responsible for carrying out and providing evidence of meaningful consultation (i.e. consultation that is free, prior and informed) with communities likely to be affected by environmental and social impacts, and with other local stakeholders. The key focus of meaningful consultation is inclusivity, namely, the approach taken needs to ensure that all groups (including those that are disadvantaged or vulnerable) are embraced within the consultation process on equal terms, and that all groups are given the capacity to express their views with the knowledge that these views will be properly considered.

The developer (in this case SSUWC) is responsible for ensuring the satisfaction of broad community support. The Bank requires that stakeholder engagement starts at an early stage during project preparation and that it shall continue throughout the project process. The results of such engagement should be adequately reflected in project design, as well as in the preparation of project documentation. In all cases, consultation should be carried out after, or in conjunction with, the release of environmental and social information. Once all stakeholders have been identified, the developer shall develop/consolidate and implement the Stakeholder Engagement Plan (SEP) that is proportionate to the project risks, impacts and development stage, and that is tailored to the characteristics and interests of the affected communities. The advantage of having a SEP is that it

[9] Broad community support is a collection of expressions by the affected communities, through individuals or their representatives, of support for the project. It can exist even if some individuals or groups do not support the project.

provides a formal commitment, defines responsibilities, and ensures that adequate funds are made available to carry out the program of consultation. A SEP typically describes measures to allow the effective consultation and participation of all affected communities, a description of any consultations that have already taken place, and a definition of the reporting procedures. A SEP has been prepared as a separate document. The project also has a Grievance Redress Mechanism, and it details the procedures for managing complaints and grievances.

During the entire project process it is important that stakeholders are informed of plans and activities. Information disclosure refers to the provision of relevant and adequate project information to enable stakeholders understand inherent risks, impacts and opportunities of the proposed project. In the context of this project, stakeholder consultations aim to:

vi) Generating a good understanding of the proposed project.
vii) Understanding and characterizing the potential environmental, socio-economic and health impacts of the project.
viii) Understanding local expectations throughout the project lifecycle.
ix) Developing effective mitigation measures and management plans.
x) Optimizing local benefits that can be delivered through the project.

7.2 Stakeholder Identification and Analysis

Public participation was encouraged throughout the process of the ESIA study. Stakeholder engagement was conducted for meaningful consultation with affected communities, local stakeholders, and also to ensure broad community support. The ESIA identified and consulted different stakeholders as listed below. The stakeholders include but are not limited to:

- Ministries at the National level
- Juba city council leaders
- State leaders
- Payam leaders and village chiefs
- Community leaders
- Affected communities living around Rokwe WWTP
- Some affected communities living along the sewer line
- South Sudan Urban water Corporation.

Stakeholder consultations were carried out to obtain views and concerns about the proposed project, and for the identification of the most suitable approaches for implementation of the proposed project.

Key stakeholders were identified and engaged during the process of conducting the ESIA Study, and these included the Local community of Rokwe, Luri Block, Juba City Council Technical Planning Committee, Local Leaders, Departments and Ministry of Environment and Forestry, Ministry of Water and Irrigation, and South Sudan Urban Water Corporation.

The Consultant team has held engagement meetings with the affected communities to update them about the project, and its possible positive and negative impacts. The stakeholders consulted were assured that AfDB's safeguards will be followed and mitigation measure for negative impacts will be set in place, and they had opportunity to raise questions and concerns.

7.3 Stakeholder Engagement

Different methods of engagement were used ranging from individual interviews to controlled small groups, and focus group discussions. Phone calls have also been used, especially to key people to follow up on issues.

Table 29: Stakeholder Identification and analysis

Administrative level	Designation	Interests/information requirements
National level	• Ministry of Environment and Forestry • Ministry of Water and Irrigation • South Sudan Urban Water Corporation • Juba City Council • Juba International Airport	Policy, guidance and control
State level	• Physical Planner • Land Officer • Community initiatives • Police/Security	Policy implementation, compensation, revenue collection, law and order
Payam	• Police/Security • Community issues	Policy implementation, compensation, revenue collection, law and order, Information disclosure, land use, approval process of the project
Community/Village level	• The community members around the WWTP • The community members along the construction of sewer pipes • Communities around the pumping stations • Communities with businesses along the sewer pipes.	Views and concerns regarding the construction and operation of the proposed WWTP and sewer lines, compensation, community development initiatives, livelihood restoration

Stakeholder engagement was carried out to solicit views from the different stakeholders to assist in the planning, implementation and monitoring of potential impacts. Activities included:

- Engagement meetings with the affected communities to update them about the project. The meeting covered general information and potential positive and negative impacts.
- The communities were assured that mitigation measures for the negative impacts will be established and compensation will be given if there are any impacts on structures, land and communal property resources, environment in according with AfDB safeguards. The questions raised by the potentially affected people were answered.
- Through consultations, the team was able to identify the vulnerable groups of people who would need special or extra support.

Figure 22: Consultation with Luri Rokwe community

7.3.1 Key issues from the consultations

Stakeholder consultations revealed that the project is generally perceived positively by the stakeholders since it has clear environmental and social benefits with improved sanitation. There are however some negative impacts that will need to be addressed for sound environmental and social management. The expected benefits that were highlighted include employment opportunities, development of the area, and infrastructural development, improved health, safer environment, and improvement in sanitation. Views and concerns raised by stakeholders are summarized in the table below.

Table 30: Sample statements from the public during consultations

Stakeholder	Views
Chief Salvatore Swaka	• Improvement of health and sanitation. • Would like the revenues from the project to go to the community and improve schools and health care facilities. • Emphasizes the importance of job creation for the community.
Mama Avelina Poni, community member	• Worried of the loss of income since she will no longer be able to farm inside the WWTP.
Mr. Lawrence Modi, community member	• Expressed that the community looks forward to the benefits and development opportunities that will result from the project, even though the community will lose its current livelihood from crop farming in the project area as the site will be fenced and they will not be allowed to access the area.
Mr. Elia Yuggu Paul, community member	• Appreciated the information disclosure and looks forward to the benefits of the project such as a healthier and cleaner environment.
Mr. Augustino Laku, community member	• Concerned about operation and where the revenues will go. Would like that the revenues to be managed by Luri payam, Juba County, so the community of Rokwe can benefit.

Stakeholder	Views
Mr. Albert Loggale, community member	• He hoped that the proposed project will improve the quality of life in the community for example by improved access to basic facilities in the area e.g. construction of schools, health centers, houses for teachers. • He suggests that a percentage (%) of revenue should be given to Luri Rokwe community for community development.
Mr. Victor Wiri, community member	• Appreciates the project as it will create job opportunities for youth and women in Luri Rokwe village.
Mr. Gabriedl Tong, community member	• The project will improve the health and sanitation • It is important that the WWTP is managed properly management and revenues that revenues goes to Luri Rokwe community. • The community needs to be further engaged on the project to discuss impacts.
Mr. Lenjino Barnaba, community member	• Ownership of the WWTP should be under Luri payam, Juba County so the revenues generated from it will be used for the development of the boma, payam, county and central equatoria in general.

7.4 Stakeholder Engagement Plan

The contractor will establish a stakeholder engagement program for all the project sites which includes a comprehensive suite of stakeholder consultation, disclosure activities and engagement exercises and media interactions. The implementation of the plan will be supervised by SSUWC. The objective of the stakeholder engagement plan includes:

- Identification and analysis of the stakeholder groups and their profiles, interests, issues/impacts and concerns relevant to the Project;
- Ensure the inclusion of women and vulnerable groups in all phases of stakeholder engagement;
- Identification of specific measures to allow meaningful engagement with the different stakeholder groups in a manner that is transparent and accessible using culturally appropriate communication methods with a specific focus on vulnerable groups;
- Allow for a relationship to be built with the various stakeholders of the Project based on mutual respect and trust;
- Facilitate adequate and timely dissemination of information to the stakeholder groups in a culturally appropriate manner;
- Provide systems for prior disclosure/dissemination of information and consultation, including seeking inputs from affected persons, incorporation of inputs, as applicable, and Principles of Stakeholder and Engagement
- Providing feedback to affected persons/groups on whether and how the input has been incorporated;
- Providing mechanisms for feedback and dispute resolution;

- To enable proof of resolution of all grievances;
- Provide a mechanism for documentation of the activities undertaken and the reporting and monitoring of the same.

A detailed Stakeholder Engagement Plan (SEP) is prepared for the project, and will be a stand-alone document supplementing the final ESIA.

8. GRIEVANCE REDRESS MECHANISM

8.1 Introduction

The implementation of a project is a complex time and labour-intensive process involving multitude of lifecycle phases and processes. Over the duration of the project, it may encounter numerous instances of conflicts and dissatisfaction from both internal and external stakeholders. Some of the issues could be related to

- compensation payment;
- Improper estimation of affected assets;
- Failure to fulfil commitments,
- Poor management of construction activities,
- Accidents due to inappropriate planning of vehicle movement, and
- Cultural conflicts between migrant workers and local communities etc.

It is important to manage complaints and conflicts appropriately from the beginning, so it does not turn into a bigger issue later on. In order to manage these risks, an internal and external grievance mechanism is required to be in place where the aggrieved parties can lodge their complaints and get it amicably settled prior to approaching the formal mode of solution available to them i.e. access to legal system through courts. In order to provide a formal forum to the aggrieved parties to deal with issues arising out of project, it is proposed that a joint grievance redress mechanism be initiated for both environmental and social related issues.

8.2 Objectives of the Grievance Redress Mechanism

The basic objective of the Grievance Redress Mechanism (GRM) shall be to provide an accessible mechanism for addressing both internal and external grievances. Internal grievances include grievances from both direct and indirect employees such as local workers, migrant workers, and contractors. External grievances include complaints from project affected people, community or any stakeholder having a stake in the project. The GRM thus aims to resolve any social (including labour, contractor, and community) and environmental related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of project related work activities. The other important objective is to have an open process and to establish accountability towards the stakeholders. It should also be noted that the GRM does not prevent the complainant from bringing his/her concerns to the courts or other relevant government bodies.

The GRM has the following objectives:

- Establish a prompt, consistent and respectful mechanism for receiving, investigating and responding to complaints from stakeholders;
- Ensure proper documentation (logging) of complaints and any corrective actions taken;
- Identify and manage stakeholder concerns and thus support effective risk management;
- Contribute to continuous improvement in performance through the analysis of trends and lessons learned; and
- Enhance trust and positive relationships with stakeholders.

8.3 Process of Grievance Redressal Mechanism

A project GRM will be established to receive, evaluate and facilitate the resolution of concerns, complaints and grievances. The grievance mechanism will aim to provide a time bound and

transparent mechanism to voice and resolve concerns linked to the project.

The following steps are taken during the grievance management process:

a) Receive and register a complaint in the grievance redress log

A Grievance Redress Log will be established for reporting and addressing grievances of the affected communities and workers. The Grievance Redress Log should at least capture the following: name (optional), contact details (optional), communication channels, type of complaint, complaint, date of complaint, and steps of complaint management, responsible person handling the case.

b) Assess and assign

The complaint will be screened, and a responsible person will be assigned the case.

c) Acknowledge

Once a complaint has been assessed, the complaint owner sends a written acknowledgement to the Complainant. The letter should normally be sent within 7 days of receiving the complaint. The complaint owner (Contractor/SSUWC) documents the acknowledgement in the Grievance Redress Log.

d) Investigate and select a resolution approach

The complaint owner (CO) investigates the factual basis for the complaint and proposes options to resolve the issue.

The CO may involve other third parties in the fact finding process as required. The identity of the Complainant should only be disclosed to the extent necessary to resolve the issue or as required by law. If the Complainant has specifically requested that his or her identity not be disclosed, their personal information may not be shared with third parties unless required by law.

The CO seeks to resolve complaints within 30 days. The maximum resolution period should not exceed 60 days. The CO is responsible for providing regular progress reports to the Complainant, such as a written update after 10 working days. If additional time is needed to complete an investigation, the CO will notify the Complainant of the reason for the delay.

When the investigation is complete, the CO documents the findings and proposes options for resolving the complaint as appropriate.

e) Respond

The CO defines a response to the Complainant. The response should communicate the findings of the investigation, set out the proposed solution and timelines, and seek feedback from the Complainant. The CO determines next steps based on feedback from the Complainant, in regards to whether the Complainant accepts the resolution or not. The Complainant's response will be documented in the Grievance Redress Log.

f) Resolution

If the Complainant accepts the proposed resolution, the agreed actions are implemented.

The CO is responsible for assigning action parties, actions and deadlines to implement the resolution. These will be recorded in the Grievance Redress Log with any supporting documentation. Monitoring arrangements may need to be put in place to verify implementation.

The CO asks the Complainant to sign the Confirmation Form. If the Complainant agrees to sign, the Complaint is closed out as Resolved. If the Complainant refuses to sign, or has failed to sign within the timeframe allowed, the Complaint will be appealed.

g) Appeal (if not resolved)

The CO will seek to reach a resolution with the Complainant that is satisfactory to both sides. If the CO and the Complainant are unable to agree on a solution, the complaint may be escalated to the Grievance Redress Committee for review.

The Grievance Redress Committee will comprise of key members from SSUWC, Juba City Council (if required) Local Authority, Local NGOs and key members of the local community Involvement of at least two female members in the GRC is mandatory. The GRC will look into the case and propose a resolution in consultation with the responsible E&S Officer/Community Liaison Officer. The GRC shall aim for providing a resolution within two weeks of receiving the complaint.

In case the Complainant does not accept the resolution proposed by the committee, the grievance will be taken to a third party for further action. Third parties may include the relevant regulatory authority (such as the Environmental Agency responsible), a lawyer, or the courts in accordance with national legislation. The involvement of a third party as the regular courts leads to closing the case, as the case will be followed up through official channels. A close out letter will be sent to the Complainant explaining the position of the CO.

h) Close the case

A Complaint is closed when no further action can be or needs to be taken. Closure status will be classified in the Grievance Redress Log as follows:

- Resolved. Complaints where a resolution has been agreed and implemented and the Complainant has signed the Confirmation Form.
- Unresolved. Complaints where it has not been possible to reach an agreed resolution
- Abandoned. Complaints where the Complainant is not contactable after one month following receipt of a Complaint and efforts to trace his or her whereabouts have been unsuccessful.

The CO is responsible for updating the Grievance Redress Log and the logistics associated with closing out the case. At the end of a case, regardless of whether agreement was achieved, the CO will seek feedback from the Complainant on their level of satisfaction with the complaint handling process and its outcome.

i) Track and evaluate results

The CO is responsible for gathering and reporting performance monitoring data under the GRM. All performance monitoring data shall be logged.

8.3.1 Awareness of Grievance Redress Mechanism

It is important that external stakeholders are made aware of the grievance mechanism. As part of the public consultation process, information regarding the GRM will be disclosed to the affected persons and other interested parties. It shall also be possible to see information about how to file a grievance on SSUWC's website. There must be multiple ways to submit a grievance; orally and in written form, through submission of complaints through a suggestion box, to a designated person, email, or phone call.

All grievances will be acknowledged, evaluated and responded through the GRM. The GRM will continue to function, for the benefit of the affected persons and the community, during the entire life of the project including the maintenance period.

To ensure effective implementation of the GRM, the Contractor/SSUWC will have an E&S officer or Community Liaison Officer, who will have the overall responsibility for addressing timely grievance including keeping and maintaining the complaint and redress records.

8.4 Internal grievances

In the respective work sections, there are team leaders, workers' representative and foremen who

are the first contact persons where employees must report their complaints or concern. In case where the raised concern fails to be resolved at the said level, the grievance is forwarded to the administration and HR departments who invite the parties for a session with the Grievance Redress Committee at a reasonable time. During the session, case details are filed, minutes are taken and signed by the complainant and witness as indicated in the Contractor Employee handbook.

8.4.1 Workers disciplinary policy and procedures

Grievances may be raised against workers during construction or operation. It is important that HR policies are in place in order to have clear guidelines and code of conducts. There should therefore be policies in place stating offences that call for disciplinary action. This could include issues which compromises safety or illegal behaviour:

a) Insubordination/disobedience of not following instructions from supervisors.

b) Theft, fraud, or dishonesty in handling company property.

c) Failure to comply with the company PPE policy and other safety procedures.

d) Receiving, soliciting, giving bribes or any unlawful gratification/remuneration.

e) Malicious damage or misuse of any company property.

f) Unsatisfactory performance or neglect of duty.

g) Sleeping while on duty without just cause.

h) Abscondment from duty without notifying the supervisor and with no justification.

i) Habitual late coming, escape from duty, irregular attendance or absenteeism.

j) Acting and working under the influence of alcohol and drugs on site.

k) Act of violence, riots, strikes, fighting, disorderly or nuisance behaviour at work.

l) Material breach of the terms of the employment contract.

m) Falsification of company records.

n) Disclosing company confidential information.

o) Inappropriate use of electronic media like pictures and internet.

p) Conviction of serious criminal offence leading to police arrest or taken to prison.

In handling disciplinary cases, an employee is invited for a hearing and if is proved guilty the following are the penalties or disciplinary actions taken sequentially if the employee continues to misbehave.

a) Oral or verbal warning.

b) Written warning.

c) Suspension.

d) Termination of employment contract with notice and payment in lieu of notice.

9. ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

The ESIA for Hybrid wastewater treatment Plant in Juba city located at Rokwe has been undertaken to assess and report the environmental and social impacts of the project. In course of the project's planning and the ESIA, project design decisions have been made taking into account the need to avoid, minimize and reduce adverse impacts., the Contractor, SSUWC and operation and maintenance (O&M) provider for the project cycle in Rokwe as well as the construction and rehabilitation of effluent disposal pipelines, Manholes and other facilities that will convey the sewage to the WWTP is the responsible entity for ensuring that the mitigation measures as suggested in the Environmental and Social Management Plan (ESMP) are addressed. Further, this ESMP provides project and site-specific mitigation measures to minimize damage to the local environment and disruption to local communities.

9.1 Implementation of ESMP

Contractor will have ultimate responsibility for implementing the provisions of the ESMP during de-commissioning, construction and operation phase of the project. This role will include the on-going management of environmental and social impacts, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems. SSUWC will also ensure that the activities of its contractors are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

9.2 Inspection, Monitoring and Audit

Inspection and monitoring of the environmental and social impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, SSUWC will ensure that the conditions stipulated in various permits are complied. The inspection and audits will be done by the project identified HSE staff in coordination with O & M sub-contractors and any other external agencies identified. The entire process of inspections and audits should be documented. The inspection and audit findings are to be implemented by the site In-charge in their respective areas. To ensure contractor compliance to the H&S requirements, the E&S Manager shall conduct daily checks and inspections. Findings from such inspections will be documented in the monthly monitoring reports. Independent audits shall be conducted during construction and once.

9.3 Reporting and Documentation

The contractor shall develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

9.4 Documentation

Documentation is an important step in implementing ESMP. The contractor will establish a documentation and record keeping system to ensure recording and updating of documents as per the requirements specified in ESMP. The documents should be kept as hardcopies as well as in electronic format. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel in form of the following:

- Master Environment Management System document;
- Legal Register;
- Operation control procedures;
- Work instructions;

- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended/closed.
- Contractor H&S Performance Reports

9.5 Internal Reporting and Communication

Inspection and audits findings along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated within the staff working on the project. To maintain an open communication between the staff and management on HSE and social issues the following are being used:

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

9.6 Training Programme and Capacity Building

Training is needed for effective implementation of ESMP. HSE Officer of the contractor, HSE In- charge of SSUWC as well as Supervising consultant HSE Head will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and during operations of the WWTP.

Also general environmental awareness will be increased among the projects' teams to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment will be imparted to the contractors and sub-contractors involved in the project. Some of the suggested training areas are as follows:

Table 31: Suggested E&S Trainings

Types of Trainings	Stakeholder	Frequency
HR Induction and Company code of Conduct	Contractor Workers and SSUWC Staff	Monthly (as applicable)
Grievance Procedures and Redress Mechanism	Contractor Workers and SSUWC	Quarterly
Health & Safety Training	Contractor Workers and SSUWC Staff	On joining (Induction training)
		Daily (Tool Box Talk)
		Monthly and Quarterly (refresher's training)
First Aid Training	First Aider	Quarterly

9.7 Environment and Social Management Plan

This section outlines the potential adverse impacts, mitigation measures, monitoring and management

responsibilities during construction and operation phases of the Projects. The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designed to mitigate potentially adverse impacts, are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place;
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Projects.

In order to minimize adverse impacts during different phases of project lifecycles, mitigation measures, monitoring plan and responsibilities for its implementation are given in below ***Table***. The responsibility for implementation of ESMP will primarily lies with Contractor & Supervising consultant. HSE Department and HSE In-charge of SSUWC, Juba City Council (JCC), and possibly others as decided at a later stage will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues.

Table 32: Environment and Social Management Plan

Issue	Project Activity	Potential Impacts	Impact Significance	Proposed Mitigation Measures	Responsible for Mitigation	Mitigation Cost (USD)*
Environmental Issues Associated with Site Construction Phase						
Drainage	Soil stripping and limited cutting, filling and levelling activities to make the site topography suitable for setting up of the WWTP.	Surface runoff from the construction site may contain eroded earth, sand, aggregate, spilled oil, lubricant, paint residues etc., however the potential to reach drainage channel near and affecting the water quality.	Minor (Negative)	Develop appropriate storm water drainage and flood water management plan	SSUWC Contractor O&M Supervisor	30,000 * * NB! All below figures in this column are estimates
Visual and Aesthetics	Grading and cleaning of land. Storage and disposal of demolition waste Storage and disposal of sludge/silt from decommissioned structure	Loss of topsoil producing an offensive odour and visual impact	Minor (Negative)	Stacking of soil heaps and sludge/silt to be done away from settlements with provision of covers so that odour and fugitive emissions are restricted. All construction activities will be restricted to the designated site upon completion of work. All temporary structures, surplus materials and wastes will be removed from the site and disposed of at a designated facility.	Contractor O&M Supervisor	15,000
Visual and Aesthetics	On-Site storage of excavated and construction materials; On-Site storage of construction waste;	Disposal of MSW in open area around the site can create odour nuisance.	Minor (Negative)	Provision of storage facility for construction materials within the site; Provision of temporary storage of wastes and collection will also be made at the site Sections excavated for pipeline route will be barricaded with tin sheets; Stacking of sections of pipeline to be done away from settlements with provision of wedges to ensure	Contractor O&M Supervisor	15,000

	Off-Site disposal of construction waste; Earth work along the sewer pipeline route; De-silting of sewer pipelines; On-Site storage and Off- Site disposal of silt/sludge from sewer pipeline; and Renovation work at linked facilities.			that rolling or movement of pipeline do not pose risks to passers-by; All the construction activities will be restricted within the designated site; On completion of work, all temporary structures, surplus materials and wastes will be completely removed from the site and disposed of at a designated facility; Construction and municipal solid waste temporarily stored at the site will be transported to the designated disposal facility at regular intervals;		
Soil Quality	Site clearing and preparation	Soil compaction	Minor (Negative)	Demarcation of routes for movement of heavy vehicles; Stripping and placing soils when dry, and not when wet	Contractor O&M Supervisor	6,000
Soil Quality	Fuelling and operation of heavy machinery and transport vehicles	Soil contamination through spills and leaks	Minor (Negative)	Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals; Storage areas for oil, fuel and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel or chemicals from contaminating soils, water or groundwater; Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks; and Installation of oil/water separators to treat surface run-off from bounded areas prior to discharge to the storm water system.	Contractor O&M Supervisor	6,000
Soil Quality	Storage and handling of chemicals	Soil contamination through spills and leaks	Minor (Negative)	Designated storage area with proper area arrangements	Contractor O&M Supervisor	6,000

Soil Quality	Storage, handling and disposal of construction waste	Soil contamination	Minor (Negative)	Design processes to prevent/ minimize quantities of wastes generated and hazards associated with the waste generated; Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period; Segregate hazardous and non- hazardous waste and provide appropriate containers for the waste types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimize odour nuisance); Store wastes in closed containers away from direct sunlight, wind and rain; Ensure storage area has an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; Dispose of waste by authorised vendor.	Contractor O&M Supervisor	6,000
Soil quality	Generation of sanitary effluent	Soil contamination	Minor (Negative)	Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce; Septic tank and soak pit will be provided to treat domestic waste water. The Waste Management Plant (including C&D waste as well as liquid waste) should also contain aspects of adequate storage, disposal, transportation route, training and record keeping for different categories of waste i.e. hazardous waste, solid waste, e-waste, bio-medical waste, municipal solid waste and chemical waste.	Contractor O&M Supervisor	6,000
Surface Water Quality	Erosion from excavation, levelling, filling and other activities	Increased sediment content of surface water	Minor (Negative)	Provision of channels, earth bunds or sand bag barriers on site to direct storm water to silt removal facilities; Protection of stockpiles by plastic sheeting to ensure that they are suitably secured against the wind at the end of		7,500

				each working day if rain is forecasted; Appropriate surface drainage will be designed and provided where necessary; Drainage systems, erosion control and silt removal facilities will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly; Any temporarily diverted drainage will be reinstated to its original condition when the construction work has finished or when the temporary diversion is no longer required; Temporary and permanent drainage pipes and culverts will be provided to facilitate runoff discharge. These will be designed for the controlled release of storm flows.		
Surface Water Quality	Fuelling and operation of heavy machinery and transport vehicles	Contamination of surface water	Minor (Negative)	Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor; Any oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal; Any surplus wastewater from the concrete batching plant will be treated to comply with discharge standards before it is discharged to waters	Contractor O&M Supervisor	7,500
Surface Water Quality	Storage and handling of chemicals	Contamination of surface water	Minor (Negative)	Designated storage area with proper boundary	Contractor O&M Supervisor	7,500
Surface Water Quality	Generation of sanitary effluent	Contamination of surface water by	Minor (Negative)	Provide sanitation facilities for worker accommodations	Contractor	7,500

	from on-site labour accommodation.	sanitary effluent generated from on-site labour accommodation.			O&M Supervisor	
Ground Water	Fueling and operation of heavy machinery and transport vehicles	Contamination of groundwater	Minor (Negative)	Proper SOP has to be followed during such kind of activity	Contractor O&M Supervisor	30,000
Air Quality	Operation of heavy machinery and transport vehicles	Exhaust Emissions	Minor (Negative)	Minimise movement of construction vehicles and enforce a speed limit around the construction site; Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM_{10} and SO_2; Where available use low Sulphur diesel (LSD) in HGVs and diesel powered equipment in collaboration with best management practices; Implement best practice procedures to control vehicle / equipment air emissions (such as turning off equipment when not in use); Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts should be serviced/ replaced.	Contractor O&M Supervisor	15,000
Air Quality	C&D waste management and Sludge Handling	Dust	Minor (Negative)	As far as possible, locate the concrete batching plant away from sensitive receptors; Implementation of a periodic watering and sprinkling regime in particular during the dry season, at least two times during the day; Minimise the height from which fill materials are unloaded during site backfilling as far as	Contractor. O&M Supervisor.	15,000

				possible. Where possible, this should be below the height of the hoarding around the Project site boundary; During construction, the approach road will be regularly maintained to keep it clean, free from mud and slurry. The approach road will be properly shaped and compacted by rolling to an even and uniform surface to receive pavement.		
Noise	Heavy machinery operations for construction works	Increase in ambient noise levels	Minor (Negative)	Normal working hours of the contractor will be between 06:00 and 21:00 hours from Monday to Sunday. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria at nearby sensitive receptors; Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; Low noise equipment should be used as far as practicable; The number of equipment operating simultaneously should be reduced as far as practicable; Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby sensitive receptors as far as practicable; Acoustic enclosure should be erected around DG sets and other stationary noise generating equipment	Contractor. O&M Supervisor.	30,000
Occupational Health and Safety	General construction activities	Health and safety of construction workforce	Moderate (Negative)	The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for working methods, plant utilisation, construction sequence and safety arrangements; Measures will be implemented to reduce the likelihood	Contractor	30,000

				and consequence of the following hazards: falling from height; falling into water; entanglement with machinery; tripping over permanent obstacles or temporary obstructions; slipping on greasy oily walkways; falling objects; contact with dangerous substances; electric shock; variable weather conditions; lifting excessive weights; A Permit to Enter system will be established to ensure that only authorised persons gain entry to the site; All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; All workers will be properly informed, consulted and trained on health and safety issues; Personal Protective Equipment (PPE) shall be worn at all times on the Site. If women will be working in the hazard prone areas, then the contractor needs to ensure proper outfit and PPEs. Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order; All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; All scaffolding will be erected and inspected in conformity with the relevant laws and the appropriate records maintained by the Contractor; Safety hoops or cages will be provided for ladders with a height in excess of two meters; When there is a risk of drowning lifejackets shall be provided and it shall be ensured that personnel wear		

				adequate buoyancy equipment or harness and safety lines, and that rescue personnel is present during work; The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress.		
Community Health and Safety	Influx of construction workers	Increased prevalence of disease	Minor (negative)	Barriers will be provided to prevent ingress of persons into the construction site and also to protect the public from exposure to hazards associated with the construction activities; Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes; Undertaking health awareness and education initiatives among workers; Avoiding collection of stagnant water;	Contractor	15,000
Community Health and Safety	Road transportation	Traffic safety	Minor (Negative)	Road safety awareness building for residents living along the transportation route.	Contractor	10,000
Social Issues Associated with Site Construction Phase						
Loss of access to farmland in WWTP	The WWTP will become a closed facility and not allow informal farming (where some farmers are doing it now).	If not addressed, loss of livelihood	Negligible (after action plan implemented)	Prepare Memorandum of Understanding ; reallocate farmers – in this regard ensure they have as minimum same or better land available for their farming ; Land ownership evidence prepared and submitted/issued ; Issue a public notice for any claimant to the proposed project site area or part of to lay claim before the project commences.	SSUWC	20,000
Access Disruption	Repair and Laying of new sewer line.	Access disruption for both residential, commercial and business operation	Minor (Negative)	Inform all the stakeholders well in advance (at least 15 days) before the start of the construction work to enable shop owners to stock up and remain unaffected if goods vehicles are unable to reach them during construction;	Contractor	20,000

		during excavation work for laying of new rising mains, replacement and construction work.		Provision of wooden planks to ensure pedestrian access, signage with project details and contact details for grievance redress and proper traffic management; Providing assistance to mobile vendors if any present during construction, to shift nearby locations if any; The contractor should provide proper barricading and signage or notices to indicate the ongoing work. In case by-lanes towards the residential areas/shops are located from the replacement stretches; Contractor to provide proper barricading and temporary alternate route for people to access their houses/shops; Alternative access route to be provided for the community to access their residential places and in case of any medical emergency.		
Livelihood Restoration Plan for Affected Persons	Repair and Laying of new sewer line.	Temporary loss of Income: Road side vendors, kiosk and shops operating their business near the project *could* face temporary livelihood / income loss during the laying of new sewer line, rising main and replacement along the RoW.	Minor	Two options exists depending on the severity and situation on site: • One-time compensation will be paid for the temporary income loss as per the entitlements detailed out in the Livelihood Restoration Framework (LRF); A Livelihood Restoration Plan will be prepared for the Affected Persons. For the purpose of the Livelihood Restoration Plan (LRP) and identifying the PAHs, primary socio-economic data will be collected for the PAHs. The primary data comprised of quantitative and qualitative data collected via a range of tools and data gathering techniques. The primary data will be collected through the following method: *Inventory of losses*: An inventory of all structures and immovable assets, livelihood loss to be impacted for each PAH will be conducted during the LRP preparation.	Contractor	30,000

				• No compensation will be paid – unless there are very special circumstances. The logic behind this is that no compensation reportedly has been paid during the very recent water supply pipeline establishment in almost the exact area of Juba town as will be covered under this Project. It has been assessed and decided that the disturbance for the water project – like can be expected for the sewage project – is very short term and has very limited economic consequences. There are as well options for avoiding undue disturbance or livelihood/economic detrimental impact, e.g. laying the pipes under the actual road or at the other side of the road. Regardless of which option above ultimately is chosen, the contractor should ensure that construction work to take place during off-peak business hour and during the night to avoid major disruption. Further, the Contractor during construction should ensure that structure near the RoW are minimally affected and excavation should be carried out to a possible extend to avoid any damages to residential and commercial structure. Finally, if any destruction of structures takes place, the structures should be re-established to same or better level immediately after the pipeline work is finished.		
Migrant Workers & Labourers	Inflow of Migrant labourers & workers expected during construction phase of the project	Potential conflict with local community; Health risks due to spread of communicable diseases and sexually transmitted diseases Issue of Sanitation and hygiene	Minor (Negative)	Provide adequate facilities to the workers and labourers such as properly constructed and well-ventilated labour camps, clean and hygienic sanitation facilities, cooking areas etc. to minimize the health-related impacts; Separate toilet and bathing facilities for men and women; Creating awareness about local tradition and culture among outside migrant and encouraging respect for same;	Contractor SSUWC Ministry of Labour	30,000

				Conducting awareness programme about sexually transmitted diseases among the migrant workers, labourers and for community around project site; Proper disposal of wastes generated from the camp and construction activity to maintain general hygiene in the area;		
Gender Empowerment including Employment of Women	Civil construction during the construction phase of the project.	The civil construction work to be taken place at the WWTP can provide employment opportunities	Moderate (Negative)	Ensure the implementation of the Gender Action Plan (GAP) for the for women residing in the project area; Ensure availability of gender sensitive facilities such as toilets, resting areas, crèches for children, and a policy against sexual harassment; Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements; Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise of 50% women.		30,000
Environmental Issues Associated with Site Operation Phase						
Visual and Aesthetic	Physical presence of the WWTP; Illumination from the WWTP facility; Operation and storage of sludge increasing odour	Visual and Odour	Minor (Negative)	Appropriate shading of lights to prevent scattering; Tree plantation and odour Monitoring	Contractor	9,000
Surface and ground water quality	Oil spills from oil tanks	Impact on soil and ground water environment	Moderate (Negative)	The secondary containment structures such as berms, dykes, or walls that could hold up to 110 % of the primary containment volume will be made of firm and impervious	Contractor	5,000

		Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel		material at diesel and lubricating oil storage areas; SOPs will be prepared to manage any oil spills, leaks seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis; Empty drums will be sent for reuse or for recycling in line with relevant guidelines; At all oil and diesel storage tank locations, emergency spill kits will be provided for the operating personnel to use. Operating personnel will be trained to use such kits and dispose of them as part of hazardous waste;		
Surface and ground water quality	Oily water-runoff	Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Moderate (Negative)	Oily water runoff collected in the oil handling & storage area and oil filled motors and pump bases will be collected in different sump and taken to a common oily waste water sump; The oily wastewater and storm runoff collected from specific areas mentioned above will be treated using an oil water separator; and Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be transferred to waste water chamber	Contractor	5,000
Surface and ground water quality	Spills of fuel, oil and chemicals	Impact on soil and ground water environment; Occupational health and safety hazard; Contaminated storm water runoff carrying contaminants to Howrah Drainage Channel	Minor (Negative)	Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation; All chemicals will be stored in primary containers that have in-built secondary containment of capacity that is at least 110% of primary containment.	Contractor	5,000

Surface and ground water quality	Discharge of domestic wastewater Non-oily site or storm water runoff	Impact on river Water and channel water quality; Impact on water quality	Minor (Negative)	The sewage from the entire plant area will be collected and treated in septic tank/soak pit No untreated sewage will be directly discharged into water or disposed of on land through the project life cycle; National and AfDB Guidelines before discharge; and In order to monitor WWTP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of WWTP.	Contractor	5,000
Air Quality	Stack emissions	Impact on ambient air Quality ; GHG emissions		Comply with the Emission guidelines for Combustion engines in given by CPC. Monitor ambient air quality in and around the Project site as per the Environment Monitoring Program formulated for the Project which will comply with National Regulatory requirements.	Contractor Juba city council	9,000
Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	Noise monitoring along with health check-up on a regular interval	Contractor	4,500
Noise	Plant operations	Impact on health of workers and staff	Negligible (Negative)	All noise generating units would be acoustically enclosed; Use of rubber padding underneath high noise and vibration generating machines; Personnel working onsite in high noise generating areas will use ear plugs. /Ear muffs;	Contractor	4,500
Community Health and Safety	Plant operations	Impact on community assets such as water due to water intake and cooking water discharge. Increased vehicular	Minor (Negative)	Comply with the Community health and safety guidelines presented in Sections	Contractor	9,000

		traffic in the region. Exposure to site accidents and incidents Project Security				
Occupational Health and Safety	Project operation phase	Risk of accident and fatality to worker	Minor (Negative)	On job training for the workers shall be carried out; Work permit system shall be followed; PPEs to be provided and use of PPEs shall be encouraged; SOPs to be developed for operation and maintenance of the project site.	Contractor	9,000
Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor (Negative)	Awareness campaign among the community residing adjacent to the road Maintaining healthy relationship with community through CSR activity	Contractor	4,500
Social Issues Associated with Site Operation						
Community Health and Safety and other issues	Project Operation Phase	Traffic Movement in newly constructed site approach road	Minor	Awareness campaign among the community residing adjacent to the Site. Maintaining healthy relationship with community through CSR activity	Contractor	4,500
Social Issues Throughout Project Cycle						
Grievances Redress	Entire Project Cycle	Health and safety risk, Non- payment of wages for workers Community Grievances Compensation and Resettlement	Minor	Awareness on the Grievance redress Mechanism Training on the process and GRM procedures	Contractor	9,000
Consultation and	Entire Project Cycle	Project Impacts and potential influence of	Minor	Sharing of Emergency Preparedness procedures with workers and community.	Contractor	9,000

Information Disclosure		stakeholders on the projects		Sharing of monitoring reports for E&S compliance Continuous engagement with stakeholders		
Total *estimated* cost of the ESMP						**459500**

9.8 Environmental and Social Safeguards monitoring

The environmental monitoring programme has been devised with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project area.

The corresponding EHSS management and ESMS procedures in relation to the proposed mitigation measures as outlined in the Table above with respect to the construction phase, needs to be developed by contractor prior to start of any development/ construction activity at the project sites or first disbursement by its lender, whichever is earlier. The following EHSS management plans shall be developed in accordance with the Good International Industry practice (GIIP).

- Development of ESMS Policy;
- Construction management plan for excavation/backfilling at site;
- Noise management plan;
- Odour management plan;
- Wastewater and sewage management plan;
- Traffic management plan;
- Labor influx and worker accommodation management plan;
- Occupational health and safety management plan;
- Emergency response plan;
- Security management plan;
- Implementation of engagement and action for project affected person (as applicable).and reporting system.

Table 33: Environmental and Social Monitoring Programme

Affected component	Potential Impact / Mitigation	Parameters to be monitored	Measurements	Frequency	Responsibility	Monitoring cost source[10]		Budget source
						Pre-construction/ construction	Operations phase	
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and operational manual	Visual inspection of all active work areas	Daily	Contractor	Management Time	Management Time	Included in O&M cost
Air Pollution	Stack emissions concentrations from Biogas power plant	NOx, CO, PM	CEM	Continuous	Contractor	N/A	2250	ESMP Budget
Air pollution	Ambient air quality	NOx, CO, PM_{10}, SO_2	Standard methods	Monthly	Environmental Consultant / Contractor	N/A	4500	ESMP Budget
Noise	Noise generation by Plant equipment	Sound Pressure Level	Noise monitoring	Monthly Quarterly	Monitoring done by SSUWC and verification by Environmental	N/A	2250	ESMP Budget

[10] These costs are tentative estimates for monitoring of project lifecycle

					Consultant			
Affected component	**Potential Impact / Mitigation**	**Parameters to be monitored**	**Measurements**	**Frequency**	**Responsibility**	**Monitoring cost source[11]**		**Budget source**
						Pre-construction/ construction	**Operations phase**	
Noise	Ambient noise	Ambient noise levels	Noise monitoring with data logger	24-hour observations with hourly noise levels, monthly once at each location	Environmental Consultant/ Contractor	N/A	2250	ESMP Budget
Soil	Soil and Sediment Contamination	pH, salinity, $NH4^+$, Total P, heavy metals, oil & grease	Standard analytical method	Half Yearly	Environmental Consultant/ Contractor	N/A	2250	ESMP Budget
Water	Groundwater quality	Drinking water quality parameters	Standard analytical methods	Monthly	Environmental Consultant / Contractor	N/A	2250	ESMP Budget
Water	Wastewater	Temperature, chlorine, pH, BOD5, COD, oil & grease, heavy metals, total faecal coliform	Standard methods	Monthly	Environmental Consultant/ contractor	N/A	2250	ESMP Budget
Affected component	**Potential Impact / Mitigation**	**Parameters to be monitored**	**Measurements**	**Frequency**	**Responsibility**	**Monitoring cost source**		**Budget source**
						Pre-construction/	**Operations phase**	

						construction		
Water	Surface water quality	Temperature, conductivity, pH, DO, TDS	Potable water quality analysis	Monthly	Monitoring done by SSUWC and Quarterly verification by Environmental Consultant	N/A	2250	ESMP Budget
Occupational Health and Safety	Accidents or incidents due to operation and maintenance activities, workers' health Emergency preparedness – Mock drill record HSE training – Social Medical camp Others for HSE	Near-misses, incidents, occupational diseases, dangerous occurrences	As to be defined in the H&S Plan to be prepared by Contractor for the Project	As defined in H&S Plan		Management Time	4500	O&M Cost
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Incidents, accidents and community complaints	Based on occurrence	Contractor	Management Cost	Management Cost	ESMP Budget
Community Health and Safety	Public concerns	Complaints from community	As per the grievance redress mechanism	Continuous	Contractor	N/A	O&M Cost	ESMP Budget

Community Health and Safety		compensated for losses	compensated for losses					
Community Health and Safety		Disclosure of project information prior to start of project.	As per SEP/ Information Disclosure Plan	Prior to start of construction	Contractor			ESMP Budget
Community Health and Safety		Implementation of GRM	GRM Register	Prior to start of construction and during LRP implementation	Contractor			ESMP Budget
Affected component	**Potential Impact / Mitigation**	**Parameters to be monitored**	**Measurements**	**Frequency**	**Responsibility**	**Monitoring cost source**		**Budget source**
						Pre-construction/ construction	**Operations phase**	
Migrant Workers & Labourers	Potential conflict with local community.	No of registered grievances and redressal status. Status of implementation Labour Mgt Plan	Incidents, accidents and community complaints	During operation of labour camp.	Contractor	Management Cost	Management Cost	ESMP Budget
Migrant Workers & Labourers	Health risks due to spread of communicable diseases and sexually	Condition of labour camp, awareness of workers, complainant	Incidents, accidents and community complaints	Every 15 days during operation of labour camp.	Contractor			ESMP Budget

	transmitted diseases; Issue of Sanitation and hygiene	register Status of implementation of Contractor Management Plan (CMP)						
Affected component	**Potential Impact / Mitigation**	**Parameters to be monitored**	**Measurements**	**Frequency**	**Responsibility**	**Monitoring cost source[11]**		**Budget source**
						Pre-construction/ construction	**Operations phase**	
Gender Empowerment including Employment of women	The civil construction work to be taken place at the WWTP can provide employment opportunities for women residing in the project area.	Ensure equitable distribution of employment opportunities between men and women through encouraging contractors to employ local workers including women for labour-based work. Availability of	Number of women employed as a percentage of total persons employed in construction activities; Number of women workers earning same wage as men workers, as a percentage of total women	Continuous Contractor	Contractor & O&M	Management Cost	Management Cost	ESMP Budget

[11] These costs are tentative estimates for monitoring of project lifecycle

		basic amenities and separate toilet at campsite; and	workers employed in construction activities; Prior to start of construction					
Gender Empowerment including Employment of women		Women should be made aware of the Grievance Redressal Mechanism (GRM) and the Grievance Redressal Committee should also comprise 50% of women members	Number of women members at the Grievance Redressal Committee (GRC)	Continuous	Contractor	Management Cost	Management Cost	ESMP Budget
Gender Empowerment including Employment of women		Women should be encouraged to participate in public meetings, discussions and consultations especially with regard to their entitlements.	As per implementation of Stakeholder Engagement Plan (SEP)	Continuous	Contractor	Management Cost	Management Cost	ESMP Budget
Stakeholder Engagement and	Health and safety risk, non-payment of	Awareness on the Grievance redress	As per implementation of Grievance	Continuous	Contractor	N/A	2250	ESMP Budget

Grievance Redress	wages for workers Community Grievances Compensation and Resettlement	Mechanism Training on the process and GRM procedures	Redressal Mechanism (GRM) and Stakeholder Engagement Plan (SEP)					
Total cost for monitoring							**27,000**	

10. DECOMMISSIONING PHASE

Decommissioning is an important phase in the project cycle and comes as the last to wind up the operations/activities of a project. The main purpose of decommissioning is to restore/rehabilitate the project site to acceptable standards. Rehabilitation is to occur after the close down of the project and when it's no longer economically viable to continue operating it. It will entail reestablishment of topographical elements once the ponds are no longer in use. The site could be developed into a forested spot or redevelopment of the project.

The lifespan of the system is dependent on the ability of the SSUWC to maintain them. In this particular case, the proponent will design a desludging schedule which if followed will enhance the lifespan of the project which is estimated at over 30 years. This gives SSUWC the option of continuing to use the system and therefore they take the responsibility of decommissioning when the time comes normally after viability of the project comes into question or when other circumstances may prevail warranting decommissioning.

It is therefore recommended that a closing Environmental Audit be conducted when the time for decommissioning comes so that all aspects will be looked at against the prevailing conditions and requirements. However, the purpose of decommissioning is mainly to rehabilitate the project site to an acceptable standard and all efforts should be geared towards making the site as close as possible to its original state before the project was implemented. The decommissioning will in brief involve replanting the area with suitable trees and vegetation, demolition of the structures, removal of debris and landscaping. The other social implications will involve the laying off workers who may have been employed. They will lose their income, as well as issues of health and safety.

In the reality of this case, decommissioning on part of the proponent will be to landscape the area and put it to any other appropriate use. As such, the effects of the decommissioning will be minimal affecting mainly the area community which will lack effective sewer services. It will also affect water quality in local stream

11. CONCLUSION AND RECOMMENDATIONS

The ESIA study extensively analysed potential positive and negative impacts of the project. The process found that the project upon completion shall significantly improve sanitary and livelihood conditions in Juba City and will have a very positive impact on the environment – if well designed (final design), constructed and properly implemented and operated. More concretely, the improved sludge collection and treatment (Phase 1) and subsequent Phase 2 and 3 of the project with piped wastewater system and combined improved wastewater and sludge treatment incrementality will have positive social and environment impact.

However, there are specific stakeholders that will be affected negatively, and whose livelihood needs to be maintained/restored. Furthermore, the project will have (short term) negative impacts emanating from construction activities.

Management plans have been proposed to address and mitigate the severity of the negative impacts, and as well to increase/upscale identified positive impacts. It is recommended to initiate a close and regular monitoring of environmental impact and potential key pollution elements from both treated sludge and wastewater generated at the treatment plant, designed and scaled (up) for each stage/phase of the project (also refer to proposed Pollution Management Plan, PMP).

It is recommended to involve all key stakeholders further during the final design phase and further clarify and consolidate mitigation plans and actions – with immediate action required for finalising Memorandum of Understanding and ensure reallocation of the farmers presently conducting "informal" farming at Rokwe (Roton) Treatment Plant. Importantly, this is also addressed in the standalone produced Stakeholder Engagement Plan (SEP). It is recommended indeed to closely involve all stakeholders throughout every stages of preparation, construction and implementation phases of the project to ensure, among others, that socio-cultural impacts are minimized. In addition, local labour should be considered for unskilled labour during construction, and adequate information on negative impacts (social, environment or otherwise) associated with construction and subsequent project stages should be disseminated to the public.

More specifically, key mitigation measures proposed for addressing impacts include:

- Noise reduction measures to minimize disturbance to adjacent residential structures,
- Dust emissions control measures during construction phase such as water sprinkling, covered transportation and storage of construction materials,
- Provision of peripheral site drainage channels to prevent water logging situation,
- Coordination with local communities for construction schedules;
- Prior information about incoming vehicles carrying construction materials,
- Deployment of traffic guides and access restriction for local people at the construction site.
- Ensure equitable participation of women in the workforce and decision-making. Gender specific mitigation measures have been detailed and developed for the project.
- Development of grievance redressal mechanism to receive and address any issues or concerns that might be reported by the neighboring community.

The Environmental and Social Management Plan (ESMP) describes these, and other, mitigation measures for impacts specific to the Project activities and also discusses implementation mechanisms. In regard to construction phase(s) specifically, some negative effect are unavoidable, but the implementation of the mitigation measures suggested can help in managing the negative impacts on air quality, ground water etc. whereas the economic opportunities in terms of local employment are assessed as generally positive if certain aspects and initiatives as outlined are taken.

In terms of clearly positive impacts (expected if project is implemented as designed and intended) the expanded and upgraded integrated wastewater treatment system and WWTP facilities will reduce the quantities of human excreta affecting the environment negatively thereby ensuring public services

and health and improved environment and social conditions.

Furthermore, implementation and consistent adjustment as required of the proposed ESMP and monitoring system for the Project – will guide the Project to comply with national/state regulatory framework as well as to meet AfDB requirements on the environmental and social performance.

Therefore, with recommended management plans the project is recommended for approval as it will result in substantial sanitary, health, social and environment benefits for the people of Juba City and surrounding areas.

11.1 Further Scope, Notes and Recommendations

The following additional "scope", special notes and more detailed recommendations are included for further consideration by client and stakeholders:

- SSUWC is recommended to take in consideration issues and concerns raised during public consultation especially issues related to compensation and jobs opportunity
- Environmental monitoring programs for this project should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during construction, operation and decommissioning phases. An environmental and Social Officer should be hired to monitor the implementation of the ESMP;
- Ensure that garbage, sanitation and drinking water facilities are provided in construction workers camp. Site.
- Ensure that as much as possible, local materials are used to avoid importation of foreign material and long-distance transportation.
- As far as it is possible, the recruitment of unspecialized manpower should benefit the population of the area of the project and thus contribute to poverty reduction.
- The entirety of solid and liquid wastes generated by the building site, including packages, food waste, will have to be collected and removed to an adequate dumping place.
- GBV and SEA should be avoided and whenever there is any violence, child abuse and exploitation, it should be reported to competent authorities.
- Occupational health and safety performance should be evaluated against national /or international standards and a full time Health and Safety officer recruited during project implementation,
- The developer should try to reduce through toolbox meeting and induction trainings; the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities
- Institutional ownership/responsibility is a key aspect to ensure sustainability and secure that the WWTP and whole wastewater system be properly maintained (which in turn will reduce E&S risks). It is noted that some crucial decisions may still be required in this regard, among others the presumed/suggested decision to embed a lead responsibility to SSUWC.
- Biogas usage. The current project proposal will – in all likelihood – imply that the biogas produced as a kind of by product during the treatment process at the WWTP will be flared, rather than utilised for energy or other purposes. At least, there is no concrete tangible design or plans to use this valuable resource. In a climate perspective this is clearly not a favorable prospect and it is highly recommended to formulate/incorporate a plan to utilise the biogas.
- Likewise, there are no clearly formulated plans or proposal yet for how to use the treated sludge/waste generated at the WWTP, but it is included as a kind of side-note in the Project proposal that it *could* be used for manuring, or even for burning processes (generating heat). It is suggested that it *should* be used as a highly valuable fertilizer/manure, but firstly that tests are conducted to ensure no harmful substances or bio components are present (should be part of the monitoring scheme).

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13 ANNEXES

1) **Terms of Reference for the ESIA Study (summary)**

2) **Consultant team engaged in the ESIA Study**

3) **Water Quality Analysis Results**

4) **Summary of Geotechnical Survey (soil, drainage, geology etc.)**

5) **Annex 5: Reptiles, birds and mammals sited in the Project Area**

Annex 1: ESIA Terms of Reference for the Project (key activities and deliverables)

The Consultant is expected to provide inputs on all key activities required for an ESIA:

- Review of proposed interventions under the Integrated Wastewater Study for Juba by interaction with the key stakeholders, including the Department of Housing under the Ministry of Land, Housing and Urban Development, the South Sudan Urban Water Corporation (SSUWC), Juba City Council, and AfDB for a good understanding of the assignment.
- Review the preliminary designs in regard to environmental impacts, i.e. technology, scope, construction requirements, operation and maintenance requirements, probable impacts among other salient aspects of the project.
- Define project area of influence on the basis of the project scope and extent.
- Provide information on location and general layout of the project's related development sites (include maps or other documentation to illustrate project areas), ownership, pre-construction activities, construction activities, operational and maintenance activities, decommissioning activities, schedules, staffing and support, and life cycle aspects for major project components.
- Review the relevant national environmental and social requirements, policies, legal and administrative aspects – and the financier (AfDB's ISS and the respective OSs) in regard to the proposed project (these aspects may relate to, among others, pertinent laws, institutions, regulations and standards governing environmental quality, health and safety, labour laws, pollution control and management, public participation, protection of sensitive areas and endangered species, land ownership, land use control, gender etc.);
- Review national treaties and conventions that South Sudan subscribes to (for ESIA relevant issues).
- Review existing masterplans and strategic plans for Juba city (for ESIA relevant issues).
- Review, verify and update data and information from Feasibility Study on the existing physical, biological, socio-economic and cultural environment of the project/subproject area, including any changes anticipated before the project commences.
- Review and expand as required the socio-economic and baseline environmental quality surveys conducted during the Feasibility Study. E.g. analyse, follow up, verify:
- Available data on the macro-environmental setting like climate (temperature, rainfall, humidity, and wind speed), physiographic, geology, geography, biological environment etc.
- The social baseline that will be used subsequently in the preparation of applicable safeguards Instruments (ESIA and RAP: where applicable), SEP and PMP.
- Conduct site visits to project/sub-project locations including formal and informal discussion with local communities, business communities, private sector, government entities and other key stakeholders.
- Ensure that the views of the stakeholders consulted are integrated into the projects design and project cycle; evidence of stakeholder's consultation provided as appendix to the ESIA report.
- For potential significant issues, conduct field studies within the impact/coverage areas/zone for various components of the environment (air, noise, water, land and socio-economic).
- Collect and include any available noise level measurements, air quality measurements and water quality tests for sensitive water resources that are likely to be impacted by the project where applicable.
- Socio-economic and cultural environment: population and demography, land use, planned development activities, economic activities, agricultural activities, employment and labour market, distribution of income, public health, education and literacy level, sources of energy, water and sanitation, waste management, cultural properties (archaeological sites), land ownership and custom, gender and vulnerable groups.
- The consultant shall undertake a social survey which will include identifying any community households that would need to be resettled (*if applicable)* from implementation of the project,

identify vulnerable groups such as people with disabilities, women and elderly who might need special assistance, organize gender disaggregated stakeholder consultation to capture specific concerns raised by women, document land tenure systems in the project area highlighting land acquisition and land use (Note that also in this regard: The outcome of the feasibility study will guide the preparation of the ESIA and *Resettlement Action Plan: where applicable* and any other associated management plans that will mitigate the envisioned environmental and social impacts). Further, the outcomes shall also be integrated for relevant issues into the Environmental and Social Management Plan (ESMP).

- To the extent possible, and with departure in the Feasibility Study and decisions already taken in the preparation of the project, analyze project alternatives. Include the "without project" situation. Compare the feasible alternatives to the proposed project site, technology, design and operation.
- Identify and described all the project all the potential environmental and social impacts that the project is likely to generate during the four phase (pre-construction, construction, operation and decommissioning)
- Assess the significance of these impacts and follow mitigation hierarchy while designing mitigation measures to make it prudent.
- As part of the ESIA, assessment of social aspects that may materialise based on the project interventions (e.g. land acquisition including temporary, involuntary resettlement, economic displacement, indigenous people, gender, public consultation, etc.) of the project planning and design phases.
- Prepare the Environment and Social Impact Assessment (ESIA) study report, Stakeholder Engagement Plan (SEP) and Pollution Management Plan (PMP) in accordance with AfDB's OSs.
- As part of the ESIA, prepare an Environmental and Social Management and Monitoring Plan for the overall project after thorough consultation with all relevant stakeholders (the ESMP will ultimately be finally verified and approved by the owner of the project). The ESMP must be complete with mitigation plan, compliance monitoring plan, effects monitoring plan, institutional arrangements, training needs, documentation and communication protocol, culturally appropriate and accessible grievance redress mechanism, costs of implementing ESMP, and mechanism to integrate ESMPs with the project(s) e.g. through contractual clauses.
- Advice and include if relevant in ESMP, for prospective contractors to be involved, risk management plans and provisions for contractors, incorporating among other things labor-related clauses for contractors and their workers.
- The consultant shall liaise with the South Sudan Urban Water Corporation (SSUWC) to obtain final ESIA approval from the Ministry of Environment.

The Consultant shall conduct his/her daily work in compliance with the South Sudan laws, regulations, guideline and procedures on environment and social safeguards as well as the African Development Bank's Integrated Safeguards System.

ESIA processing Schedule (deliverables, key milestones)

1. Documentary Review, verification (first assessments) of all identified issues in Feasibility Study
2. Field work and preparation of an Environmental and Social Survey Report
3. Submission of Draft ESIA, SEP and PMP to the South Sudan Urban Water Corporation, the Department of Housing of the Ministry of Lands, Housing and Urban Development, Ministry of Environment and the African Development Bank.
4. Drafts are reviewed and comments submitted from all interested parties (within max 2 weeks if

to be considered in redrafting process), i.e. review by South Sudan Urban Water Corporation, Ministry of Lands, Housing and Urban Development, Ministry of Environment, and AfDB. The Consultant considers timely, submitted review comments and ensures they are incorporated in the Final ESIA report.

5. Submission of Final ESIA report, SEP and PMP to client(s), the African Development Bank, and other stakeholders as advised.
6. Submission for issuance of ESIA for approval by Ministry of Environment.
7. Recommendations, key inputs and preparation of draft Resettlement Action Plan (RAP), if applicable (if the project components, sub-components, and activities will lead to an outcome that may instigate any economic and/or physical displacements).[12]
8. Any other advice, inputs and recommendations for Environmental and Social (E&S), stakeholders and pollution related issues, final summary reports.
9. If further refinement and re-submission is required for a final ESIA, SEP or PMP (to either AfDB or Ministry of Environment), facilitate/prepare and submit for approval (until formal closure of Consultant engagement).
10. Working with project owner/borrower and other relevant stakeholders as required for consolidation of all above, most especially updating and consolidation of the ESIA, SEP and PMP (until formal closure of Consultant engagement).
11. Working with project owner/borrower and other relevant stakeholders as required any other detailed plans related to E&S issues (until formal closure of Consultant engagement).

Deliverables:

At the end of the assignment, the consultant shall be expected to deliver the following.

a) An Environmental and Social Impact Assessment (ESIA) Report cleared by the Client and the AfDB and approved by the National Regulatory Authority in South Sudan.

b) A Stakeholder Engagement Plan (SEP) Report cleared by the Client & AfDB.

c) A Pollution Management Plan (PMP) cleared by the Client & AfDB.

d) Any other Safeguards Document agreed upon by the Client and the AfDB.

Transfer of Knowledge:

The Consultant shall work closely with the environmental and social focal persons at the South Sudan Urban Water Corporation, the Department of Housing (MLHUD) and other members of the project implementation unit to transfer all relevant knowledge required.

[12] Please note, assumption is that only minor, and as well most likely temporary, resettlement is required, i.e. relevant tp prepare for. The consultant will report and discuss relevant options with key stakeholders if this assumption is not valid.

Annex 2: Key Experts and specialists involved in ESIA. And general areas of Expertise.

NAMES	**AREA OF EXPERTISE**
Dr Leju John Celestino	ESIA Expert
Mr. Michael Juel	International ESIA Specialist
Ms. Jessica Melati Olsson	International Resettlement Specialist
Mr. Sven Jacobi	International Water Specialist
Dr. Malik Doka	National ESIA Expert
Mr. Anthony Oryada	National Social specialist
Mr. Andrew L. Athiba	National ESIA Expert
Dr. Christopher Tombe	National ESIA specialist

Annex 3: Water Quality Analysis Results

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CERTIFICATE OF ANALYSIS -WASTEWATER QUALITY

CLIENT : Eco-Consultancy Ltd & NIRAS

PROJECT : Environmental and Social Impact Assessment for Hybrid Wastewater Treatment System in Rokwe (Roton), Juba City)

Sampling date : 22nd April 2024 **Analysis date** : 24th to 26th April 2024

Parameter	Units	Wastewater sources-Sample ID				NEMA Effl stds*	Sudanese Guidelines for Discharge
		1	2	3	4		
pH		5.9	6.4	6.4	6.5	6.0 - 8.0	6.0 – 9.0
EC	µS/cm	2940	3250	3420	3420	ns	
TDS	mg/l	1460	1620	1700	1700	1200	
Temperature	°C	31.8	32.0	32.1	21.1	ns	
Apparent colour	PtCo	2255	2160	2270	1263		
Turbidity	NTU	352	358	333	220		
Nitrates	mg/l	23	15	25	12	20	30
Total Phosphorus	mg/l	15.2	13.5	14.5	14.8	10	
Sulphates	mg/l	6.0	10.5	7.2	3.2	500	
Total Suspended solids (TSS)	mg/l	317	311	290	260		
Chromium	mg/l	0.015	n.d	n.d	n.d	1	
Lead	mg/l	0.1	0.04	0.11	0.03	0.1	0.5
Chemical Oxygen Demand	mg/l	1080	1384	1080	300	100	

**Uganda National Effluent discharge standards, 1999-values for heavy metals are for total concentrations; ns-not specified; n.d-not detected;* detection limit for Cadium, Copper, Lead, and Zinc is 0.001mg/l.

Sources:
1. Wastewater influent to the ponds;
2. Anaerobic Pond effluent wastewater;
3. Facultative Pond effluent wastewater;
4. Facultative Pond effluent entering the swamp and/or used in irrigation.

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Commentary

The wastewater from the sampled sources, which are ponds and arranged in series from Anaerobic to Facultative ponds. The effluent from facultative pond discharged to the environment (Sample 4) or reused is the one expected to meet the effluent standards. However, a number of parameters do not comply for discharge of wastetwaer, such as: TDS, phosphates, Colour, and COD. The Sudanese guidelines took precedence wherever the parameters are present, or else, the Ugandan NEMA guidelines (2020) were used for missing parameters from the Sudanese guidelines.

It is important to note that the treatment efficiency of all the ponds was very low since a minimal noticeable change in water quality was observed as wastewater was moving from one pond to another. The following could explain the escalation of some parameters in the waste stabilization ponds.

a) ***High Apparent Color and Turbidity:*** Stabilization ponds typically rely on settling and biological processes to remove suspended solids. The high apparent color and turbidity levels suggest that these processes may be inadequate, possibly due to insufficient hydraulic retention time, poor settling characteristics, or excessive organic loading.

b) ***High Nutrient Levels:*** The presence of elevated total phosphorus indicates inadequate nutrient removal in the stabilization ponds. This could be attributed to incomplete biological degradation.

c) ***High Chemical Oxygen Demand (COD):*** Stabilization ponds are generally effective at reducing organic pollutants through biological degradation. However, the high COD levels in the effluent suggest that the ponds may be overloaded with organic matter, leading to incomplete treatment and elevated levels of biodegradable pollutants.

The wastewater quality data indicate non-compliance with certain effluent standards, particularly regarding turbidity, total phosphorus, and COD. This highlights the need for improved treatment processes to meet regulatory requirements and protect the environment. Some of the additional treatment to be investigated can include: addition of aeration ponds, pre-treatment of faecal sludge by pre-settlement before added to the ponds, additional unit such as constructed wetlands.

Checked by:

29/04/2024

Ag. In Charge: PHEE lab

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Annex 4: Summary of Geotechnical Survey (soil, drainage, geology etc.)

Geotechnical investigations conducted in January – February 2024 involved soil borehole drilling at three selected sites within the WWTP area and involved logging, soil sampling, testing and analysis, and technical reporting.

Objective: The purposes of the geotechnical investigations were to determine the subsurface soil conditions, the relative soils characteristics and texture, consistency, and classification at the project sites. The focus is on the geologic and subsurface soil conditions and subsoil parameters that will be used for the design of engineering structures for the project sites.

In accordance with ASTM D 420-93 "Investigating and Sampling Soil and Rock for Engineering Purposes", the objectives for the investigations further include: To determine the suitability of the site and the environment for the work which has been determined; To enable an adequate and economic design to be provided; To plan the best method of construction; To determine the changes that will occur in the soils and surrounding environment due to the proposed project works.

Geotechnical Category of the Project: The proposed project works involve no exceptional risk or difficult soil or loading conditions and therefore are classified as Geotechnical Category 2, according to ASTM D6169 /D6169M- 21, Eurocode 7 part 1 and SANS 10160-5. "The design for structures in Geotechnical Category normally includes quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied. Routine procedures for field and laboratory testing and for design and execution may be used for this kind of project".

Site Topography: The site is situated amid vast expanses of open space, including swamplands and agrarian landscapes. Located within a wide valley of lush greenway that stretch and gently deeps away into the White Nile. With an elevation of approximately 461m above sea level, the site at Rokwe has existing infrastructure comprising of present and in use wastewater treatment structures, i.e., lagoons, sewer lines, earth access roads and administrative buildings utilized by staff within the facility.

Site Geology, Bedrock: According to available geological maps and observations, the site is located within the area known to be underlain by tertiary quaternary rocks of Ruwaba formation. This formation consists of fine sediments. These sediments are of clean washed sands with laminated clays. The sands are without pebbles and are well graded. Some iron-stained horizons have been recorded. This formation is polygenetic, and the sediment was swept by the Nile and its tributaries, and by the wadis and khors draining the Nuba Mountains and the adjacent areas. No rock outcrop was encountered within the site.

Soils: The surficial soils at the proposed site and its surrounding are mainly ferrallitic soils of non-differentiated dark horizons. The proposed site was majorly overlain by sandy clay loams and silty clay composition.

Site seismic experience: The study area lies within an intraplate region in the centre of Africa. It is bounded by active tectonic features, namely the Red Sea Rift in the northeast and the East African Rift System to the south and southeast. South Sudan has recorded so far, the highest seismic activity during the 1990 earthquake near Juba (Ms=7.2), Naila M. O. et al. (2015) which was followed by a series of aftershocks. It was the largest earthquake occurred in Africa in the last century. There were however no major damages and no losses of lives as the area affected was mostly uninhabited. South Sudan is composed of three major seismic source zones (SSSZ, CSSZ and NSSZ) that have been recognized. The seismic source zones are defined on the basis of earthquake clusters and tectonic setting. The SSSZ in which the proposed site is located is characterized by the highest earthquake frequency related to the East African Rift. It is for this reason that the seismic analysis for all structural designs be considered.

Main Geotechnical Findings and interpretation:

- The entire site was characterized by loose and soft clayey silts distributed around the site.
- Fill Materials: There was fill encountered within the site, however these were not found significant at bore hole drilling locations. He probable fill material was observed within the lagoon area as a result of previously executed earth works.
- Fat Clays and Clays: All test Borings encountered considerable lithological deposit thickness. These clays were especially found overlying sandy layers of water holding character. These soils majorly consisted of organic clay top soils, underlain by an alternate deposition of sands, clays and sandy-clay matrix as alluvial deposits. The alternation in deposition, indicates history of seasonal deposition with respect to surface water velocity and area climatic conditions. These alluvial deposits extend deeply up to approximately 5 – 8m within the site.
- There were also pockets for Grey Poorly Graded Gravel and sandy deposits found in the site. The size of boulder and cobbles included increased further with increase in depth of exploration, an indication of bedrock of deposit bearing formation approach.
- Bedrock: Bedrock was encountered at two boreholes in form of highly weathered sand stone of granitic and gneiss origin at depths ranging from 4.5m to 7.5m respectively. Bedrock may be described as a fair quality, dark grey to brown, weak to medium strong, fresh to slightly weathered, igneous rock (Granitic gneiss).
- Groundwater Conditions: Ground water was encountered in all the boreholes. Groundwater measurements were made and were herein observed to differ distinctively due to the difference in elevation of the boreholes. Ground models demonstrate significant variation in ground profile and water table as encountered.
- Engineering Classification Testing: Classification testing results generally indicate the site is characterized by fine grained soils of clayey nature, with alternating deposition lenses of sands. These were underlain by coarse grained soil deposits of sandy nature with fine inclusions of majorly clay composition. This was found to be uniform to all boreholes.
- Soil Chemical test results: It is observed that the sulphate and chloride contents of the soils as determined indicate that the chemical contents in the soils have no adverse effect on reinforced concrete. In addition, the pH values of the soils indicate negligible acidity (close to neutral) and therefore considered to have no adverse effect on Portland cement and steel (or environment in general). All values tested have been observed to be within the allowable limits of requirement in accordance with BS 882: 1992.
- Scour and Erosion Control: Due to location of the site along the slope of the general area, scour and erosion of the embankments is expected, along embankment slopes. The use of rip rap or any other erosion control method as approved by the consultant, along the newly constructed embankment slopes is recommended herein to control the scour. In particular, erosion protection should be placed near the drainage channels. The recommendations for scour and erosion protection are based on experience with similar projects and on-site observations of the existing conditions. We however further recommend that hydrological studies of the area should be conducted to enable proper scour and erosion designs.

Conclusions and Recommendations:

- The soil profile obtained from the drilling revealed that, the project site is generally characterized by alluvial deposits at the lower portion of the site and residual soils at the upper portion of the site with embankment fills midway the site. The site comprised of surficial moderate to high plasticity silty clayey and sandy soils underlain by sandy gravel and weathered rock deposits.
- Ground water was encountered in all the drilled boreholes. Details of specific depth of ground water and corresponding test pits are given herein the test pit logs.

- We anticipate filling earth works in the project. The fills shall herein give rise to slope at the lower side of the embankment fills. All permanent slopes in native soil or imported fills should be no steeper than 2 horizontals to 1 vertical (2H:1V). If steeper slopes are required, permanent slopes as steep as 1.5H:1V may be constructed provided that a minimum 3 m buttress (measured horizontally) of angular well-graded rock fill is placed on the slope.
- We herein recommend a maximum allowable bearing capacity of 170 KPa to be utilized in the design of foundations at depths not less than 2.0m from the existing surface.
- Site Drainage and moisture protection; Adequate drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. A proper surface drainage plan including continuous conveyance of water along adjacent access road should be implemented by the designer and contractor. The site should be graded and maintained such that surface drainage is directed away from structures and adjacent access road into the proposed or existing road storm water drain system or adjacent catchment area. We herein confirm evidence of flooding and risk of flood on the proposed site, hence the need for design of flood resistant structures in the new system.

Annex 5: Reptiles, birds and mammals sited in the Project Area

Table A: Reptiles inhabiting the Areas/swampy sites south and east from the WWTP

SCIENTIFIC NAME	ENGLISH NAME	LOCAL NAME
Chalcides ocellatus	Skink	Sehlia (S)
Mabuya sp.	Skink	Sehlia (S)
Tranteola annularis	Gekko	Dab (S)
Crocodylus niloticus)	Crocodile	Tomsah
Varanus niloticus	Nile monitor	Waral
Echis carinatus	Viper Washasha	Washasha
Grayia thalloni	Gray's snake	Agabash
Philothamus sp.	Green snake	Abo al Khidair
Phython sp.	Phython	Asala
Psammophis sp.	Hissing snake	Abo si'aevea

Table B: Birds in the Project Area

SCIENTIFIC NAME	ENGLISH NAME	LOCAL NAME
Struthio camellus	Ostrish	Neaam
Podceps ruficollis	Little grebe	But
Egretta intermedia	Yellow-billed egret	Unknown
Egretta garzetta	Little egret	Unknown
Bubulcus ibis	Cattle egret	Tair al Bagar
Adrea goliath	Goliath heron	Unknown
Grus grus	Common crane	Rahaw
Balearica regulorum	Crowned crane	Garnoog
Ciconia abdimi	Abdim's stork	Simper
Leptopilous crumeniferus	Marabou stork	Abo al S'inn
Plecopterus gambensis	Spur wing goose	Wiz
Sarkidiorins mellanotoes	Knob billed goose	Wiz
Apus apus	Swift Grain	Hashash
Falco biarmicus	Lanner	Sagor
Falco ardosiaceus	Kestrel	Sagor

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Millvus migrans	Kite	Heddia
Trigonoceps occipitalis	White-headed vulture	Kling abo sal'a
Actophilorins Africana	Jacna Terat	Al Sholok
Hemiparra crassirostris	White-shouldered	plover Unknown
Streptpelia decipiens	Mourning dove	Gomrey
Oena capensis Namaqua	dove	Baloam
Meropis nubicus	Carmine bee eater	Massas
Gallingo gallingo	Snipe	Shagnab
Polcus taeniopterus	Masked weaver	Asfoor
Polcus badus	Cinmon weaver	Asfoor
Euplectes orix	Dura bird	Teerat Al Zura
Numida melagris	Guinea fowl	Dojaj Al Wadi
Corvus albus	Pied crow	Gorab
Corvus rhipidurus	Fan-tailed raven	Gorab
Cercotrichas podobe	Black bush robin	Fngoose
Pycnonotus barbatus	White vented	bulbul Bulbul
Campethera nubica	Nubian woodpecker	Nagar Alkhasab Alnobee

Table C: Mammals in the Project Area

SCIENTIFIC NAME	ENGLISH NAME	LOCAL NAME
Wild mammals seen		
Phacochoerus aethiopicus	Common warthog	Kadrook
Hystrix cristata	Crested Porcupine	Abo Shook
Leptailurus serval	Serval cat	Kadees Khala
Kobs kob	Saddle back cob	Teel
Wild mammals reported		
Gazella restiforms	Red fronted gazelle	Gazal
Paraechinus aethiopicus	Hedgehog	Abo Gonfod
Panthera pardus	Leopard	Nimir
Corcutta corcutta	Spotted hyaena	Dab'a
Hyaena hyaena	Stripped hyaena	Dab'a
Ichneumia alblcauda	Mangoose	Abo Jamaa
Lepus capensis	Brown hare	Arnab

Papio anubis	Baboon	Tigil
Eythrocebus patas	Patas Monkey	Gerd Al Talih
Hippopotamus amphibus	Hippopotamus	Grintia (Melut area)